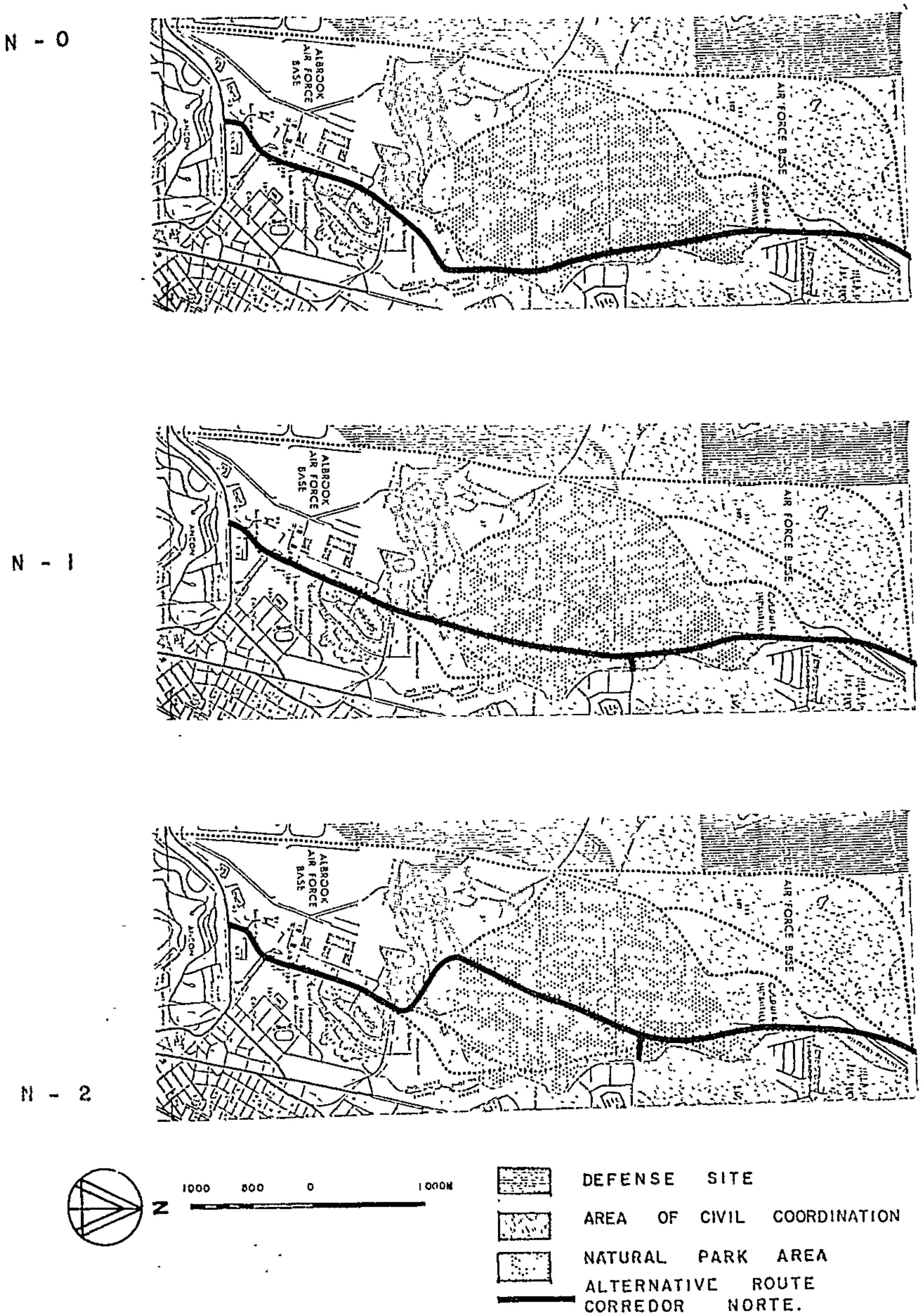
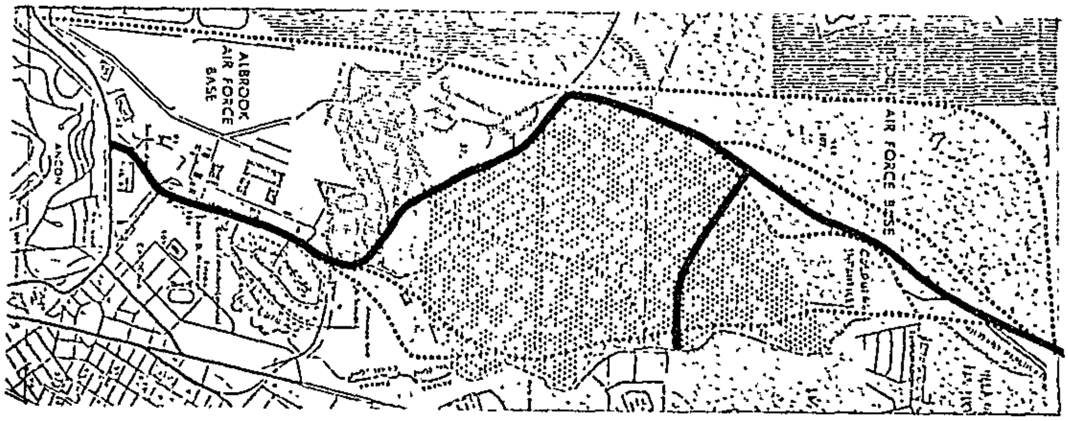
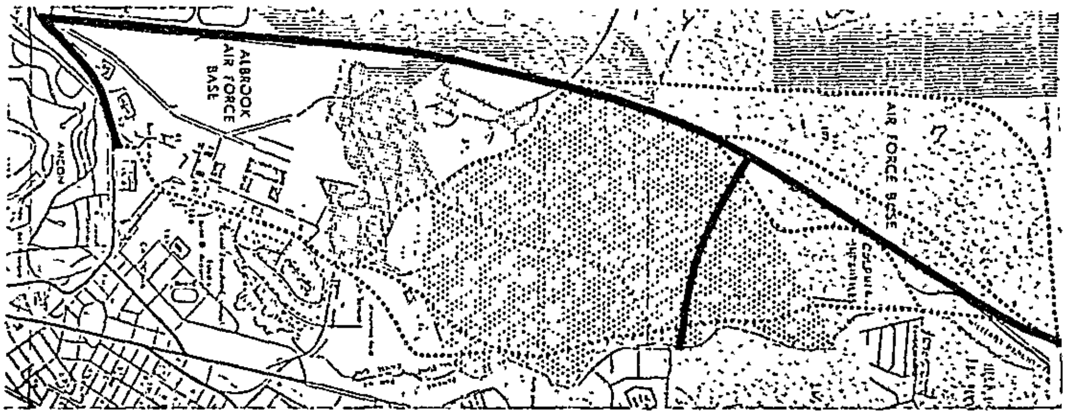


Fig. III-1-1 ROUTE ALTERNATIVES OF CORREDOR NORTE IN REVERTED AREA(1)

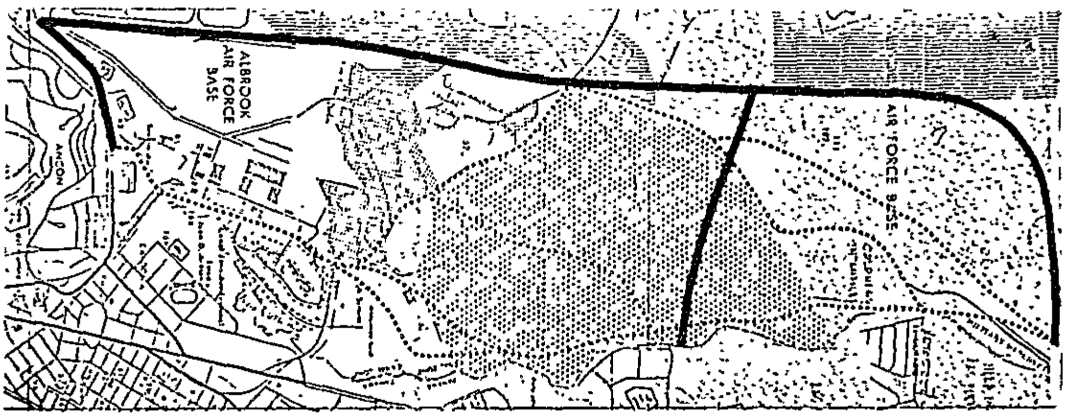
N - 3



N - 4



N - 5



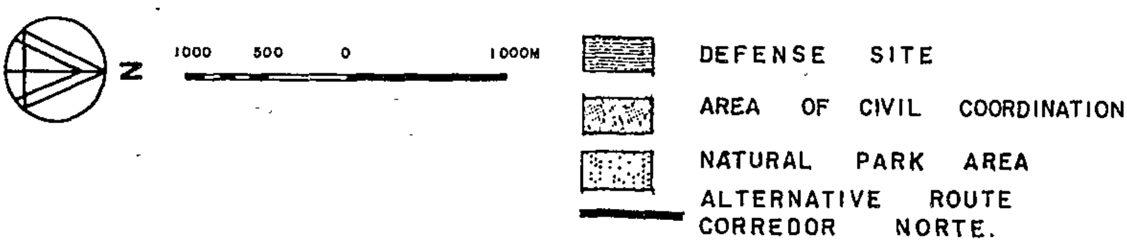


Fig III-1-1 ROUTE ALTERNATIVES OF CORREDOR NORTE IN REVERTED AREA(2)

d) Alternative Route N-3

This route will follow the existing roads, Curundu Road, Albrook Clayton Road, and Camino de La Amistad, thereby avoiding the Park and the military area. However, it will be poor in both horizontal and vertical alignments and will hinder the function of each of the existing roads in their serving the local area.

e) Alternative Route N-4

This route will utilize previous Albrook Airfield runway and extend the function of Corredor Norte as the transport axis up to the development area of the previous airfield. The construction of this route, which will go through the military area in part, is predicated upon military clearance. This route is nearly the same as N-5, and it was taken up in ESTAMPA Masterplan but was conceived of as a minor arterial to be constructed in the 1990s due to said military implication.

f) Alternative Route N-5

This route will follow previous Albrook Airfield runway and go through the military area, and its western section will surround the Reverted Area on its edge. This was conceived of as "Ave. Albrook" in ESTAMPA Masterplan.

A comparison of the six alternative routes, as presented in Table III-1-2, has resulted in the selection of alternative route N-4 for the following reasons:

TABLE III-1-2 COMPARISON OF ROUTE ALTERNATIVES OF CORREDOR NORTE

	N-0	N-1	N-2	N-3	N-4	N-5
Length of route and access	○	○	○	▲	▲	▲
Construction Cost	○	▲	▲	△	○	△
Land Acquisition	△	▲	▲	○	▲	▲
Geometric Design	▲	△	▲	▲	○	○
Problems of Construction	▲	▲	▲	▲	○	○
Environmental Problem	△	▲	▲	○	▲	▲
Effect for Development of the Area	△	△	△	○	○	△
Traffic Assigment	○	○	○	△	△	▲

Note; ○ : Good
△ : Fair
▲ : Bad

a). The policy of early development of previous Albrook Airfield and other parts of Reverted Area as one unit, has been internally confirmed by OPDAC and other government agencies.

b). Since the Panamanian Government has started official negotiation for the reversion of the part of the existing military area, the possibility remains of using this area for the road purpose.

c). Traffic on a route laid away from the urban area will not be appreciably smaller than that on a route laid closer to the urban area.

d). Of all the six, N-4 will accompany the least of negative factors in terms of alignment, work condition, obstructing buildings, and so forth.

(2) Los Andes Section

The terminal point of Corredor Norte subject to this Study is the point of connection with Transistmica. In the future however, it is to be extended up to Pedregal in order for it to be completed as the transport axis of the northern urban area in the true sense of the word. If route beyond said connection point is conceived of as that which will go through the squatter area in the north of Samaria, Los Andes housing area will be the inevitable point of connection. For this section, from intersection with Via San Miguelito Oeste up to Los Andes, three alternative routes shown in Fig. III-1-2 are possible. In this section, hills with exposed rocks continue and on the hillside area sporadic squatter sheds. A fair portion of Los Andes housing area is already developed, and streets in the area have the width insufficient to accommodate wide, high standard roads.

a) Alternative Route N-11

This route will make a long detour toward south, going through the hills of Nueve de Enero and a squatter area thereon, and then the southern housing area of Los Andes. The adoption of a high standard alignment is difficult from topographical reasons, and the construction will involve the removal of squatter sheds.

b) Alternative Route N-12

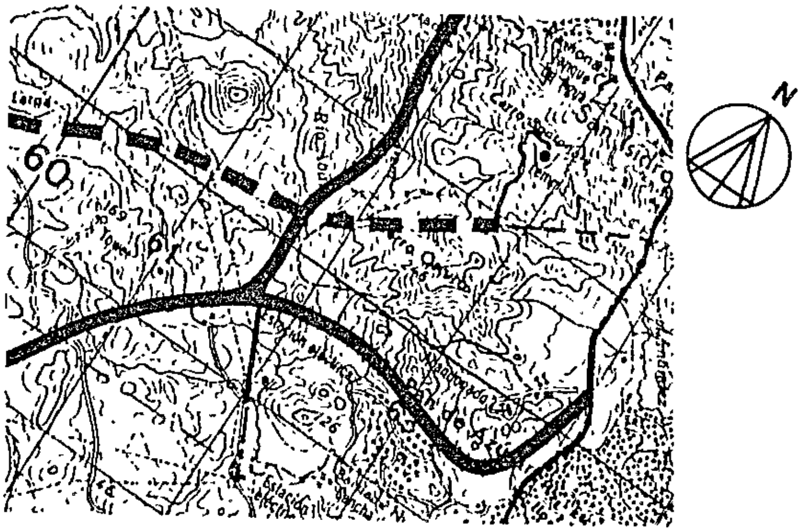
This route will first traverse the same hills as N-11. Then, it will proceed on the west side of the lake and go through, as will N-13, the housing area of Los Andes. Like N-11, the adoption of high standard alignment will be difficult.

c) Alternative Route N-13

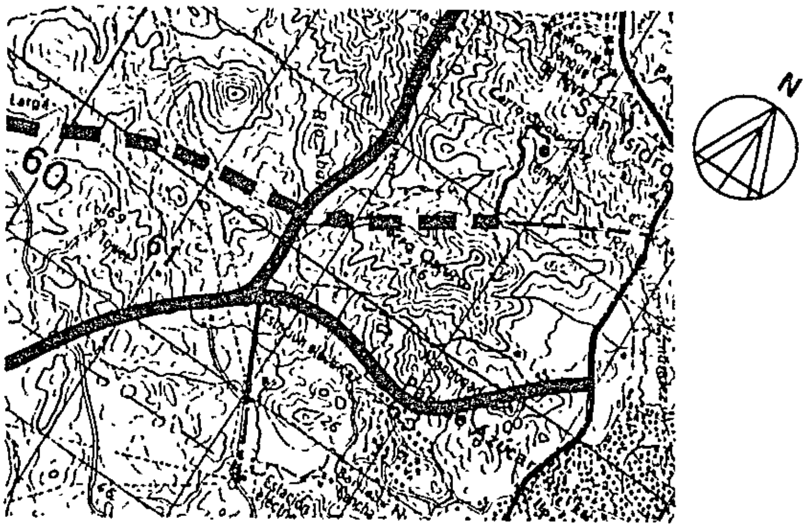
This route will be the shortest of the three, following the valley south of Cerro Oscuro and going through Los Andes housing area. Topographical conditions are somewhat more favorable than the other two.

As the result of the comparative examination of the above three routes, N-13 route is selected because of the fact that this route is easy to secure the standard of road alignment and requires less construction cost and also less number of houses for compensation.

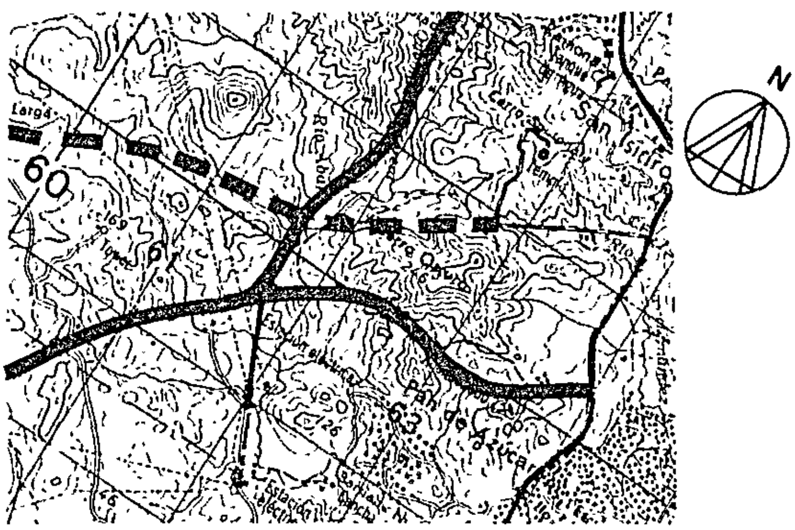
ALTERNATIVE
N-11



ALTERNATIVE
N-12



ALTERNATIVE
N-13



* EACH MESH SHOWS 1.0 Km

Fig. III-1-2 ROUTE ALTERNATIVES OF CORREDOR NORTE IN LOS ANDES AREA

2) Via El Paical Extension

Via El Paical, together with Via Brasil, will connect Corredor Norte with Corredor Sur and will be an important arterial for the dispersion of a large volume of traffic into the urban area. However, it is mostly a 2-lane road without sufficient right-of-way width. The need of relocating a large number of houses, particularly in the housing area of Villa Soberania and La Loceria, suggests the difficulty of implementing this project. The route of Corredor Norte has been laid on the north side of the Park and the route of Via El Paical Extension will have to traverse the Park.

In view of the problems accompanying this route as originally conceived of, other possible alternative routes should be evaluated. Thus, the following three alternative routes, including the original and two additional (see Fig. III-1-3), are compared:

a) Alternative Route 1

This is the ESTAMPA Masterplan concept of widening the present Via El Paical and extending it nearly straight up to Corredor Norte.

b) Alternative Route 2

This alternative will also require the widening of Via El Paical but will avoid the Natural Park by making a detour along Curundu River to reach Corredor Norte. The advantage of this route will be that, if another arterial is needed (but not in the near future, as indicated by the forecast of transport demand) parallel to Corredor Norte (which means N-0 or N-1 in the Albrook Section of Corredor Norte), this route can become a part of that arterial. This alternative involves the following problems:

i) The same problem in La Loceria housing area as Alternative Route 1.

ii) The small radius of curvature to be formed at the curved connection with the present Via El Paical will become an obstacle to the future route extension.

