Table 11.2.2 Bus Routes in 2010

Route No.	Type	Route
1	Key Route	Z19-EW Corridor-Peri-CBD
2	Key Route	Z19-EW Corridor-CBD
3	Key Route	Mixco-CA1W-Peri-CBD
4	Key Route	Mixco-CA1W-CBD(Bolivar)
5	Key Route	Mixco-CA1W-CBD(6&7 Av)
6	Key Route	Villa Nueva-CA9S-CBD(Bolivar)
7	Key Route	Villa Nueva-CA9S-CBD(6&7 Av)
8	Key Route	Villa Nueva-Ciudad Real-FEGUA-CBD
9	Key Route	Petapa-DR14-Ciudad Real-FEGUA-CBD
10	Key Route	Villa Canales-DR1-11Av-7Av-CBD(Bolivar)
11	Key Route	Villa Canales-DR1-11Av-7Av-CBD(6&7 Av)
12	Key Route	Villa Canales-DR1-Av Las Americas-CBD(Bolivar)
13	Key Route	Villa Canales-DR1-Av Las Americas-CBD(6&7 Av)
14	Key Route	San Jose Pinula-NR18-CA1E-CBD(Bolivar)
15	Key Route	San Jose Pinula-NR18-CA1E-CBD(6&7 Av)
16	Key Route	Paraiso-CA9N-Inner Ring E-CBD(Bolivar)
17	Key Route	Paraiso-CA9N-Inner Ring E-CBD(North)
18	Key Route	Paraiso-CA9N-Inner Ring E-CBD(South 6&7 Av)
19	Key Route	Maya-CA9N-Inner Ring E-CBD(Bolivar)
20	Key Route	Maya-CA9N-Inner Ring E-CBD(North)
21	Key Route	Maya-CA9N-Inner Ring E-CBD(South 6&7 Av)
22	Key Route	Jocotales-DR15-CBD(Bolivar)
23	Key Route	Jocotales-DR15-CBD(6&7Av)
24	Ordinary	Amparo-Peri-CBD(Bolivar)
25	Ordinary	Amparo-Peri-CBD(6&7 Av)
26	Ordinary	CBD(North)-Diagonal14-CBD(Bolivar)
27	Ordinary	Diagonal14-CBD(South)-CBD(North)-Diagonal14
28	Ordinary	Diagonal14-CBD(North)-CBD(South)-Diagonal14
29	Ordinary	Z19-EW Corridor-Peri-CA9S-Villa Nueva
30	Ordinary	Z19-EW Corridor-Peri-FEGUA-Ciudad Real-DR14-Petata
31	Ordinary	Z19-EW Corridor-Peri-DR1-Boca del Monte
32	Ordinary	Mixco-CA1W-Peri-CA9S-Villa Nueva
33	Ordinary	Mixco-CA1W-Peri-FEGUA-Ciudad Real-Petapa
34	Ordinary	Mixco-CA9N-Peri-DR1-Boca del Monte
35	Ordinary	Paraiso-CA9N-Peri-Boca del Monte
36	Ordinary	Maya-CA9N-Peri-Boca del Monte
37	Ordinary	Ciudad Nueva-10&11 Av-2 Ca-Vista Hermosa
38	Ordinary	Ciudad Nueva-10&11 Av-2 Ca-URL
39	Ordinary	Hipodromo-CA9N-Av Elena-Av Cementerio-7 Ca-5 Av-Av Mariscal-Bl San Cristobal-18 Av
40	Ordinary	Hipodromo-CA9N-Av Elena-Av Cementerio-7 Ca-5 Av-Av Mariscal-Comunidad-Mixco
41	Ordinary	Mixco-Bl San Cristobal-CA9S
42	Ordinary	San Cristobal-Bl Balcones-CA9S
43	Ordinary	San Cristobal-Bl Sur-Ca9S
44	Ordinary	Barcenos-Villa Nueva-NR2-Villa Canales
45	Ordinary	Milagro-NR5-7 Ca-Av Cementerio-13 Ca
46	Ordinary	1 de Julio-NR5-7 Ca-Av Cementerio-13 Ca
47	Ordinary	Ciudad Real-DR14-Av Bolivar-Av Cementerio-Av Elena-Ca9N(UMG)
48	Ordinary	Paraiso-CA9N-10&11 Av-Av Reforma-Av Americas
49	Ordinary	Maya-CA9N-10&11 Av-Av Reforma-Av Americas
50	Ordinary	Amparo-Peri-USAC
51	Ordinary	Amparo-Peri-NR5-DR14-Ciudad Real
52	Ordinary	Amatitlan-CA9S-CBD
53	Ordinary	Amatitlan-CA9S-Villa Nueva
54	Ordinary	Amatitlan-Lago Road(?)-Villa Canales
55	Ordinary	North Terminal-CA9N-Los Ocotes-San Jose Pinula
56	Ordinary	Canalitos-URL-2 Ca-11 Av-CA9N-Canalitos
57	Ordinary	Canalitos-CA9N-10 Av-2 Ca-URL-Canalitos
58	Ordinary	Santa Catarina Pinula-20 Ca-Av Reforma-10&11 Av-Ciudad Nueva
59	Ordinary	Z19-Tierra Nueva-Hipodromo-CA9N-Av Elena-Av Cementerio-7 Av-CA1W
60	F-KR1,3	Amparo
61	F-KR1,2	Z19(North)-1 de Julio
62	F-KR1,2	Z19(South)-Milagro
63	F-KR6,7	CA9S-Mezquital) EXCLUDED FROM SIMULATION
64	F-General	CA9S-USAC-DR14-FEGUA
65	F-KR8,9	Ciudad Real-Nimajuyu-Justo Rufino Barrios
66	F-KR14,15	CA1E-Santa Catarina Pinula
67	F-KR16-21	Inner Ring E-Santa Rosita
68	F-KR16-21	North Terminal-Lomas del Norte
69	F-KR16-21	Paraiso-Maya
70	Extra U.	West Terminal-NR5-PT60
71	Extra U.	West Terminal-CA1W-PT43-PT62-PT61
72	Extra U.	West Terminal-CA1W-PT43-PT62-PT63
73	Extra U.	South Terminal-CA9S-PT64
74	Extra U.	Zone 4 Terminal-Av Castellana-Liberacion-Av Las Americas-DR1-PT65
75	Extra U.	Zone 4 Terminal-Castellana-Liberacion-CA1E-PT66
76	Extra U.	Zone 4 Terminal-Castellana-Liberacion-CA1E-Fraijanes
77	Extra U.	Zone 4 Terminal-Castellana-Liberacion-CA1E-NR18-PT66
78	Extra U.	North Terminal-CA9N-PT67
79	Extra U.	Zone 1 Terminal-10&11 Av-6&9 Ca-15 Av-Diag13-Chinautla-PT69

Table 11.2.3 Urban Bus Route Characteristics in 2010

Route No.	Type	Pax/Day (PT)	Max/Sect (PT)	Peak Time Pax (PT)	Distance (km)	Time (minutes)	Capacity (pax/bus)	Fleet (buses)	Frequency (times)	Pax/bus (pax/day)	Efficiency (PT/buskm)
1	Key Route	52,219	22,449	2,245	24.33	65.37	80	28	312	1,882	6.88
2	Key Route	142,753	45,732	4,573	31.17	81.03	80	71	635	2,025	7.21
3	Key Route	144,365	49,863	4,986	26.49	79.47	80	76	692	1,906	7.87
4	Key Route	115,721	45,906	4,591	28.03	84.09	80	74	638	1,574	6.48
5	Key Route	63,848	24,108	2,411	34.85	104.55	80	48	335	1,330	5.48
6	Key Route	66,817	21,124	2,112	34.23	102.69	80	41	293	1,620	6.65
7	Key Route	57,060	19,474	1,947	41.07	123.21	80	46	271	1,247	5.13
8	Key Route	76,742	14,546	1,455	36.52	87.65	80	24	202	3,198	10.41
9	Key Route	124,767	38,671	3,867	37.52	111.01	80	82	537	1,526	6.20
10	Key Route	29,996	10,555	1,056	47.65	176.81	80	36	146	833	4.31
11	Key Route	5,211	1,987	199	48.75	180.11	80	7	28	772	3.85
12	Key Route	76,885	22,627	2,263	46.93	171.13	80	74	314	1,035	5.21
13	Key Route	152,844	59,021	5,902	43.81	161.77	80	182	820	839	4.25
14	Key Route	132,469	80,248	8,025	55.27	177.21	80	272	1,115	488	2.15
15	Key Route	47,499	21,701	2,170	52.13	167.79	80	70	302	681	3.03
16	Key Route	84,379	29,804	2,980	25.32	91.60	80	53	414	1,607	8.05
17	Key Route	114,731	49,764	4,976	26.46	92.92	80	89	692	1,296	6.27
18	Key Route	30,051	12,157	1,216	26.37	93.14	80	22	169	1,382	6.75
19	Key Route	38,961	14,906	1,491	25.32	91.60	80	26	207	1,484	7.44
20	Key Route	34,798	15,673	1,567	26.46	92.92	80	28	218	1,254	6.04
21	Key Route	9,466	4,041	404	26.37	93.14	80	8	56	1,262	6.39
22	Key Route	97,915	38,335	3,834	21.93	71.13	80	52	533	1,892	8.39
23	Key Route	131,909	55,153	5,515	23.60	76.14	80	80	766	1,644	7.29
24	Ordinary	17,305	7,909	791	18.55	59.95	60	12	146	1,442	6.39
25	Ordinary	29,130	15,702	1,570	21.09	67.57	60	27	291	1,079	4.75
26	Ordinary	60,066	22,463	2,246	14.86	55.36	60	32	416	1,877	9.72
27	Ordinary	37,533	22,617	2,262	13.96	46.53	60	27	419	1,390	6.42
28	Ordinary	41,003	25,760	2,576	14.48	48.15	60	32	477	1,281	5.94
29	Ordinary	57,725	17,770	1,777	41.98	126.52	60	57	329	1,013	4.18
30	Ordinary	44,408	14,419	1,442	48.14	155.66	60	57	267	779	3.45
31	Ordinary	65,373	23,175	2,318	40.38	137.84	60	81	429	807	3.77
32	Ordinary	41,132	14,554	1,455	37.44	120.52	60	45	270	914	4.07
33	Ordinary	38,639	14,490	1,449	43.80	149.66	60	55	268	703	3.31
34	Ordinary	42,774	15,437	1,544	35.84	131.84	60	52	286	823	4.17
35	Ordinary	15,110	6,068	607	40.10	154.80	60	24	112	630	3.36
36	Ordinary	2,205	954	95	40.10	154.80	60	5	36	441	1.53
37	Ordinary	10,098	4,861	486	18.55	74.20	60	9	90	1,122	6.05
38	Ordinary	931	506	51	18.95	75.80	60	3	36	310	1.36
39	Ordinary	119,438	46,438	4,644	26.06	104.24	70	105	737	1,133	6.22
40	Ordinary	4,959	1,641	164	37.77	151.08	60	6	36	827	3.65
41	Ordinary	24,897	11,502	1,150	16.68	66.72	60	20	213	1,245	7.01
43	Ordinary	9,911	7,270	727	10.50	42.00	60	8	135	1,239	6.99
44	Ordinary	331,994	91,560	9,156	23.60	94.40	70	189	1,454	1,761	9.67
45	Ordinary	203,645	97,175	9,718	33.54	134.16	70	285	1,543	716	3.93
46	Ordinary	68,406	32,033	3,203	23.86	95.44	60	78	593	877	4.83
47	Ordinary	49,001	17,975	1,798	24.07	93.94	60	43	333	1,140	6.11
48	Ordinary	121,227	56,520	5,652	32.03	128.12	70	158	897	769	4.21
49	Ordinary	36,805	16,619	1,662	32.03	128.12	60	54	308	682	3.73
50	Ordinary	74,127	27,072	2,707	19.42	71.82	60	50	501	1,483	7.62
51	Ordinary	70,259	17,822	1,782	30.13	115.37	60	52	330	1,351	7.07
52	Ordinary	219,601	63,243	6,324	54.93	164.79	70	227	1,004	967	3.98
53	Ordinary	26,762	12,180	1,218	21.00	63.00	60	20	226	1,338	5.64
54	Ordinary	26,310	8,942	894	42.60	170.40	60	39	166	675	3.72
55	Ordinary	20,709	10,261	1,026	47.70	190.80	60	50	190	414	2.29
56	Ordinary	52,797	33,802	3,380	26.56	106.24	60	91	626	580	3.18
57	Ordinary	22,092	11,619	1,162	26.83	107.32	60	32	215	690	3.83
58	Ordinary	112,919	71,564	7,156	26.28	105.12	70	165	1,136	686	3.78
59	Ordinary	31,811	11,143	1,114	32.98	122.70	60	35	208	909	4.68
61	Feeder	42,446	21,642	2,164	6.02	36.12	30	40	802	1,061	8.79
62	Feeder	2,092	1,224	122	15.12	60.48	30	4	72	523	1.92
64	Feeder	8,934	4,648	465	4.64	27.84	30	8	172	1,117	44.78
65	Feeder	43,583	21,803	2,180	11.70	70.20	30	78	808	559	4.61
66	Feeder	2,369	1,886	189	9.30	55.80	30	6	72	395	3.54
67	Feeder	8,599	4,648	465	5.00	30.00	30	8	172	1,075	10.00
69	Feeder	21,144	11,587	1,159	4.50	27.00	30	16	430	1,322	10.93

Note : Few negligible routes are not included in the simulation.

Feeder buses in CBD are not included in the simulation. They are to improve passengers convenience in CBD and not an arterial structure of the urban bus network.

1) Key Route Buses

Route numbers 1 to 23 are urban key routes connecting suburban population centers and the CBD. Route numbers 1 and 2 operate on the busway along the East-West Corridor. Route numbers 8 and 9 operate along the busway along the FEGUA line. Other key routes are mostly supported by bus lanes.

The key route buses carry 1831 thousand passengers a day or 44.8 % of the total bus passengers. Each of the 23 routes has 79600 passengers on average.

2) Ordinary Buses

Route numbers 24 to 59 are ordinary buses. Route numbers 24 to 28 connect Amparo and Zona 5 with the CBD. Route number 29 to 36 are circular routes along the Middle Ring Road (Periferico). Route numbers 37 to 43 are routes along eastern and western borders of the CBD and along San Cristobal Area. Route 44 is along the National Road 2. Route numbers 45 to 49 are along old main corridors such as National Road 5, Department Road 14 and CA9 North. Route numbers 50 and 51 are circular routes to and from Amparo. The remaining ordinary routes serve centers of suburban areas in the Metropolis.

Ordinary buses carry 2131 thousand passengers accounting for 52.1 % of the total. On average, one route has 59200 passengers.

3) Feeder Buses

Route numbers 60 to 69 are feeder buses. Route number 64 is zone buses serving USAC. The other feeder buses are connected to specific key route buses.

Feeder buses carry 129 thousand passengers accounting for 3.2 % of the total. On average, one route has 18500 passengers.

4) Extra-urban Buses

Route numbers 70 to 79 represent extra-urban buses along major inter-regional corridors. They account for 3.0 % of the total passengers.

(3) Bus Traffic in CBD

In CBD, the total bus frequencies are 4400 along 6th and 7th Avenues, 4200 along Bolivar Avenue and 740 along the busway for each direction. These figures are less than the present bus traffic along Bolivar Avenue.

During the peak hour, the headway at each stop is estimated to be 8 to 9 seconds along these roads and approximately 50 seconds along the busway.

To keep smooth operation of the buses, each of these stops should have more than one pair of bus bays and platforms. By having 4 pairs corresponding to directions of routes, each bay will have headway longer than 30 seconds during the peak hour.

11.3 Development of Bus Stops, Centers and Terminals

11.3.1 Improvement of Bus Stops

For passengers' convenience and the smooth flow of buses and other vehicles, bus stops have to be clearly identified and equipped with such facilities as sign posts, boards of bus routes/schedules, shelters, liter boxes, bus bays and marking on the roads.

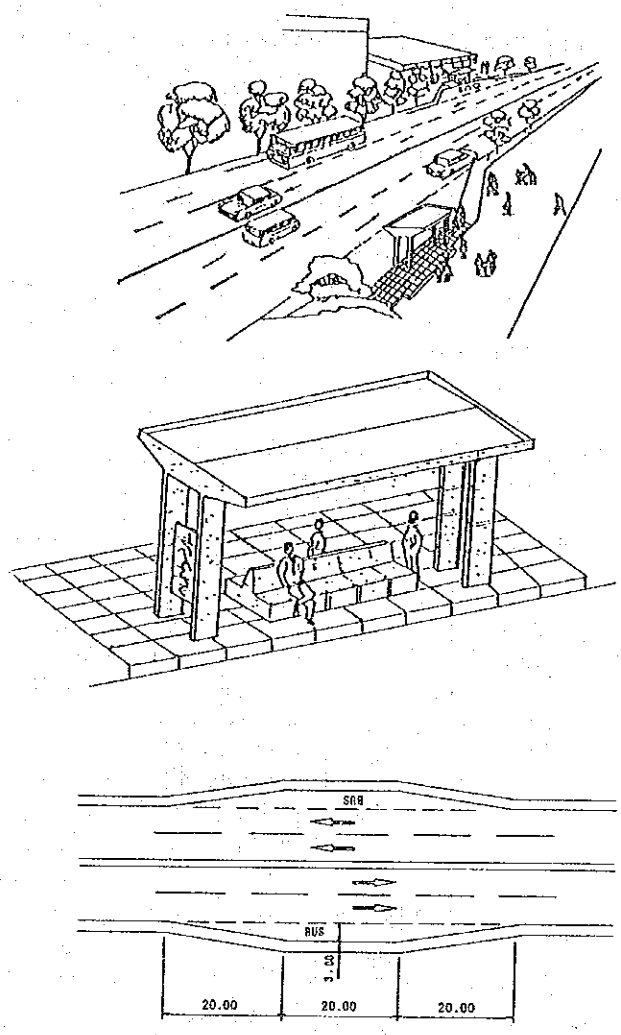


Figure 11.3.1 Example of Bus Stop

The routes of the key route buses should have priority for the improvement.

Along major routes in CBD such as 6a and 7a Avenue and Av. Bolivar, each stop should have more than one pairs of platforms and bays. Each pair is for a group of routes toward a direction. For example, one for west, one for south, one for north-east and one for others.

When there is demand for a bus stop at an intersection, it should be located approximately 30 m after the intersection for smooth traffic flow wherever possible.

The Guatemala Municipality and other municipality offices are to build bus stops. Private companies are also expected to contribute.

11.3.2 Development of Bus Centers

(1) Zona 1 Bus Center

The FEGUA Central Station and the surrounding areas should be redeveloped to have the following functions.

i. Railway station
ii. Bus stops
iii. Taxi stops
iv. Car parking
v. Urban commercial, business, service and culture centers such as a department store, restaurants, a hotel, a railway museum, etc.
vi. Urban park and plaza

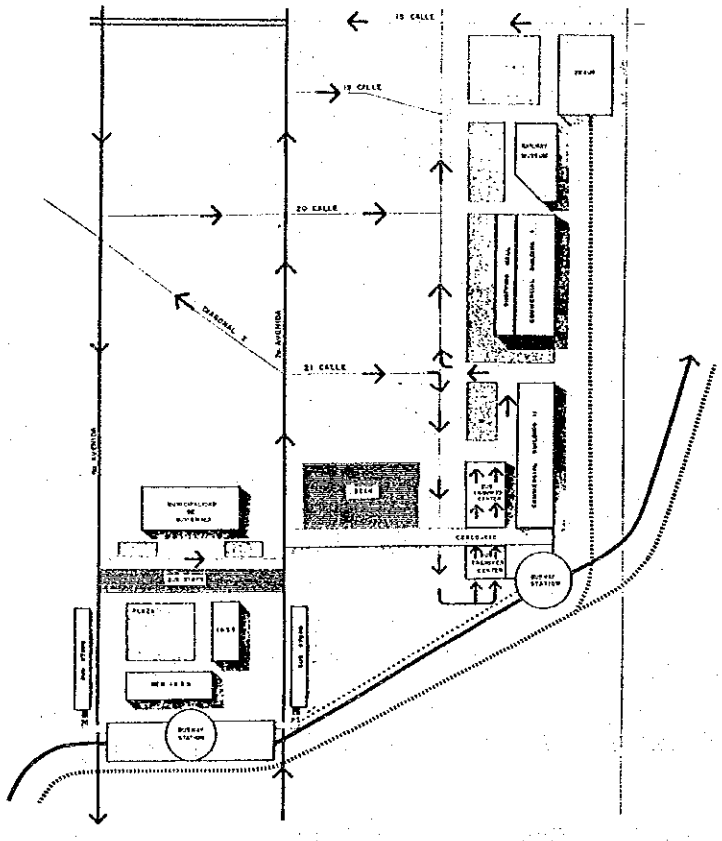


Figure 11.3.2 Conceptual Plan of Zona 1 Bus Center

The roughly estimated number of berths for public transport is as follows.