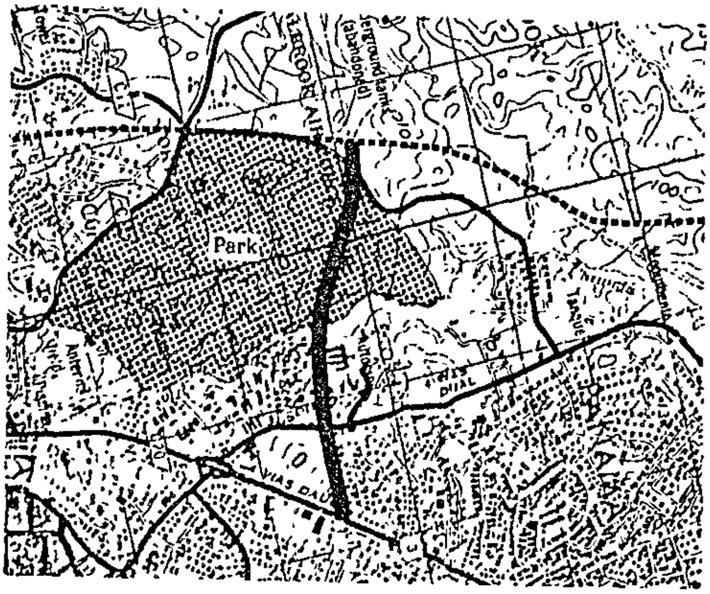
iii) The route-side presence of an orphanage (Aldeas Infantiles S.O.S.) and a rehabilitation center for handicapped persons (CAIPHECRI), which require the maintenance of peace and tranquility.

c) Alternative Route 3

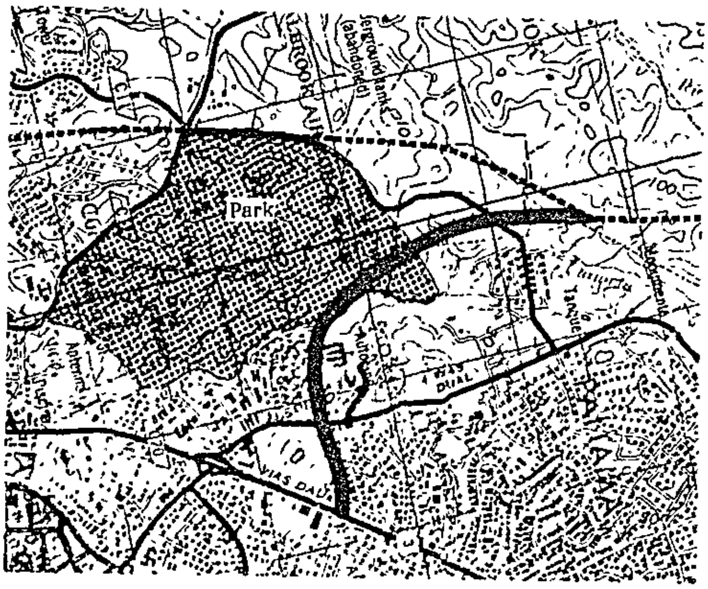
This route will leave Corredor Norte and reach Via El Paical and existing roads, Camino de la Amistad, Boulevard Torrijos and Via Ricardo J. Alfaro. Accompanying problems will be:

i) The influx of a large volume of traffic onto Camino de La Amistad and Boulevard Torrijos will be beyond and above the levels of their functions, when Corredor Norte is opened for service.

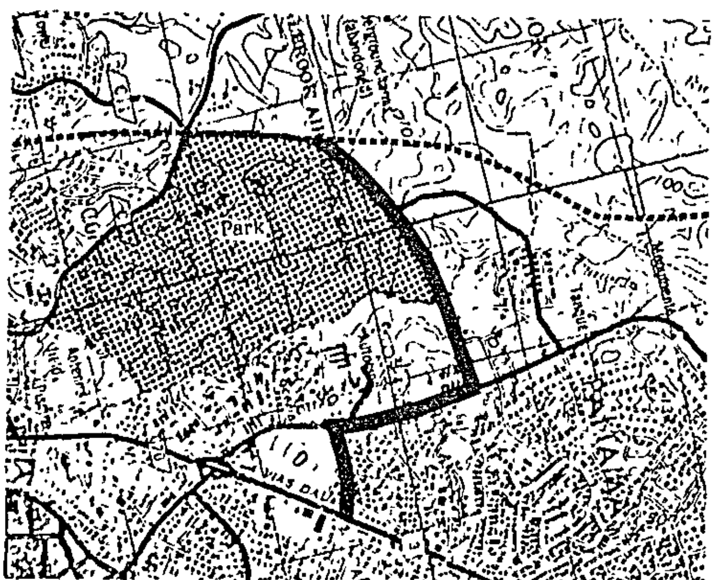
ii) The volume of turning traffic at two intersections on Via Ricardo J. Alfaro will be beyond their capacities.



ALTERNATIVE -1-
ACROSS PARK AREA



ALTERNATIVE -2-
ALONG CURUNDU RIVER



ALTERNATIVE -3-
BOULEVARD OMAR TORRIJOS
Ave. RICARDO J. ALFARO

* EACH MESH SHOWS 1.0 Km

Fig. III-1-3 ROUTE ALTERNATIVES OF VIA EL PAICAL EXTENSION

From the above analysis, all three alternatives have their own difficulties. However, from the viewpoint of synthetic enforcement of north-south traffic axis on the future road network, route alternative 1 can secure the smoothest traffic flow. Concerning the adjustment with park plan, the alignment and structures shall be accommodated to natural environment, while certain necessary period for implementation of project shall be secured in order to solve the problem of widening at the residential area of La Loceria.

1.3. Design Standards

1.3.1. Design Speed

Design speed is established for each of the Project Roads as listed in Table III-1-3, depending on the road function and the area which the road will go through. Corredor Norte is divided at the Via San Miguelito Oeste intersection into two sections with greatly varying transport demand, topography, and future land use, for the purpose of design speed determination.

TABLE III-1-3 APPLIED DESIGN SPEED

Type of Road	Road	Section	Design Speed (Km/h)
New Road	1. Corredor Norte	Gaillard Road- Via San Miguelito Oeste	80
		Via San Miguelito Oeste- Transistmica	60
	2. Via El Paical Extension		50
	3. Via Martin Sosa Extension		50
	4. Via San Miguelito Oeste		60
Road Improve-ment	5. Via Espana		50
	6. Via Bolivar		50
	7. Via Cerro Ancon		50
	8. Via El Paical		50

1.3.2. Cross Section Elements

(1) Lane Width

The series of metric conversion values of American Association of State Highway and Transport Officials (AASHTO) of 10 feet, 11 feet, and 12 feet to 3.05m , 3.35m , and 3.65m are applied to lane widths of the Project Roads. In Panama, major roads are constructed by MOP, which adopts the above metric conversion values, while local roads are usually constructed by developers under the guidance of MIVI, which has agreed with MOP to use 3.00m, 3.25m, and 3.50m as minimum lane widths. The above metric conversion values will be used in the Study because AASHTO standards are to be used as a principle. The Project Roads are all major arterials, and such values are used as standards for roads in Mexico, which are usually referred to in road construction in Panama.

(2) Shoulder Width

Road shoulder width is determined so as (a) to provide adequate lateral clearance needed to accommodate the certain level of traffic, (b) to reserve space for temporary haulting or for parking vehicles in trouble, and (c) to offer space for the installation of draining and other facilities. With regard to (b) 3 different parking widths are proposed as shown in Fig. III-1-4, using the design automobile dimensions of Table III-1-4. As for (c) a minimum width of 45cm is applied in consideration of the structure of the gutters, which are usually installed on the shoulder.

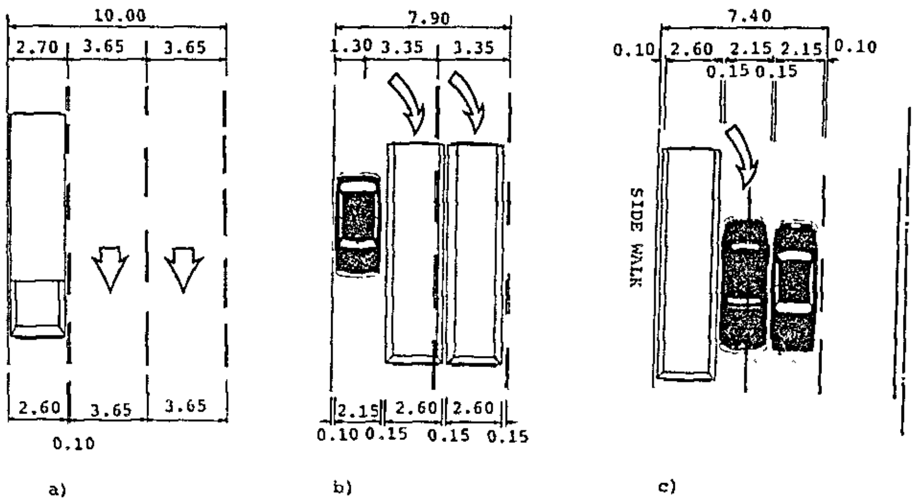


Fig. III-1-4 SHOULDERS

TABLE III-1-4 DESIGN VEHICLE DIMENSIONS

Design Vehicle	Wheel Base	Front Overhang	Rear Overhang	Overall Length	Overall Width	Height
1. Passenger Car	11'	3'	5'	19'	7'	--
	(3.35)	(0.91)	(1.52)	(5.79)	(2.13)	--
2. Single Unit Truck	20'	4'	6'	30'	8.5'	13.5'
	(6.10)	(1.22)	(1.83)	(9.14)	(2.60)	(4.11)
3. Semitrailor	40'	4'	6'	50'	8.5'	13.5'
Combination	(12.19)	(1.22)	(1.83)	(15.24)	(2.60)	(4.11)
Intermediate						
4. Semitrailor	50'	3'	2'	55'	8.5'	13.5'
Combination	(15.24)	(0.91)	(0.61)	(16.76)	(2.60)	(4.11)
Large						

Note: (); Dimensions in Meters

(3) Center Median

Three different center median widths have been applied, as shown in Fig. III-1-5, depending on how an exclusive left-turn lane is installed, but retaining at least 1m, which is a minimum width needed for erecting any barrier for the separation of traffic flowing in opposite directions. The applied cross section elements to each road are summarized in Table III-1-5.

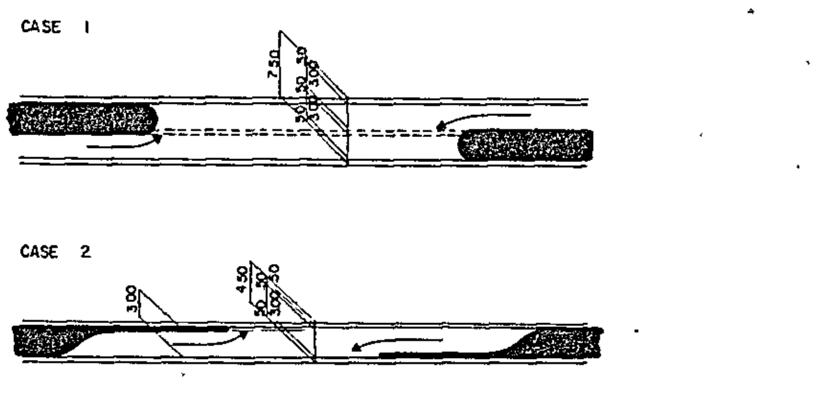


Fig. III-1-5 MEDIANS

TABLE III-1-5 APPLIED DISIGN SECTION ELEMENTS

Type of Road	Road	Section	Lane Width(m)	Shoulder Width(m)	Median Width(m)	R.O.W (m)	Existing R.O.W.(m)	Existing Const. Line
New Road	1. Corredor Norte	Gaillard Road-Via San Miguelito Oeste	3.65	2.70	16.0	80.0	---	---
		Via San Miguelito Oeste-Transistmica	3.65	2.70	7.5	60.0	---	---
	2. Via El Paical Extension		3.35	0.70	4.5	50.0	---	---
	3. Via Martin Sosa Extension		3.35	0.70	4.5	50.0	---	---
	4. Via San Miguelito Oeste		3.65	2.70	4.5	50.0	---	---
Road Improvement	5. Via Espana		3.35	0.45	1.0	41.2	40.0	50.0
	6. Via Bolivar		3.65	0.80	4.0	60.96	60.96	60.96
	7. Via Cerro Ancon		3.35	1.15	4.5	36.0	---	---
	8. Via El Paical		3.35	0.70	4.5	26.0	20.0	30.0

1.3.3. Geometric Design Standard for Road

The road geometric design standards prescribed by AASHTO for design speeds of 50 miles per hour (mph), 40 mph and 30 mph are used for the design speeds of 80 kilometers per hour (km/h), 60 km/h, and 50 km/h, respectively, as shown in Table III-1-6.

TABLE III-1-6 GEOMETRIC DESIGN STANDARD

Design Speed	80 km/h 50mph	60 km/h 40mph	50 km/h 30mph
I. Horizontal Alignment			
1. Minimum Radius			
Minimum (e=0.06)	533'(254m)	508'(154m)	278'(85m)
Absolute Minimum (e=0.10)	694'(211m)	427'(130m)	231'(70m)
For Normal Crown	11459'(3493m)	7639'(2328m)	5730'(1747m)
For Remove Adverse Crown	7639'(2328m)	5730'(1747m)	2865'(873m)
For Remove Transition Curve	7639'(2328m)	7639'(2328m)	5730'(1747m)
2. Minimum Curve Length			
For Circular Curve	----	----	----
For Transition Curve	2 lane: 150'(46m) 4 lane: 230'(70m)	2 lane: 130'(40m) 4 lane: 190'(58m)	2 lane: 110'(34m) 4 lane: 160'(49m)
II. Sight Distance			
1. Minimum Stopping Sight Distance	350'(107m)	275'(84m)	200'(61m)
2. Desireable Stopping Sight Distance	450'(137m)	300'(91m)	200'(61m)
3. Minimum Passing Sight Distance	1800'(547m)	1500'(457m)	1100'(335m)
III. Vertical Alignment			
1. Maximum Grade			
Without Limitation	----	----	----
With Length Limitation	F: 6%: 600'(183m) R: 7%: 530'(162m) H: 9%: 480'(146m)	F: 7%: 530'(162m) R: 8%: 490'(149m) H:10%: 480'(146m)	F: 8%: 490'(147m) R: 9%: 480'(146m) H:11%: 480'(146m)
Minimum Vertical Curve			
Crest	8500'(259m)	5500'(1676m)	2800'(853m)
Sag	7500'(2286m)	5500'(1676m)	3500'(1067m)
Desireable Vertical Curve Radius			
Crest	14500'(4920m)	6500'(1981m)	2800'(853m)
Sag	10000'(3048m)	6000'(1829m)	3500'(1067m)
Minimum Vertical Curve Length	150'(46m)	125'(38m)	100'(31m)

SOURCE: POLICY ON GEOMETRIC STANDARD FOR RURAL HIGHWAY, AASHTO.

NOTE. F: Flat area
R: Rolling Area
H: Hilly Area

These geometric design standards will be used for the alignment of new road improvement, but road improvement, which is often restricted by the existing land use or the presence of buildings, will be planned in accordance with the present alignment, unless to do so will cause serious difficulties to vehicle operation.

1.3.4. Geometric Design Standard for Intersection

Vehicle turning movement at intersection is planned using 3-centered compound curves as shown in Table III-1-7, but Fig. III-1-6 d) is applied to left turn traffic at the intersection with a narrower road, allowing only the movement of large vehicles to enter onto other lanes.

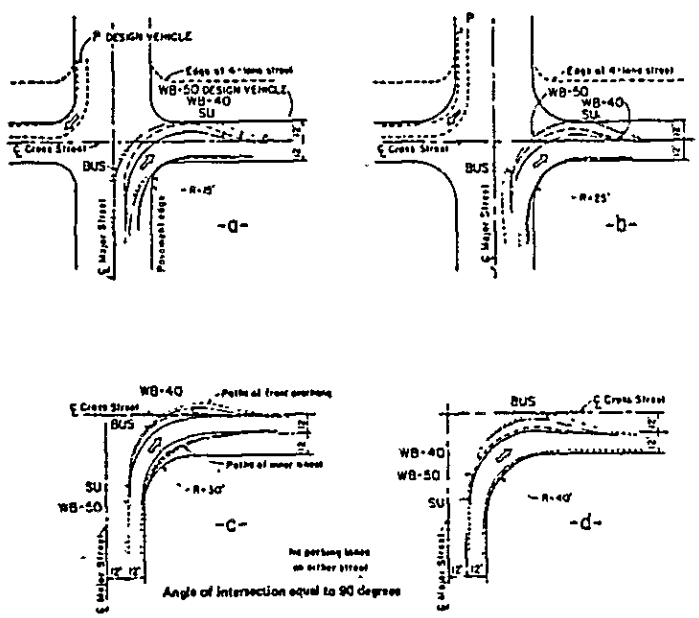


Fig. III-1-6 EFFECT OF CURVE RADII ON TURNING PATHS OF VARIOUS DESIGN VEHICLES

TABLE III-1-7 MINIMUM DESIGNS FOR TURNING ROADWAYS

Angle of Turn (Degree)	Design Classification	3-Centered Radi II (Feet)	Compound Curve Offset (Feet)	Width of Lane (Feet)
75	A	150-75-150	3.5	14
	B	150-75-150	5.0	18
	C	180-90-180	3.5	20
90	A	150-50-150	3.0	14
	B	150-50-150	5.0	18
	C	180-65-180	6.0	20
105	A	120-4—120	2.0	15
	B	100-35-100	5.0	22
	C	180-45-180	8.0	30
120	A	100-30-100	2.5	16
	B	100-30-100	3.0	24
	C	180-40-180	8.5	34
135	A	100-30-100	2.5	16
	B	100-30-100	4.0	26
	C	160-35-160	7.0	35
150	A	100-30-100	2.5	16
	B	100-30-100	4.0	30
	C	160-35-160	7.0	38

NOTE: A: Primarily passenger vehicles. Permits occasional design single-unit truck to turn with restricted clearences.
B: Provides adequately for SU. Permits occasional bus and WB-50 to turn with slight encroachment on adjacent traffic lanes.
C: Provide fully for all design vehicles.
SOURCE: POLICY ON GEOMETRIC STANDARD FOR URBAN HIGHWAY, AASHTO.

1.4. Pavement

1.4.1. Pavement Design Standards

Various types of pavement shall be designed in accordance with "Interim Guide for Design of Pavement Structures, 1972" of AASHTO. The values of the variables used in pavement design are determined as follows:

1) Regional Factor

AASHTO recommends a value within a range of 0.5 to 4.0 as regional factor. The value of 1.0 is used for Panama, where temperature remains unchanged throughout the year and no regional variance of climate exists.

2) Serviceability Index

The serviceability of a pavement is defined as the ability to serve high-speed high-volume automobile and truck traffic. AASHTO recommends the serviceability index of 2.5 for arterials and 2.0 for other roads. For the project roads subject to the Study, which are arterials to accommodate a relatively large volume of traffic, the index of 2.5 is applied.

3) Traffic Volume and Axle Load

Traffic volumes for a period of twenty years from the anticipated service year of 1990 shall be used. The growth rate of traffic volume from the estimated traffic volumes in 1990 and in the year 2000 shall be used. Of the vehicle types used in traffic volume estimation, trucks and large buses, which are believed to include those whose total weight is about five tons, shall be considered large vehicles for the purpose of calculating the large vehicle ratio of traffic. Because the average of the single axle load distribution of trucks shown by AASHTO is about four tons, this axle load distribution shall be used.

4) Subgrade

As for asphalt pavement, CBR is used as the representative value of support capacity of subgrade, as converted to support coefficient (Soil Support Value). As for cement concrete pavement, the K value of five kg/cm4 are used in view that a high quality subgrade is expected in almost all sections of the subject project and that a good subgrade material can be obtained from cutting and excavation. Where necessary, subgrade shall be replaced in order to achieve these values.

1.4.2. Types of Pavement

The distribution of pavement types used in Panama is illustrated in Fig. III-1-7, which shows that in the Republic as a whole, cement concrete pavement is used three times as much as asphalt concrete pavement and in Panama Metropolitan Area, the uses of these types about compare to each other.

The existing roads to be improved have mostly a cement concrete pavement, with or without an asphalt overlay (see Table III-1-8).