Busway for north and south	= 2
Key route buses (East-West Corridor-Periferico-Centro)	= 1
Key route buses (CA1West-Periferico-Centro)	= 1
Feeder buses for north of 18 Calle (clockwise and anti-clockwise)	= 2
Feeder buses for south of 18 Calle (clockwise and anti-clockwise)	= 2
Extra-urban buses to and from Chinautla	= 3
International/tourism buses	= 5
Taxi arrival and departure	= 2
Total	=18

Other characteristics of the center is estimated as follows.

Number of buses per day	= 4,800
Area requirement excluding the urban center	= 5,900 sqm
Floor area of buildings excluding the urban center = 1000 sqm * 3 floors	= 3,000 sqm
Construction cost excluding the urban center	= Q9,620 thousand

Integrated with the public transport functions, a redevelopment project of an urban center can be planned in the FEGUA station area.

In coordination with these projects, the following areas should also be redeveloped.

i. 18 Calle between the bus center and 4a Avenida as a pedestrian mall with or without bus stops

ii. Centro Civico, between the municipality building and I.G.S.S. as a park on the top floor, urban bus stops on the middle floor and a car park on the bottom floor, and also behind the I.G.S.S. building as a busway stop

(2) Zona 4 Bus Center

The Zona 4 Terminal should be redeveloped in coordination with relocation of the extra-urban bus terminal and the wholesale market.(See Figure 11.3.3)

It should have the following functions.

i. Railway station
ii. Bus stops
iii. Taxi stops
iv. Car parking
v. Urban commercial, business, service and culture centers including a retail market, etc.
vi. Urban park and plaza

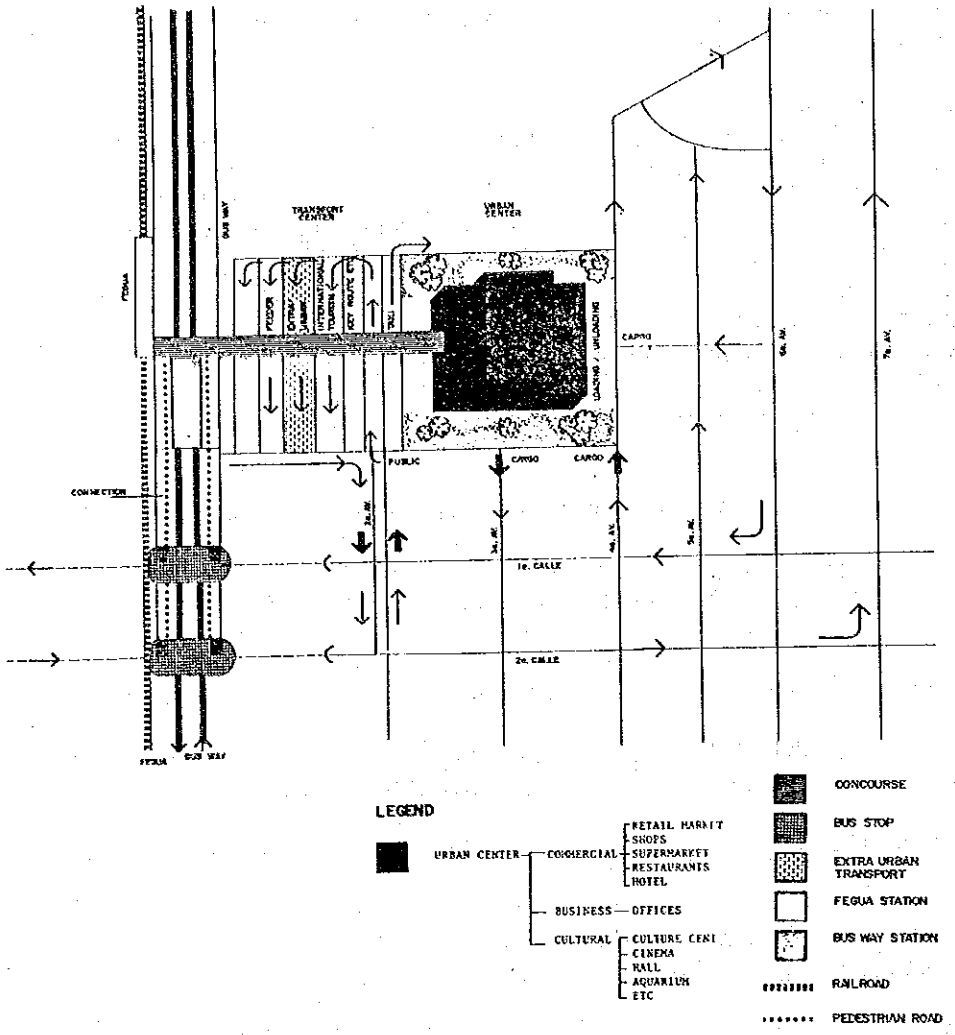


Figure 11.3.3 Conceptual Plan of Zona 4 Bus Center

Roughly estimated number of berths for public transport is as follows.

Busway along FEGUA for north and south	= 2
Busway along East-West Corridor	= 2
Urban buses	= 4
Feeder buses for north of the Center (clockwise and anticlockwise)	= 2
Feeder buses for south of the Center (clockwise and anticlockwise)	= 2
Extra-urban buses to/from CA1East	=12
Extra-urban buses to/from Department Road 10	= 1
International/tourism buses	= 5
Taxi arrival and departure	= 2
Total	=32

Other characteristics of the center is estimated as follows.

Number of buses per day	= 6,000
Area requirement excluding the urban center	= 10,600 sqm
Floor area of buildings excluding the urban center = 1000 sqm * 3 floors	= 3,000 sqm
Construction cost excluding the urban center	= Q11,985 thousand

In coordination with the redevelopment of the Zona 4 Bus Center, routes of public transport, private transport and cargo transport should be revised.

(3) Institutional Aspects of the Centers

The organization who constructs and manages the centers can be the following or combination of them.

i. Guatemala Municipality or FEGUA
ii. Newly established semi-public corporation or company
iii. Private company on a commission basis or by "Build, Operate and Transfer" scheme

Considering the public nature of the projects, the centers should not collect high charges from buses.

Suppose that Q1.00 charge be paid by buses for each stop and Q20.00/sqm be the monthly rent from the tenants of the floors, both projects can have the internal rate of return of approximately 20%. The projects are not highly profit making but they can be operated on a cost recovery basis.

Integrated with the transport centers, urban centers should be developed to fulfill the functions mentioned above.

11.3.3 Development of Extra-urban Bus Terminals

(1) Outline

Non-commuter extra-urban bus terminals should be located near the intersections of the Periferico and the following locations.

i. Between NR5 and CA1 West
ii. CA9 South
iii. CA9 North
(iv. CA1 East in operation after 2010)

These terminals should have functions such as:
(See Figure 11.3.4)

i. Operation control of non-commuter extra-urban buses
ii. Connection of non-commuter extra-urban buses with urban buses
iii. Core for new urban development
iv. CA 9 South Terminal should have good access to CENMA

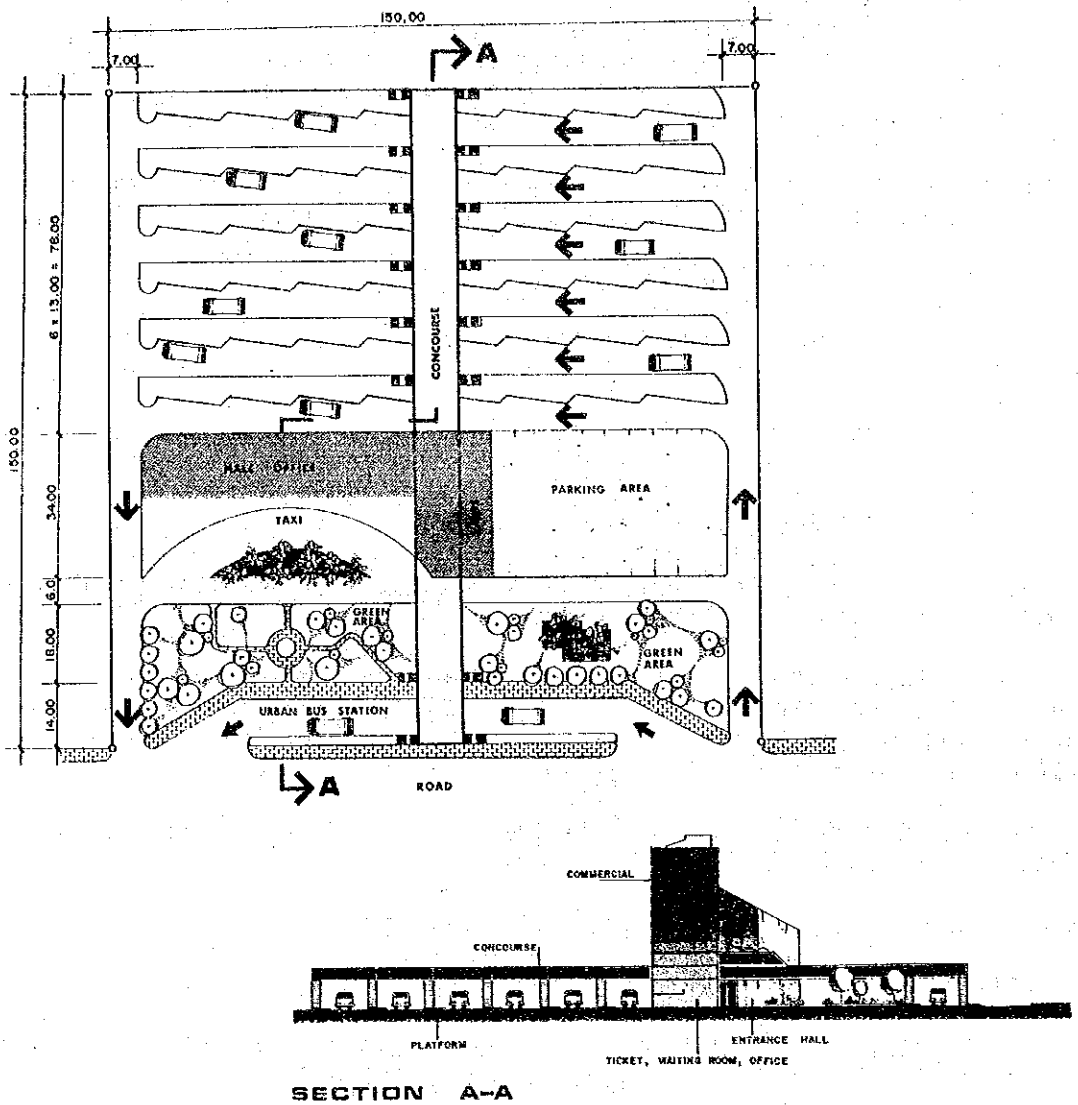


Figure 11.3.4 Conceptual Plan of Extra-urban Bus Terminal

Table 11.3.1 Demand for Non-Commuter Extra-urban Bus Terminals

	No.of Buses & Microbuses in Peak Hour	Future No. Buses in in Peak Hour	No.of Dept or Arrival Berths
National Road 5	42	56	4
CA 1 west	70	93	8
Subtotal	112	149	12
CA 9 South	52	69	6
CA 9 North	44	49	4
CA 1 East	25	33	3
Total	233	300	25

Assumptions
- Present no. of buses & microbuses = Buses & microbuses crossing cordon line during peak hour
- Future passenger demand = Present passenger demand * 2
- Future bus capacity = Present bus capacity * 1.5
- Time at berth = 5 minutes for arrival and 5 minutes for departure
- Parking time during peak hour = 1 hour

Notes
- The existing zona 4 terminal has 86 berths for passengers.
- Existing extra-urban terminals in Zone 4, Zona 1 and Zona 6 include extra-urban buses for commuting within the Metropolitan Area.

(2) Characteristics of Extra-urban Bus Terminals

Table 11.3.2 Characteristics of Extra-urban Bus Terminals

	West Terminal	South Terminal	North Terminal
Extra-urban bus routes	NR5 & CA1West	CA9South	CA9North
Number of extra-urban buses per day	1,640	790	580
Number of berths for arrival	12	6	4
Number of berths for departure	12	6	4
Bus parking space	149	69	49
Area requirement in sqm	30,270	14,310	9,990
Floor area of building in sqm	3,000	3,000	3,000
Estimated construction cost in Q1,000	19,088	12,790	10,964

(3) Institutional Aspects of Terminals

The above 3 terminals can also be developed and operated by either the public, semi-public or private sector. With Q5.00 charge for each visit of extra-urban buses and Q20.00 monthly rent per square meter of the floor from the tenants, the projects can recover the costs, though they are not on a commercial basis (Internal rates of return are estimated to vary between 10 % and 20 % depending on various conditions.)

11.3.4 Development of Bus Inspection and Maintenance Center

(1) Rationale and Outline

According to the passengers questionnaire survey conducted in 1990, "Old and poorly maintained buses" was the third most serious problem, "air pollution of buses" was fourth and "noise of buses" was ninth out of the 24 selections. Lack of maintenance causes occasional breakdown and low operation rate of the fleet, and reduces operation efficiency of the operators.

This center is to inspect mechanical conditions of buses and to promote better maintenance of them. Functions of the center are:

i. Inspection of buses
ii. Repair of buses and
iii. Training and information service.

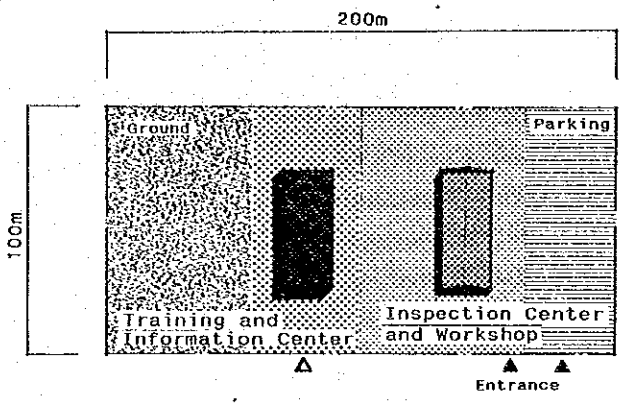


Figure 11.3.5 Conceptual Plan of Bus Inspection Center and Maintenance

The center has an office for administration, training and information service and a workshop for inspection and repair. Related equipment such as a fuel station, a car wash and a parking is also attached.

The location close to the South Extra-urban Bus Terminal can be proposed, considering access from buses and accumulation of car related industries along CA 9 South.

(2) Facilities

1) Training and Information Center

The training and information center has three functions.

Training: Like a vocational school, short to medium term programs of training and schooling for bus maintenance are held.
On-the-job training is carried out in the workshop and audio-visual programs and material are

	used for effective education.
Information:	Information of buses and the parts is controlled by personal computers.
Administration:	Administration for the whole Bus Inspection and Maintenance Center.

The building has the total floor area of about 2,000 sqm and such rooms as offices, classrooms, conference rooms, an audio-visual room, an information center, etc.

2) Inspection Center and Workshop

Inspection of mechanical conditions of buses is done in the inspection center and repair work is carried out in the workshop, which is used also for training of maintenance. The accommodation capacity is around 10 units and the total floor area is about 1,000 sqm.

The following equipments will be provided:

- Lubrication	grease pump, oil drain pump, auto lift, fitting tool etc.
- Tire repair	tire spreader, tire pressure gauge, quick hose connector etc.
- Engine repair	piston ring compressor, valve lifter, air valve lapper, mechanic set etc.
- General service	hydraulic press, drilling machine, air impact wrench, air hose etc.
- Electric	battery charger, tool set etc.
- Washing	Car washer, washing brush etc.
- Body & painting	ace cutter, spray gun, air hose etc.
- Tool	wrench, driver, hammer, gauge etc.
- Air compressor	air compressor and hose
- Fuel station	fuel stand, tank and pump

(3) Institutional Aspects of Center

The initial capital cost is estimated approximately at Q21,700 thousand, of which Q11,800 thousand or 54 % is for the equipment. The Guatemala Municipality or a newly established semi-public company can develop and operate the center.

11.3.5 Major Bus Operation Space at Peripheries of CBD

In the peripheries of CBD, key route buses and ordinary buses need space with priority for changing directions at the following locations.

i. Intersection of 6 Av., 7 Av., 4 Av. and 5 Av. with Calle Marti
ii. Intersection of 6 Av.and 7 Av. with Liberacion
iii. North-western corner of CBD (Beginning of Periferico, Super 24, Mariano Galvez Univ., Diamante, etc.)
iv. South-western corner of CBD (Trebol, Airport, Santa Fe, etc.)
v. South-eastern corner of CBD (Intersection of 18C., 19C. and 20C., Av. Las Americas, Santa Fe, etc.)
vi. North-eastern corner of CBD (Colonia Ciudad Nueva, etc.)

11.4 Service Improvement

(1) Sales of Tickets

The tickets should be available at major terminals and centers.

Bus passes available for a certain period and bunches of tickets for discount prices can also be sold.

Regarding the students bonus, the balance between normal fares and student fares should be compensated by the government.

(2) Maintenance of Security of Public Transport and Improvement of Night Service

The security in the buses can be improved by equipping automatically closed doors, alarm bells or emergency sirens and PR of these security systems, and security campaign.

Some buses may have security guards at night.

(3) Reduction of Pollution

Air pollution, noise and occasional breakdown can be reduced by a mechanical inspection system of buses. The system should be linked with bus licensing and financial support system for renewal of buses.

(4) Orderly Driving

Bus companies and their associations should emphasize the importance of the service for their passengers and care of other traffic.

(5) Bus Information for Passengers

Bus stops should be clearly identified. At stops, bus routes and schedules should be presented. Handy route maps should be available for passengers.

(6) Introduction of Special Buses

In order to attract private car users to buses, special buses such as express buses and more comfortable buses can be promoted.

(7) Peak Cut

To reduce the high demand in peak hours, various work and school hours should be promoted.

11.5 Financial and Institutional Set-up

11.5.1 Fares and Public Finance

(1) Fares and Subsidies

The subsidy of Q72 millions has been paid annually to the urban bus owners by Ministry of Finance through the municipality. It was originally planned to help low income citizens.

It is necessary to examine weather the existing subsidy system is the best system or not. Experiences in many countries show inefficiency of subsidy systems. There are also critical opinions on the subsidy, an example of which is that rich passengers also enjoy the subsidized low fare.

In a case without subsidy, measures to help low income people should be considered first. Such examples are students tickets, compensation of transport expenses by the employers, special social welfare system etc.

The fund saved by reduction or termination of the subsidy should be utilized to develop the urban transport infrastructure for economic growth and eventually for citizens' benefit.

As an option of the initial step, coexistence of unsubsidized key route buses with Q0.50 fare and subsidized ordinary buses with Q0.40 fare can be a way to solve the passengers' issue. Passengers who prefer high service to low fare can choose the key route buses and those who prefer low fare to high service can choose ordinary buses.

Full operation of the key route buses can account for approximately 50% of the total number of bus passengers in the Study Area. Therefore, if the new system is promptly introduced, instead of the annual 72 million Quetzales, 36 million Quetzales will be enough for the total budget for the subsidy.

The subsidy to poorly maintained buses, small size buses and old buses after the loan payment can be terminated at an early date.

Then, per capita economic growth of 3 % per annum fully supports termination of the whole subsidy before the year 2000.

The fare of feeder buses can be lower than other buses such as Q0.25 or free of charge when the passengers ride the connected key route buses. Some feeder buses and few ordinary buses can be cross-subsidized by other more profitable routes within each company. Only in cases when it is not possible, the government can consider special subsidies during a limited period on condition that the bus companies submit accurate performance records. During the period, the companies have to work out the performance improvement plans.

For long distance trips beyond the present urban bus area, inter-zonal fares should be added to the base fares. The inter-zonal fare is an additional fare for trips between different fare zones. For example, the fare zones consist of the present urban bus area and outer areas along different radial arteries. (See Figure 11.5.1)

Table 11.5.1 Estimated Financial Performance of Urban Buses in 2010

Route No.	Type	Each Bus							Each Route		
		Loan (Q/day)	Operation & Mainte. (Q/day)	Total Cost (Q/day)	Fare (Q)	Income (Q/day)	Balance withLoan (Q/day)	Balance w/oLoan (Q/day)	Balance withLoan (Q/day)	Balance w/oLoan (Q/day)	Income/ Cost
1	Key Route	392	424	816	0.50	941	125	516	3,463	14,333	1.70
2	Key Route	392	433	824	0.50	1,012	188	580	13,262	40,876	1.80
3	Key Route	392	402	793	0.50	953	159	551	12,080	41,750	1.79
4	Key Route	392	396	788	0.50	787	-0	391	-26	28,763	1.50
5	Key Route	392	391	782	0.50	665	-117	274	-5,636	13,165	1.28
6	Key Route	392	444	836	0.70	1,134	298	690	12,298	28,455	1.97
7	Key Route	392	433	825	0.70	873	48	440	2,195	20,114	1.55
8	Key Route	392	535	927	0.70	2,223	1,312	1,703	31,479	40,879	3.36
9	Key Route	392	444	835	0.70	1,069	233	625	19,057	51,077	1.86
10	Key Route	392	385	777	0.70	583	-194	198	-6,979	7,122	1.13
11	Key Route	392	389	780	0.70	540	-240	152	-1,620	1,024	1.04
12	Key Route	392	395	786	0.70	725	-62	330	-4,578	24,505	1.38
13	Key Route	392	388	780	0.70	587	-193	199	-35,133	36,252	1.13
14	Key Route	392	408	800	1.10	537	-263	129	-71,413	34,930	1.00
15	Key Route	392	415	807	1.10	749	-58	334	-4,046	23,274	1.37
16	Key Route	392	365	756	0.50	804	47	439	2,484	23,048	1.62
17	Key Route	392	364	755	0.50	648	-107	285	-9,476	25,188	1.31
18	Key Route	392	364	755	0.50	691	-65	327	-1,404	7,115	1.40
19	Key Route	392	362	754	0.50	742	-12	380	-307	9,974	1.51
20	Key Route	392	363	755	0.50	627	-128	264	-3,549	7,320	1.27
21	Key Route	392	356	748	0.50	631	-117	275	-877	2,061	1.30
22	Key Route	392	389	781	0.50	946	165	557	8,536	28,806	1.82
23	Key Route	392	384	776	0.50	822	46	438	3,698	35,131	1.60
24	Ordinary	245	292	537	0.50	721	184	429	2,211	5,149	1.93
25	Ordinary	245	286	530	0.50	539	9	254	247	6,856	1.47
26	Ordinary	245	285	530	0.50	939	409	654	13,087	20,921	2.56
27	Ordinary	245	287	531	0.50	695	164	409	4,421	11,031	1.89
28	Ordinary	245	284	529	0.50	641	112	357	3,582	11,415	1.75
29	Ordinary	245	334	579	0.70	709	130	375	7,429	21,383	1.71
30	Ordinary	245	319	564	0.70	545	-18	226	-1,050	12,904	1.36
31	Ordinary	245	314	559	0.70	565	6	251	493	20,322	1.43
32	Ordinary	245	322	567	0.70	640	73	317	3,271	14,287	1.58
33	Ordinary	245	310	555	0.70	492	-63	181	-3,492	9,973	1.25
34	Ordinary	245	306	551	0.70	576	25	270	1,285	14,014	1.48
35&36	Ordinary	245	304	548	0.70	418	-131	114	-3,785	3,314	1.08
37&38	Ordinary	245	267	512	0.50	460	-52	193	-627	2,311	1.32
39	Ordinary	245	264	509	0.50	566	57	302	6,025	31,834	1.64
40	Ordinary	245	280	525	0.50	413	-112	133	-670	799	1.14
41	Ordinary	245	264	509	0.50	622	113	358	2,263	7,159	1.80
43	Ordinary	245	264	509	0.50	619	110	355	884	2,842	1.79
44	Ordinary	245	277	522	0.50	880	359	603	67,617	113,780	2.46
45	Ordinary	245	256	501	0.50	358	-143	102	-40,632	28,982	1.06
46	Ordinary	245	259	504	0.50	439	-65	180	-5,092	14,003	1.29
47	Ordinary	245	267	511	0.50	570	58	303	2,507	13,033	1.64
48	Ordinary	245	257	502	0.50	384	-118	127	-18,564	20,045	1.13
49	Ordinary	245	256	501	0.50	341	-160	85	-8,625	4,595	1.01
50	Ordinary	245	278	522	0.50	741	219	464	10,946	23,186	2.06
51	Ordinary	245	273	518	0.50	676	157	402	8,190	20,920	1.90
52	Ordinary	245	333	577	0.70	677	99	344	22,549	78,154	1.63
53	Ordinary	245	296	540	0.50	669	129	373	2,573	7,469	1.77
54	Ordinary	245	294	539	0.70	472	-67	178	-2,612	6,935	1.26
55	Ordinary	245	290	535	0.90	373	-162	82	-8,122	4,118	1.00
56	Ordinary	245	258	503	0.70	406	-97	148	-8,827	13,451	1.19
57	Ordinary	245	260	505	0.70	483	-22	223	-696	7,138	1.41
58	Ordinary	245	255	500	0.50	343	-157	88	-25,817	14,471	1.02
59	Ordinary	245	266	511	0.50	454	-56	189	-1,967	6,601	1.31
61	Feeder	147	144	290	0.10	106	-184	-37	-7,371	-1,496	0.55
62	Feeder	147	197	344	0.10	52	-292	-145	-1,168	-580	0.21
64	Feeder	147	136	283	0.10	112	-171	-24	-1,369	-194	0.60
65	Feeder	147	142	289	0.10	56	-233	-86	-18,150	-6,693	0.29
66	Feeder	147	137	284	0.10	39	-245	-98	-1,469	-588	0.21
67	Feeder	147	139	286	0.10	107	-178	-31	-1,425	-249	0.57
69	Feeder	147	145	292	0.10	132	-159	-12	-2,550	-200	0.68

Note : Few negligible routes are not included in the simulation.

Table 11.5.2 Basic Idea of Additional Fares for Inter-Zonal Trips

Unit: centavos

Fare Zone	1	2	3	4	5	6	7	8	9
1	0								
2	50	0							
3	50	100	0						
4	50	100	100	0					
5	50	100	100	100	0				
6	50	100	100	100	0	0			
7	50	100	100	100	50	0	0		
8	50	100	100	100	100	100	50	0	
9	50	100	100	100	100	100	100	100	0

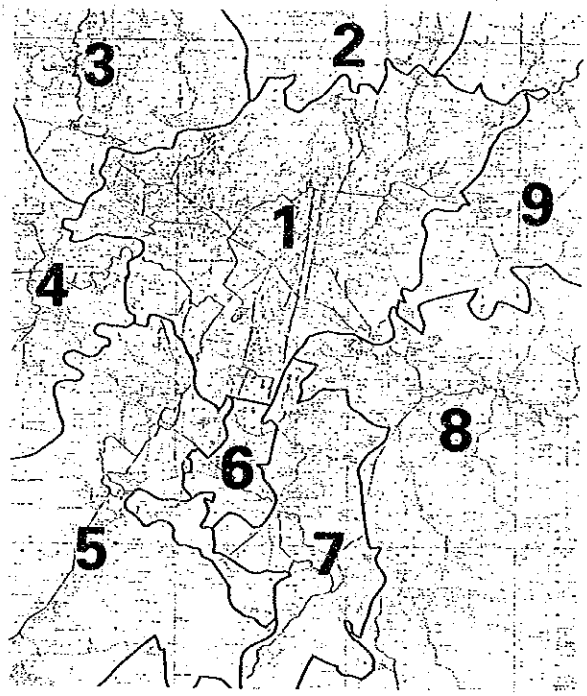


Figure 11.5.1 Example of Fare Zones

Analysis of estimated indicators shows that operation of key route buses with proposed feeder buses can be profitable. (See Table 11.5.3)

Table 11.5.3 Financial Performance of Key Route Buses and Feeder Buses

Route number	TtlCost withLoan	TtlCost w/oLoan	Route Income	Income/ Cost(*)
1	22,646	11,777	26,110	1.70
2	58,114	30,500	71,377	1.80
61	11,615	5,740	4,245	0.55
62	1,377	790	209	0.21
Total	93,753	48,807	101,940	1.60
8	22,240	12,840	53,719	3.36
9	68,294	36,274	87,351	1.86
65	22,508	11,051	4,358	0.29
Total	113,042	60,165	145,429	1.87
14	217,129	110,786	145,716	1.00
15	56,295	28,975	52,249	1.37
66	1,706	825	237	0.21
Total	275,130	140,586	198,202	1.07
16	39,705	19,141	42,190	1.62
17	66,842	32,177	57,366	1.31
18	16,430	7,911	15,026	1.40
19	19,788	9,506	19,481	1.51
20	20,948	10,079	17,399	1.27
21	5,610	2,672	4,733	1.30
67	2,284	1,109	860	0.57
69	4,664	2,314	2,114	0.68
Total	33,507	16,175	25,106	1.14
64	2,316	1,141	2,234	1.46 (**)

Note(*) : Average cost is calculated based on :
Loan period=5years, Life year=15years
Note(**): Q0.25 fare is assumed in this case.

(2) Financial Support for Service Improvement

High shares of loan payment in the cost of the bus operators are regarded to be one of the major causes to impede renewal of buses and to use buses in poor conditions. Establishment of a loan system with soft conditions for renewal of buses can be considered. The system requires the bus companies to maintain good operation and regular reporting of the performance.

No need has been found to financially support the operators after the loan period.

11.5.2 Organizations and Administration

(1) Private Sector

It is important to reinforce bus companies' management capability. Each company should have a more rigid organization for more integrated efforts for higher service and efficiency, instead of being a loose group of bus owners. No evidence has been found for need to merge existing companies into only few number of much larger companies.

Therefore, licensing and any kind of public support should be given to the companies with sufficient capability to manage themselves. For example, the subsidy, as long as it is continued, should be provided to the companies and not to the individual owners.

The companies with licenses of bus operation should regularly present their performance records to the administration bodies in charge.

(2) Public Sector

The public transport directions of the Guatemala Municipality and Ministry of Communications, Transport and Public Works are core public organizations of the public transport of the Metropolis.

According to the proposed changes of the bus system, coordination between the two organizations become more important. For example, it is to be clarified whether some key route buses beyond the present urban bus area be supervised either by the municipality or by the ministry.

As urbanization of the Metropolis expands, importance of the municipalities around Guatemala City will increase. Therefore close cooperation among the two organizations, the municipalities' offices and other members of the transport committee of the Metropolis will have to be strengthened.

The market of the bus operation should be kept free from monopoly. At the same time, necessary requirement to the bus operators for good service should be enforced in exchange of the license. To keep balance between different bus companies and to promote financial independence of each company, packages of licenses of more profit making and less profit making routes should be offered.

11.6 Major Plans and Projects

11.6.1 Summary of Major Plans and Projects

Major plans and projects are listed in Table 11.6.1.

Table 11.6.1 Major Plans and Projects of Public Transport

Projects	Average Cost (Q1,000)	Quantity	Cost (Q1,000)
Introduction of New Bus Systems			-
Bus Rerouting			-
Changes of Fare & Subsidy System			-
Bus Renewal & Maintenance Measures			-
Bus Stop Dvelopment	33.1 /stop	100	3,306
Bus Lane Development	44.6 /km	85	3,794
Busway development	18,998 /km	26	493,950
Viaduct	31,250 /km	13	406,250
Surface	6,746 /km	13	87,700
Zona 1 Bus Center	1.6 /sqm	5,940	9,620
Zona 4 Bus Center	1.1 /sqm	10,560	12,000
Extra-urban Bus Terminals	0.8 /sqm	54,570	42,842
West Terminal	0.6 /sqm	30,270	19,088
South Terminal	0.9 /sqm	14,310	12,790
North Terminal	1.1 /sqm	9,990	10,964
Bus Inspection & Maintenance Center	1.1 /sqm	20,000	21,700
Total			587,212

Cost estimation is limited to capital costs of construction and related physical projects.

For each project, costs for surveys and design, administration cost and contingencies are added to the direct construction costs in economic terms. Each of the 3 items is assumed to be 10 % of construction cost.

As unit costs for construction, common figures are used with road project cost estimation.

The exchange rate between Quetzales and US Dollars is set at US$1.00=Q4.90.

11.6.2 Implementation Schedule

The implementation schedule of construction and related physical projects is shown in Figure 11.6.1. Non-physical plans and projects can be initiated promptly.

Projects	Cost
Bus Stop Dvelopment	3306
Bus Lane Dvelopment	3794
Busway Development	493950
Initial Stage(Zona 4-Ciudad Real)	11000
East-West Corridor	158630
Second Stage of FEGUA Route	324320
Zona 1 Bus Center	9620
Zona 4 Bus Center	12000
Extra-Urban Bus Terminals	42842
West Terminal	19088
South Terminal	12790
North Terminal	10964
Bus Inspection & Maintenance Center	21700
Total	587212

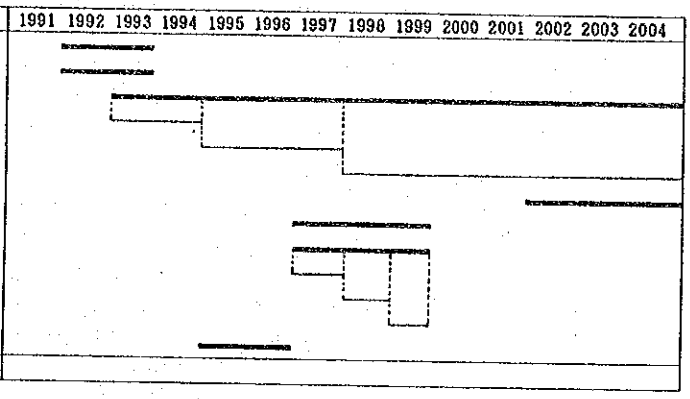


Figure 11.6.1 Implementation Schedule of Public Transport Projects

11.7 Urgent Improvement Measures

11.7.1 Introduction of Key Route Buses

Key route buses can be introduced along 7 trunk roads.

1) 1o de Julio & Milagro-NR5-Periferico-Centro
2) Paraiso & Maya-CA9N-CBD
3) 1o de Julio & Milagro-NR5-CBD
4) Villa Nueva-CA9S-CBD
5) Jocotales-DR15-CBD
6) Nimajuyu-DR14-CBD
7) Mixco-CA1W-CBD

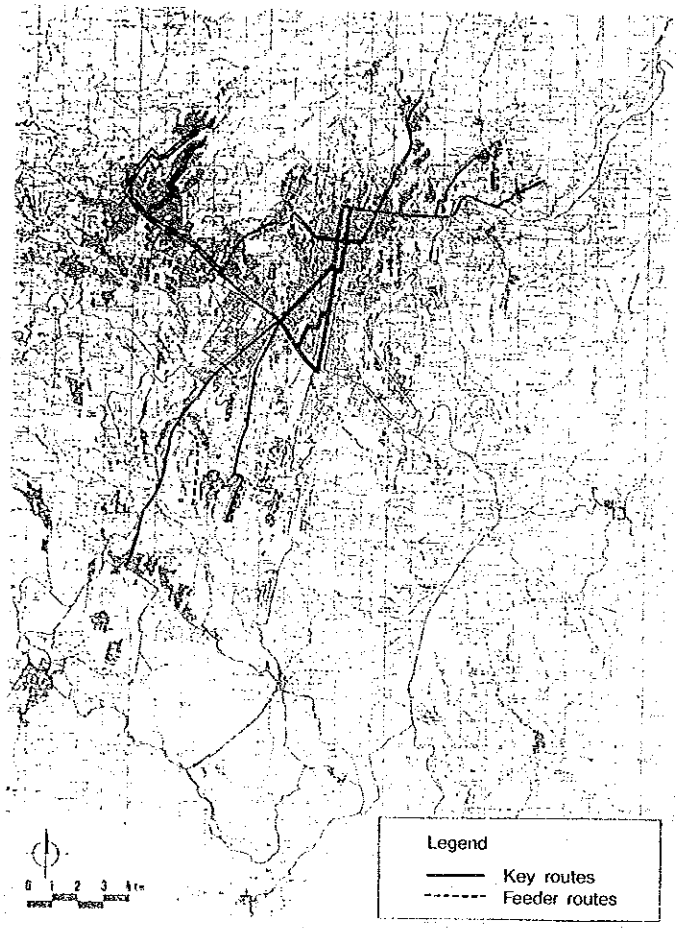


Figure 11.7.1 Short Term Plan of Key Route Buses

Each route can have 3 patterns of actual routes in CBD. They are:

i. 6a and 7a Avenidas in CBD south and 8a and 9a Avenidas in the Centro
ii. Similar to the above but stop at Zona 4 Terminal
iii. Avenida Bolivar and 4a and 5a Avenidas in Centro

Existing routes covered by or similar to the key route buses have to

reduce or reroute the operation. One way to avoid conflicts between existing and new routes is to convert some of the existing routes to key route buses. The key route buses may well be operated by the major bus companies on the trunk road.

11.7.2 Introduction of Feeder Buses

The following feeder buses can be introduced urgently.

1) Feeder Buses for No.1) 1o de Julio & Milagro-NR5-Periferico-Centro Route and No.3) 1o de Julio & Milagro-NR5-CBD Route
   - Connection of Amparo to Periferico
2) Feeder Buses for No.2) Paraiso & Maya-CA9N-CBD Route
   - Connection in Zona18 areas to 20 Avenida and/or 12 Calle
3) Feeder Buses for No.4) Villa Nueva-CA9S-CBD Route
   - Connection of Mezquital to CA9S
4) Feeder Buses for No.6) Nimajuyu-DR14-CBD Route
   - Connection among Ciudad Real, Nimajuyu and Justo Rufino Barrios
5) Feeder Buses Not Connected to Specific Buses
   - Connection among CA9S, USAC and DR14

11.7.3 Improvement of Other Routes

The following ordinary buses can be introduced or improved.

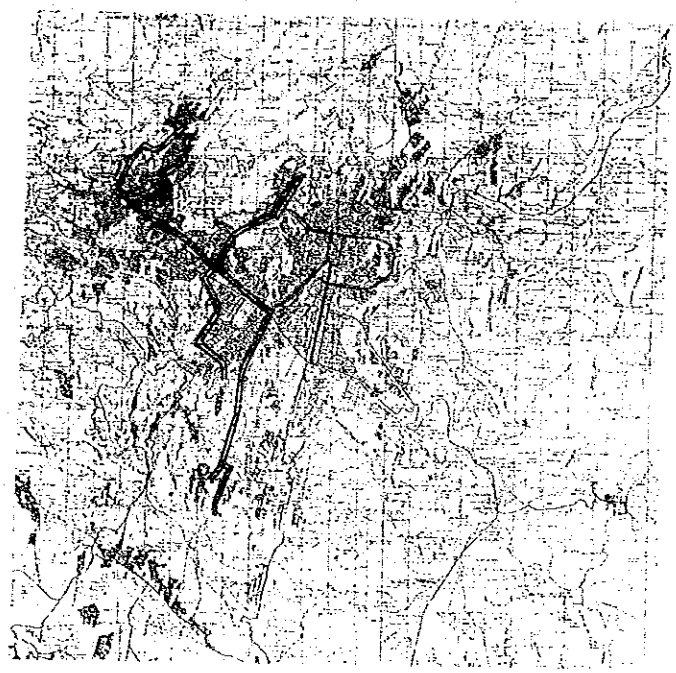


Figure 11.7.2 Short Term Plan of Ordinary Buses

1) West-South Routes
   - 1o de Julio & Milagro-NR5-CA9S/Periferico-USAC (Service for USAC, etc.)
   - 1o de Julio & Milagro-NR5-DR14-Nimajuyu/Ciudad Real (Service for factories along DR14, etc. This can be an extension of the above.)

2) Diagonal14-CBD Route

3) Amparo Routes
   - Amparo-CBD
   - Amparo-Periferico-USAC (Service for USAC, etc.)
   - Amparo-Periferico-DR14-Nimajuyu/Ciudad Real (Service for factories along DR14, etc. This can be an extension of the above)

11.7.4 Priority Measures and Service Improvement

(1) Bus Lanes

The following bus lanes can be introduced urgently.(See Figure 11.7.3)

1) Periferico between Avenida Elena and NR5
2) NR5 between Trebol and Border of Guatemala Municipality
3) CA1W between Trebol and Mixco
4) CA9S between Trebol and Castanas
5) Avenida Bolivar between Trebol and Bolivar Park
6) Boulevard Liberacion between Trebol and 7a Avenida
7) 6a Avenida between Boulevard Liberacion and 18 Calle(?)
8) 7a Avenida between Boulevard Liberacion and 18 Calle(?)
9) 4a Avenida in Centro
10) 5a Avenida in Centro
11) 8a Avenida in Centro
12) 9a Avenida in Centro
13) 8a Calle in Centro
14) 9a Calle in Centro

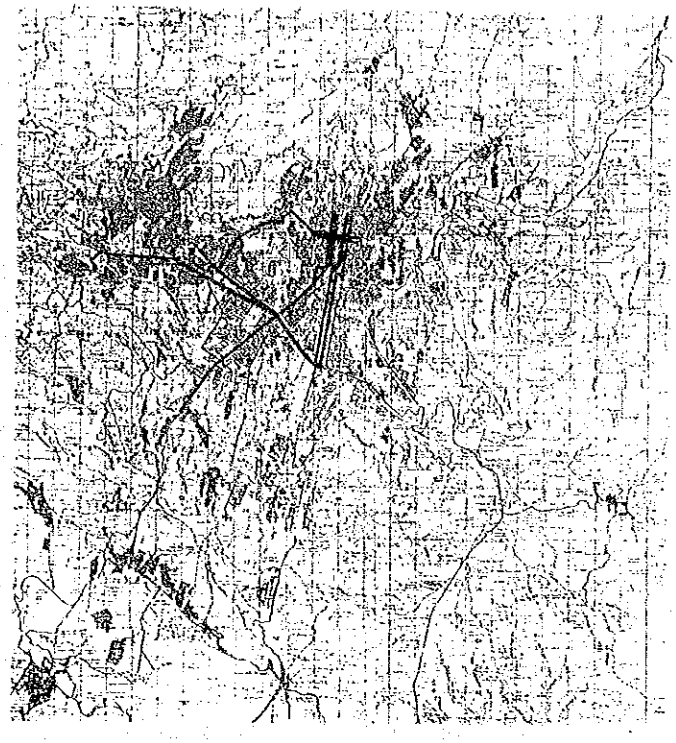


Figure 11.7.3 Short Term Plan of Bus Lanes

(2) Improvement of Bus Stops, Bus Operation Space and Roads for Buses

Especially for key bus routes, bus stops should be improved and bus operation space should be kept. For all bus routes, pavement and improvement of the roads is an urgent task. Bus routes should have physical conditions for regular size buses.