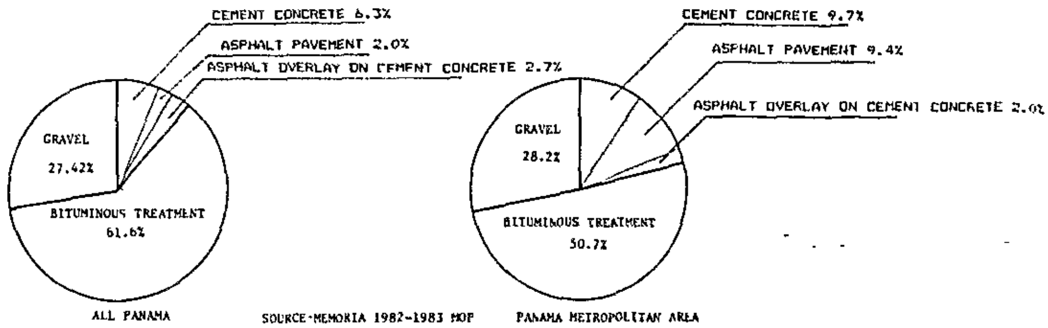


Fig. III-1-7 ROAD LENGTH BY PAVEMENT TYPE

TABLE III-1-8 EXISTING PAVEMENT TYPES

Name of Road	Section	Pavement Type
1. Via Espana		OV
2. Via Bolivar		OV
3. Via Cerro Ancon	Calle 3 de Noviembre	PCC
	Ave. de los Martires	PCC
	Gaillard Road	AC
4. Via El Paical		PCC
5. San Miguelito Intersection	Via R. J. Alfaro	PCC
	Via Domingo Diaz	PCC
	Transistmica	OV PCC for Widening
	Via Bolivar	OV

Note: OV: Asphalt Overlay on Portland Cement Concrete Pavement.
PCC: Portland Cement Concrete Pavement
AC: Asphalt Concrete Pavement.

The cross sections of the types of cement concrete pavement and asphalt concrete pavement usually used in Panama, and their costs, are compared in Fig. III-1-8 and Table III-1-9. The cost comparison shows that cement concrete pavement is more economical than asphalt concrete pavement and, therefore, cement concrete pavement should be applied generally for the project roads. However, asphalt concrete pavement could be applied in low lands where settlement is expected, such as in Rio Curundu basin and Cinco de Mayo area. Whenever a road presently paved with cement concrete and asphalt overlay is widened, asphalt concrete pavement is applied in order to maintain the continuity of the surface condition.

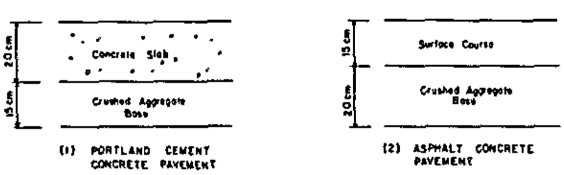


Fig. III-1-8 TYPICAL PAVEMENT STRUCTURES IN PANAMA

TABLE III-1-9 COST COMPARISON OF PAVEMENT TYPES

(1) PORTLAND CEMENT CONCRETE PAVEMENT

Description	Unit	Quantity	Unit Price	Amount (B/.)
1. Base Course	CUM	4,026	22.00	88,572.00
2. Portland Cement Concrete Slab T=20cm	SQM	24,333	19.85	483,010.05
3. River-run	CUM	2,406	12.00	28,872.00
4. Cut-back Asphalt MC-250	Lts	15,714	0.46	7,228.44
5. Cut-back Asphalt RC-250	Lts	13,750	0.46	6,325.00
6. Crushed Aggregate	CUM	138	30.00	4,140.00
7. Curb Stone	LM	560	20.00	11,200.00
Total				629,347.49

(2) ASPHALT CONCRETE PAVEMENT

Description	Unit	Quantity	Unit Price	Amount (B/.)
1. Base Course	CUM	6,560	22.00	144,320.00
2. Asphalt Concrete	TON	9,675	85.00	822,375.00
3. River-run	CUM	1,750	12.00	21,000.00
4. Cut-back Asphalt MC-250	Lts	52,558	0.46	24,176.68
5. Cut-back Asphalt RC-250	Lts	17,850	0.46	8,211.00
6. Crushed Aggregate	CUM	138	30.00	4,140.00
7. Curb Stone	LM	560	20.00	11,200.00
Total				1,035,422.68

Note: Estimate for a 2 lane 3.8 Km highway 1983 price.

1.4.3. Pavement Design

The structural numbers (SN) required for asphalt concrete pavement and the cement concrete slab thicknesses required for cement concrete pavement by project roads are shown in Table III-1-10. Fig. III-1-9 shows the structure of various types of pavement, provided that the elements of pavement are translated into SNs at the conversion coefficients shown in Table III-1-11.

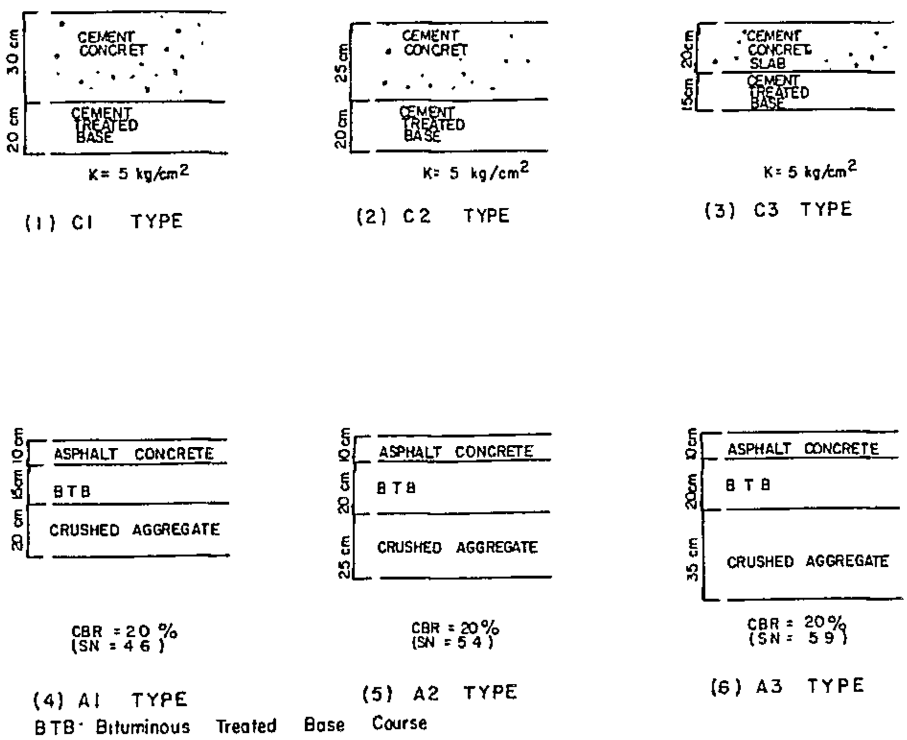


Fig. III-1-9 PROPOSED PAVEMENT STRUCTURES

TABLE III-1-10 REQUIRED PAVEMENT THICKNESS

CORREDOR NORTE

LINK No	AADT	TRUCK	ANNUAL GROWTH	SN	CONCRETE THICKNESS
6006	15338	2830	0.95	3.05	17
6035	27368	5133	0.98	3.54	20
6036	27469	5115	1.00	3.62	21
6037	30009	5570	1.00	3.69	21
6512	30534	5661	1.01	3.74	22
6583	40569	7304	1.03	4.02	23
6580	38538	7403	1.04	4.13	24
6582	38538	7403	1.04	4.13	24
6041	38166	8217	1.04	4.21	24
6055	38166	8217	1.04	4.21	24
6042	10622	2542	1.06	3.62	21
6043	10622	2542	1.06	3.62	21

CERRO ANCON

LINK No	AADT	TRUCK	ANNUAL GROWTH	SN	CONCRETE THICKNESS
1201	12030	2303	1.01	3.26	19
1203	16578	3657	1.03	3.61	21
1219	17817	3487	1.04	3.63	21
6025	22733	6385	0.99	3.71	21
1057	26221	8431	0.96	3.70	21
1529	27628	5653	1.01	3.76	22
6023	17206	2996	1.01	3.40	20
6114	17206	2996	1.01	3.40	20
6117	9384	1163	0.92	2.52	14

MARTIN SOSA

LINK No	AADT	TRUCK	ANNUAL GROWTH	SN	CONCRETE THICKNESS
6584	6295	804	1.10	3.22	18
6074	8231	1115	1.07	3.24	19
6073	11317	1918	1.05	3.36	19
6599	12416	1906	1.03	3.26	19
6072	12416	1906	1.03	3.26	19
1408	21546	4104	1.01	3.54	19

EL PAICAL EXTENSION

LINK No	AADT	TRUCK	ANNUAL GROWTH	SN	CONCRETE THICKNESS
6076	17212	2531	1.04	3.51	20
6533	17212	2531	1.04	3.51	20
6592	17212	2531	1.04	3.51	20
6075	17303	2538	1.04	3.51	20
1103	21524	2869	1.01	3.35	20

SAN MIGUELITO OESTE

LINK No	AADT	TRUCK	ANNUAL GROWTH	SN	CONCRETE THICKNESS
6082	21068	4602	1.03	3.78	22
6040	21068	4602	1.03	3.78	22
6032	21068	4602	1.03	3.78	22
6081	21068	4602	1.03	3.78	22
6053	21068	4602	1.05	3.94	23

VIA SIMON BOLIVAR

LINK No	AADT	TRUCK	ANNUUAL GROWTH	SN	CONCRETE THICKNESS
1001	17161	6918	0.90	3.30	19
1002	37987	8427	0.96	3.71	21
1003	38725	8279	0.99	3.83	22
1004	13579	4827	0.98	3.50	20

VIA ESPANA

LINK No	AADT	TRUCK	ANNUAL GROWTH	SN	CONCRETE THICKNESS
1010	13563	3502	1.00	3.39	19
1011	6313	2640	0.99	3.23	19
1012	12211	4140	0.98	3.41	20
1061	12211	4140	0.98	3.41	20
1070	14429	5033	0.99	3.55	20
1071	20602	5395	0.99	3.57	21
1072	12215	4698	0.98	3.49	20
1073	12215	4698	0.98	3.49	20
1013	12215	4698	0.98	3.49	20
1014	12215	4698	1.03	3.76	22
1074	24421	6382	1.00	3.76	22
1015	30555	8167	1.00	3.90	23
1016	40298	7985	1.00	3.93	23
1017	19537	3835	1.02	3.56	21
1085	24070	4376	1.01	3.62	21

SAN MIGUELITO INTERSECTION

LINK No	AADT	TRUCK	ANNUAL GROWTH	SN	CONCRETE THICKNESS
6059	20082	3720	0.94	3.15	18
1008	11778	6108	1.01	3.81	22
1042	31800	6989	0.96	3.60	21
6157	15246	4999	1.00	3.63	21

Unit. AADT : veh./day
TRUCK : veh./day
ANNUAL GROWTH RATE : %
CONCRETE THICKNESS : cm

Individual project roads shall receive the pavement described below.

a) Corredor Norte

The cement concrete pavement type C2 is applied, with the exception of previous Albrook Airfield runway section where an asphalt overlay will be applied on the existing cement concrete pavement and at the section between Gaillard Road and the runway where the consolidation settlement is expected asphalt concrete pavement Type A1 is applied .

b) Via San Miguelito Oeste, Via El Paical Extension and Via Martin Sosa Extension

Based on the cost comparison of the pavement types, cement concrete pavement type C3 will be applied for the whole length.

c) Via Espana

The widening strips shall receive asphalt concrete pavement type A1 in conformity with the existing pavement surface.

d) Via Bolivar

Cement concrete pavement type C3 is applied in accordance with MOP plan to use such type of pavement for the widening of this road.

e) Via Cerro Ancon and Via Cerro Ancon Extension

Although this road is now partly paved with cement concrete, asphalt concrete pavement type A1 will be applied because its vertical alignment must be corrected and because settlement is expected.

f) Via El Paical

In line with the present pavement, cement concrete pavement type C3 is applied.

TABLE III-1-11 STRUCTURAL LAYER COEFFICIENTS

PAVEMENT COMPONENT	COEFFICIENT
1. Surface Course	
Road Mix (Low Stability)	0.20
Plant Mix (High Stability)	0.44
Sand Asphalt	0.40
2. Base Course	
Sandy Gravel	0.07
Crushed Stone	0.14
Cement Treated	
Compressive Strength at 7 days	
650 psi or more (4.5 kg/cm2)	0.23
400 psi to 650 psi (2.8-4.5 kg/cm2)	0.20
400 psi or less (2.8 kg/cm2)	0.15
Bituminous Treated	
Coarse Graded	0.34
Sand Asphalt	0.30
Lime Treated	0.15-0.30
3. Sub-Base Course	
Sandy Gravel	0.11
Sand or Sandy Clay	0.05-0.10

SOURCE: INTERIM GUIDE FOR DESIGN OF PAVEMENT STRUCTURE AASHTO.

1.5. Structures

1.5.1. Design Standards

In Panama, AASHTO's design standards are applied to structures, and this Study shall follow this practice. The major design criteria are as follows:

1) Load

(1) Live Load

AASHTO prescribes 5 kinds of live load chiefly depending on design traffic volume. In view of the fact that the designing of structures of the important arterial roads in Panama Metropolitan Area is at hand, the most demanding HS20-44 shall be used.

(2) Earthquake Effects

Although earthquakes are not so frequent in Panama, earthquakes occasionally attack La Palma in the east and Puerto Armuelles in the west. In Panama Metropolitan Area, earthquake effects are taken into consideration only for important structures. This Study shall consider seismic load and use the lowest seismic coefficient value prescribed, which will be applied to such main structures as bridges, by AASHTO; C=0.06.

3) Clearance

According to AASHTO standard, horizontal clearance is the roadway width including curbs and vertical clearance is 4.877m (16 feet). In Panama the vertical clearance of 5.0m is introduced. Therefore, this Study shall use the clearance of 5.0m as a principle (see Fig. III-1-10).

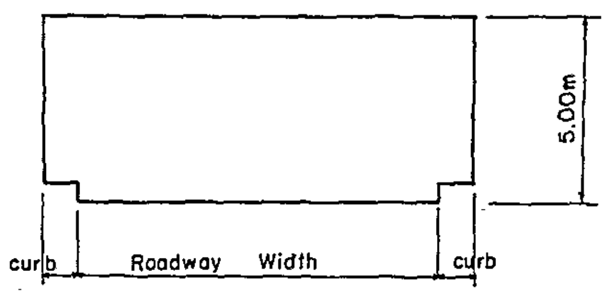


Fig. III-1-10 CLEARANCE

4) Material Strength

The standard strength of concrete is determined in view of the locality and record of past work in Panama. While the strength of steel sections is based on the strength stipulated by ASTM, the standard strength of various materials applied in the Study are listed in Table III-1-12.

TABLE III-1-12 STRENGTH OF MATERIALS

Material		
Concrete	For Superstructure	fc =315 kg/cm2
	For Substructure	fc =210 "
	For Prestress	fc =350 "
Reinforcing bar	(Grade 40)	fv =2800 "
Prestressing Steel	(Grade 270)	fv =161 kg/mm2
Structural Steel	(M-183)	fu =4000 kg/mm2

Note: fc: Specified compressive strength of concrete at 28 days
fv: Specified yield strength of reinforcement
fu: Minimum tension strength

1.5.2. Bridge Structure Types

This Study addresses several bridges over creeks and streams in connection with the construction of new roads, and bridges for grade separation at three instersections in connection with the improvement of existing roads.

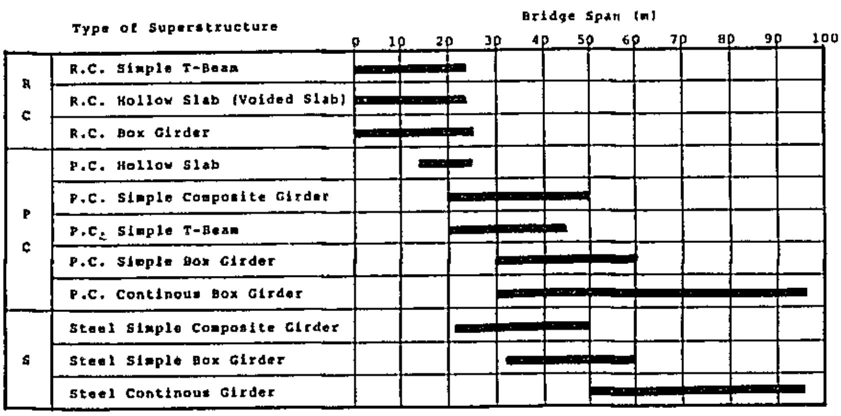
These bridges should be economical, both in terms of construction and maintenance costs, should be of a structure to secure both safety for working during construction and safety for traffic, should have an aesthetic value and, particulary those to be constructed in urban area, should be harmonious with the surrounding environment without causing a discontinuation in the existing community.

In view of the above, the types of bridges will be discussed hereunder in three parts: superstructure, substructure, and foundation.

(1) Superstructure

Superstructures are usually classified by the materials used: reinforced concrete (RC) bridges, prestressed concrete (PC) bridges, and steel bridges. The type of superstructure presented in Table III-1-13, according to required span length, is adopted in the Study. Only short spans are used for RC bridges, and medium to long spans are used for PC bridges and steel bridges. The type of structure to be prefered in Panama is concrete (RC or PC) bridge, whose substructure requires only reasonable quantity of materials under limited seismic load, in view of the abundant supply of concrete. Steel bridges require only limited amount of work on site and need only limited time for completion, but their construction costs are believed expensive. In fact, an economic comparison of structures of different materials (substructure height of 10m and spread foundation) in Fig.III-1-11 reveals that steel bridges are somewhat more costly than concrete. Therefore, bridges with a span of up to 23m shall be of RC and those with a span longer than 23m shall be of PC.

TABLE III-1-13 BRIDGE TYPE AND STANDARD SPAN APPLICATION



Note : R.C.: Reinforced Concrete
P.C.: Prestressed Concrete
S : Steel

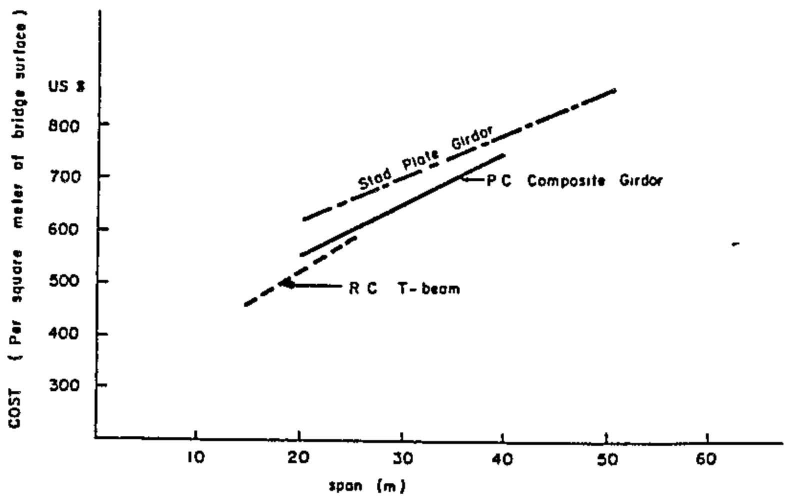


Fig. III-1-11 COST OF VARIOUS BRIDGE TYPES

(2) Substructure

Slender type piers can be used under low seismic load and, particularly for one-piece superstructure for handling traffic in both directions, rigid-frame piers shall be used.

(3) Foundation

Soil in the Project Area, with the exception of Curundu area, is clayey or silty sand down to the depth of 1 to 7m, underlaid by basalt, which is believed to offer a reliable stratum for founding structures. The type of foundation is determined in reference to boring data obtained from the locations of the bridges. Generally, spread foundation shall be use where the bearing layer is not more than 4m from the ground surface, and pile foundation shall be used where the bearing layer is deeper than 4m. Pre-cast concrete piles with the diameter of less than 30cm could be used in consideration of the low seismic load.

1.5.3 Miscellaneous Structures

Non-bridge structures which will be used shall be box culverts, pipe culverts, and retaining walls. The area of internal opening of culverts, which are used for draining across the road, is determined by the discharge. Because reinforced concrete pipe culverts are domestically manufactured up to the maximum diameter of 1.5 meters, pipe culverts shall be used up to the diameter of 1.5 meters and box culverts, for larger diameters. Retaining walls shall be used to protect the abutments of bridges for the grade separation of intersections, to protect the slope toe adjacent to rivers, and to minimize the land acquisition at the area where land is limited. The cantilever type and the gravity type are planned.