11.7.5 Other Non-physical Measures

Most of the measures proposed in the previous chapters which do not need construction or purchase of expensive equipment can be implemented immediately.

11.8 Rail Transit System

11.8.1 Basic Characteristics of Rail Transit Systems

As population grows, urbanization expands and the level of economy rises, demand for a rapid mass transit system will increase. Urban railway systems are a candidate mode to meet the demand. Certain railway systems can transport more passengers more rapidly and more punctually than ordinary buses. In general, railways are better than buses also in air pollution, but the capital cost of railways is considerably higher than bus systems.

An rail transit system with high maintainability and reasonably low cost is considered as a candidate system of the future metropolis. The system should consist of fully established conventional technology. A track capacity of more than 30,000 passengers per hour and a commercial speed of 30 km/h can be expected. A candidate route is basically the alignment of the busways.

Guideway buses could also be a candidate. However, the capacity is generally less than that of rail transit systems and the operational and management issues in Guatemala have to be cleared.

11.8.2 Financial Analysis

According to Table 8.2.4, the future number of trips is estimated about 6 million trips, while the projected passengers using the railway system are estimated about 700 thousands per day. Therefore, almost 11 percent of total trips within the Study area will use the proposed railway system, if introduced. This section gives a simple financial analysis in case of introducing the railway system.

(1) Preconditions of the analysis

Six alternative plans are examined in the Study. Among them Alternative Plan C and Alternative Plan F are plans introducing the railway system. The railway project cost is estimated 3,499 million Quetzales for Alternative Plan C and 2,799 million Quetzales for Alternative Plan F, respectively. The following is the analysis for Alternative Plan F, the cheaper railway construction cost case, since the cheaper cost has higher possibility to introduce the railway system.

The followings are preconditions of the analysis:

1. The project starts in the year 2001.
2. Construction period (including land acquisition) is assumed to be 5 years.
3. Interest rate of the international lending agencies is assumed to be 12 %, while 26% from domestic bank.
4. The railway service starts from 2006
5. The number of passengers per year is estimated as follows:
   Weekday (265 days per year) 700,000 passengers
   Holiday (100 days per year) 350,000 passengers
6. The number of passengers (per day) in year of 2006(opening year) is assumed to be half of 700,000 per day. The number of passenger increases gradually to 700,000 until 2010.

(2) Evaluation Criteria

Criteria for the financial analysis is:

1. In several years after the railway system opens, the yearly income should be positive (to get profit).
2. In about 10 years after the railway system opens, the accumulated income should turn over from negative to positive.

(3) Alternatives of the financial analysis

The financial analysis is performed in "Without Subsidy Case" and "With Subsidy Case". Each case is analyzed depending on the fare level. The recommended financial statement is shown in Figure 11.8.1. The following is the Summary of the financial analysis.

Summary of Financial Analysis

Without Subsidy Case

Fund Source: 80% of Cost from the World Bank (12%)
20% of cost from the Domestic bank (26%)

		Yearly Income turns to plus	Accumulated Income turns to plus
Fare Level	Q.1	More than 20 years	More than 20 years
Fare Level	Q.3	5 years	12 years

With Subsidy Case - 1

Fund Source: 80% of cost from the World Bank
20% of cost from subsidy

		Yearly Income turns to plus	Accumulated Income turns to plus
Fare Level	Q.1	20 years	More than 20 years
Fare Level	Q.2	8 Years	More than 18 years
Fare Level	Q.2.5	4 Years	8 years

With Subsidy Case - 2

Fund Source: 50% of cost from the World Bank
50% of cost from subsidy

		Yearly Income turns to plus	Accumulated Income turns to plus
Fare Level	Q.1	20 years	More than 20 years
Fare Level	Q.1.5	12 years	More than 20 years
Fare Level	Q.2	4 years	7 years

With Subsidy Case - 3

Fund Source: 100% of cost from Subsidy

	Yearly Income turns to plus	Accumulated Income turns to plus
Fare Level Q.1	5 years	15 years

Table 11.8.1 Recommended Financial Statement

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Revenue						221	262	312	371	442	441	441	441
Passenger						110	131	156	186	221	221	221	221
Fare(Q2)						2	2	2	2	2	2	2	2
Cost						442	444	448	452	457	451	445	437
Operating						33	39	47	56	66	66	66	66
Depreciation						140	140	140	140	140	140	140	140
Interest						269	265	261	256	251	245	239	231
Income						-221	-182	-136	-81	-15	-10	-4	4
Accumulate						-221	-404	-540	-620	-636	-646	-649	-646
Source	-560	-560	-560	-560	-560	-81	-42	4	59	125	130	136	144
Income						-221	-182	-136	-81	-15	-10	-4	4
Depreciation						140	140	140	140	140	140	140	140
Investment	-560	-560	-560	-560	-560								
Foreign	-448	-448	-448	-448	-448								
Domestic	-112	-112	-112	-112	-112								
Application	672	672	672	672	672	300	300	300	300	300	300	300	300
Capital	112	112	112	112	112								
Loan	560	560	560	560	560								
Repayment						300	300	300	300	300	300	300	300
Surplus	0	0	0	0	0	-381	-342	-296	-241	-175	-170	-164	-156

	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
Revenue	441	441	441	441	441	441	441	441	441	441	441	441	441
Passenger	221	221	221	221	221	221	221	221	221	221	221	221	221
Fare(Q2)	2	2	2	2	2	2	2	2	2	2	2	2	2
Cost	429	420	409	398	385	370	354	336	315	293	267	238	206
Operating	66	66	66	66	66	66	66	66	66	66	66	66	66
Depreciation	140	140	140	140	140	140	140	140	140	140	140	140	140
Interest	223	214	203	192	179	164	148	130	109	86	61	32	0
Income	12	21	32	43	56	71	87	105	126	148	174	203	235
Accumulate	-634	-613	-581	-538	-482	-411	-324	-219	-94	55	229	431	666
Source	152	161	172	183	196	211	227	245	266	288	314	343	375
Income	12	21	32	43	56	71	87	105	126	148	174	203	235
Depreciation	140	140	140	140	140	140	140	140	140	140	140	140	140
Investment													
Foreign													
Domestic													
Application	300	300	300	300	300	300	300	300	300	300	300	300	300
Capital													
Loan													
Repayment	300	300	300	300	300	300	300	300	300	300	300	300	300
Surplus	-148	-139	-128	-117	-104	-89	-73	-55	-34	-11	14	43	75

(4) Concluding Remarks

Generally speaking, the financial situation can be judged to be feasible if the yearly income turns to plus in several years and the accumulated income turns to plus in 10 years after the railway service starts. Considering this criteria, in "Without Subsidy Case" the railway system could be feasible if the fare level is 3 Quetzales per passenger. On the other hand, if the government gives subsidy 20% of the cost in "With Subsidy Case", the railway system is feasible for the fare level of 2.5 Quetzales. In case of subsidy of 50% of the cost, the fare level of 2 Quetzales becomes feasible for the introduction of the railway system.

However, according to the report "Urban Transit Systems Guidelines for Examining Options" published from the World Bank, the limit of payment to the transportation cost should be less than 10% of the income. Since the average monthly income is 500 Quetzales per month in Guatemala, the maximum payment to the transportation cost is considered to be 2 Quetzales per day (500/25*0.1=2, assuming 25 working days per month). Since passengers usually pay twice the fares for going to the working place and going back home, the maximum fare should be 1 Quetzal per trip. From the above financial analysis, only "With Subsidy Case - 3 " (all project cost is covered by the subsidy from the government) is feasible for the fare level of 1 Quetzal. However, this is unrealistic, judging from the existing unfavorable financial situation in Guatemala. Other cases are unfavorable from the viewpoint of the passenger's burden of fare ability. Only if the introduction of the railway system is strongly insisted by all means, it is recommended that the government burdens the 20% of the project cost and the fare level is 2 Quetzales per passenger when the Guatemala economy will be improved and the average income level will increase in the near future.

11.8.3 Conversion from Busways to Railways

Under the preconditions mentioned above, the situation in 2010 will not yet be mature to totally recommend a railway system as the best option. However, changes in socio-economic situation may justify railway transit in future. The right time when a railway system should be introduced depends on the future situation.

As a practical approach, the busway should be planned and designed so as to be converted to a railway system when the situation is changed in favor of railways.

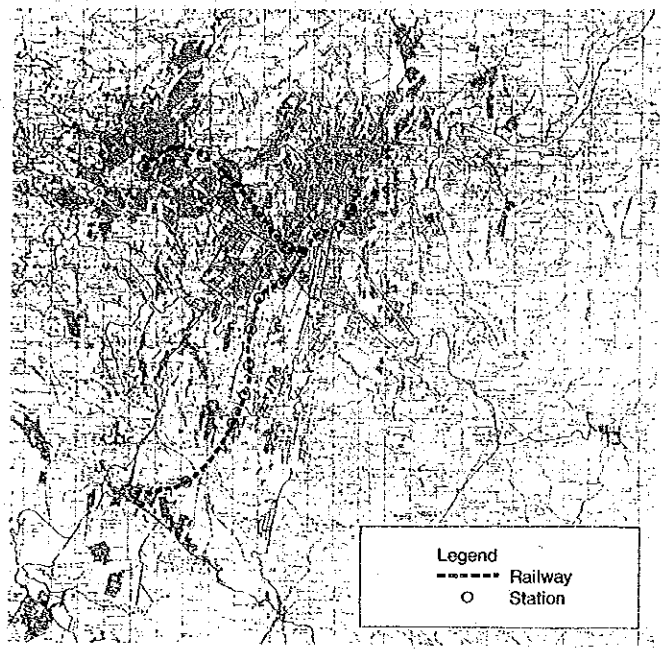


Figure 11.8.1 Conceptual Plan of Urban Railway Routes and Stations

The following criteria should be considered to design the busway.

1) Horizontal alignment (e.g. Minimum radius >= 100m-200m)

2) Vertical alignment (e.g. Maximum gradient =< 4%-5%)

3) Right of way (e.g. 10 m)

4) Built-in facility in the track

5) Spacing of stops/stations

The locations of the rail transit are preliminarily proposed. There are 21 stations along a total of 26 km route. The interval is shorter in urbanized areas and longer in suburban areas. Some busway stops are expected to be expandable for railway stations. Other stops will have to be demolished because the busway stops are more than the railway stations.

6) Load on infrastructure

In general, there is not much difference in load on the infrastructure between light railways and busways. However, detailed design of the busways needs careful study on this subject.

7) Change of routes

In some areas, alignment of bus routes and that of railways may well be different. For example, the bus route to Villa Nueva can be an improved road though Petapa or El Frutal and the railway route in future can be through Santa Catalina. In future, a busway or a railway route directly connecting Zona 19 (Florida) and San Francisco should be considered.

For the conversion with minimum negative effects, the following points should also be considered.

1) During the construction, the roads parallel to the busways such as DR14, East-West Corridor and NR5 can be used by the key route buses. Moreover, part of the space of the busway such as one lane may also be used.

2) Periods to close a road section can be minimized by dividing the whole project into several sections to be constructed stage by stage.

12. TRAFFIC MANAGEMENT PLAN

There are two concepts to solve traffic problems all over the world. One is the construction of new roads and the improvement of the existing road network, which requires a long implementation period and high construction/land acquisition costs. The other solution is a traffic management scheme, which does not require a large investment or a long implementation period.

In the Study, the traffic management schemes have planned mainly short term improvement, and the target year is set at 1995. Details of results of analysis as well as improvement plans, including cost estimation are presented in Technical Report "Traffic Management Study".

12.1 Planning Concept

12.1.1 Planning Concepts for Traffic Management Schemes

There are three major objectives for the traffic management schemes as shown below.

- To increase traffic capacity.
- To control traffic flow and volume.
- To decrease traffic accidents.

The basic conditions for planning of traffic management schemes in the Study are as follows.

a) The traffic management scheme is formulated by the combination of two or three individual traffic control systems and should coordinate closely with the broad transportation improvement plans.

b) The majority of traffic management schemes are considered to be the short term improvement plans with a target year of 1995. However, some plans are long term improvement plans due to the longer implementation period.

c) The implementation of the traffic management scheme does not require a huge amount of investment; however, it is necessary to re-examine the scheme every 3 to 5 years.

Taking into account the present traffic characteristics, road facilities conditions and land use features in the Study Area, the following traffic management schemes are considered to be effective.

Table 12.1.1 Concepts of Traffic Management Schemes

Traffic Management Scheme	Problems to be Solved
- Control of traffic generation - Restriction of car usage - Control of traffic flow - Improvement of facilities for pedestrians, bicycles and motorcycles - Traffic safety plan - Improvement of public transportation	Traffic congestion Traffic accidents

12.1.2 Examination of Applicability of Traffic Management Schemes

(1) Examination of Applicability of Traffic Management Schemes

There are various traffic management schemes to improve traffic conditions mainly from the traffic engineering point of view. According to the present traffic conditions, as well as various conditions in the Study Area, applicability of above mentioned measures has been evaluated using the following criteria. The results of examination are shown in Table 12.1.2.

Criteria "A": Limited amount of investment.
Criteria "B": Short term implementation with rapid effects.
Criteria "C": Short term implementation with rather slow effects.
Criteria "D": Long term implementation
Criteria "E": Already implemented in other cities of almost the same size as Guatemala City.

Table 12.1.2 Examination of Applicability of Traffic Management Schemes for the Study

Traffic Management Scheme	Criteria A	B	C	D	E	Applicability
1. Control Traffic Generation						
a. Control Traffic Generation by Land Use	X	X	X	O	O	No
b. Control Premises/Facilities with High Traffic Demand	X	X	X	O	O	No
a. Time-lag Commuting System	O	X	O	O	O	Yes
2. Restriction of Car Usage						
a. Restriction of Car Ownership	X	X	X	O	X	No
b. Restriction of Car Usage	X	X	X	O	O	No
3. Control Traffic Flow						
a. Effective Lane Usage	O	O	X	O	O	Yes
b. Improvement of Traffic Control System	O	O	X	O	O	Yes
c. Traffic Information System	X	X	X	O	O	No
d. Elimination of Obstacles for Traffic Flows	O	O	X	O	O	Yes
e. Effective Car Usage	X	X	X	O	O	No
4. Improvement of Facilities for Pedestrians, Bicycles & Motorcycles						
a. Measures for Pedestrians	O	O	X	O	O	Yes
b. Measures for Bicycles	O	O	X	O	O	Yes
c. Measures for Motorcycles	O	O	X	O	O	Yes
5. Traffic Safety Plan						
a. Traffic safety education	O	X	O	O	O	Yes
b. Traffic Engineering	O	X	O	O	O	Yes
c. Traffic Law Enforcement	O	O	X	O	O	Yes
6. Improvement of Public Transportation System						
a. Efficient Public Transportation System	X	X	O	O	O	Yes

(2) Applicable Area of Selected Traffic Management Schemes

Applicable areas of selected traffic management schemes differ with each scheme. Table 12.1.3 summarize the applicable area of each scheme.

Table 12.1.3 Applicable Area of Traffic Management Schemes

Traffic Management Scheme	Applicable Area		
	Whole Study Area	Road Section	Road Spot
1. CONTROL OF TRAFFIC GENERATION			
a. Time-lag Commuting System	O	X	X
2. CONTROL OF TRAFFIC FLOW			
a. Effective Lane Usage	X	O	X
b. Improvement of Traffic Control System	O	O	O
c. Elimination of Obstacles for Traffic Flows	X	O	O
3. Improvement of Facilities for Pedestrians, Bicycles and Motorcycles			
a. Measures for Pedestrians	O	O	O
b. Measures for Bicycles	X	O	O
c. Measures for Motorcycles	X	O	O
4. Traffic Safety Plan			
a. Traffic Safety Education	O	X	X
b. Traffic Engineering	O	O	O
c. Traffic Law Enforcement	O	O	O
5. Efficient Public Transport System			
a. Improvement of Public Transportation System	O	O	X

Note -- O : Applicable X : Not applicable

12.2 Traffic Management Plans

Based on the present traffic conditions, identified problems and applicable traffic management schemes for the Study Area, traffic management plans have been prepared and presented below.

12.2.1 Effective Lane Usage Plan

The one-way traffic system in the Study Area was introduced about 30 years ago and with few exceptions, the present one-way system has not been changed since 1976. Hence, the present one-way system is very familiar to drivers. However, there are some problems with the one-way street system, particularly 6a and 7a Avenidas in Zonas 1, 4, 9 and 10, where medians exist even after introduction of the one-way traffic system.

Hence, improvement plans of 6a and 7a Ave. are prepared from the effective lane usage point of view.

(1) Present Conditions of 6a and 7a Avenida

- Function
  6a and 7a Ave. are arterial roads connecting CBD with Blvd. Liberación, which is a major arterial road passing through the southern part of the city. Hence, traffic volume on these 2 roads are very heavy throughout a day.

- Median
  There are medians along these two roads and median openings are provided even at unsignalized intersections, because there are many crossing roads. Crossing vehicles and vehicles changing lanes at these median openings cause confusion of through traffic flows. In addition, existence of medians clearly decreases the traffic capacity on 6a and 7a Ave.

- Number of lanes
  At most of sections, it is possible to accommodate 6 lanes, however, only 4 lanes are utilized due to parked vehicles. In addition, only 4 lanes can be accommodated on 7a Ave. at the boundary between 1 and 4 Zonas, where an arch type railway bridge with limited width and vertical clearance is located.

- Bus routes
  These two roads are major bus routes and traffic volume of buses are very heavy. These buses often cause confusion of traffic flows.

- Traffic accidents
  Many traffic accidents have occurred along these two roads. About 100 accidents with 8 fatalities were recorded in 1989.

(2) Improvement Plan

1) Demolition of Medians

In order to solve problems of traffic confusion caused by vehicles changing lanes and crossing vehicles at median openings, as well as

insufficient traffic capacity, demolition of medians on most parts of these two roads is recommended.

2) Provision of Exclusive Bus Lanes

In order to maintain smooth operation of buses as well as avoid confusions between buses and other vehicles, provision of exclusive bus lanes for the whole stretch of these two roads, together with bus bays, is recommended.

Segregation of exclusive bus lanes only with pavement markings or small size curbs is considered to be suitable, because of necessity for provision of weaving sections for right turning vehicles at major intersections and approach to roadside premises, and broken down buses.

In addition, in parallel with provision of exclusive bus lanes, it is necessary to conduct strict enforcement for vehicles running bus lanes in order to maintain the function of exclusive bus lanes.

3) Cross Section

The proposed typical cross section of 6a and 7a Avenidas is illustrated in Figure 12.2.1. Basically, provision of five lanes for vehicular traffic and one other lane for an exclusive bus lane is recommended. However, for the time being, only 4 lanes can be accommodated at the section of 7a Ave. due to a railway bridge. Therefore, as a long term plan, reconstruction of railway bridges on 6a Ave. and 7a Ave. as one span bridges are recommended, if introduction of either a bus-way system or new railway system utilizing the existing right-of-way of FEGUA is confirmed.

In addition, in order to maintain a good urban environment, newly planting or replanting trees from medians on sidewalks is highly desirable.

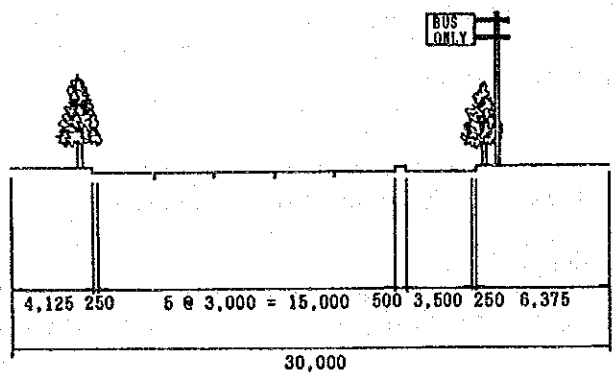


Figure 12.2.1 Proposed Typical Cross Section of 6a and 7a Ave.

4) Signalization of Intersections

In order to solve problems of traffic accidents as well as confusion of traffic flows at unsignalized intersections, installment of traffic signals at 9 unsignalized intersections with rather heavy traffic volume on crossing roads is recommended. In this case, in order to maintain smooth traffic flows on both 6a and 7a Avenidas, introduction of a coordinated signal system is proposed. For which, replacement of signal displays as well as controllers at 14 existing signalized intersections are also required.

It is also necessary to prohibit through movement from crossing roads at other unsignalized intersections.

5) Provision of Good Walking Environment for Pedestrians

Since many commercial and business activities are located along these two roads, it is necessary to maintain a good walking environment for pedestrians.

In this respect, provision of sufficient width of sidewalks and the planting of trees is recommended, as it is mentioned in 3) Cross section.

For pedestrians crossing carriageways, demolition of medians greatly affects crossing activities, because there will be no more refugee space on wide carriageways. In order to solve this problem, provision of pedestrian signals at intersections is required. In addition, construction of three pedestrian overpasses is also necessary at locations where distances between signalized intersections are more than 400m.

Locations of intersections for signalization and replacement of existing signals, and construction sites of pedestrian overpasses are illustrated in Figure 12.2.2, and a perspective view of 6a and 7a Ave. improvement is illustrated in Figure 12.2.3.

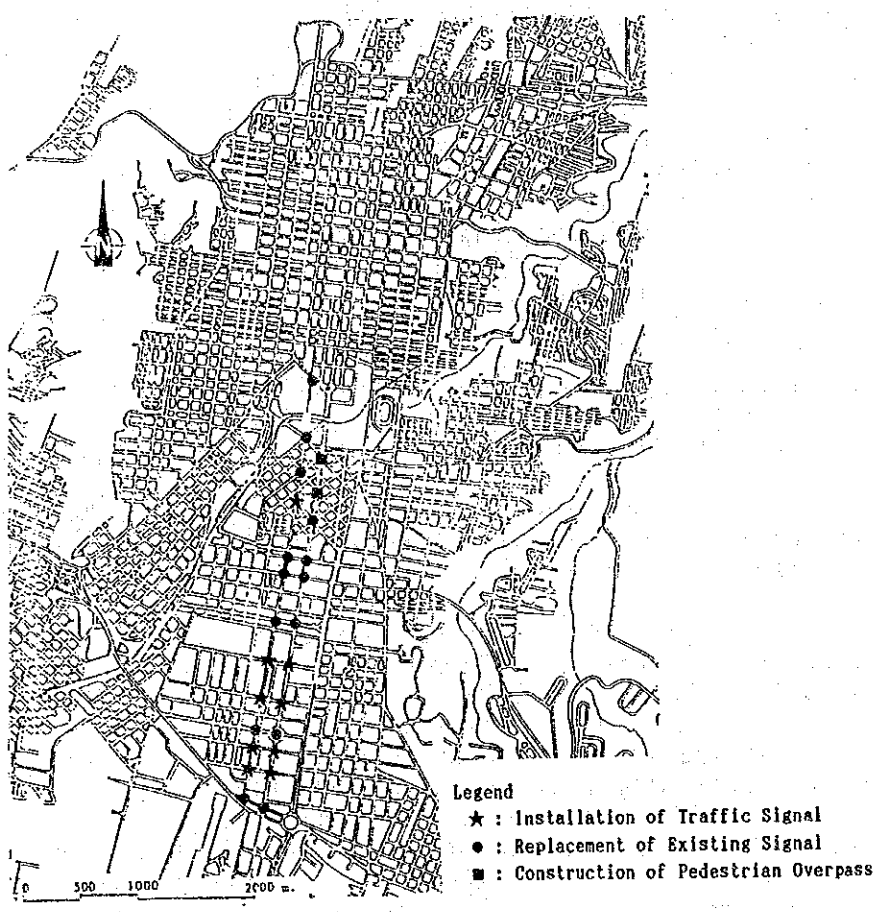


Figure 12.2.2 Improvement Plan of 6a and 7a Ave.

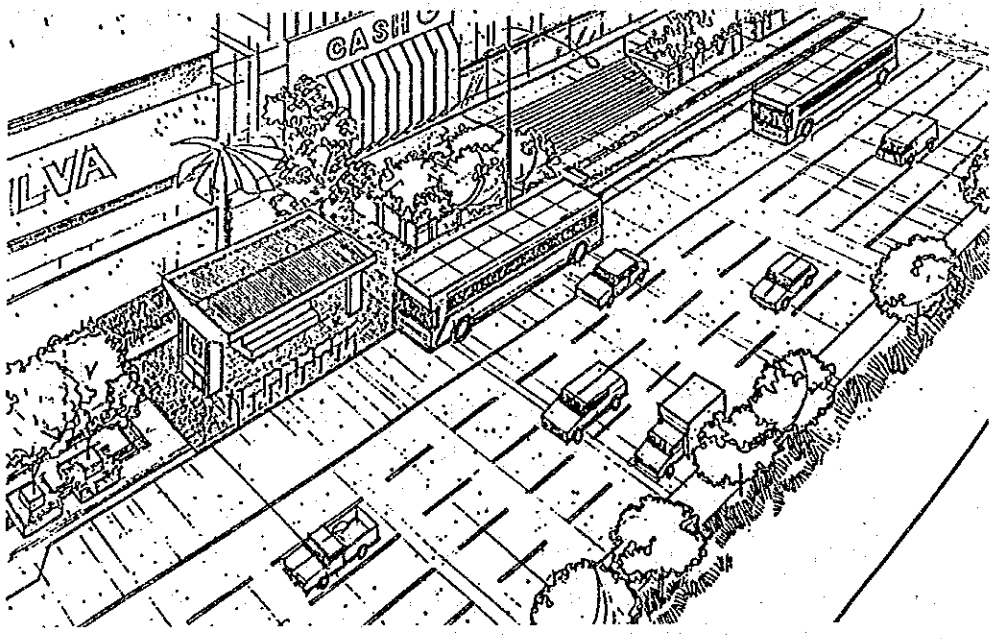


Figure 12.2.3 Perspective View of 6a and 7a Ave. Improvement

(3) Rough Estimation of Improvement Cost

Based on the above mentioned improvement plan, the improvement cost is roughly estimated and summary of improvement cost is shown in Table 12.2.1.

Table 12.2.1 Improvement Cost of 6a and 7a Ave.

Item	Improvement Cost
1. Demolition of medians, pavement, pavement markings, construction of sidewalks, planting trees, etc.	Q2,920,000.-
2. Installation and replacement of traffic signals	Q1,246,000.-
3. Construction of pedestrian overpass	Q675,000.-
Total Improvement Cost	Q4,841,000.-

12.2.2 Improvement Plan of Traffic Control System

(1) Present Conditions of Traffic Control System

1) "Centro" Area (Zona 1)

There are 171 signalized intersections in the "Centro" area and its surroundings, and 161 of them are controlled by the center controller stationed in NPTD only for switching on/off signals. On certain Avenidas, the single program coordinated signal control system are utilized.

Most of signals have been used for more than 20 years and they consume about 25% more electricity than newly installed signals. In addition, their visibility is lower due to pedestal-type installation as well as small diameter lenses.

2) Zonas 4, 9 and 10

These three Zonas are also a part of a business district in Guatemala City and three north-south links, -- Ave. Reforma, 6a Ave. and 7a Ave.-- and four east-west links, -- 1a Calle, 2a Calle, 12 Calle and Blvd. Liberación -- are main arterial roads. Most signals are installed along these roads. Of these roads, improvement plans of 6a and 7a Ave. are already discussed in the former section.

Most of signals installed in this area are suspension-type due to wide intersection areas.

3) Calle Martí

Calle Martí is a sole arterial road located at the northern part of Guatemala City and there are six signalized intersections along this

road. According to traffic accident data in 1989, 101 accidents with 9 fatalities occurred along this road alone.

4) Ave. Elena and Ave. del Cementerio

These two roads are arterial roads passing through the western edge of the Centro area. There are five and one signalized intersections on Ave. Elena and Ave. del Cementerio, respectively.

These two roads are utilized as bypass roads in the Centro area; hence traffic volume will be expected to increase in the near future, with travel speed of vehicles as high as 30 km/h.

5) Other Radial Roads

The following roads are major radial roads with 4 to 6 lanes and some intersections are signalized. However, several intersections contain traffic problems.

- Ave. Bolívar and Blvd. Aguilar Batres
- Cal. San Juan Sacatepéquez
- Cal. Roosevelt
- Ave. Petapa
- Blvd. Vista Hermosa

(2) Improvement of Traffic Control System

1) "Centro" Area

In order to improve the efficiency as well as visibility of the rather old signal system, replacement of all signals in the "Centro" area with overhang type displays with 30mm diameter lenses is recommended.

At the same time, the multi program control system is desirable in order to cope with fluctuating traffic volume, as shown below:

- Daytime pattern
- Evening peak pattern
- Off peak pattern

In order to maintain smooth traffic flows on certain main roads, introduction of the multi program coordinated signal control system is desirable on the following roads:

- Major Avenidas between 1a Ave. and 12 Ave.
- 8a and 9a Calle
  Total : 13 roads

In total, traffic signals at 171 intersections should be replaced.

In addition, installation of a traffic signal at the intersection of 6a Ave. and 20 Calle is recommended because of the modification of traffic movements affected by the closure of 18 Calle.

Location of intersections for signalization and replacement of existing traffic signals in the Centro area and its surroundings is shown in Figure 12.2.4.

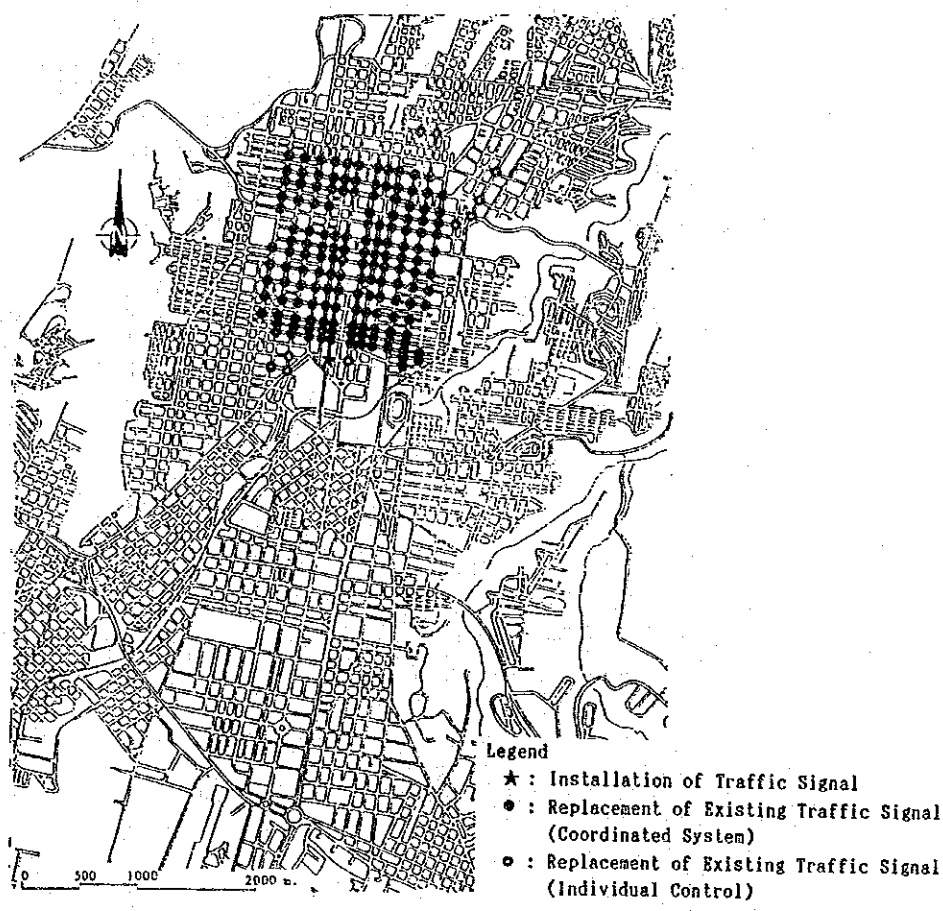


Figure 12.2.4 Traffic Control System Improvement in the "Centro" Area

2) Zonas 4, 9 and 10

From the traffic safety as well as traffic capacity points of view, installation of traffic signals at the following intersections are recommended.

- 5a Ave./5a Calle, Zona 9
- 5a Ave./8a Calle, Zona 9
- 5a Ave./12 Calle, Zona 9
- Ave. Reforma/Ruta 6/10a Ave., Zona 4
  (Improvement of this intersection is discussed in detail as the intersection improvement plan of I-12)
- Ave. Castellana/5a Calle, Zona 9
- 2a Ave./12 Calle, Zona 9

In addition, replacement of existing traffic signals at 12 intersections by overhang signal displays with 30mm diameter lenses is desirable in order to maintain efficiency as well as good visibility, except 18 Calle in Zona 10.

As in the Centro area, the preferable signal control system is the multi program control system. Introduction of the multi program coordinated signal control system on 5a, 6a and 7a Ave. and Ave. Reforma is also desirable.

In total, improvement of traffic control system in this area is:

- Installation of signals : 6 intersections
- Replacement of existing signals : 13 intersections

Location of intersections for signalization and replacement of existing traffic signals in Zonas 4, 9 and 10 is shown in Figure 12.2.5.

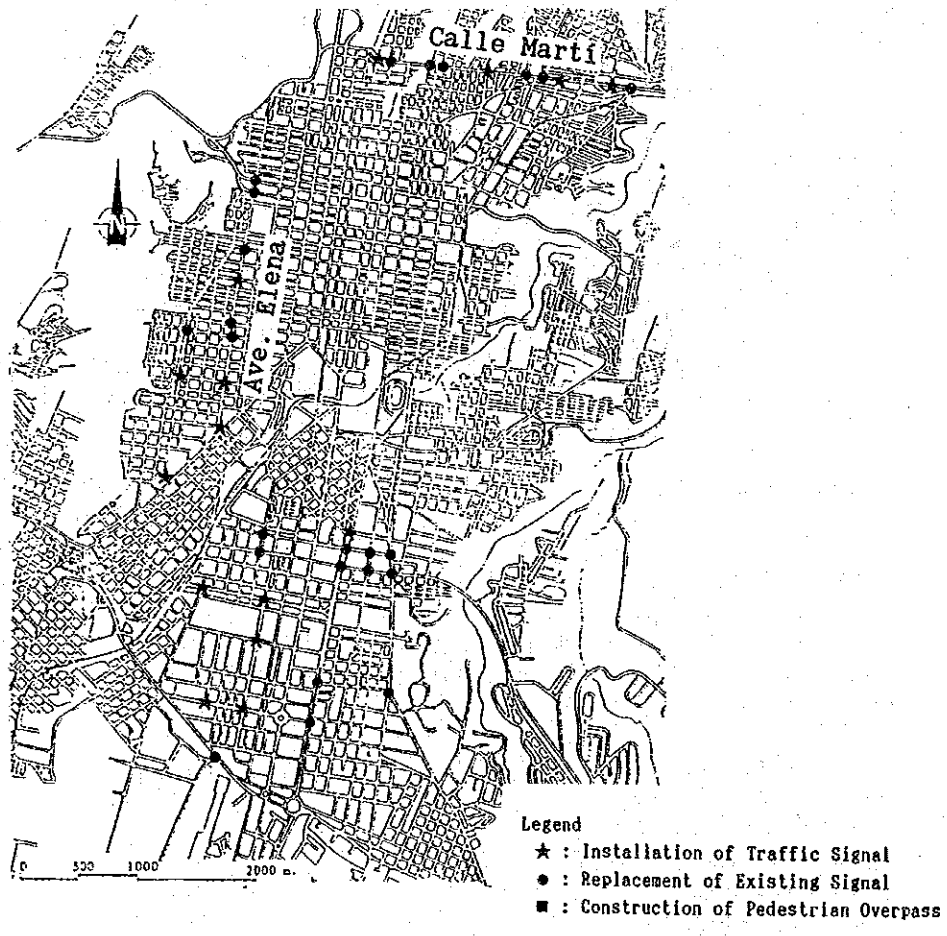


Figure 12.2.5 Traffic Control System Improvement Location

3) Calle Martí

From the traffic safety as well as traffic capacity points of view, installation of traffic signals at the following intersections along Calle Martí is recommended.

- Calle Martí/6a Ave., Zona 2
  (Improvement of this intersection is discussed in detail as the intersection improvement plan of I-7)
- Calle Martí/12 Ave., Zona 2
- Calle Martí/16 Ave. A, Zona 6
- Calle Martí/20 Ave., Zona 6

In addition, replacement of six existing traffic signals with overhang signal displays with 30mm diameter lenses is desirable in order to maintain efficiency as well as good visibility.

The control system of traffic signals along Calle Martí should be the multi program coordinated control system.

In total, improvement of traffic control system on this road is as follows.

- Installation of signals : 4 intersections
- Replacement of existing signals : 6 intersections

Location of intersections for signalization and replacement of existing traffic signals on Calle Martí are shown in Figure 12.2.5.

4) Ave. Elena and Ave. del Cementerio

Since Ave. Elena will be a part of the inner ring road according to the highway network planning, an increase in traffic volume is expected in the near future. Ave. del Cementerio functions as a bypass of congested Ave. Bolívar.

Hence, from the traffic capacity point of view, improvement of signal system on these two roads are essential.

Under consideration of location of present signalized intersections, installation of traffic signals at the following 3 intersections along Ave. Elena and 2 intersections along Ave. del Cementerio is recommended.

- Ave. Elena/15 Calle, Zona 3
- Ave. Elena/24 Calle, Zona 3
- Ave. Elena/28 Calle. Zona 3
- Ave. del Cementerio/24 Calle, Zona 3
- Ave. del Cementerio/32 Calle, Zona 3

In addition, replacement of six existing traffic signals with overhang signal displays with 30mm diameter lenses are desirable in order to maintain the efficiency as well as good visibility.

The desirable control system of traffic signals along Ave. Elena and

Ave. del Cementerio is the multi program coordinated control system. In total, improvement of traffic control system in this area is as follows.

- Installation of signals : 5 intersections
- Replacement of existing signals : 6 intersections

Location of intersections for signalization and replacement of existing traffic signals on Ave. Elena and Ave. del Cementerio is shown in Figure 12.2.5.

5) Other Radial Roads

From the traffic safety, traffic capacity, efficiency of operation and improvement of visibility points of view, installation and replacement of traffic signals on the following major radial roads is recommended.

a) Ave. Bolívar and Blvd. Aguilar Batres

* Replacement of existing signals at 9 intersections.

b) Cal. San Juan Sacatepéquez

* New installation of traffic signals at the following 4 intersections.

- Cal. San Juan Sacatepéquez/30 Ave., Zona 7
  (Improvement of this intersection is discussed in detail as the intersection improvement plan of I-20)
- Cal. San Juan Sacatepéquez/47 Ave., Zona 7
- Cal. San Juan Sacatepéquez/Blvd. San Nicolas, Zona 7
- Cal. San Juan Sacatepéquez/5a Ave., Zona 19

* Replacement of existing signals at 5 intersections.

c) Calzada Roosevelt

* New installation of traffic signals at the following 7 intersections. In this case, the semi traffic actuated signal control system is desirable due to rather light traffic volume on crossing roads.

- Cal. Roosevelt/12 Ave., Zona 7
- Cal. Roosevelt/15 Ave., Zona 7
- Cal. Roosevelt/23 Ave., Zona 7
  (Improvement of this intersection is discussed in detail as the intersection improvement plan of I-18)
- Cal. Roosevelt/35 Ave., Zona 7
- Cal. Roosevelt/37 Ave., Zona 7
- Cal. Roosevelt/40 Ave., Zona 7
- Cal. Roosevelt/20 Calle., Zona 7, Mixco (Calle de los Pinos)

* Replacement of existing signals at 2 intersections.

d) Ave. Petapa

* New installation of traffic signals at the following intersection.

- Ave. Petapa/14 Ave., Zona 12
  (Improvement of this intersection is discussed in detail as the intersection improvement plan of I-37)

* Replacement of existing signals at 3 intersections.

e) Blvd. Vista Hermosa

* New installation of traffic signals at the following intersection.

- Blvd. Vista Hermosa/3a Calle, Zona 15

* Replacement of existing signals at 2 intersections.

In total, improvement of traffic control system on major radial roads are:

- Installation of signals : 13 intersections
- Replacement of existing signals : 21 intersections

Location of above mentioned intersections is shown in Figure 12.2.6.

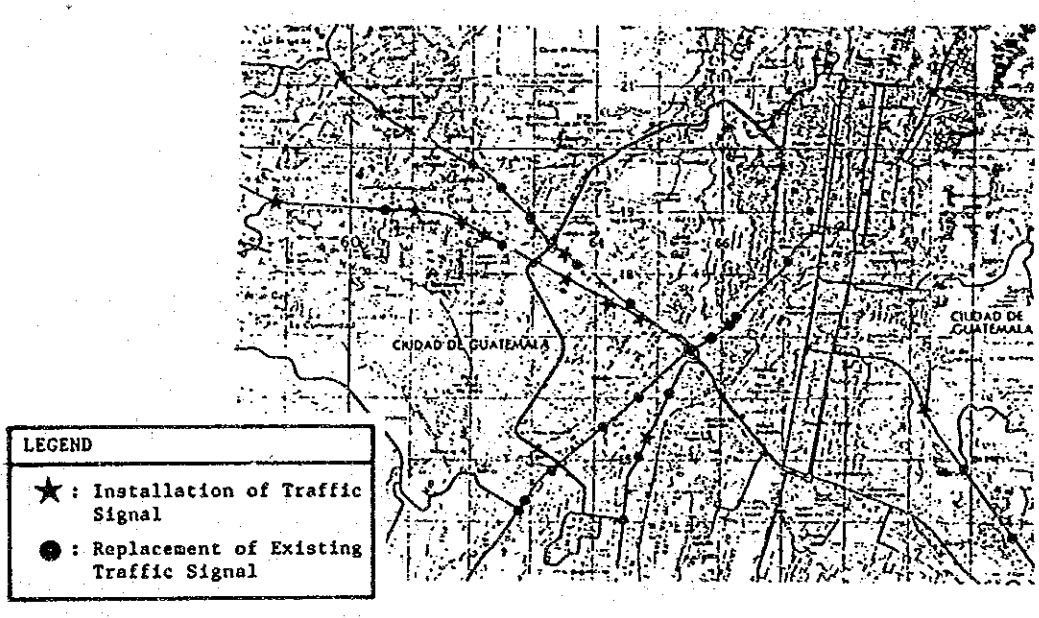


Figure 12.2.6 Traffic Control System Improvement on Major Radial Roads

(3) Priority of Improvement

Since it is not an easy task to improve all intersections mentioned above at once, in considering the improvement costs, it is necessary to determine the priority of improvement. Hence, the improvement of the traffic control system consists of the short term plan, the mid term plan and the long term plan.