1.6 Auxiliary Facilities

1.6.1 Road Lighting

Road lights are installed either for continuous lighting of the entire route or for spot lighting, by the criterion of road surface brightness to the driver's eye. Road sections generally subject to continuous lighting and to spot lighting are shown in Table III-1-14. For the subject new road construction projects, spot lighting shall be used as a principle in sections where roadside area development is not expected and continuous lighting shall be used in all other sections.

TABLE III-1-14 APPLICATION OF STREET LIGHTING

Description	Application
Contineous lighting	Built-up area Artery in residential area Area where roadside is developed
Partial lighting	Other area (at Intersection, Interchange, Pedestrian crossing, sharp curve, and etc.)

The footcandle of 0.5 to 1.0 cd/m2 is usually used as criterion for road light installation. In view of the relatively heavy traffic on the project roads, the criterion of 1.0 cd/m2 shall be used. Typical lighting installtion arrangements on 2-lane and 3-lane roads are shown in Fig. III-1-12.

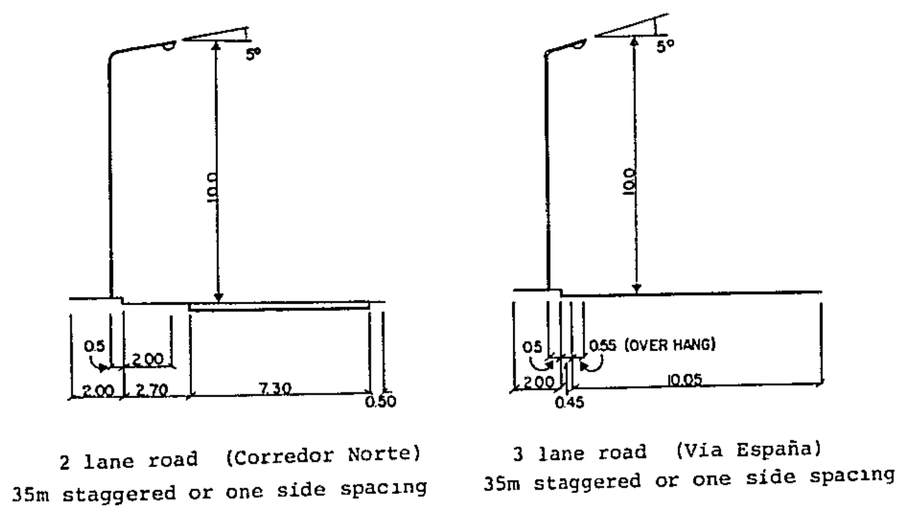


Fig. III-1-12 TYPICAL LIGHTING INSTALLATION

1.6.2 Guardrail

In Panama Metropolitan Area, almost no guardrail is installed by roads except for Juan Pablo II and other recently opened roads. Therefore, guardrails shall be installed for traffic safety, depending on the roadside gradient or level difference, as shown in Fig. III-1-13. Guardrails shall be installed also in front of obstacles facing roadway such as bridge piers and handrails, as well as along a sharp curve and in sections where pedestrian crossing is to be controlled.

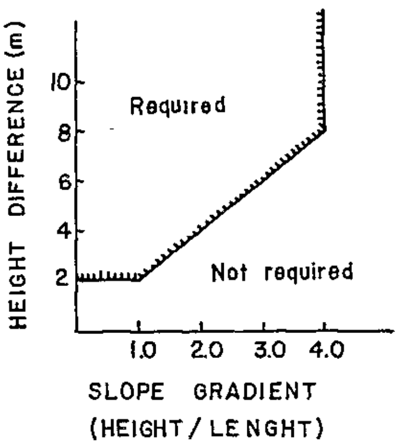


Fig. III-1-13 APPLICATION OF GUARD RAIL

1.6.3 Traffic Signs

Traffic signs are classified into regulatory signs, warning signs, and guide signs. Regulatory signs indicate speed limit, no parking, no stopping, and other controls. They are installed by MOP upon the construction of the road and maintained by DNTTT. Warning signs are installed and maintained by MOP for the purpose of warning drivers of road alignment, road surface condition, or some unusual road side condition. Also installed and maintained by MOP, guide signs are to show direction, destination, and other information to the driver.

These signs are erected by methods shown in Fig. III-1-14. Regulatory and warning signs usually show a symbol on a single roadside poles. While guide signs, many of which show the name of a place in writing, are either installed on roadside dual poles or cantilever arms, or hang overhead. In the case of 2-lane roads, road side installation is usually considered satisfactory, as the signs can be seen by drivers in either lane. However, cantilever or overhead installation should be desirable for roads with three or more lanes.

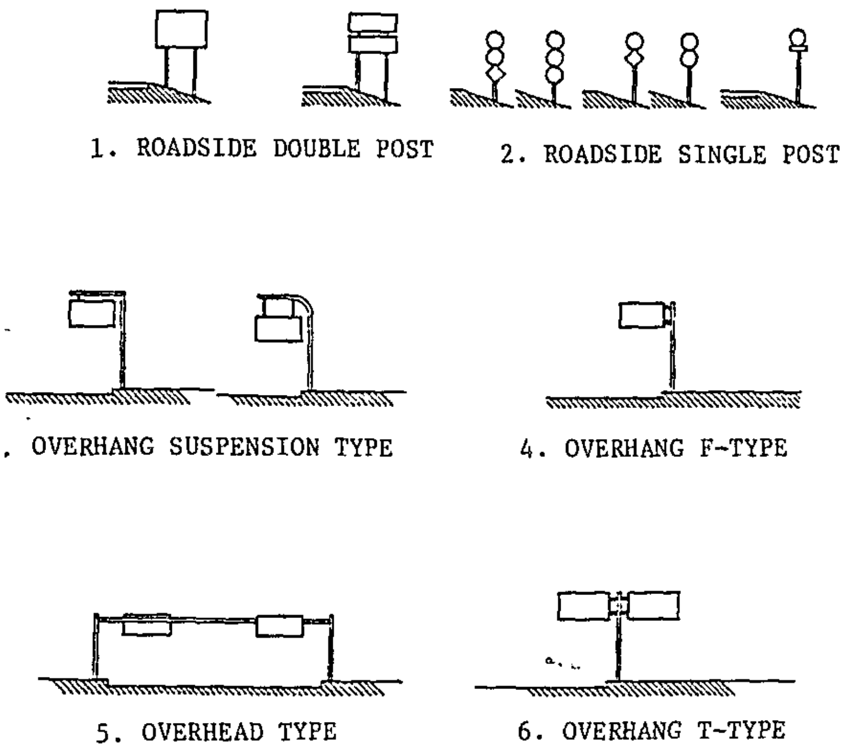


Fig. III-1-14 VARIOUS TRAFFIC SIGN MOUNTINGS

1.6.4 Road Markings

The kinds of road markings are shown in Table III-1-15. These markings make a set with traffic signs in giving an appropriate guidance to the driver at an intersection. Not only should they be effected at the time of road construction, but these markings should also be well maintained throughout the service life of the road.

TABLE III-1-15 VARIOUS PAVEMENT MARKINGS

Classification		
1. Lines	a. Center line	
	b. Lane line	
	c. Pavement edge line	
	d. Stop line	
2. Zone	a. Pedestrian crossing	
	b. Obstacle, No passing area, Diversing and Merging.	Diagonal and Chevron marks
	c. Bus stop	
	d. No stopping zone	
3. Symbol	a. Lane use	Arrow
	b. Direction guide	Characters
	c. Regulatory Signs	Speed limit, No turn, Direction restriction, and etc.
4. Curb Markings for parking restriction		
5. Reflecter units	Stads, Chatter bar, Jiggle bars, cats eye Delineators and etc.	

1.6.5 Street Trees and Shrubs

1) Basic Policy

The trimming of sidewalks with trees shall be achieved aiming at the improvement of esthetic value of the road, separation of footpath from roadway for pedestrian safety, production of shadow, provision of visual guidance, noise buffering, the adsorption of exhaust gas matters, and atmospheric purification. Aims of tree planting on Center Median and Traffic Island are the esthetic improvement of the road, enhancement of partition effect between opposite roadways, light shielding, and visual guidance. Tree planting on the interchange aims at the provision of visual guidance along the ramp and at the traffic merging point. Slopes resulting from road construction shall be planted for esthetic effect and as buffers between the road and the roadside area.

2) Tree Varieties

In order that tree planting will have a maximum effect and that the post-planting maintenance of trees will be easy, the varieties of trees to be planted shall be selected in accordance with the following guideline:

a. Attractive shape and high diseases and insect resistence
b. Easy rooting, easy growing, and long life
c. Producing no excessive odor and no troublesome fruits.
d. Availability of the same variety, shape, and size in a reasonable lot
e. Relatively small rooting range
f. If possible, varieties found in local vegetation
g. As for roadside trees, 2 or 3 meter under-the-branch clearance can be easily taken

Panama Metropolitan Area has a savannah climate, which is comparatively dry of tropical climates and is favorable to vegetation, with a mean temperature of around 26 C (Panama City, amplitude being 2 or 3 C), average humidity of nearly 80%, (never under 70%) and annual precipitation between 2,000 and 3,000mm. Thus, trees root easily and grow fast in the Area, where a large variety of trees are seen. The urban sprawl phenomenon accompanied vigorous deforestation activities, however, and the Environment Protection Agency (RENARE) has been making central efforts for environmental protection during the past decade.

Tree varieties have been selected for individual projects as shown in Table III-1-16, chiefly drawing upon the varieties available in the local vegetation but adding colors of various flowering plants so as that each project will be characterized thereby. The characteristics of trees and sharbs are shown in Tables III-1-17 and III-1-18.

TABLE III-1-16 SELECTED VEGETATION

PROJECTS	TREES	SHRUBS
Corredor Norte	Guayacan Tulipan Africano	Cojon de Gato Frijolillo
Via El Paical Extension	Maria Guayacan	Capulin Canelito
Via Martin Sosa Extension	Cassia Rosada Macano	Croton
Via San Miguelito Oeste	Arbol Panama Guayacan Algarrobito Laurel	Canelito
Via Espana	Lluvia de Plaza Guayacan	Estrellita de Cielo Camaroncillo
Via Bolivar	Jacaranda Boca Vieja	Frijolillo
Via Cerro Ancon	Palma Roja Palma 1	Manto de Jesus
Via El Paical	Roble Luea	Laureno Algarrobito
Cinco de Mayo Bus Center	Astromelia Palo de Orquidea	Sanchezia Camaroncillo
San Miguelito Intersection	Ilan-ilan Boca Vieja	Embeleso Estrellita de Cielo
Chanis Bus Center	Sauce Flamboyan	Bouquet de Novia Croton

TABLE III-1-17 DESCRIPTION OF SELECTED TREES

Tree Common Name	Height Mts.	Diameter Foliage	Flowering-Color, Season	Time of Growth Length	System of Sowing	Quality of the Soil Sowing Climate
Jacaranda	10-17	9.5	Purple Blue Jan. to March	-	Seed or Slips	Humid Climate Lower Elevations
Guayacan	35	9.0	Yellow Bri-lliant Feb. to March	Slow Growth	Seeds	Grow Lower Elevations with Humid Climate & Strong Summer
Roble	13-17 to 25	9.5	White to Pink Jan. to March	-	Seeds with Successful Transplanta-tion	Grow Lower Elevations with humid Climate
Laurel	10-20 to 25	Irregular Spreaded Round Up	February to April	Fast Growth	Seeds	Grow Lower Elevations under Humid to very Humid Climate
Palma Roja	10	3.5	Petiole (leafstalk) Red Pointed Leaves	-	-	-
Palo de Orquideas	3-5 10	7 not very dense	Clear Purple Shows up during the whole year	- -	Seeds or Shoot	Any surroundings on lower elevations
(Nunandra)	3.5-9	7	Pink with Red poins/Nov.-July			
Tulipan Africano	15	11	Big Red & Orange Flowers	Fast Growth	Seeds & Beams	Grow in any kind of soil but better on fertile filtrating soil without excessive
Maria	15-30	9	Fragant White flowers small & good looking cluster	-	-	Tropical climate in lower elevations & humid soil
Astromelia	8-12	8.5	Purple pink & White	Fast Growth	-	Adaptable to medium-lower
Luea	7.5	5	Frail leaves & White flower	-	-	elevations dry climate or humid
Casia	7	9	Leaves all Green Pink with White March to July	Fast Growth	-	-
Macano	medium High	-	Yellow	-	-	Humid region to medium level
Tree Panama	3.5 or more	16	Redish April & May	Medium Growth 400 year	Seeds	Low elevations with Strong summer
Lluvia de Plata	15-20	13	Cream White	-	-	Prefers low elevations with rainy climate
Boca Vieja	6.5	6.5	White almost all the year	-	Seeds	Humid climate
Palma 1	5-7	-	White & Yellow Greenish	-	-	-
Ilan-ilan	8-12	10	Pale Yellow Prolonged flowering	Fast growth	Seeds	-
Sauce	9-14	4.5	Without	-	Slips	-
Flamboyan	10-14	12-25	Red Orange Feb. to June	Fast growth	Seeds or beams	Medium low elevations a little exigent as Much as land

TABLE III-1-18 DESCRIPTION OF SELECTED SHRUBS

Tree Common Name	Height Mts.	Diameter Foliage	Flowering-Color Season	Time of Growth Length	System of Sowing	Quality of the soil Sowing Climate
Cojon de Gato	7		Yellows all year		Seeds & Slips	Humid climate to dry
Frijolillo	3		Yellows July-Dic.		Seeds	Secundary vegetation dry
Capulin	10		White all year	Fast growth	Seeds	Lower elevations dry climate or humid
Canelito	6		Red-Yellow all year		Seeds & Slips	
Algarrabito	4		White May to Sept.		Seeds	Lower elevations humid Climate
Estrellita	0.45		Violet to Purple		Seeds & Transplantation	
Camaroncito	2		Orange Sept.1-Dic. Jan.-Feb.		Seeds & Slips	Border of forest 1,000mts & over the level of sea
Manto de Jesus	2		Vine Red all year		Stiks	Argillaceous earth Alkaline & good drainage
Laureno	4		Yellow Oranges		Seeds & Slips	Open places humidity soil
Tabogana	5.5	6	Beiges, Pink all year	Fast growth	Slips & Seeds	Alkaline earth, humid & fertile
Sanchezia	2		Red all year	-	Stiks Slips	-
Embelezo	0.70		Light Blue		Branch or Slips	Fertile earth, moderate humidity
Bouquet de Novia	1-2		Pink-Redish all year	-	Stiks	Open earth, alkaline & good drainage
Croton	2		Showing sheets not important flower	-	Slips	Open earth alkaline good drainage
Crespon	4-1.8	1.8	Pink, Purple Feb.-Sept.	Fast growth	Seeds & Slips	Alkaline earth moderate humidity

3) Planting Patterns

a. Pattern-1 (Corredor Norte and Via San Miguelito Oeste)

Along these wide suburban arterials with the right-of-way of generally 80 meters, trees shall be planted rather sparsely so that they will be in harmony with the suburban type development of the roadside areas, where nature will be much preserved. On the wide center median, groups of low trees or shrubs shall be planted in rows but particularly sparsely with long intervals between them.

b. Pattern-2 (Via El Paical Extension and Via Martin Sosa Extension)

Dense plantation of trees and shrubs on center median will harmonize Via El Paical Extension with the natural green environment of the park which it will traverse and characterize Via Martin Sosa Extension against the diverse future land uses (houses, factories, athletic park facilities) of the roadside areas.

c. Pattern-3 (Via El Paical, Via Cerro Ancon, and Via Simon Bolivar)

Pedestrian traffic will continue in the future to be heavy on these roads lined with houses and public facilities, and a dense plantation of trees and shrubs shall be effected on the center median and along sidewalks in order to create pleasant road spaces.

d. Pattern-4 (Via Espana)

Going right through the new CBD of the City, Via Espana is crowded with commuters, shoppers, and students all day long. The road, which can never be too beautified, shall be embellished with the dense linear plantation of tall trees, belts of shrubs, and, particularly, the colors of flowering plants.

These patterns are presented in Fig. III-1-15.

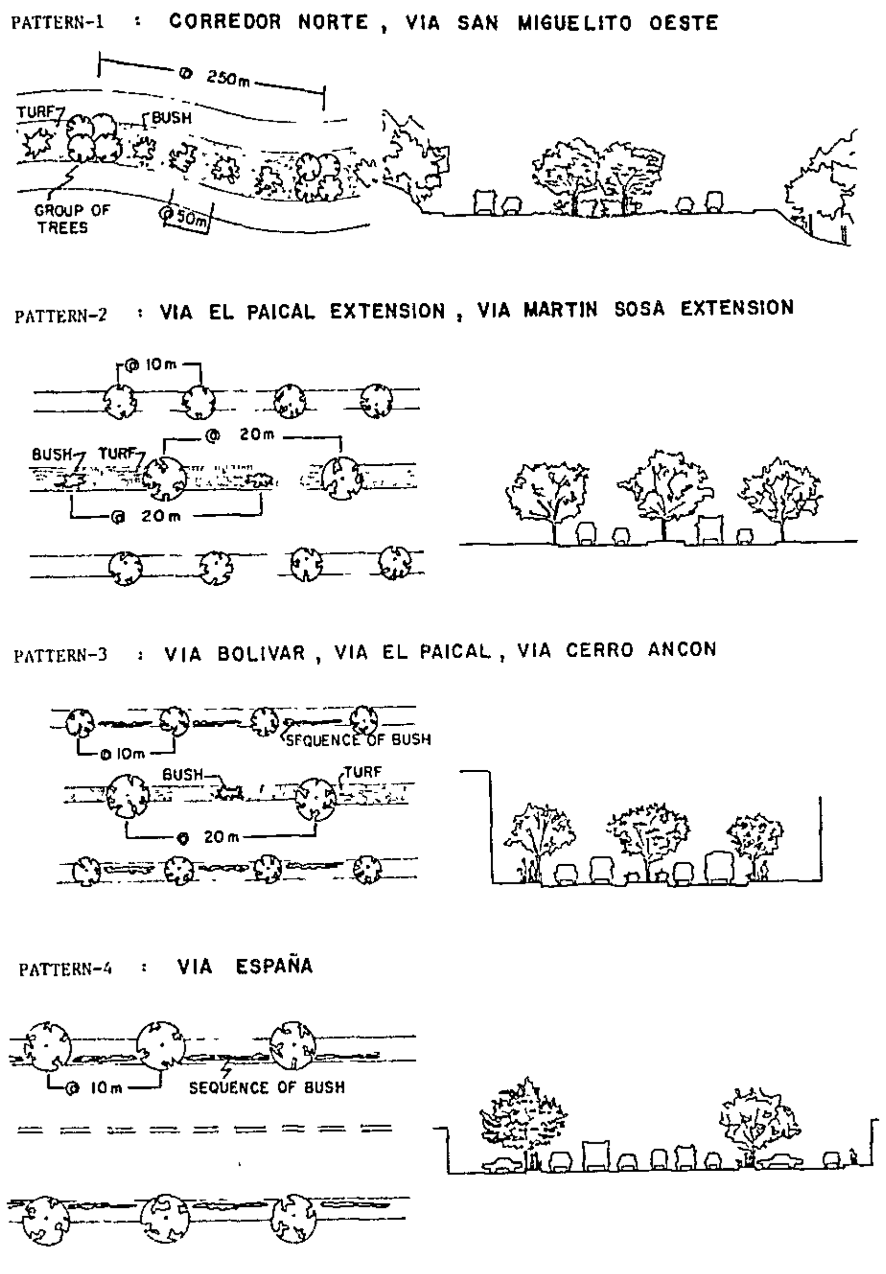


Fig. III-1-15 TYPICAL STREET PLANTING PATTERN

2. New Road Construction Projects

2.1. Corredor Norte

2.1.1. Land Use and Access Condition

1) Present Roadside Land Use

This road will lie between Previous Albrook Airfield and Via Transistmica, and will traverse the Reverted Area.

In the Previous Airfield, the buildings still remain, part of which has been remodeled and occupied by government agencies. This road will go through a part of the military area used by the United States forces between the previous runway and Ave. Curundu. Then, this road will go east along Camino de la Amistad and through the hills of the Reverted Area, cross the upper reaches of Rio Abajo, and reach Via Transistmica. The point of contact with Via Transistmica is the area called Los Andes, where housing development has been undertaken recently. Of the total extension of this road of about 12 kilometers, nearly 10 kilometers lie in area yet to be developed.

2) Future Land Use Image

The roadside area is to be used for various purposes, as stated in Section II-1 (Land Use), under the preliminary land use concept: industrial, commercial, government facilities, housing, and natural park area. Thus, it is predicted that nearly the entire roadside area will have been urbanized by the year 2000.

a) Commercial Area

The commercial area which will develop in the vicinity of Corredor Norte is envisaged as chiefly the type which will have an areal spread, rather than roadside strips of commercial activities, which will not conform with the function of this principal arterial road.

b) Residential Area

The fundamental distribution of residential areas, from the roadside towards the hinterland, will be high density areas of high-rises, medium density areas of medium-rises, and low density areas of low-rises, in that order. More self-contained residential areas will develop around a community center composite of public and commercial facilities. Tall and medium height houses will prefer flat topography, while slopes will provide for low single-family houses(Fig. III-2-1). The road will be trimmed with green belts in residential areas.

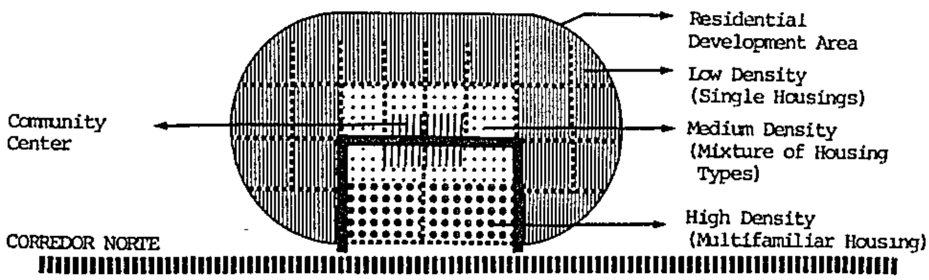


Fig. III-2-1 RESIDENTIAL AREA DEVELOPMENT MODEL

d) Industrial Area

Industrial areas will be developed in the form of estates with lots in a grid pattern for functional efficiency.

e) Institutional Area

No typical road pattern will be adopted for institutional area, where the present practice of individual agencies obtaining the sizes of lot as they need will be continued.

3) Local Development and Traffic Network

(1). Road Hierarchy

The fundamental road pattern that will effectively support the future development of areas along Corredor Norte can be determined only after the assignment of hierarchical orders to relevant individual roads. In order to assure that housing blocks will be apart from each other but well served by local roads and that an access road network will attend commercial and industrial areas, the road hierarchy shall be determined as follows:

a. Traffic generated in blocks and emerging from local roads will be gathered onto collector roads, which are distributed at the intervals of 500 meters.

b. Traffic flowing from the collector roads will be led onto frontage roads for access to Corredor Norte.

c. The roadside areas separated by Corredor Norte will be connected by arterial roads crossing Corredor Norte at the intervals of one kilometer either by an underpass or an overpass.

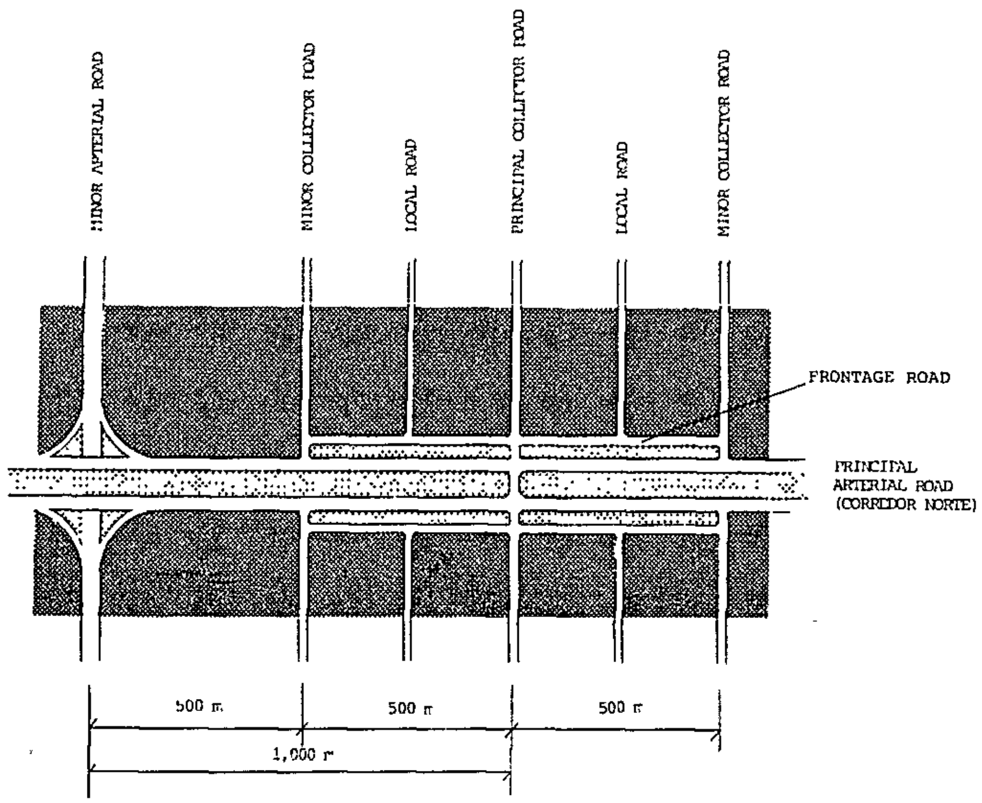


Fig. III-2-2 ROAD HIERARCHY

(2) Local Road Network

Presented in Fig. III-2-2 is an example of traffic networks along Corredor Norte, which can be conceived of according to the above road hierarchy and in consideration of the basic future land use concept and the local topography. In this network, Corredor Norte and other east-west arterials are connected by Via Cerro Ancon, Via El Paical Extension, Autopista Access Road, and other arterials. If the future development of the surrounding area will stimulate the construction of a connecting road between Corredor Norte and Via Ricardo J. Alfaro, however, three or four routes, such as those identified in Fig. III-2-3 , can be the candidate. Then, intersections, irrespective of their type, will be distributed at an average interval of about one Km (see Fig. III-2-4).

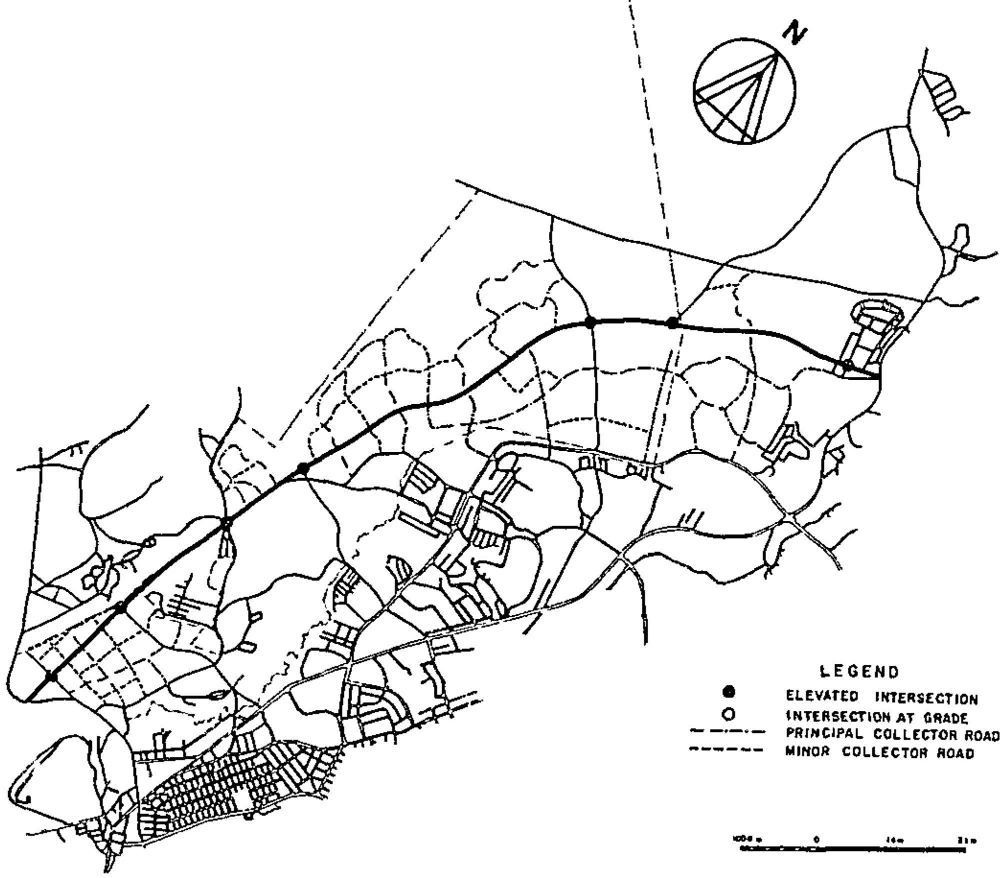


Fig. III-2-3 CORREDOR NORTE AND SURROUNDING TRAFFIC CIRCULATION

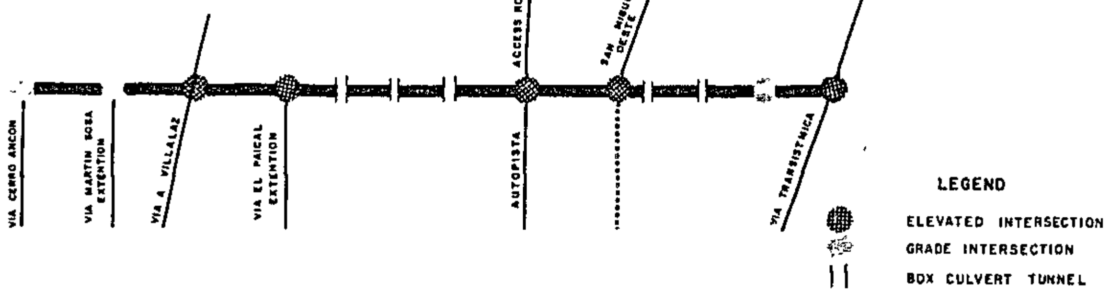


Fig. III-2-4 INTERSECTION ALOCATION ALONG CORREDOR NORTE

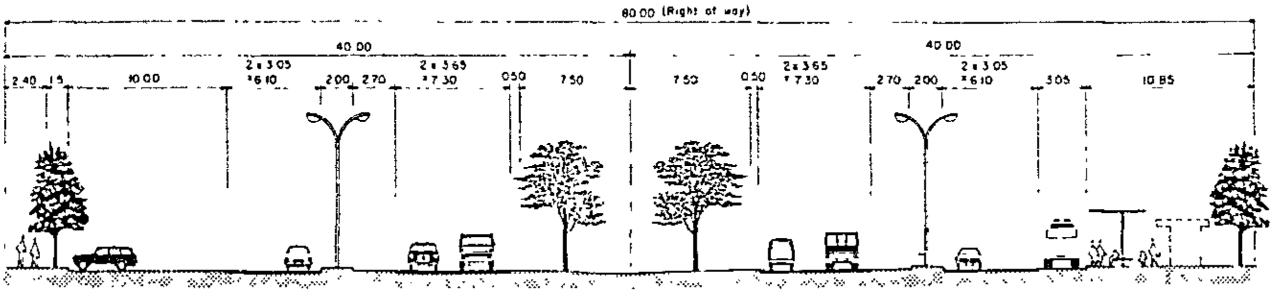
2.1.2. Geometric Design

For Corredor Norte, different design speeds and standard cross section structures are applied to its western half and eastern half as divided by Via San Miguelito Oeste interchange, where Ancon Corregimiento and San Miguelito border with each other. The western half is the Reverted Area, which will be developed from now, and the eastern half is where housing development has already started except for privately owned hills.

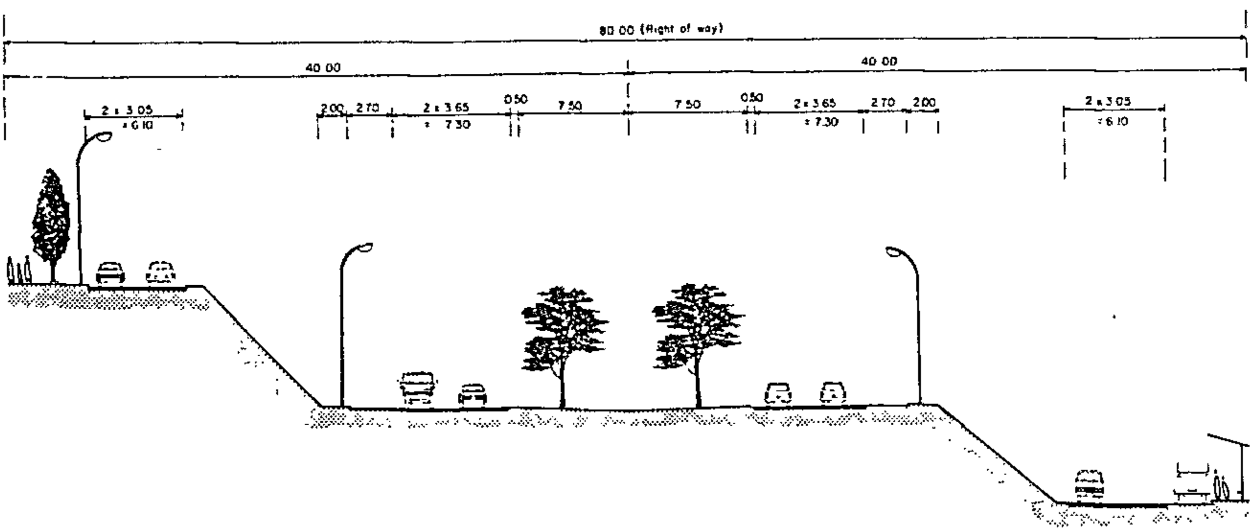
1) Standard Cross Section

Standard cross sections are shown in Fig. III-2-5. The section from the starting point to Via San Miguelito Oeste (the western half) is designed as a high standard road with the design speed of 80 Km/h in order to provide for a large volume of fast moving traffic. For this reason, the lane and the shoulder are given adequate widths of 3.65m and 2.70m, respectively. The sidewalk is designed with the width of 2.0m, which, depending on the state of roadside development, may be used as a separation strip between the road and parking strip and frontage roads, where such will be provided. The center median is given a liberal width of 16m, should it become necessary in the future to install exclusive left turn lanes or to increase the number of lanes. A 80m right-of-way is designated.

The section from Via San Miguelito Oeste to Transistmica (the eastern half), which will go through partly hilly area and partly the housing area of Los Andes, is given the design speed of 60 Km/h and a center median of 8.5m. The widths of lane, shoulder, and sidewalk will be the same as the other half. A 60m right-of-way is designated.

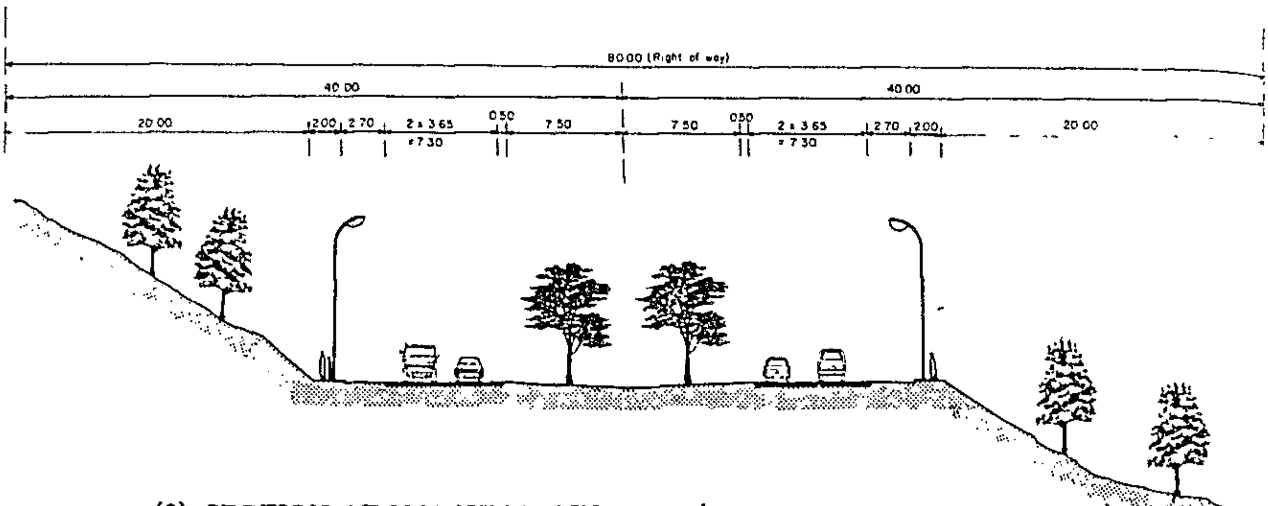


(1) SECTION AT ALBROOK AIRFIELD

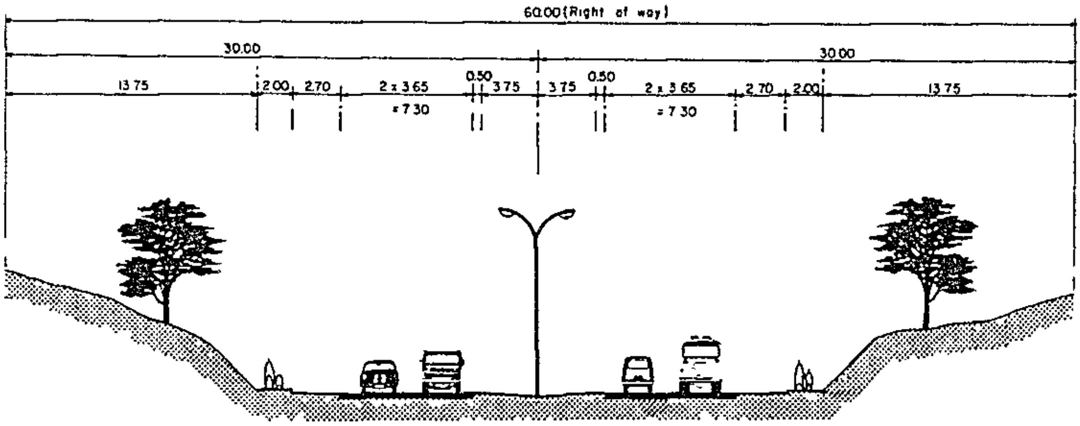


(2) SECTION AT MOUNTAINOUS AREA(WITH FRONTAGE ROAD)

Fig. III-2-5 TYPICAL CROSS SECTION OF CORREDOR NORTE



(3) SECTION AT MOUNTAINOUS AREA(WITHOUT FRONTAGE ROAD)



(4) SECTION BETWEEN VIA SAN MIGUELITO OESTE AND TRANSISTMICA

Fig. III-2-5 TYPICAL CROSS SECTIONS OF CORREDOR NORTE

2) Alignment Design

The entire extention is divided into sections between major intersections, as illustrated in Fig. III-2-6, and horizontal and vertical alignments are prescribed for each of such sections.