1) Short Term Plan

As a short term plan, the priority should be given to new installation or replacement of traffic signals at intersections with serious traffic problems, with many traffic accidents and under other improvement projects. Those intersections are as follows.

- 2 intersections in the "Centro" area
- 5 intersections in Zonas 4, 9 and 10
- 4 intersections on Calle Martí
- 5 intersections on Ave.Bolívar and Blvd. Aguilar Batres
- 4 intersections on Cal. San Juan Sacatepéquez
- 1 intersection on Cal. Roosevelt
- 3 intersections on Ave. Petapa
  Total 24 intersections

2) Mid Term Plan

As a mid term plan, the priority should be given to new installation of traffic signals at intersections with potential traffic problems and traffic accidents in the near future. Those intersections are as follows.

- 5 intersections in Zona 9
- 3 intersections on Calle Martí
- 3 intersections on Ave. Elena
- 2 intersections on Ave. del Cementerio
- 3 intersections on Cal. San Juan Sacatepéquez
- 5 intersections on Cal. Roosevelt
- 1 intersection on Blvd. Vista Hermosa
  Total 22 intersections

As a mid term plan, replacement of existing signals in the "Centro" area as well as on other roads to conserve electricity is desirable. Those intersections are as follows:

- 170 intersections in the "Centro" area
- 8 intersections in Zonas 4, 9 and 10
- 3 intersections on Calle Martí
- 6 intersections on Ave. Elena and Ave. del Cementerio
- 9 intersections on other major radial roads
  Total 196 intersections

(4) Rough Estimate of Improvement Cost

For the estimation of improvement cost regarding to the traffic control system, the following conditions are taken into consideration.

- Unit costs of equipment, installation, etc. are based on 1991 price.
- An exchange rate of US$1.00 = Q4.90 is used for the conversion of costs of imported equipment/material.
- Installation and replacement of signals at intersections planned under the 6a & 7a Ave. improvement plan and the intersection improvement plans are excluded from the cost estimation in this section, since the cost estimations are already made in relevant sections.

The summary of roughly estimated improvement costs of traffic control system is shown in Table 12.2.2.

Table 12.2.2 Improvement Cost of Traffic Control System

Area/Road	Type of Improvement	No.	Improvement Cost
"Centro" area	-Installation of signal	1	Q53,000.-
	-Replacement of signal	170	Q8,500,000.-
Zonas 4, 9 & 10	-Installation of signal	5	Q271,000.-
	-Replacement of signal	9	Q465,000.-
Calle Martí	-Installation of signal	3	Q162,000.-
	-Replacement of signal	3	Q162,000.-
Ave. Elena & Ave. Cementerio	-Installation of signal	5	Q256,000.-
	-Replacement of signal	6	Q321,000.-
Other major radial roads	-Installation of signal	10	Q609,000.-
	-Replacement of signal	9	Q502,000.-
T O T A L		221	Q11,301,000.-

12.2.3 Control of Traffic Generation Plan

(1) Concentration of Traffic in Certain Peak Period

At present, peak hours of traffic flows are 7:00-8:00 in the morning and 17:00-18:00 in the evening on most of the major roads in the Study Area.

These concentrations of traffic are mainly generated by commuting traffic to and from work places and schools, since most offices begin working at 8:00 in the morning and most schools begin at 7:30 in the morning.

(2) Time-lag Commuting System

In order to solve the problem of concentration of traffic in certain peak periods, the time-lag commuting system is one answer.

This system is based on the concept of different office hours and school hours. By this system, office hours of a certain percentage of offices are set as different from other offices (e.g. 9:00-17:00 or 10:00-18:00). At the same time, it is also necessary to change the school hours of a certain percentage of schools, since many parents send their children to either schools or bus stops just before they go to their work places. In this case, however, combination of office hours and school hours might be difficult, because a majority of married females in Guatemala are employed outside the house.

In this case, introduction of a Flexible Work Hours System is recommended. By this system, employees are requested to work at least for a certain period of time, including a compulsory working hours, as explained below.

- Office hours : 8:00 - 18:00
- Minimum working hours : 8 hours
- Compulsory working period : 10:00 - 16:00

Introduction of above mentioned system, however, is not an easy task, because it is necessary to obtain consensus from private sectors. Hence, it is recommended to introduce this system for government offices at the first stage.

12.2.4 Traffic Safety Plan

Traffic accidents severely impact lives of the general public as well as to the national economy by means of human casualties and property damages. This problem is complex and its solution requires ceaseless efforts, and shall be resolved by various safety measures including the traffic safety education, the traffic engineering approaches and the traffic law enforcement.

In this section, concepts of traffic safety measures are mainly proposed. In addition, the majority of traffic safety measures from the traffic engineering point of view are already included in a series of traffic management measures presented in the previous sections.

(1) Traffic Safety Education

The main object of the traffic safety education is traffic safety consciousness and observance of the traffic rules and regulations among the general public, through training of drivers and education of children, and through campaigns to the general public on the importance of traffic safety.

Contents for the recommended traffic safety education programs are as follows.

1) For Children

- Compulsory traffic safety education course in every school.
- Actual traffic safety education at a traffic safety park. The outline of a traffic safety park is described below, while conceptual plan is

illustrated in Figure 12.2.7.

Table 12.2.3 Outline of Traffic Safety Park

Name of Facility	Traffic Safety Park
Required Area	5 hectares including play ground
Required Equipments	Traffic signal, traffic signs, bicycles, etc.
Training Course	Field training of basic traffic rules to school children by traffic policemen (policewomen)
Rough Construction Cost	Q5,940,000.- (including land acquisition cost and equipment cost)

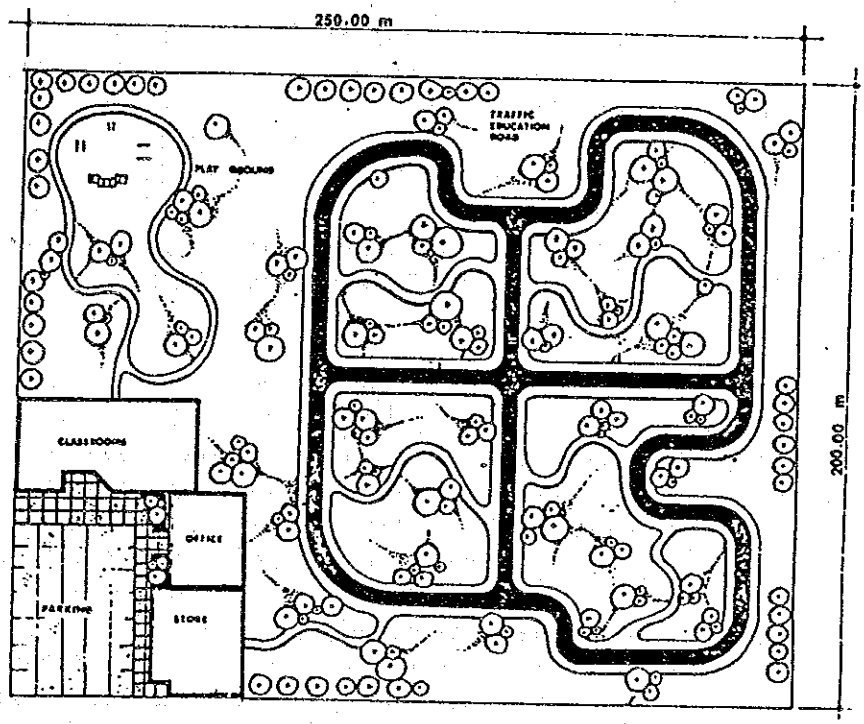


Figure 12.2.7 Conceptual Plan of Traffic Safety Park

2) For Drivers

- Safety driving course for drivers newly obtaining a license as well as renewing a license by using VTR to show a good driving technics as well as danger of traffic accidents.
- Supplementary safety driving course for drivers who commit serious traffic violation or cause serious traffic accident.

3) For Transport Company Management

- Traffic safety seminar for transport company managements.
- Selection of a person in charge of traffic safety in each company.

4) Traffic safety campaign

- Information of traffic accident statistics.
- Campaign for prevention of typical accident pattern.
- Safe driving manners.

(2) Engineering

Since most of traffic safety measures from the engineering points of view are already included in the traffic management measures, only remaining measures are presented in this section.

1) Analysis of Traffic Accident Data

Traffic accident data is fundamental data for identification of hazardous road sections as well as preparation of traffic safety measures.

At present, however, those data are not regularly available for road administrators, such as Municipalities and Caminos, unless their own staff transfers the contents of accident investigation reports at the National Police Headquarters. In addition, some police corps (stations) have not sent accident investigation reports to the National Police Headquarters for the last few years.

Hence, it is recommended to consolidate the traffic accident data collection and analysis system. At this case, it is desirable to utilize an unified traffic accident data format, which would include information of an exact accident location, number of casualties, a collision diagram, type and cause of accident among other things. Then, collected accident data should regularly be available for the Traffic Division of National Police as well as road administrators.

2) Installation of Road Apparatuses

Due to the hilly terrain in the Study Area, alignment of even arterial roads consists of sharp curves or steep gradients. However, insufficient installation of road apparatuses, such as traffic signs, at those hazardous locations may cause traffic accidents.

Since it is difficult to change the geometrical alignment of road at hazardous locations, it is recommended to install the following kinds of road apparatuses at hazardous locations in order to call drivers' attention to the danger.

- Traffic signs (Regulatory and warning signs)
- Pavement markings
- Street lightings

(3) Traffic Law Enforcement

Traffic law enforcement is an important in order to regulate traffic conditions as they were planned. In addition, enforcement for certain violations can prevent traffic accidents.

According to the cause of traffic accidents occurred in the Study Area, it is recommended to strengthen enforcements for the following violations from the traffic safety point of view.

- Speeding
- Improper overtaking
- Disregarding of traffic signals and signs
- Illegal parking
- Drunken driving

12.2.5 Improvement Plan of Pavement Marking Installation

(1) Present Condition of Pavement Markings

At present, ordinary cold traffic paint is used for the pavement markings. This type of paint can last only for one to two months and regular repainting is required. However, due to insufficient budget allocation for maintenance, most pavement markings on major roads have already disappeared.

(2) Improvement Plan of Pavement Marking Installation

Since pavement markings are essential to encourage drivers for "keep lane", -- a very important factor for orderly traffic flows as well as traffic safety -- it is necessary for pavement markings to exist all of the time. On the other hand, durability of an ordinary cold traffic paint is very short, so regular repainting are required.

In considering the durability as well as the visibility, introduction of either the hot mixed traffic paint or thermoplastic traffic paint, which can last for 15 to 20 months, for pavement markings is recommended. In this case, the purchase of five sets of equipments is advised. Then, three sets will be stationed in Guatemala, while the other two sets will be stationed in Villa Nueva and Mixco.

(3) Improvement Cost

A rough estimation of the cost of improvement of pavement marking installation, including purchasing equipments, is made and the result is summarized in Table 12.2.4.

Table 12.2.4 Improvement Cost of Pavement Marking Installation

Item	Quantity	Unit Cost	Total Cost
1.Special Truck	5 sets	Q70,000	Q350,000
2.Hot Paint Mixer	- do -	Q21,000	Q105,000
3.Painting Machine	- do -	Q21,000	Q105,000
4.Beads Sprayers	- do -	Q11,000	Q55,000
5.Prime Coating Machine	- do -	Q7,000	Q35,000
6.Other Equipments	- do -	Q7,500	Q37,500
7.Hot Mixed Paint (50% of 1 - 6)	5 units	Q69,000	Q345,000
8.Sub Total	-	Q206,500	Q1,032,500
9.Transport, Tax, Etc. (50% of 8)	5 units		Q516,000
Total			Q1,549,000

12.3 Traffic Management Plan in the Central Area

Zona 1, 4, 9 and the area along Avenida Reforma is the central business and commercial area. Particularly in the historical central area along 5a, 6a, 7a Avenida in Zona 1, business, commercial and institutional buildings are historically concentrated, width of streets is narrow and urban problems prevail, while in Zona 4,9,10, the streets are wide and the lot size is large. Therefore, in this section, parking is studied in Central Urban Area and the central area of Zona 1 (hereafter referred as "the Centro Area") is studied in detail to solve problems and the improve the urban environment.

12.3.1 Planning Policy

The following will be employed as the planning policy for the traffic management plan of the Centro Area;

- Creation and improvement of pedestrian environment
- Formation of pedestrian network
- Smooth and convenient public transportation
- Smooth traffic flow
- Adequate parking

12.3.2 Parking Plan

(1) Future Parking Demand

The future parking demand in Central Urban Area is forecasted as follows, using the car attraction by traffic zone in 2010 and the parking ratio. In 2010, parking demand will be about 147,400 or increase 24,000.

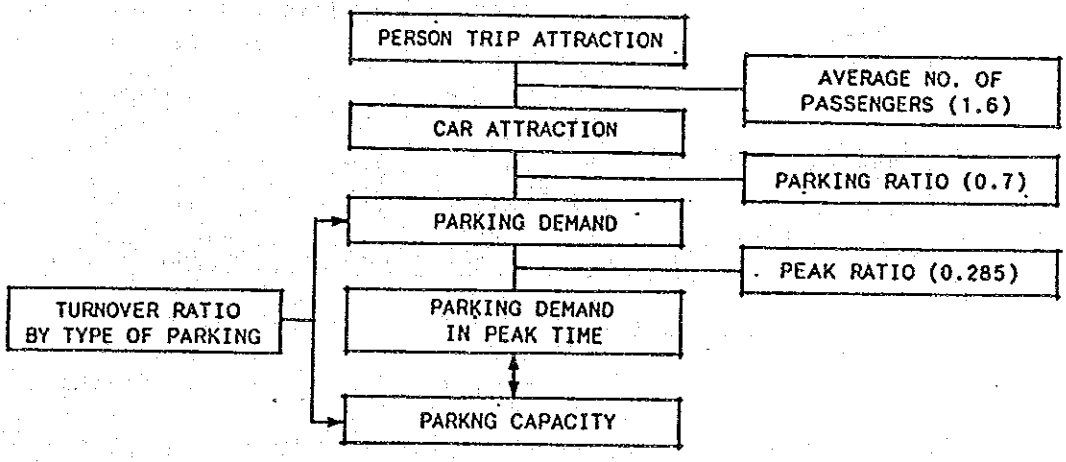


Figure 12.3.1 Flow of Parking Demand Forecast

Table 12.3.1 Future Parking Demand

ZONE	TRAFFIC ZONE	PT ATTRACTION 1990	PT ATTRACTION 2010	CAR ATTRACTION 1990	CAR ATTRACTION 2010	PARKING DEMAND	PARKING AT PEAK	PARKING RATIO	PARKING DEMAND IN 2010	PARKING DEMAND IN PEAK
1	1	69,448	97,235	43,405	60,772				41,802	11,914
	2	47,995	56,795	29,997	35,497				24,416	6,959
	3	8,806	8,744	5,504	5,465				3,759	1,071
	4	10,179	11,640	6,362	7,275				5,004	1,426
	SUBTOTAL	136,428	174,414	85,268	109,009	58,651	16,716	0.6878	74,981	21,370
4	8	38,255	41,745	23,909	26,091	16,536	4,713	0.6916	18,045	5,143
9	18	16,030	17,113	10,019	10,696				8,341	2,377
	19	28,071	28,855	17,544	18,034				14,063	4,008
	SUBTOTAL	44,101	45,968	27,563	28,730	21,494	6,126	0.7798	22,404	6,385
10	20,21	59,018	70,913	36,886	44,321	26,582	7,576	0.7206	31,940	9,103
	TOTA	277,802	333,040	173,626	208,150	123,263	35,130	0.7099	147,369	42,000

AVERAGE NO. OF PEOPLE IN A PASSENGER CAR = 1.6

(2) Future Parking Capacity

By 2010, the area of controlled on-street parking will be expanded and the capacity will increase to about 3,500 lots. On the contrary free off-street parking will be reduced and the total on-street parking will decrease for smooth traffic.

Assuming that private off-street parking will increase in proportion to increase of number of vehicles, it will be about 38,500 lots. Public off-street parking should be 16,000 to satisfy the parking demand in 2010 using turn-over ratio of 4.0. In this case, the hourly peak demand of 42,000 will be covered.

Table 12.3.2 Assumed Parking Capacity

	1990	2010		
	PARKING CAPACITY	TURN-OVER RATIO	AN ASSUMED PARKING CAPACITY	PARKING DEMAND
CONTROLLED ON-STREET PARKING	2,000	7.0	3,500	24,500
FREE ON-STREET PARKING	15,500	2.0	10,000	20,000
PRIVATE OFF-STREET PARKING	14,800	1.0	38,500	38,500
PUBLIC OFF-STREET PARKING	7,400	4.0	16,000	64,000
TOTAL	39,700		68,000	147,000

(3) Parking Planning

Parking planning has two respects; hardware (construction of parking facilities) and software (parking policies and systems). These are related to each other, and a balanced combination of execution of these two sides should be important.

For example, construction of parking facilities depends on financial status and level of economical activity.

Also without sufficient parking capacity, strong control will not be

possible. In other words, without control of illegal parking, not only will traffic safety be disturbed, but the private sector will be discouraged from providing new parking facilities.

a) Increase of Public Parking

To increase public parking, the following methods will be considered:

Use of open spaces of the Municipality

At present, the Municipality is planning to offer its lands for parking lots to the private sector, which would pay the construction cost. The open spaces of the Municipality should be effectively used for parking.

Construction of underground parking under parks or plazas in the Central Area

When the proposed street plan in the Centro Area is carried out which is described later, capacity of on-street parking will decrease by about 800 lots. Particularly shortage of parking space will get serious around calle 18. In order to alleviate this situation, municipal public parking should be provided. In this matured commercial area, land acquisition will be difficult and costly. Therefore like the parking under Plaza Mayor, underground parking should be constructed for the increasing parking demand under the parks or plazas such as:

- Parque Enrique Gómez Carrillo (Parque Concordia)
- Plaza Bolívar
- Parque Centenario
- Parque Colón

Redevelopment of FEGUA Station

In the redevelopment of FEGUA Station, public parking should be provided in addition to self-use parking.

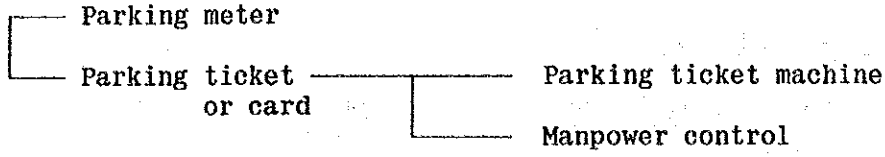
Reconstruction of Mercado La Placita Sur

The existing Mercado La Placita Sur is old and has no proper loading and unloading space. It should be reconstructed with loading/unloading space and sufficient parking space.

b) Control of On-street Parking

On-street parking should be controlled to increase turn-over ratio, to keep public fairness and to be based on the principle of "beneficiaries should pay". At the same time, markings indicating no parking zones should be provided.

The following methods are considered for control of on-street parking:



There is a tendency shifting from parking meters to a parking ticket system, because a parking meter system requires more maintenance cost and disturbs the townscape. However, parking ticket machine accepting notes requires a huge initial investment, it is vulnerable to vandalism and not realistic. Parking meters require much initial and running cost, and damage the pedestrian environment. Therefore, a parking ticket system with manpower control should be sought. To cope with it, the following parking card method can be considered. The driver who parks his car in on-street parking area should stick the parking card on the window from inside showing the starting time of parking. On the parking card, numbers for date and time indication are printed and covered with removable paint. The driver indicates the date and time the parking started, removing the paint from the numbers, which prevents reuse. The parking cards are sold at every shop by commission, like cigarettes. Clocks as street furniture should be provided on every calle to show the correct time. If the driver intentionally indicates a later time and the patrol comes and checks it before that indicated time, the car should have a penalty as illegal parking as well.

c) Improvement of Systems for Parking

Incentive to construction of parking facilities

Measures for promotion of parking facilities should be taken, such as:

- Tax reduction
- Introduction of finances for preparation of a parking facility
- Bonus for parking space beyond limitation of building floor area ratio

Effective use of parking facilities

It is preferable that usage of parking facilities should be high; for example, parking of office or public buildings are used only during daytime of weekdays, while some shops have parking demand in evening time and holidays.

In case the occupancy of off-street parking increases, the driver will have difficulty in finding empty space. To use the full capacity, a parking guidance system would be required in the future.