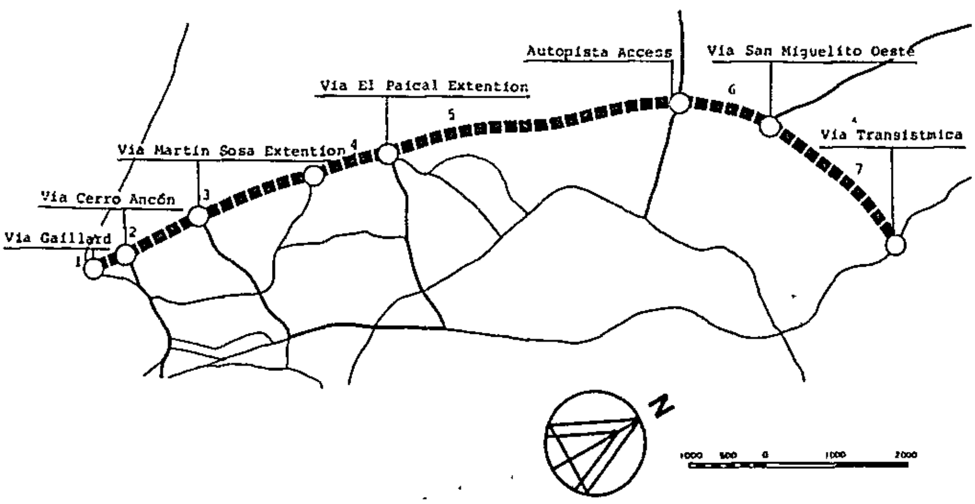


Fig. III-2-6 SECTIONS OF CORREDOR NORTE BY MAIN INTERSECTIONS

(1) Sections 1 and 2

Sections 1 and 2 are defined by intersections with Gaillard Road, Via Cerro Ancon Extension, and Via Martin Sosa Extension and go through the previous Albrook Airfield, where horizontal and vertical alignment will be straight. The vertical alignments will be shaped by the application of an overlay onto the runway.

Corredor Norte shall start from intersection with Via Gaillard (by at-grade crossing for the time being) to facilitate extension up to the port in a long run. Despite the possibility of extension in the distant future, it is believed reasonable that connections with Via Cerro Ancon and Via Martin Sosa Extension in the previous Albrook Airfield be made by at-grade intersection for the time being. The right-of-way is adequate for grade separation.

(2) Section 3

This section will occur between intersections with Via Martin Sosa Extension and Ave. Ascanio Villalaz. A part of this section will be on the Previous Albrook Airfield, and the remainder will go through the hills within the military area. The horizontal alignment of this section will avoid the hill tops and military houses. In view of the elevation gap between the hilly part and Ave. Ascanio Villalaz, intersection with this road will be by a grade separated interchange, which will serve only in the direction of the terminal point.

(3) Section 4 (Sta. 32+70 - Sta. 44+66)

This section will be between intersections with Via. Ascanio Villalaz and with Via El Paical Extension and will run generally on the edge of the Natural Park. The horizontal alignment will be such that the road will avoid the military facilities (in the defence area) but partly cut into the park a little. The vertical alignment will follow that of the existing Camino de la Amistad except for intersection portions.

(4) Section 5 (Sta. 44+65 - Sta. 85+30)

This section will be from intersection with Via El Paical to that with Autopista Access and will follow the border between institutional and housing areas. The horizontal alignment, which was initially drawn to pick relatively flat areas, has been changed to move the route north so that the land area surrounded by Camino de la Amistad and Rio Curundu can be used as institutional area.

The vertical alignment is designed so as that the volumes of soil cutting and embankment will be about equal, but the steep topography will make deep cutting imperative at certain locations. The location at which this section will cross Autopista Access happens to be a gorge, and an interchange will be constructed with Corredor Norte overpassing Autopista Access.

(5) Section 6 (Sta. 85+30 - Sta. 94+65)

This section will be between intersections with Autopista Access and Via San Miguelito Oeste and will follow a gorge. The horizontal alignment is drawn so as to avoid Rio Abajo tributaries, and the vertical alignment will include the interchange where Corredor Norte will underpass Via San Miguelito Oeste.

(6) Section 7 (Sta. 94+65 - Sta. 120+00)

Extending from Via San Miguelito Oeste intersection to Transistmica intersection, the end point of this project, this section will occur outside the reverted area and enter into Corregimiento Belisario Porras. Steep topography predominates the land, except for Rio Abajo flood area and Los Andes housing area. Control points for the horizontal alignment are Rio Abajo crossing, the peak near Sta. 109, streets in Los Andes area, intersection with Transistmica, and the direction of future extension of Corredor Norte.

Vertical alignment problem is the precipitous topography. With the highest point near Sta. 109, this section constitutes the longest and steepest slope of the entire extension of Corredor Norte, so that the installation of climbing lane is necessary for reducing a big amount of rock cutting.

3) Intersection Plans

About 12.2 Km section of Corredor Norte from Gaillard Road to Transistmica intersects with six principal arterial roads. Also there are connections to and from frontage roads and intersections with collector roads in developed area. The volumes of intersection traffic in the year 2000 assigned to the future road network are shown in Fig. III-2-7.

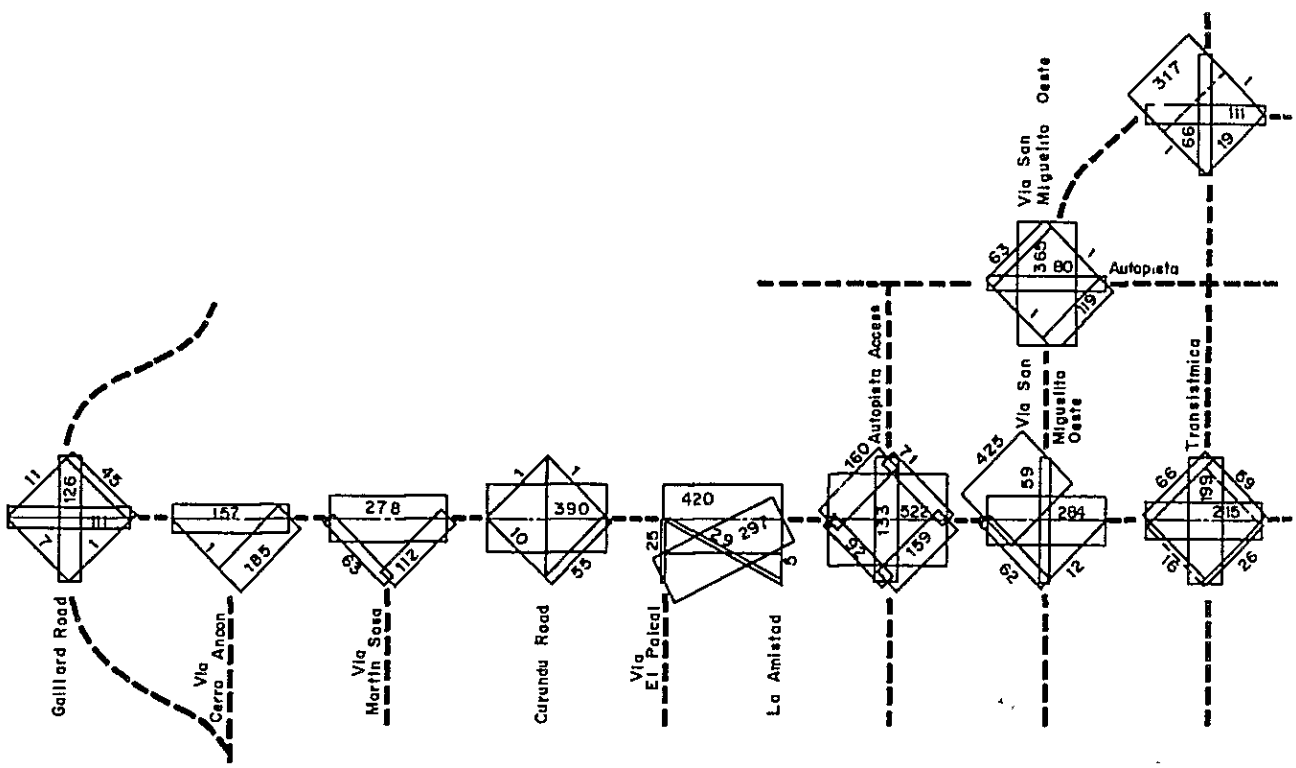


Fig. III-2-7 FUTURE TRAFFIC VOLUME AT CORREDOR NORTE INTERSECTIONS(YEAR 2000)

(1) Intersections with Principal Arterial Roads

a. Corredor Norte Originating Point (Gaillard Road)

Corredor Norte will be extended to directly connect with Balboa Port in a long future. Also in the future, even if Autopista is completed and traffic flows onto Gaillard Road from west of the Canal, saturation rate of the intersection will be 1.0 with one straight and right-turn lane and one left-turn lane at Gaillard Road approaches, and therefore the intersection shall be at-grade. Also, if Via Cerro Ancon is further extended in such a way as to shortcut Gaillard Road, the saturation rate will decline to 0.5 and its importance will reduce. This intersection, on the other hand, is located adjacent to Panama Railway, and if the railway crossing on the future Corredor Norte Extension and the intersection with Via Cerro Ancon Extension is grade-separated, the through way of Corredor Norte will not be able to touch with Gaillard Road because of the short 300m interval between the railway crossing and the intersection, and the vertical gradient limit. Therefore, the intersection with Gaillard Road shall remain at grade even in future and the connection with Corredor Norte throughway from Via Cerro Ancon intersection can be kept by sideroads of Corredor Norte.

b. Via Cerro Ancon Extension

This presently 3-leg intersection, with its at-grade configuration, can meet the traffic demand (saturation rate is 0.75), although it will be made a 4-leg intersection when Via Cerro Ancon is further extended in the distant future. When it is extended, it will be an access road to Autopista, in addition to its function of collecting traffic and dispersing traffic from Corredor Norte, and the volume of traffic on Via Cerro Ancon will increase to the extent of requiring the grade separation. Therefore, a right-of-way sufficient for the future grade separation shall be obtained under this Plan.

c. Via Martin Sosa Extension

Saturation rate is calculated at 0.83 for the 3-leg intersection with two exclusive left-turn lanes for traffic flowing on Corredor Norte from suburban areas. Thus, the at-grade intersection will have an adequate capacity.

d. Via Ascanio Villalaz

Traffic on Via Ascanio Villalaz is light, but through traffic on Corredor Norte requires 65% of the split. With the saturation rate of 1.3, the at-grade intersection is short of meeting the demand. The separation of the straight traffic on Corredor Norte by overpassing will result in a reduction of saturation rate to 0.5.

In view of the facts that the route of Corredor Norte goes through hilly land avoiding housing area, that Via Ascanio Villalaz passes through gorges, that traffic demand from Via Ascanio Villalaz toward the starting point of Corredor Norte is low, that Via Ascanio Villalaz itself runs in parallel with Corredor Norte toward the starting point of the latter, and that there is another road running parallel to Corredor Norte on the other side, across Corredor Norte from Via Ascanio Villalaz, a half-diamond type interchange serving toward the ending point of Corredor Norte is planned.

e. Via El Paical Extension

At the quasi 4-leg at-grade intersection with Camino de la Amistad, straight traffic on the main road occupies 42% of the split and traffic turning left from Corredor Norte onto Via El Paical occupies 38%. The at-grade configuration of this intersection fails to offer an adequate capacity with the saturation rate of 1.52. Reduction of this rate to 1.2 by overpassing the straight traffic will be still inadequate. The use of loop ramps will reduce saturation rate to 0.78 by eliminating conflict at one location.

Because more than half of the traffic flowing on Corredor Norte from north, or a substantial 30,000 vehicles per day, enter onto Via El Paical, a trumpet type interchange with 2-lane ramp in this direction shall be constructed in the gorges at a location favorable to future grade-separation.

f. Autopista Access

Straight traffic on Corredor Norte is 52,000 vehicles per day, the heaviest of all the subject sections, and in order not to disrupt this traffic, grade-separation is needed. With a diamond type, saturation rate at under-the-viaduct at-grade intersection will be 0.91 with the installation of two left-turn lanes each for entry and exit for the satisfaction of the intersection capacity. In view of the elevation gap between Corredor Norte running on hills and Autopista Access running in gorges, the grade-separation shall be by a diamond type interchange with Autopista Access underpassing Corredor Norte.

g. Via San Miguelito Oeste

Only the straight traffic on Corredor Norte and the traffic between the west side of Corredor Norte and the north side of Via San Miguelito Oeste exceed the capacity of the at-grade intersection with saturation rate of 1.8. If the straight traffic on Corredor Norte is overpassed, the left-turn traffic from the starting side of Corredor Norte will occupy 47% of the split, and the resulting saturation rate of 1.2 will not be sufficient. Recommended, therefore, are either a loop ramp or a direct ramp by which this traffic will be allowed to flow without disruption. Because a 2-lane ramp is needed to accommodate the heavy traffic of about 42,500 vehicles per day in Via San Miguelito Oeste-west side of Corredor Norte, which is heavier than the intersection traffic, and because a directly connected ramp which considers connections with frontage and other related roads can serve all directions, the intersection shall be a Y shaped direct connection interchange. While the cost of a loop ramp is low with its simple intersection structures, the service speed of loop ramp is slower than that of Y type.

h. Transistmica

Straight traffic is heavy on both Corredor Norte and on Transistmica, and the intersection capacity is inadequate with the saturation rate of 1.35. A capacity increase of about 35% can be expected from the overpassing of Corredor Norte. Thus, the intersection plan shall allow for its modification into a diamond type interchange when Corredor Norte is extended in the future.

(2) Connection and Crossing with Frontage Roads and Collector Roads.

a. Connection with Development Roads

Despite the absence of practical land use plans and a road network plan, the locations of minor arterial streets in areas set aside for development have been determined in view of road network density, traffic flow, topography, and connection with existing roads. Their intersection with Corredor Norte shall be grade separated and their connection therewith shall be by frontage roads (see section on frontage roads).

b. Connection with Collector Roads

Corredor Norte will intersect with collector roads in the housing areas on both sides. To keep the same level of service for the traffic on the existing roads, frontage roads shall be constructed for the combined connection of such roads with Corredor Norte.

2.1.3. Structures

In addition to box culverts at two locations, the following bridges are planned for Corredor Norte:

a) Ave. Ascanio Villalaz Bridge
b) El Paical Intersection Bridge
c) Autopista Intersection Bridge
d) Rio Abajo Bridge

Of these, that which will cross an existing road will be Ave. Ascanio Villalaz Bridge, and the rest will cross either a river or a new road to be constructed.

A cast-in-place superstructure will be used at locations where under-girder space can be used for work, and a type of superstructure with little on-site work (precast beam) will be used at other locations. Of the two possible pier types, wall type piers, which require less timbering and are therefore easier to work than rigid-frame piers, will be used. Rigid-frame piers will be used, however, for bridges with a large width, when wall type piers will be uneconomical. Individual bridges are discussed below.

1) Ave. Ascanio Villalaz Bridge

The bridge construction site will be where Ave. Ascanio Villalaz crosses Calle 6th and Camino de La Amistad. Necessary for crossing Ave. Ascanio Villalaz will be a bridge with a 60 meter span, which will not be economical. Because traffic on Calle 6th is very light, a side path will be installed parallel to the planned bridge so that Calle 6th will be connected to Ave. Ascanio Villalaz, and the bridge will have two 30m spans with piers arranged so as to allow the securing of the width of Ave. Ascanio Villalaz. In view of the 30m span and of the fact that the bridge will be built above an existing road, the superstructure of the bridge is designed with prestressed simple composite girder.

2) El Paical Intersection Bridge

This bridge will be for the grade-separated interchange of Via El Paical Extension and Corredor Norte. In view of Via El Paical Extension's road width (26m) and vertical clearance (5m), the bridge length will be about 43m. A pier can be founded on the center median (3.5m) of this road, and the bridge is designed with a 21m span. For this span, a reinforced concrete superstructure is likely, either of hollow slab type or T-girder type. The girders are set lower with the former type and therefore a neater appearance is achieved than the latter, but it requires the use of circular steel voids, the setting of which calls for skill. Since the hollow slab type superstructure has never been constructed in Panama, while T-girder type superstructures are many, the latter type is believed sensible.

3) Autopista Intersection Bridge

This bridge, which will overpass Autopista Access, is planned with a road width of 27.05m, and will have a length of about 47m. A 23m span is possible because a pier can be founded on the center median. T-girder type superstructure will be used for the same reason as for El Paical Intersection bridge.

4) Rio Abajo Bridge

River improvement work has not been done on Rio Abajo, which is a small river with a width of 8m. In order to minimize the cutting of hills on both sides of the river, the planned height of the road is 9m higher than the river, and the road will cross the river at an angle of about 60 degrees. Given these conditions, the bridge span will be 30m. Because timbering cannot be erected underneath the girders, prestressed simple composite girders will be used for superstructure.

2.1.4. Auxiliary Facilities

1) Auxiliary Lanes

Auxiliary lanes are left and right turning and speed change lanes to be added to through traffic lanes. All intersections shall be given such auxiliary lanes as their fundamental composition elements.

The turning lane provides turning traffic with a space for deceleration and halting to wait for time to make the turn. The length needed for slowing down is determined through calculation based on design speed of the main lanes and vehicle running speed at the exit. The length needed for queueing depends on the volume of turning traffic and the length of waiting time for signal change.

Where traffic speed in the approach needs to be raised to the level of that of through traffic before the former can merge with the latter, an acceleration lane shall be installed.

The necessary length of speed change lanes is calculated using an arithmetic model, but the installation of auxiliary lanes of the thus calculated length is difficult on arterial streets such as Corredor Norte. Therefore, such lanes shall be planned as follows in view of the volume of traffic which will utilize them.

(1) Taper Length

Taper length equals the distance available for the vehicle to shift from the approach lane into the through traffic lane, or vice versa. AASHTO examples are used in deciding taper lengths.

(2) Deceleration Lane Length

Studied are deceleration lane length needed for exit to ramp from a grade-separated interchange, for making left- or right-turn at an at-grade intersection, and for exit into a frontage road.

In the case of grade-separated interchange, traffic speed passing through the nose point is assumed at 20% lower than the design speed for the through lane, but, AASHTO values are used as correction coefficient for the vertical alignment gradient of the through lane. At-grade intersection conforms with that stipulated by AASHTO. Although traffic is light on frontage road, it is contiguous with the through lane and, therefore, the minimum taper length of 20 meters is used.

(3) Acceleration Lane

Although acceleration lanes are used for queueing as well, the present plan is made assuming that the running speed of truck at the merging nose is 60% of the design speed of through traffic lane. The acceleration lane, therefore, shall have the standard length of 120 meters under the design speed of 80 kilometers per hour, and 65 meters under the design speed of 60 kilometers per hour. AASHTO value is used as correction coefficient for the vertical alignment gradient of the through traffic lane.

As for at-grade intersection and entrance from a frontage road, acceleration lane shall not be added because adequate acceleration can be achieved in through traffic lane in view of the level of traffic. Therefore, taper is added to these approaches only for entry into through traffic lane.

(4) Climbing Lane

At two locations, a vertical alignment of 4 to 7% is used for over 400 meters: in the vicinity of Station 81 - Station 90 and the vicinity of Station 99 - Station 109. In these sections, traffic is expected to be heavy at 30,000 to 60,000 vehicles per day with a high truck factor of 17 to 19%. Truck speed calculation by AASHTO indicates that, when uphill is 4% or more, the speed drop is substantial enough to impair the traffic capacity of the road, traffic safety, and driver amenity. In order to secure the maximum possible capacity, safety, and amenity by removing slow moving vehicles, a slow climbing lane shall be installed where the drop of speed of trucks will be appreciable.

A slow climbing lane shall be installed in the sections where truck speed will drop by 25 kilometers per hour (15 miles per hour) or more from the design speed (880-meter up line from Station + 30 to Station 90 + 10 and 400-meter down line from Station 95 + 00 to Station 108 + 00).

The wide 14-meter canter median has an adequate width for the installation of an additional lane. This additional lane shall be used as passing lane, and the shoulder-side lane replaced by this center shall be used as the slow climbing lane.

2) Frontage Roads

(1) Function

Frontage roads along Corredor Norte, whose installation is expected in connection with the progress of Corredor Norte roadside area development, shall provide for the concentrated control of access from roadside areas to facilitate smooth traffic flow on Corredor Norte and to substitute for Corredor Norte in emergencies.

(2) Installation Policy

It is expected that by the year 2000 the roadside area development will progress throughout the entire extension of Corredor Norte, with the exception of a fair number of natural reserves. Frontage roads, if installed in the sections along such reserves where development is physically difficult, will have a steep vertical alignment and, therefore, be hard to use. Frontage roads shall be installed only in sections where housing, commercial, industrial, or government area will be actively developed, and at the locations as dominated by the traffic network pattern(see Drawing Volume).

Frontage roads, which are to function also as local service roads, shall be two-way streets as a principle. It is believed appropriate, however, that frontage roads be made one-way streets near major intersections, where the flow of traffic between the frontage road and the intersection will otherwise be complicated.

(3) Case Study

The development pattern and the traffic network discussed in the above have been applied to the actual topography of the area. The result is the development model plan presented also in Drawing Volume.

3) Local Development Pattern

Relationship between development pattern and road connection is defined in reference to residential development model (see Fig. III-2-1). As an example of roadside residential development along Corredor Norte, model plans are given in Fig. III-2-8 (1) through (5) by applying said development model and road hierarchy to the actual topography of the area.

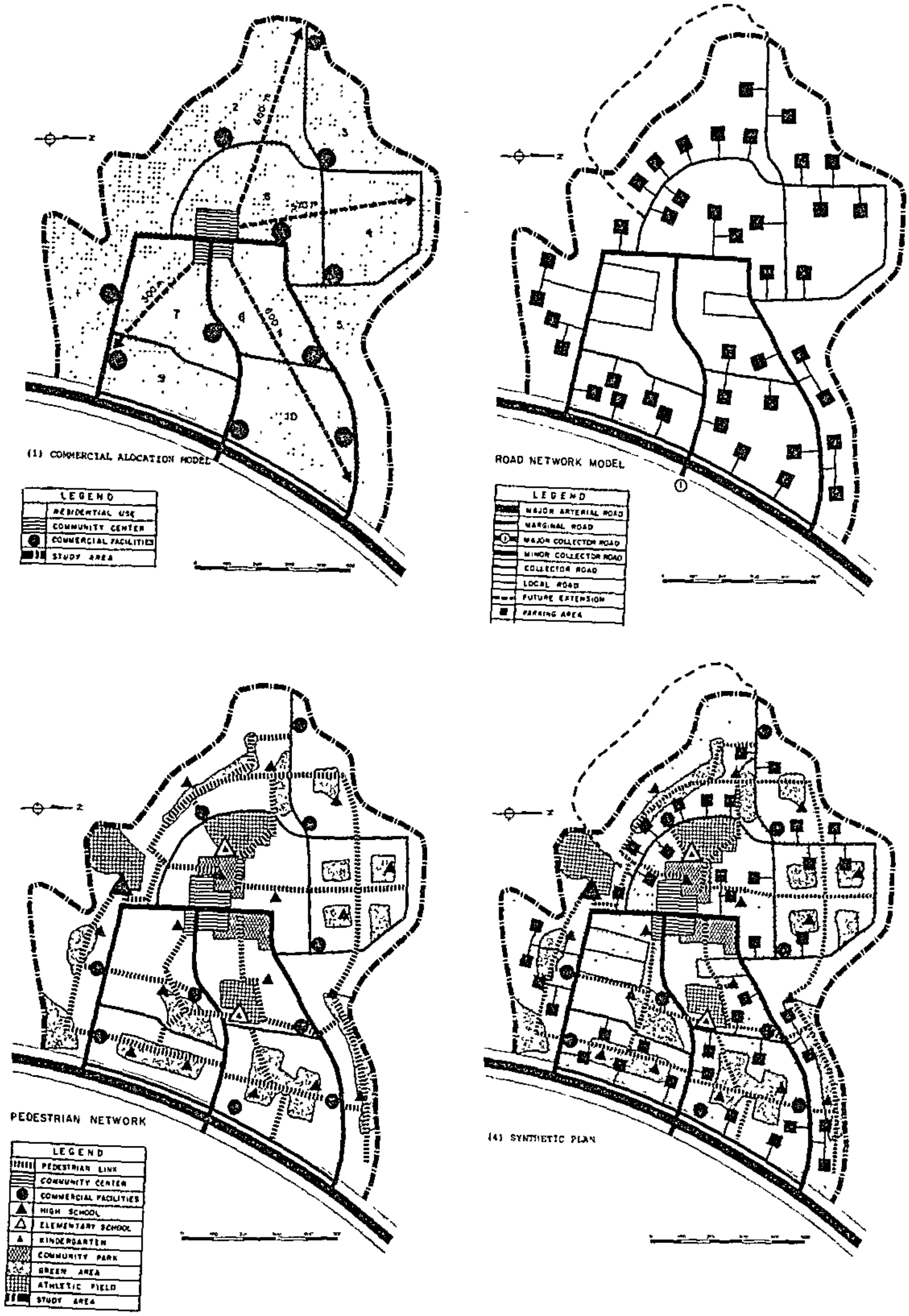


Fig. III-2-8 RESIDENTIAL DEVELOPMENT MODEL PLAN ALONG CORREDOR NORTE

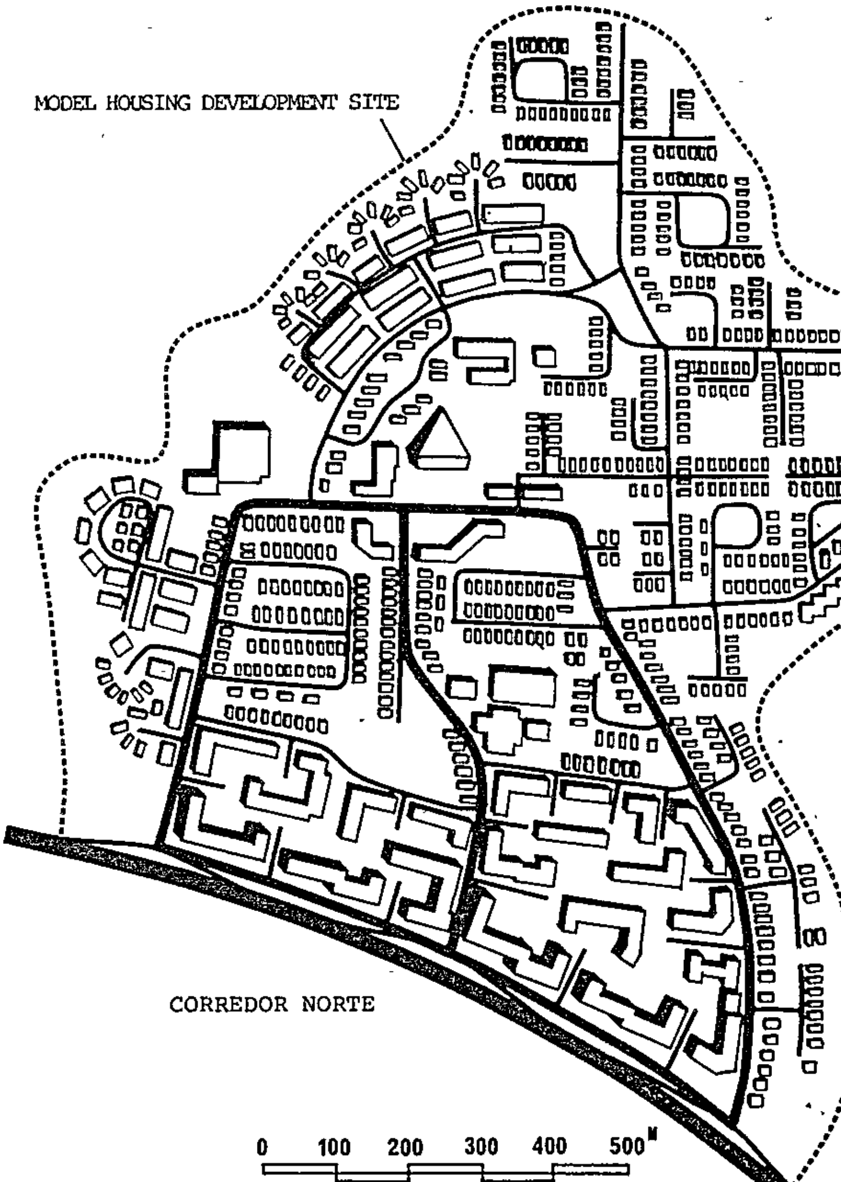


Fig. III-2-8 RESIDENTIAL DEVELOPMENT MODEL PLAN ALONG CORREDOR NORTE
(Cont'd)

2.2. Via El Paical Extension

2.2.1. Land Use and Access Condition

1) Present Roadside Land Use

The extension of the existing Via El Paical up to Corredor Norte under this project will go through the Natural Park to be created in the Reverted Area. The Park (265 hectares) will have facilities for various activities in the western part, leaving the eastern part natural. This extension road will go through undulating forests in the east.

2) Future Prospect

Because the Park Plan aims to preserve nature in its eastern part, the roadside area will not be utilized for locating facilities or other purposes.

3) Remarks for Road Plan

Care should be used so as to preserve the so-called Camino de las Cruces, by which gold and silver mineral were carried from the Pacific coast to the Atlantic in the 16th to 18th centuries as well as to maintain a harmony with the surrounding natural forests.

2.2.2. Geometric Design

1) Standard Cross Section

Standard cross section for Via El Paical Extension will be as shown in Fig. III-2-9 and will have the same width structure as that of the planned cross section for road improvement portion. The relatively wide right-of-way will enable the construction of environment protection facilities.

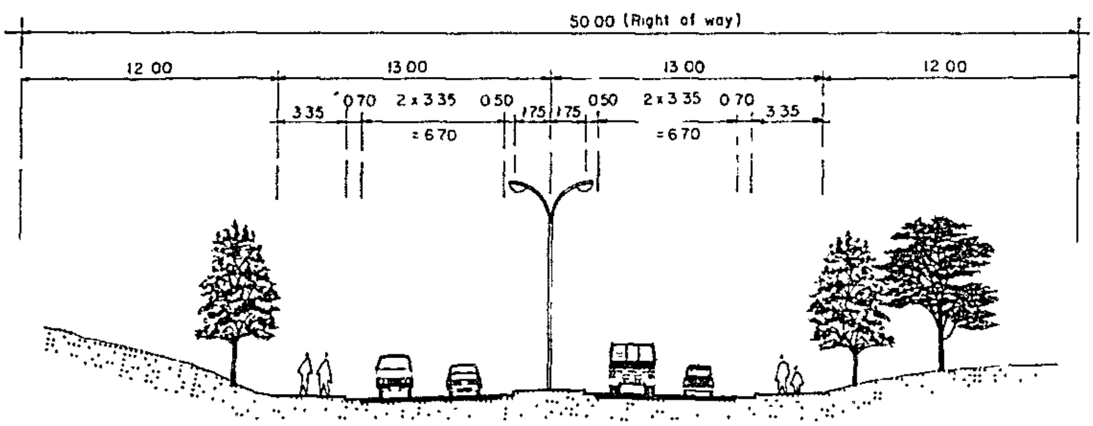


Fig. III-2-9 TYPICAL CROSS SECTION OF VIA EL PAICAL EXTENSION

2) Alignment Design

This road, which goes through the Natural Park in most of its total extension, will be aligned so that required earthwork will not be great. The horizontal alignment will be designed so as to avoid Camino de Las Cruces, which is to be retained as a path through the Park. Via El Paical Extension will be connected with Corredor Norte at a location where its further extension will be possible in the future.

3) Intersection Plan

At the originating point, Via El Paical Extension is connected with Via Juan Pablo II, and at the ending point, with Camino de La Amistad and Corredor Norte. All these connections shall be by 3-leg intersections.

a. Via Juan Pablo II Intersection

The alignment of the curved part of Via Juan Pablo II shall be improved as a 3-leg intersection.

b. Camino de La Amistad Intersection

The existing La Amistad Road shall be used as a part of the route of Corredor Norte, near Corredor Norte Interchange. This intersection planning is aimed at locating it as far away from the Interchange as possible, while improving the intersecting angle. As a result, the intersection shall be 100 meters away from ramp to and from Corredor Norte. With traffic signals, the at-grade 3-leg intersection shall have an adequate capacity.

c. Corredor Norte Intersection

In view of the heavy traffic, this 3-leg intersection shall be made a trumpet type interchange (see details under Corredor Norte).

4) Environment Measures

As an important route for connection between Panama urban area and Corredor Norte, Via El Paical Extension is predicted to have a traffic of 30,000 to 40,000 vehicles per day. The functions of the natural park, through which this road will run, will have to be protected from the effects of said heavy traffic.

(1) Vegetation Protection

The route of the road through the park is so selected that the amount of necessary soil cutting and banking will be minimized, lest a large scale earthwork should affect the level of underground water table or embankment should bury trees and shrubs. Also, curved horizontal alignment shall be given the road in an attempt to minimize the divided appearance of the park by the road and the detrimental effects of excessive ventilation to the vegetation.

(2) Scenery Protection

The use of bridges, retaining walls, and other road structures which will not harmonize with the natural environment of the park shall be minimized. Slopes resulting from the unavoidable soil cutting shall be covered with green. Also, for an extension of one kilometers, the road shall be sunk deep enough to conceal it from park visitors.

(3) Anti-Noise Measure

The natural tranquility must be preserved in the Park, where this road will pass through. The following shall be done toward this end.

a. Source Measure

In order to minimize the generation of traffic noise, the vertical alignment of the road shall be designed keeping all gradients within the maximum of 4.0%.

b. Sheltering Measure

In order to minimize traffic noise, the road structure shall incorporate a noise sheltering embankment or a sunk (dug out) road shall be used.

(4) Functional Integrity Protection

Park functions should be connected across the road, and effect of road construction shall be minimized by the use of promenades and malls across the road. In the absence of the Park's facilities arrangment plan, practical method of the connecting facilities may not be determined at this time. However, in view that a bridge overpassing the road should be more pleasant to Park visitors than an underpass crossing the road, the road structure shall be designed to reserve several locations for such promenade flyovers.

2.2.3. Structures

The only structure subject to this road extension project is the box culvert across Rio Curundu, which was installed upon the construction of Ave. Juan Pablo II. In consideration of the river improvement project formulated by M.O.P. this culvert has a cross section of (4.5m + 4.5m) x 3.5m and a length of about 20m. Via El Paical Extension will require a culvert with the length of about 34.3m, and the existing wing wall will be taken down and a new wing wall with a larger cross section will be constructed.

2.3 Via Martin Sosa Extension

2.3.1. Land Use and Access Condition

1) Present Roadside Land Use

This project is to extend the existing Via Martin Sosa starting from Via Bolivar, across Rio Curundu and Curundu Road, and up to Corredor Norte in previous Albrook Airfield. The section from Via Martin Sosa to Curundu Road will be sandwiched between the existing Curundu Heights housing area and an unused old antenna field (Campo de Antena). Section from Curundu Road to Corredor Norte will go through an area where a baseball field and other sports facilities and old airfield facilities, now being used by government agencies, are located. The military coordination area is used for residences.

2) Future Prospect

According to the plan now being carried forward by OPDAC, Via Martin Sosa roadside area will see by the year 2000 the development of a 20-hectare residential area in Curundu to accommodate a total population of 2,300 (115 persons per hectare) and a 28-hectare residential area in Campo de Antena to accommodate a total population of 9,700 (350 persons per hectare). Also, government and commercial facilities will be located across Curundu Road and the existing group of sports facilities will be arranged into an expanded sports park (9 hectares) according to the plan. Close to Corredor Norte is a plan for a residential area (3,000 population, and 10 hectares and an industrial area.

3) Remarks for Road Plan

Diverse kinds of land use will be developed to trim this project road, and the installation of some kind of environmental measures will be necessary particularly along the residential areas and the sports park.

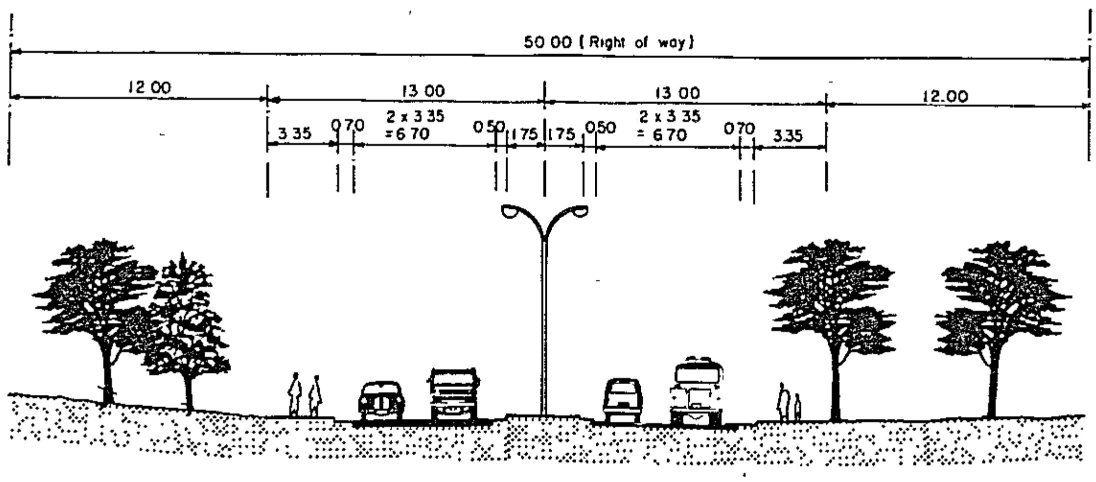


Fig III-2-10 TYPICAL CROSS SECTION OF VIA MARTIN SOSA EXTENSION

2.3.2. Geometric Design

1) Standard Cross Section

In consideration of its lane width, planned traffic volume, and roadside condition, Via Martin Sosa Extension is designed with a standard cross section with 3.35m width, which is one level lower than the standard for Corredor Norte. The shoulder is given the width of 0.7m so that two small vehicles can pass even when a large vehicle is parked (Standard cross section is shown in Fig. III-2-10).

2) Alignment Design

Given the 3-leg trumpet interchange now under construction, Via Martin Sosa Extension will be joined with Via Bolivar by a semi-clover-leaf interchange which will conform with the "existing" trumpet interchange. The horizontal alignment is designed along Calle Leon A. Soto so as to stay out of Campo de Antena as much as possible and so that the road will set off the border between the Reverted Area and a military coordination area. The vertical alignment will generally follow the topography of the existing ground, because crossing with Ave. Ascanio Villalaz and Corredor Norte will be by at-grade intersections.

3) Intersection Plan

Via Martin Sosa Extension shall be connected with Via Bolivar, Via Bella Vista, Curundu Road, and Corredor Norte in that order, starting from the originating point. Via Bolivar is presently planned to have a trumpet type intersection, to which Via Martin Sosa Extension shall be connected by the addition of a loop ramp to form a half cloverleaf interchange. Via Bella Vista Intersection shall be an at-grade 4-leg intersection to achieve connection with the Campo de Antena housing development area under the plans of MIVI. Traffic on Curundu Road, an existing arterial road, will shift onto Corredor Norte upon the opening of the latter, and traffic through this intersection is estimated to decrease or remain constant at the most. This intersection shall be an at-grade, 4-leg intersection, which has an adequate capacity. Corredor Norte Intersection shall be an at-grade, 3-leg intersection, which has an adequate capacity (see datails under Corredor Norte).