Fair and resolute control of illegal parking

Control of illegal parking is considered to be very important for disposition to prepare public parking by the private sector. Figure 5.3.15 shows the relation of demand and capacity of parking with number of off-street parking and parking charge (price).

When the parking charge is set higher, the private sector tend to increase the rate of off-street parking, and the capacity line rises on the right hand side. On the other hand, when the parking charge is higher, drivers are discouraged from parking and the demand line declines on the right hand side. At present, it is set that parking charge is P(Q) and the rate of off-street parking is N. In the case that the control to illegal parking is not be done, drivers will tend to park on roads. Only when it is convenient or parking space cannot be found on roads, off-street parking would be used. Therefore, the demand line would shift downward or left hand side. The parking charge would be cheaper and the number of off-street parking would decrease. (P <P, N <N), as actually only weak control is being done. If strict control was carried out, the demand line would shift upward or right hand side. The parking charge would get higher and the number of off-street parking would increase. (P<P", N<N").

Thus, the market of off-street parking depends not only on simple demand-supply market, but also on the level of control to illegal parking.

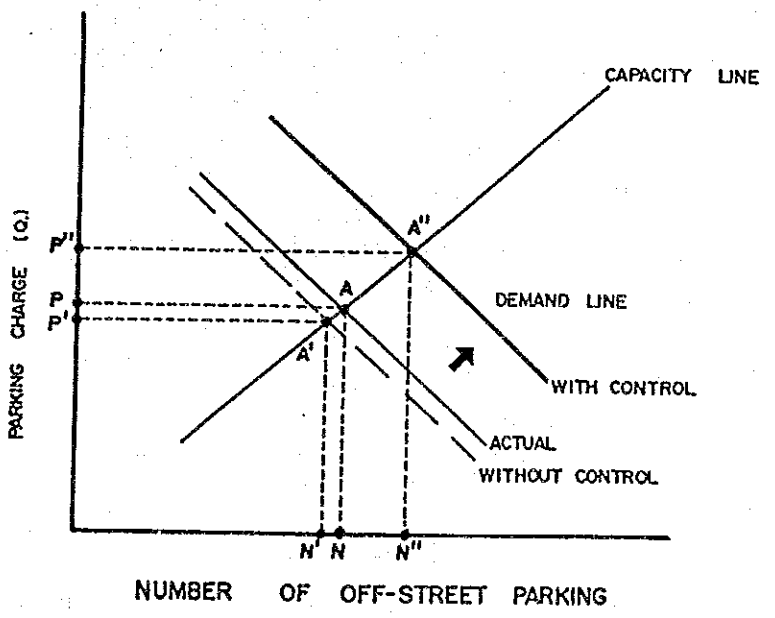


Figure 12.3.2 Market of Off-street Parking and Parking Control

This shows the importance of control to illegal parking. As it is impossible to control all illegal parking, fair and effective control should be carried out.

Moreover, with strict control, some drivers would shift to public transportation, giving up using the cars and parking demand would decrease.

At present, no periodic control for parking is executed. Loading and unloading requires short time on-street parking. Periodic control should be introduced to busy streets. For example, on 4 - 9 Avenidas, short time parking would be admitted only from 9:00 p.m. to 7:00 a.m.

For effective control, the following methods are considered:

- Remove an illegally-parked car by a wrecker truck.
- Fix a clamp or chain with a lock and upon the payment of a fine, it is unlocked.

Reasonable Parking Charge

As mentioned above, a too-cheap parking charge would discourage the private sector from preparing public parking, and the drivers would not like to use too-expensive parking. To support private activity, the charge of on-street parking should be raised (now Q0.10 per hour), and illegal parking should be resolutely punished.

Regulation for obligatory provision of parking facilities in new buildings

Buildings should have parking space depending on the classification according to the criteria of the Municipality. The design is checked during the procedure of building license. This system is considered very effective and important.

On the other hand, non-profitable parking space would be burden for new building activity.

In the future, the criteria should be checked and revised properly according to a survey study.

4) No Parking and On-street Parking Control

Parking should be prohibited on the major streets. On-street parking in the central zone should be controlled by parking meters or a parking card system. In any case, long time parking (e.g. more than 10 hours), should be prohibited to keep public fairness.

The plan for no-parking streets and controlled on-street parking is shown in Figure 12.3.3.

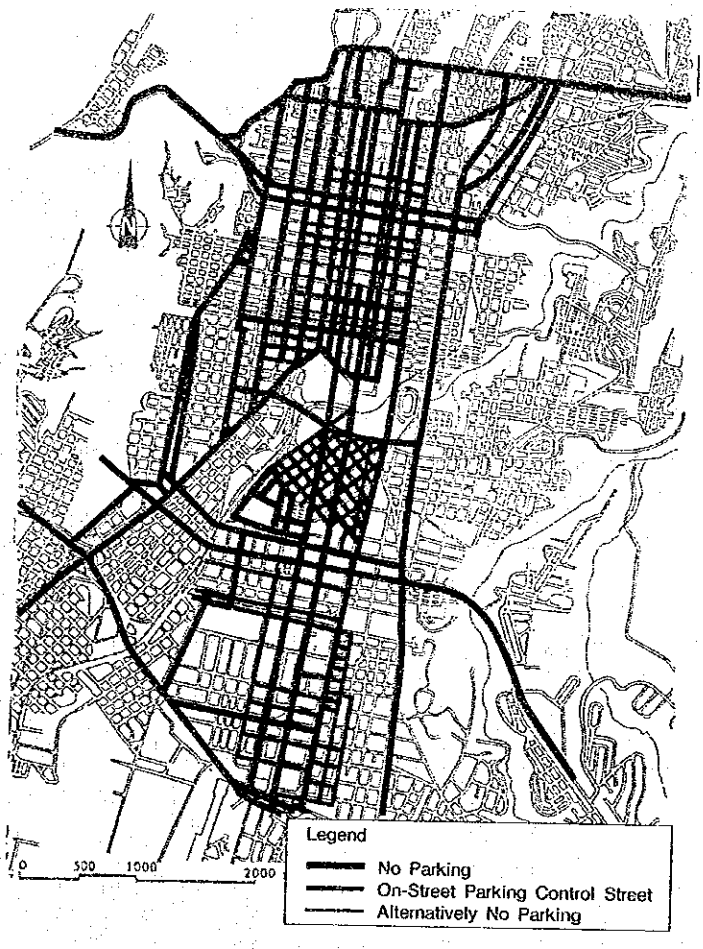


Figure 12.3.3 Parking Control Plan

12.3.3 Street Plan and Traffic Management Plan

As the existing streets in the Centro Area are not adequately arranged (e.g. narrow sidewalk), they are designed with the following criteria:

- The width of a lane of road way is 3.0 m.
- The road way should have the shoulders of 0.5 m width.
- The width of a parking zone is 2.5 m.
- The minimum width of sidewalk is 2.0 m.
  (It is allowed up to 1.5 m.)

The street plan is summarized in Table 12.3.3 and examples are shown in figures 12.3.4 to 7.

6a and 7a avenidas will be the bus priority streets with 2 lanes between 8a and 18 calle. Through traffic of private cars will be regulated. Private cars can enter the avenidas but should make a turn at every crossing and will not be allowed to go straight. The right hand side lane will be for exclusive bus use. The width of right hand side sidewalk will be 2.5 to 2.7 m for the bus stops and the other is 2.0 m.

10 and 11 calle have parking zone and planting and street furniture in the center, thus road ways form curves and reduce the speed of cars and give amenity to the streets.

The mall will be proposed on 12 and 15 calle between 5a and the 8a avenida, and 6"A" avenida. Cars will be stopped in these area in the daytime except emergency cars. Plants and street furniture such as benches, street lighting, street signs, fountains, clocks, etc. and natural stone or block paving will be provided on the mall. A excellent pedestrian space will be created in the mall however discussion and consensus making will be necessary before the execution as to how the use along the street will be regulated.

A comparison of advantages and disadvantages of improvement of sidewalks is shown in Table 12.3.4.

The sidewalks in other parts of the area will be extended and paved with natural stone according to the criteria.

Figure 12.3.8 shows the traffic management plan in the Centro Area.

Table 12.3.3 Projection of Improvement of Roads in Centro Area

ROAD	WIDTH (m)	PEDE.=PEDESTRIAN WAY PEDE.	PEDE.	ROADWAY	SHOULDER	PARKING	LANE	STRAIGHT OR CURVE	PARKING ZONE	DESCRIPTION
CALLE 6	11.9	2.90	2.00	3.00	1.00	3.0(0.0)	1(2)	STRAIGHT	1(0)	PARKING ZONE CAN BE OPEN TO TRAFFIC.
CALLE 8a	11.7	2.70	2.00	6.00	1.00	0.00	2	STRAIGHT	0	BUSY FOR BOTH VEHICLES AND PEDSTRIANS
CALLE 9	11.6	2.60	2.00	6.00	1.00	0.00	2	STRAIGHT	0	BUSY FOR BOTH VEHICLES AND PEDSTRIANS
CALLE 10	12.0	4.00	2.00	3.00	0.50	2.50	1	CURVE	1	PEDESTRIAN PRIORITY STREET
CALLE 11	11.5	4.00	1.50	3.00	0.50	2.50	1	CURVE	1	PEDESTRIAN PRIORITY STREET
CALLE 12	11.7	11.70	0.00	0.00	0.00	0.00	0	FULL MALL	0	FULL MALL BETWEEN 5 A. & 8 A.
CALLE 13	11.5	2.25	2.25	3.00	1.00	3.0(0.0)	1(2)	STRAIGHT	1(0)	PARKING ZONE CAN BE OPEN TO TRAFFIC.
CALLE 14	11.4	2.20	2.20	3.00	1.00	3.0(0.0)	1(2)	STRAIGHT	1(0)	PARKING ZONE CAN BE OPEN TO TRAFFIC.
CALLE 15	12.1	12.10	0.00	0.00	0.00	0.00	0	FULL MALL	0	FULL MALL BETWEEN 5 A. & 8 A.
CALLE 16	11.4	2.20	2.20	3.00	1.00	3.0(0.0)	1(2)	STRAIGHT	1(0)	PARKING ZONE CAN BE OPEN TO TRAFFIC.
CALLE 17	11.6	2.30	2.30	3.00	1.00	3.0(0.0)	1(2)	STRAIGHT	1(0)	PARKING ZONE CAN BE OPEN TO TRAFFIC.
C.18(A.4)	11.5	2.25	2.25	6.00	1.00	0.00	2	STRAIGHT	0	BUSY FOR BOTH VEHICLES AND PEDSTRIANS
C.18(A.7)	33.0	9.00	4.00	18.00	2.00	0.00	6	STRAIGHT	0	BUSY FOR BOTH VEHICLES AND PEDSTRIANS
C.18(A.8)	18.0	4.00	4.00	9.00	1.00	0.00	3	STRAIGHT	0	BUSY FOR BOTH VEHICLES AND PEDSTRIANS
AV. 4	12.3	2.65	2.65	6.00	1.00	0.00	2	STRAIGHT	0	LAEDING TO AVENIDA BOLIVAR AND 6
AV. 5	11.7	2.35	2.35	6.00	1.00	0.00	2	STRAIGHT	0	BUSY COMMERCIAL AREA
AV. 6	11.7	2.70	2.00	6.00	1.00	0.00	2	STRAIGHT	0	BUS AND PEDSTRIAN PRIORITY AVENUE
AV. 6'A'	11.0	11.00	0.00	0.00	0.00	0.00	0	FULL MALL	0	FULL MALL BETWEEN 5 A. & 8 A.
AV. 7	11.5	2.50	2.00	6.00	1.00	0.00	6	STRAIGHT	0	BUS AND PEDSTRIAN PRIORITY AVENUE
A.7(C.19)	18.0	2.50	2.50	12.00	1.00	0.00	4	STRAIGHT	0	HEAVY TAFFIC
AV. 8	11.6	2.30	2.30	6.00	1.00	0.00	2	STRAIGHT	0	FOR PRIVATE VEHICLES
AV. 9	11.7	2.35	2.35	6.00	1.00	0.00	2	STRAIGHT	0	FOR PRIVATE VEHICLES

Table 12.3.4 Effects of Improvement of Sidewalks in the Centro Area

	Improvement	Do nothing
Urban environment	-Wide pedestrian way -Pleasant pavement -Favorable environment for pedestrians	-Narrow sidewalk -Unfavorable environment -for pedestrians
Pedestrian way network	-Pedestrian network of a ladder pattern will be formed.	-Pedestrian network will not be formed.
Traffic	-The bus route will be convenient. -Through traffic will be regulated. -The traffic will be arranged by the traffic zone effect.	-The buses will be disturbed by private cars. -The traffic of private cars will disturb pedestrians.
Parking	-Moderate and arranged on-street parking	-Parking on both sides will disturb the use of road sides and town-scape.

a) Public Transport

The major bus route will be 6a and 7a avenidas and Avenida Bolivar with exclusive bus lanes and many of them will run via the new transfer center at the FEGUA station. Bus shelters will be prepared on the major route.

b) Pedestrians

The traffic volume of pedestrians on 6 avenida in a peak time was surveyed as about 4000 people per hour or 67 people per minute. 86 people per minute in a peak time in 2010 is forecasted in proportion to the increase of number of employees of the tertiary sector in the area.

Considering service level and platoon-making in crossing, the recommended maximum volume is 20 people per minute per meter (Push Karev,B.and Zupan,J.,Urban Space for Pedestrian).

Under the above conditions, a minimum width of 4.3 m will be required for pedestrians on 6a avenida in 2010.

On the other hand the width of 2.0 m should be required for the traffic of wheel chairs for the handicapped. In addition, space for traffic signs, signals and street furniture should be added, and 0.5 m of buffer zone along buildings will be necessary on a shopping street.

While the present width of sidewalks in the Centro Area is 1.5 m to 2.4m, the pedestrian ways should be widened. The pedestrian way

network will be formed in a ladder pattern on 6a and 7a avenidas and 8a, 12, 15, 18 calle connecting the cores, Plaza Mayor, 6a avenida, 18 calle and the new transfer center (Figure 12.3.8).

On the calles where sidewalks are wide enough, planting and street furnitures such as signs, clocks should be prepared (Figure 12.3.4).

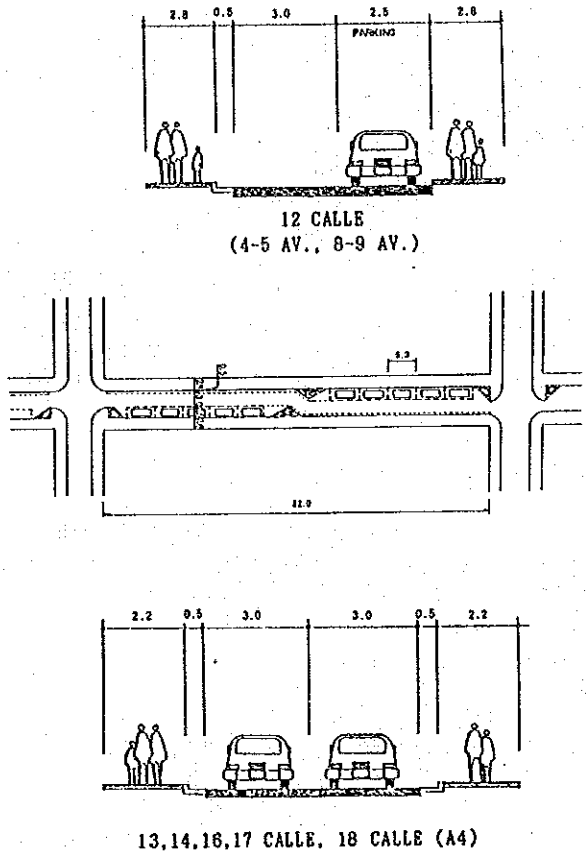


Figure 12.3.4 Depiction of Streets in Centro Area

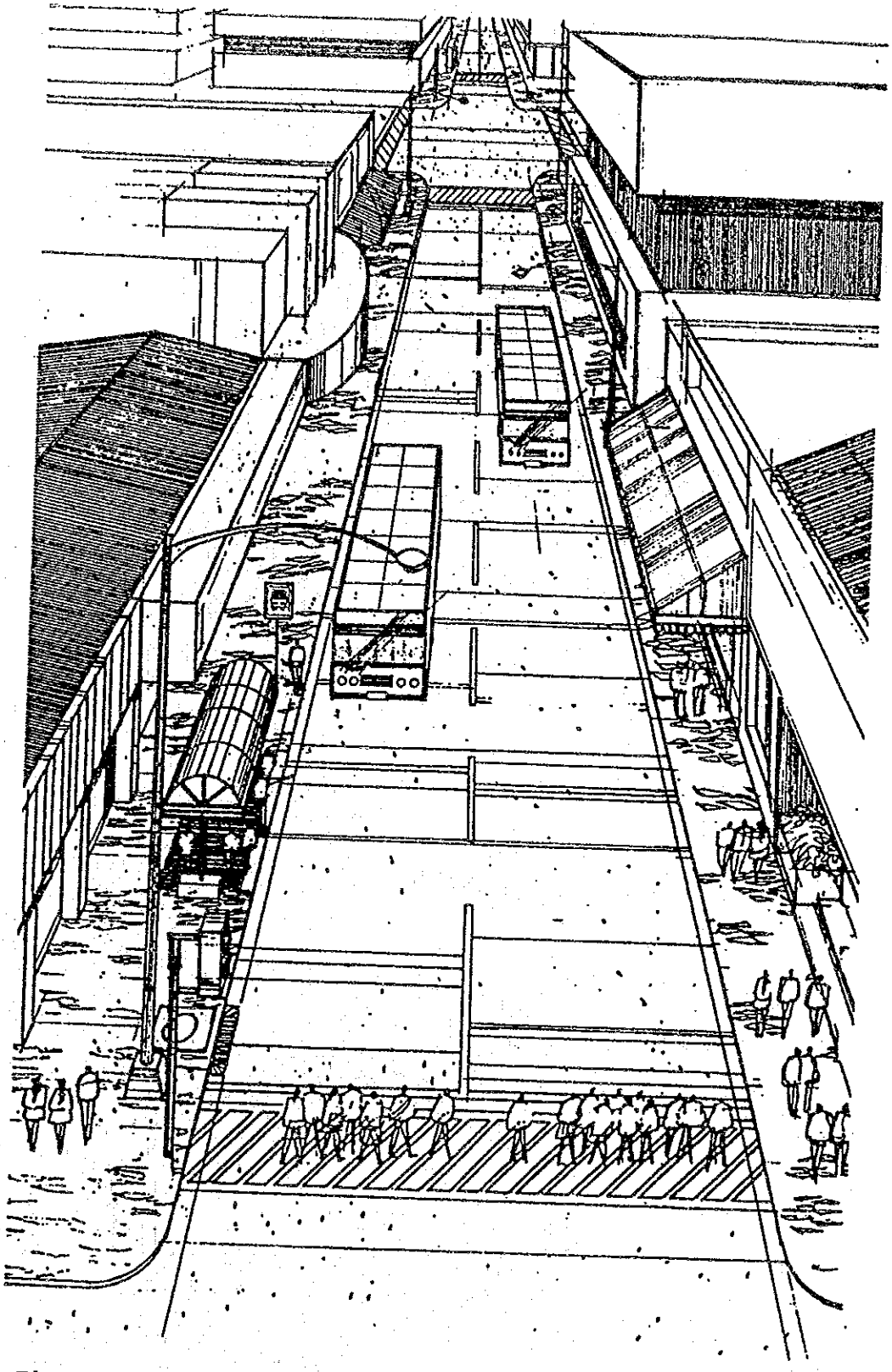


Figure 12.3.5 Perspective of 6a Avenida (Bus Priority Street)

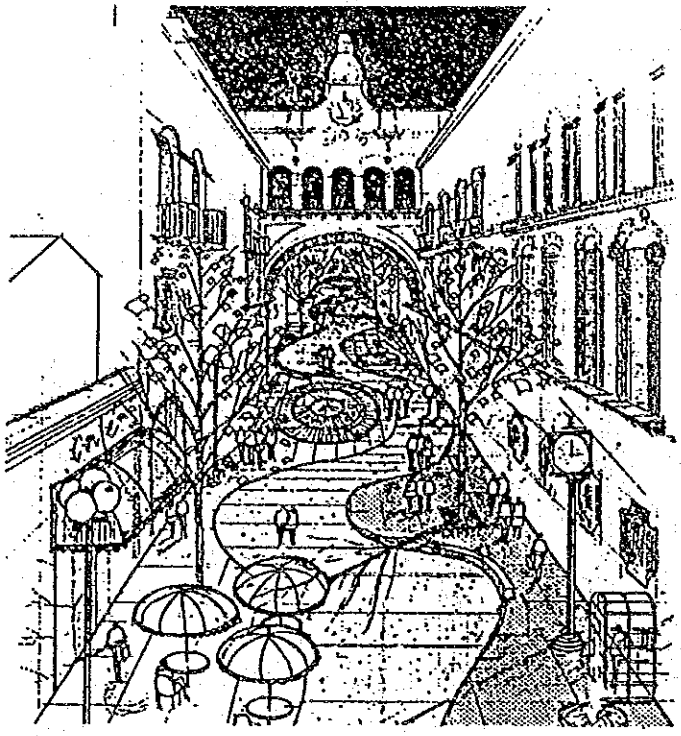


Figure 12.3.6 Perspective the Mall on 12 Calle

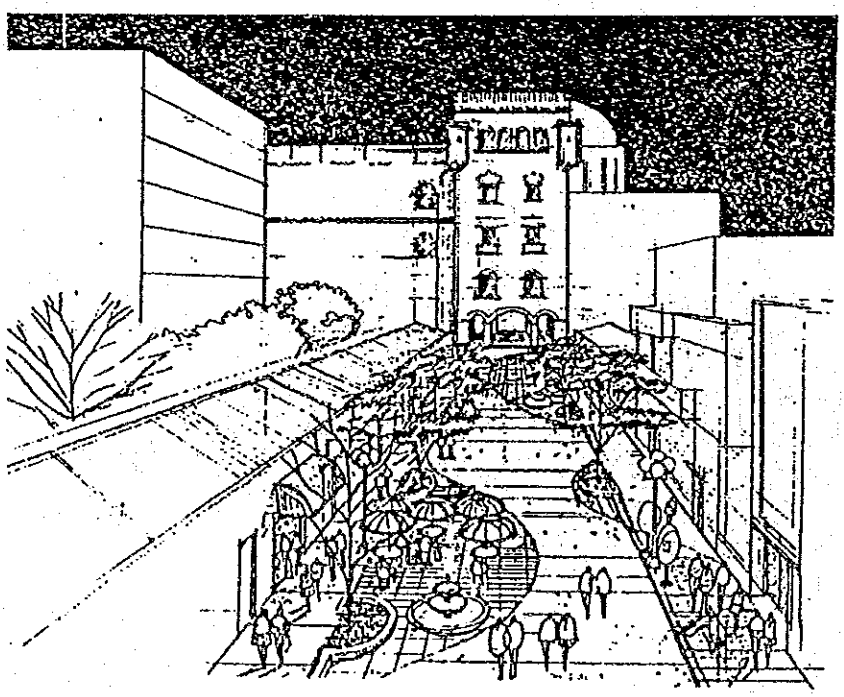


Figure 12.3.7 Perspective the Mall on 6"A" Avenida

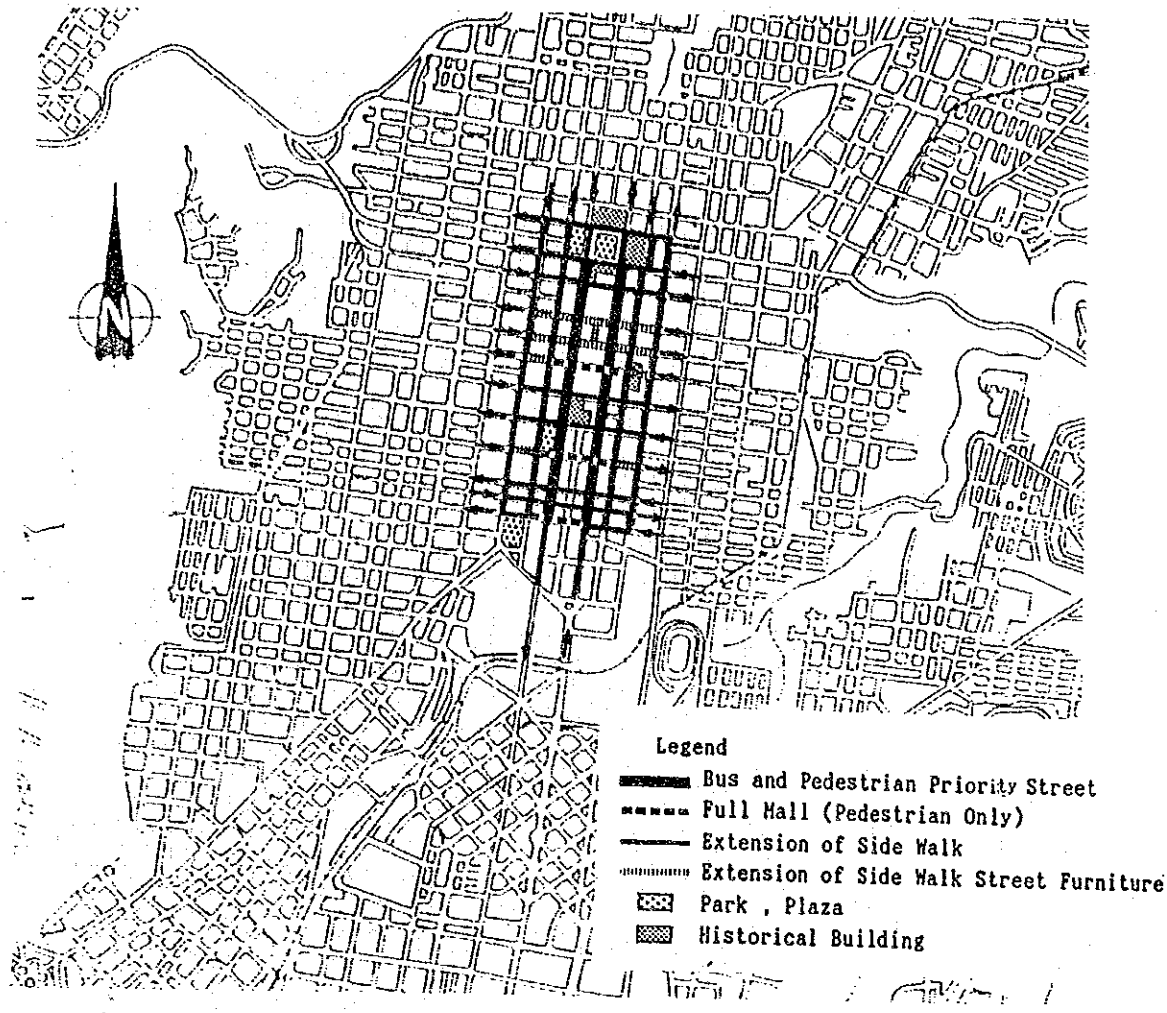


Figure 12.3.8 Traffic Management Plan in the Centro Area

12.3.4 Projects

Though commercial and business activity is still vital in Centro Area, there is a tendency to decline due to narrow road and old facilities.

Improvement of streets that will include widening of sidewalk, upgrading of paving, provision of planting and street furniture is considered very important and effective to increase urban amenity, to serve to many people and to encourage development of urban activities.

At the same time public parking should be provided to meet increase of parking demand and decrease of capacity of on-street parking.

The following is identified for the projects of traffic management plan in the central area:

- Improvement of sidewalks on 4,5,6,7,8,9a Avenida and 6, 8, 9, 13, 14, 16, 17, 18 Calle (See Figure 12.3.8 and 12.3.9) (Cost: Q2.68 million)

- Improvement of sidewalks with street furniture and planting on

10,11,12,15 Calle and preparation of mall on 12 Calle and 6"A" Avenida
(See Figure 12.3.8 and 12.3.9)
(Cost: Q2.85 million)

- Construction of public parking under parks or plazas of Plaza bolivar, Parque Concordia, Parque Centenario and Parque Colon with total capacity of about 2,170 lots
(See Figure 12.3.11)
(Cost: Q72.2 million)

- Preparation of parking cards and public relations
(See Figure 12.3.3)
(Cost: Q0.5 million)

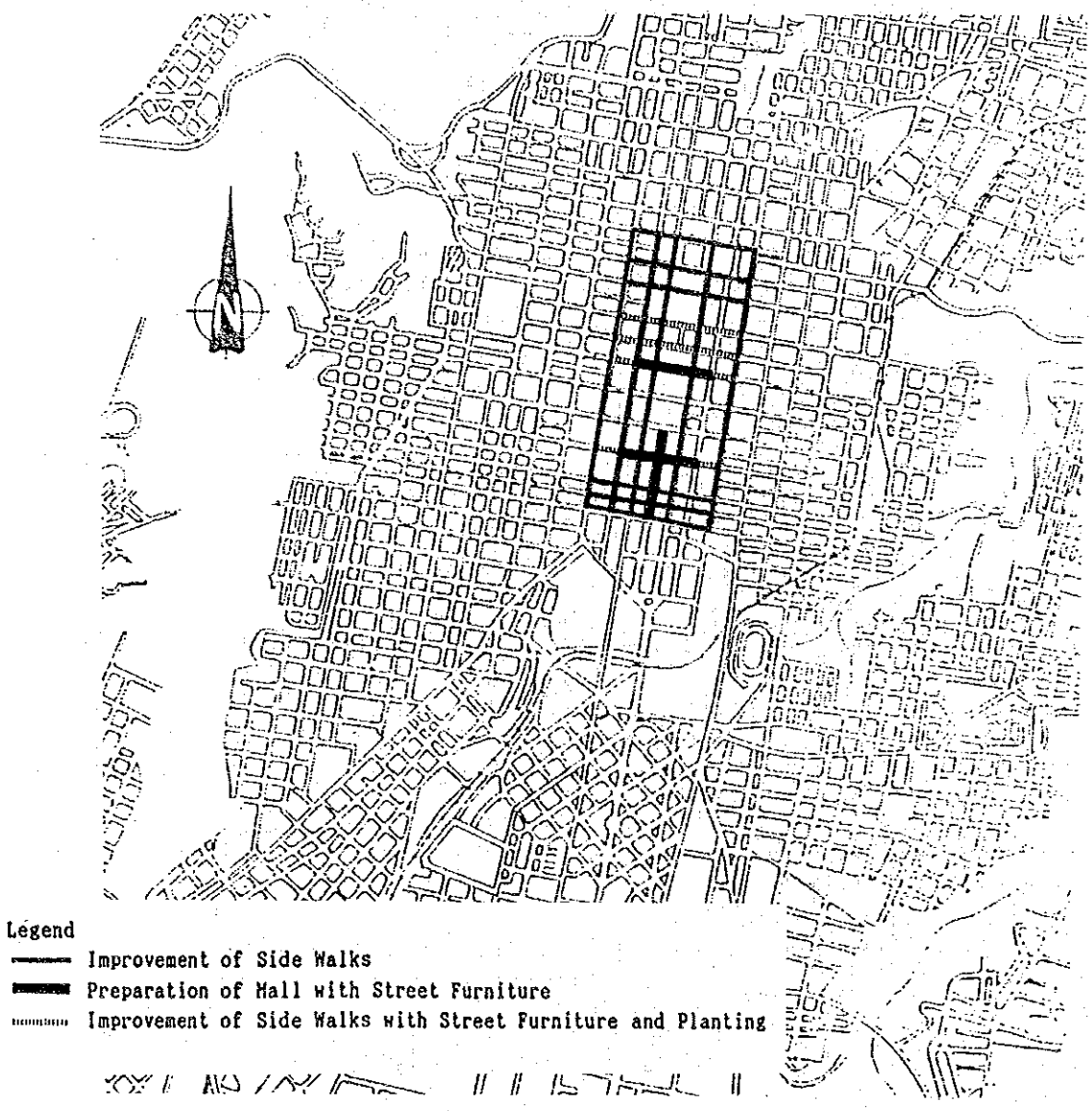


Figure 12.3.9 Location of Projects

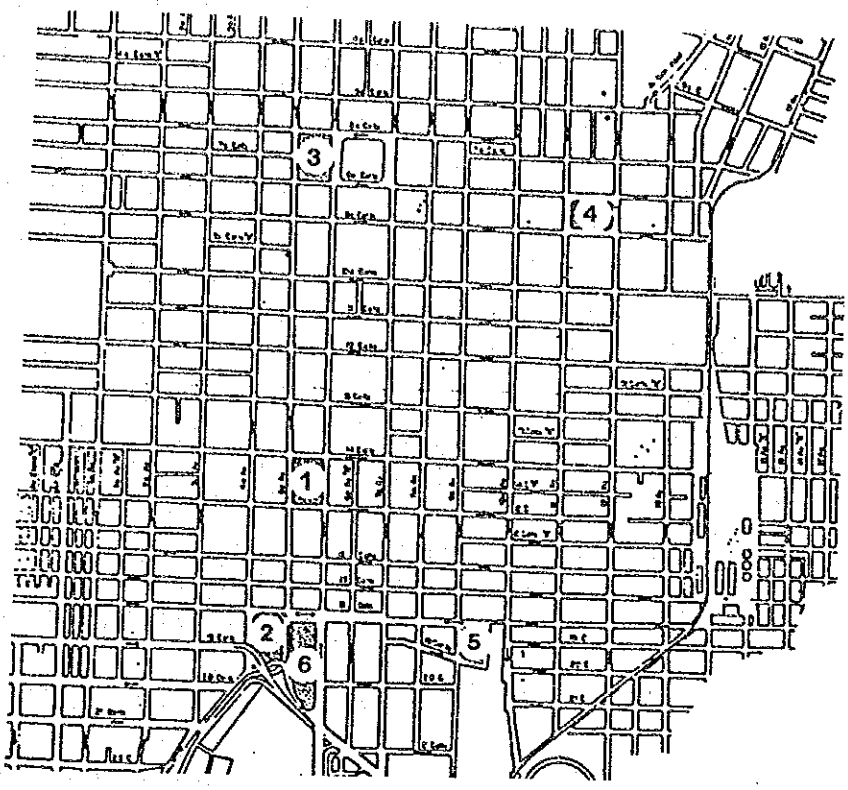


Figure 12.3.10 Location of Public Parking to be Constructed

1. Parque Enrique Gómez Carrillo (Parque Concordia)
2. Plaza Bolívar
3. Parque Centenario
4. Parque Colón
   (For Reference)
5. Redevelopment of FEGUA
6. Redevelopment of Mercado La Placita Sur

13. TRANSPORT MASTER PLAN

13.1 Formulation of Master plan

13.1.1 Identification of Projects

As mentioned previous chapter 9, the alternative plan- E was selected for the future transport master plan in the Study Area based on the technical and economical evaluation.

The transport master plan selected consists of there main technical fields that is road facilities field, public transport field and traffic management field.

Based on the alternative plan-E , the road planning, public transport planning and traffic management study were conducted for the sector plan as mentioned in chapter 10, 11 and chapter 12 respectively.

According to the road sector plan, the ring and radial roads development plan are examined for mitigation measurement of traffic problems in the Study Area. As the results of road sector planning , 16 projects are identified.

According to the public transport sector plan, 7 strengthening of public transport projects are identified.

The traffic management sector planning is conducted on the existing urban area based on the planning policy of the traffic management planning. As the results of traffic management planning, 8 projects are identified.

13.1.2 Outline of Transport Master Plan

As mentioned above, the transport master plan on the Study Area in year 2010 consists of 31 projects. The detailed of projects on the transport master plan are described in chapter 10, 11 and chapter 12 respectively.

The outline of the projects are summarized in Table 13.1.1 and the location of projects are also illustrated in Figure 13.1.1 respectively.

Table 13.1.1 Outline of Projects on Transport Master Plan

Project Name	Project Cost (Q1,000)	Contents	
		Type	Size
1. Outer Ring Road(North)	287,525	New Construction	L=16,700m (4-Lane)
2. Outer Ring Road(South)	163,339	New Construction	L=23,150m(4.2-Lane)
3. Middle Ring Road	469,999	New Construction	L=20,400m (4-Lane)
4. E-W Corridor	151,399	New Construction	L=11,540m (4-Lane)
5. Periferico Tramo	25,519	New Construction	L=3,500m (4-Lane)
6. Inner Ring Road	81,029	Widening	L=1,580m (4-Lane)
7. CA-9 (South)	61,048	Widening	L=700m (6-Lane)
8. CA-1 (East)	84,743	Widening	L=10,500m (6-Lane)
9. Av.Hincapie	124,670	Widening	L=10,000m (4-Lane)
10. Av.Perapa	59,361	Widening	L=6,000m (4-Lane)
11. 13.Av.Zona 7	2,642	Widening	L=2,050m (4-Lane)
12. 6.Av.Zona 2	17,001	Widening	L=1,120m (4-Lane)
13. 15.Av.Zona 6	16,514	Widening	L=2,300m (4-Lane)
14. 35.Av.Zona 11	35,784	Widening	L=10,090m (6-Lane)
15. Boalevard Sar	11,729	Widening	L=1,400m (4-Lane)
16. Intersection Improvement	105,817	Improvement	32 intersections
17. Bus Stop Development	3,306	New Construction	Along Priority Routes
18. Bus Lane Development	3,794	Improvement	Along Arterial Roads
19. Busway Development	493,950	New Construction	L= 24,000m(2-Lane)
20. Traffic Center Zona 1	9,620	New Construction	1 unit
21. Traffic Center Zona 4	12,000	New Construction	1 unit
22. Ext. bsu Terminal	42,842	New Construction	3 units
23. Bus Inspection Center	21,700	New Construction	1 unit
24. Effective Lane Usage	4,841	Improvement	6a,7a Avenida
25. Traffic Control System	11,301	Improvement	221 Intersections
26. Traffic Safety Park	5,940	New Construction	1 unit
27. Pavement Marking	1,548	Improvement	Urban Area
28. Parking Card System	500	Improvement	Urban Area
29. Pedestrian Mall	2,843	Improvement	Centro Area
30. Car Parking	72,200	New Construction	4 units
31. Sidewalk development	2,673	Improvement	Centro Area
Grand Total	2,387,177	-	-

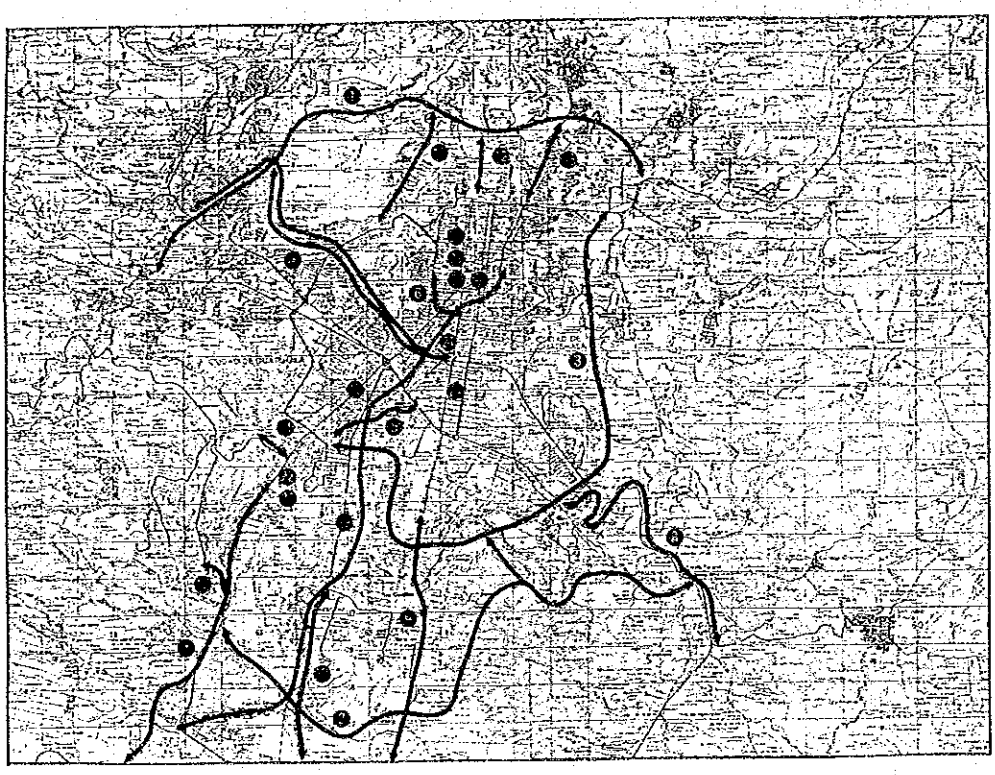


Figure 13.1.1 Location Map of Projects

13.2 Implementation Program

13.2.1 Implementation Schedule

(1) Phasing Plans

The implementation program is prepared according to following phases.

Phase	I	1992 - 1993	Immediate Action Projects
Phase	II	1992 - 1995	Short Term Projects
Phase	III	1996 - 1999	Mid Term Projects
Phase	IV	2000 - 2009	Long term Projects

(2) Implementation Schedule

The policies for the implementation program of phasing are described as follows:

1) Phase I (1992 - 1993, Immediate Action Projects)

From 1992 to 1993 during period 2 years, following policies are adopted for implementation of immediate action projects.

a) To expect high efficiency development.
b) To implement without large size construction.
c) To implement without additional land acquisition.

According to the above mentioned implementation program policies, following projects are selected for Immediate Action projects considering the function and characteristics of the projects.

a) Bus stop development project
b) Bus lane development project
c) Effective lane usage project
d) Pavement marking development project
e) Side walk development project

2) Phase II (1992 - 1995, Short Term Projects)

From 1992 to 1995 , during period 4 years, following policies are adopted for implementations of the Short Term projects.

a) To expect high efficiency development.
b) To implement without large size land acquisition.
c) To implement without large size construction.
d) To implement transport axes of East - West (Centro to Mixco) and North - South (Centro to Villa Nueva).

According to the above mentioned policies, following projects are selected for Short Term project considering the function and characteristics of the projects.

a) East - West corridor development project.
b) Periferico tramo development project.
c) Ave. Petapa improvement project.