2.3.3. Structures

This project involves the construction of two structures: an interchange bridge over Via Bolivar and a structure for crossing Rio Curundu.

Under the MOP plan, a bridge over Via Bolivar has already been designed with the length of 97.5m as governed by the width of Via Bolivar (25.00m x 3 + 20.00m), with four spans, and with the width of 14.20m. The superstructure will be of prestressed simple composite girders, and the piers will be of rigid-frame with precast concrete piles.

The new bridge over Via Bolivar in Via Martin Sosa Extension Project will be constructed parallel to the existing bridge with the same vertical alignment, but a different width of 11.70m. Therefore, the same superstructure and substructure types will be used.

A box culvert will be used for crossing Rio Curundu, because the road and two ramps in the interchange are planned at varying heights in relation to the river and will cross the river with substantial distances between them.

2.4 Via San Miguelito Oeste

2.4.1. Land Use and Access Condition

1) Present Roadside Land Use

This road will start from Corredor Norte and proceed north through hilly forest, across the planned route of Autopista, and reach Via Transistmica. Flat land occurs only in Rio Abajo upstream near Corredor Norte and in the vicinity of intersection with Transistmica, where housing area is spontaneously expanding toward hillside slopes.

2) Future Prospect

Although development potential is not so high due to the topographical limitations, it is possible that the housing development plan for the Reverted Area and the spread of houses from Transistmica will result in the formation of a housing area in the vicinity of Corredor Norte. On the other hand, commercial facilities will not be located in the vicinity of Via San Miguelito Oeste, because there is a plan for locating a commercial base near the Corredor Norte/Autopista Access Intersection.

3) Remarks for Road Plan

Regulatory controls should be quickly enforced on the development activities in the roadside areas, particularly in the areas around the terminal points of this road. Such controls will be also useful in preventing the spread of squatter areas such as the one seen in nearby Los Andes. In the hilly area where development will be difficult, care must be used so that the road construction will have minimum impact upon the natural environment.

2.4.2 Geometric Design

1) Standard Cross Section

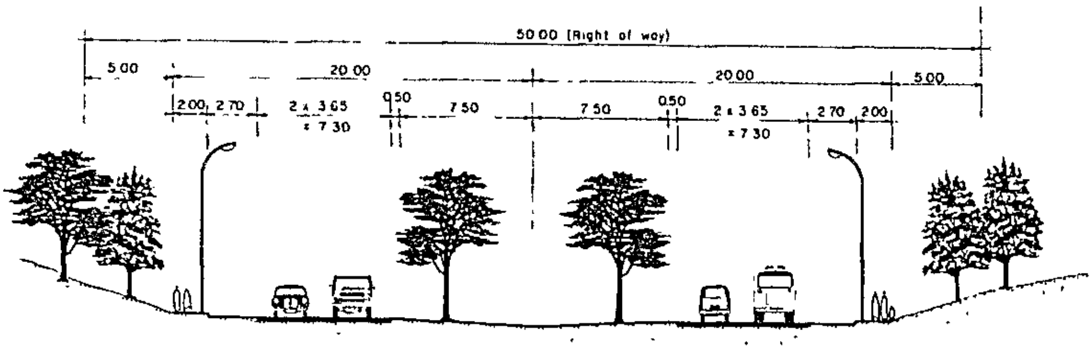
Although it will be a relatively short road, Via San Miguelito Oeste will function as a bypass for Transistmica, handling a large volume of traffic. Therefore, its road width is designed to the high standard (see the standard cross section for this road in Fig. III-2-11). However, grade-separated (up and down traffic lanes) cross sections are designed for most of the sections in view of the mountainous topography.

2) Alignment Design

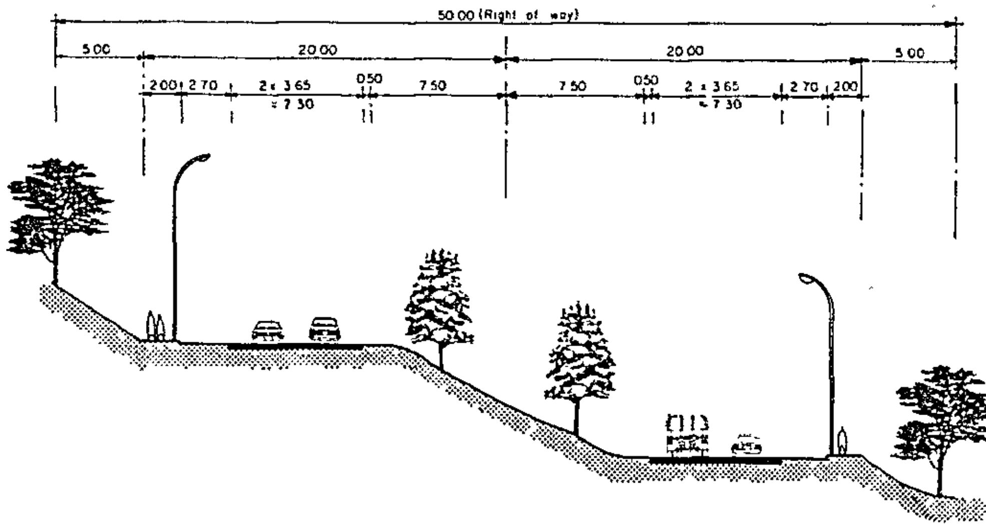
As shown in Fig. III-2-12, the project section of San Miguelito Oeste is divided into the following two sections:

(1) Section 1 (Sta. 0 + 00 - Sta. + 08)

This section starts from intersection with Corredor Norte, goes through the Reverted Area, and reaches intersection with Autopista. The location of intersection with Autopista has been selected considering the crossing angle and the acquisition of land, and Via San Miguelito Oeste will underpass Autopista because of the topographic condition.



(1) SECTION AT SAME LEVEL OF CARRIAGEWAY



(2) GRADE SEPARATED SECTION

Fig. III-2-11 TYPICAL CROSS SECTIONS OF VIA SAN MIGUELITO OESTE

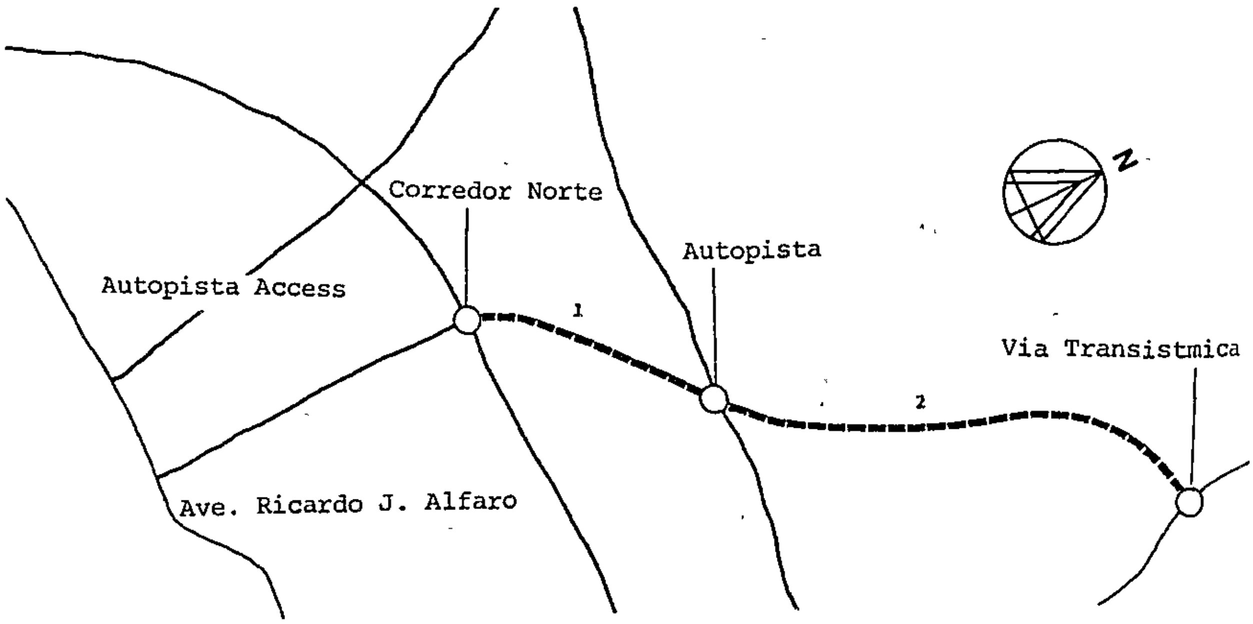


Fig. III-2-12 SECTIONS OF VIA SAN MIGUELITO OESTE BY MAIN INTERSECTIONS

(2) Section 2 (Sta. 10 + 08 - Sta. 40 + 00)

From intersection with Autopista to intersection with Transistmica, this section will go through the area of a precipitous topography along Quebrada Tesorera in the upper reaches of Rio Abajo. The alignment is designed so as to bring little effect on Quebrada Tesorera, but large scale soil cutting and embankment will be inevitable in view of the undulating topography. About the last kilometer of the section toward the terminal point will join Camino Chivo Chivo and will go through an area with scattering houses, and the vertical alignment will follow that of the existing road as much as possible. The part crossing with Transistmica is designed so that it will become an interchange ramp when it is further extended in the future.

3) Intersection Plan

The intersection traffic volumes according to the future road network are shown in Fig. III-2-13.

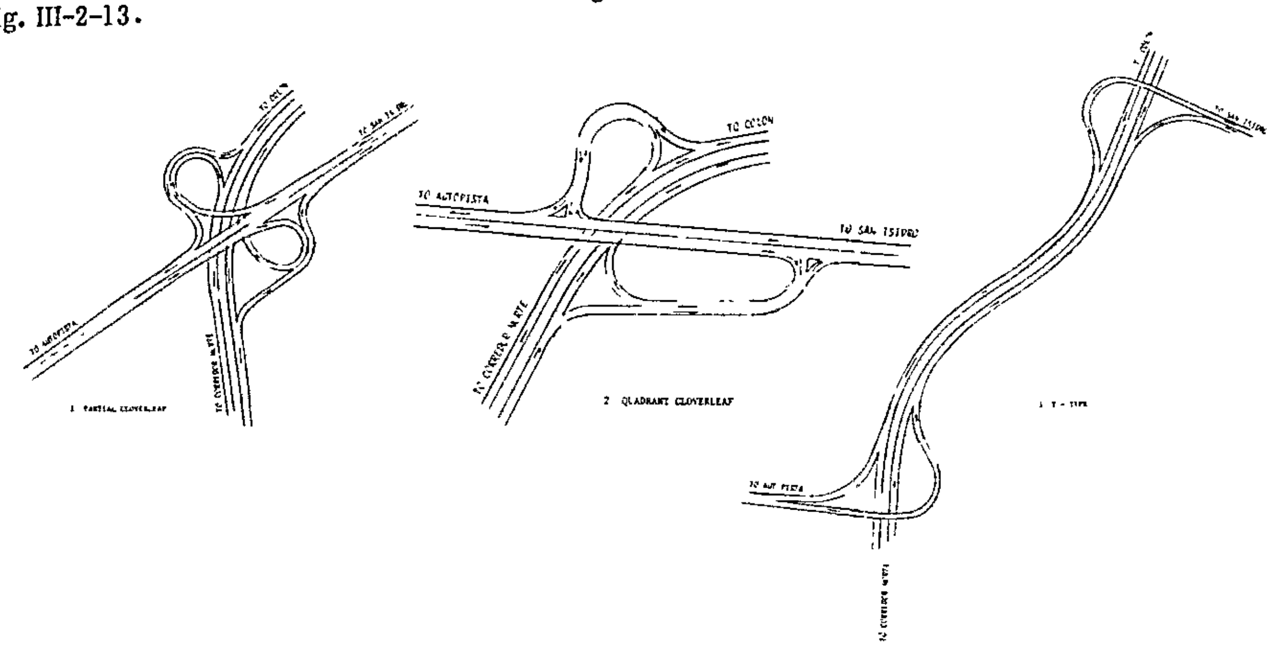


Fig. III-2-13 ALTERNATIVE INTERCHANGES OF VIA SAN MIGULITO OESTE - AUTOPISTA

(1) Autopista Intersection

Through traffic on Via San Miguelito Oeste will be heavy at about 36,000 vehicles per day, and this intersection, if at-grade, will have an inadequate intersection capacity with the saturation rate of 1.3. This through traffic shall be overpassed for an estimated 60% improvement of the intersection capacity, rather than overpassing through traffic on Autopista for an improvement of only about 13%. Connection ramps on west side of the roads will be desirable in keeping traffic between Colon way and west of Panama from entering into the urban area, but if Autopista through traffic is to be also allowed to proceed without stopping, the interchange will have to be either a cloverleaf or a partial cloverleaf with loop ramps, or a multigrade interchange, all of which will be a very big construction work in the mountainous area. The quantity of an interchange construction work can be reduced by the weaving of Autopista and Via San Miguelito Oeste using a double trumpet interchanges or 4-leg quadrant cloverleaf disfavoring Autopista through traffic (see Fig. III-2-14), under the understanding that Autopista in the vicinity of this intersection will have less traffic than Via San Miguelito Oeste.

Now that the Autopista Project is being suspended, no decision can be made to select either of these intersection configurations, but necessary right-of-way should be secured in the vicinity of the intersection location.

(2) Transistmica Intersection

Traffic on Transistmica from Colon way moving onto Via San Miguelito Oeste, and vice versa, will be the main flow through this intersection with about 32,000 vehicles per day, which should be overpassed for the best effect. The saturation rate of this intersection, which will be inadequate if it is an at-grade intersection with ramps serving in all three directions, will be improved to 0.89 by controlling service to Colon way on Transistmica and to the extension of Via San Miguelito Oeste. Therefore, present plan shall allow for future use of direct connection ramps upon the extension of Via San Miguelito Oeste.

(3) Other Intersections

Via San Miguelito Oeste intersects collector roads at the existing residential area. These intersections are integrated by frontage roads, which will be installed to keep the function of the existing roads, and are planned as at-grade intersections.

2.4.3 Structures

The structures required for this project will be San Miguelito Oeste Intersection Bridge, Quebrada Tesorera Bridge, and box culverts at three locations. The types of these structures are determined by the same criteria as the structures of Corredor Norte. The two bridges are explained below.

1) San Miguelito Oeste Intersection Bridge

This bridge will be constructed at the 3-leg "Y" interchange between Corredor Norte and Via San Miguelito Oeste. In order to overpass the down line of Corredor Norte at a 30-degree angle, the bridge span can exceed 60 meters, which will mean an expensive construction work. Therefore, the bridge shall be designed as a 30-meter span bridge with rigid frame portal piers to cross over the road. Also, the very site of the bridge is a curved part of the road, and, therefore, this curved bridge shall use 3-span continuous box girders, which is highly resistent to torsional morement.

2) Quebrada Tesorera Bridge.

This bridge will cross Quebrada Tesorera river almost at a right angle. Because the road is grade separated at the bridge location, abutments for the opposing traffic lanes are planned at the different locations. Although the river is only about 5m wide, the bridge will have to be about 68-m long due to the vertical alignment of the road, which was designed to minimize the amount of cutting into the riverside bluffs. If the bridge is to stride the river, it will have three 22-m spans. While the use of precast girders is possible in view of the ease of its work and the steep topography of the bridge location, the superstructure will use reinforced concrete T-girders because the height of timbering will be limited (8m at the most).

2.5. Via Cerro Ancon Extension

2.5.1. Land Use and Access Condition

1) Present Land Use

The construction of Via Cerro Ancon Extension has been planned to offer a shortcut road in line with Gaillard Road, which goes around the previous Albrook Airfield. However, the route of this road north of Corredor Norte will occur outside the reverted area, and the project shall cover approximately 350 meters from the terminal point of Via Cerro Ancon to Corredor Norte. This project route will go through a flat land of a previous airfield presently unused except the old airplane hangar, which is now being used as a warehouse.

2) Future Prospect

The previous Albrook Airfield is flat in topography, is the hinterland of Balboa Port, and has a high accessibility to existing roads. For this reason, the Government plans to locate transport facilities, port facilities, commercial facilities and government facilities in the vicinity of Via Cerro Ancon Extension. It is believed that this area will be developed at an early opportunity under government leadership.

3) Planning Consideration

In planning Via Cerro Ancon Extension to be constructed in a previous airfield where warehouses and other port and commercial facilities will be built, care should be used so as to secure adequate roadside green belts and lots, as well as sidewalks, in order to make the area attractive.

2.5.2. Geometric Design

1) Standard Cross Section

Via Cerro Ancon Extension will become the major channel of transport between Panama Urban Area and western Panama when it is further extended north beyond Corredor Norte to reach Gaillard Road in the future. In consideration of the future traffic volume and the road function which it will be required to perform in the future, Via Cerro Ancon Extension shall be given the same standard cross section as Via Cerro Ancon with six lanes and 3.5m center green belt.

2) Alignment Design

The route of this project road shall be decided as follows, in consideration of plan for the widening of Via Cerro Ancon and of plan for its future extension across Corredor Norte up to Gaillard Road.

a) The parking lots provided in front of DNTTT should be preserved.
b) The relocation of the previous airfield hangar, now being used as a warehouse, cannot be helped should it become imperative due to route planning.

c) The long intersection extension, formed by freight train track crossing Gaillard Road obliquely, should be shortened, if possible, by relocating the track to make a detour in approaching the Road and crossing it at a wider angle.

3) Intersection Plan

a) Gaillard Road Intersection

The sharp angle at which Gaillard Road joins Via Cerro Ancon will be corrected. With an access to DNTTT, this intersection will be a 4-leg intersection. The major flow through this intersection will be straight traffic on Via Cerro Ancon, with almost no traffic moving straight from Gaillard Road onto the access, or vice versa. With the addition of two each exclusive lanes for traffic turning right from Gaillard Road and for traffic turning left from Via Cerro Ancon onto Gaillard Road, the intersection will have an adequate capacity with the calculated saturation rate of 0.63. When Via Cerro Ancon will be extended in the future, the turning traffic will decrease.

b) Corredor Norte Intersection

This intersection will be used as a 3-leg intersection for the time being, because Via Cerro Ancon will not be extended beyond Corredor Norte until the Panama-Arraijan section of Autopista is opened. Therefore, major flow will be turning traffic between Corredor Norte in the direction of San Miguelito and Via Cerro Ancon, of which, traffic turning left from Corredor Norte onto Via Cerro Ancon will be particularly critical and require two exclusive left-turn lanes. With the calculated saturation rate of 0.75, this at-grade intersection is expected to be adequate. If grade separation becomes necessary when Via Cerro Ancon is extended in the future, grade separation will be possible within the right-of-way.

3. Road Improvement Project

3.1. Via Espana

3.1.1. Land Use and Access Condition

1). Present Roadside Land Use

The section subject to this project constitutes a new commercial and business center of Panama city, consisting of foreign banks and other offices, hotels, and prestigious specialty stores. Particularly, Via Federico Boyd - Via Brasil section is lined with the National Bank of Panama building and other high-rises, from where offices nd tall buildings are spreading towards the hinterland area. At the same time, however, the sporadic presence of vacant lots leave room for further roadside development.

2) Future Prospect

As the roadside area is shaping up as a new central business district, vacant lots will be utilized and houses will be converted into offices. As a result, the utilization of the roadside area will become denser, while the commercial /business belt zone will increase its depth towards the hinterland area.

3) Intersections

In the Study section of about 3.3 kilometers from Via Martin Sosa to Ave. J. Zarak, there are 20 intersections as shown in Table III-3-1, of which 11 intersections have signals at present, and of the 11, seven intersections need to continue to function as the crossings with 4-lane arterials in the future. In order to arrange intersections at the intervals of 200m to 250m to secure service between areas on both sides of the road, the remaining four intersections with signals and Ave. J. Zarak intersection at the end point of the Study section will have to function as the crossings with collector streets even in the future (see Fig. III-3-1).

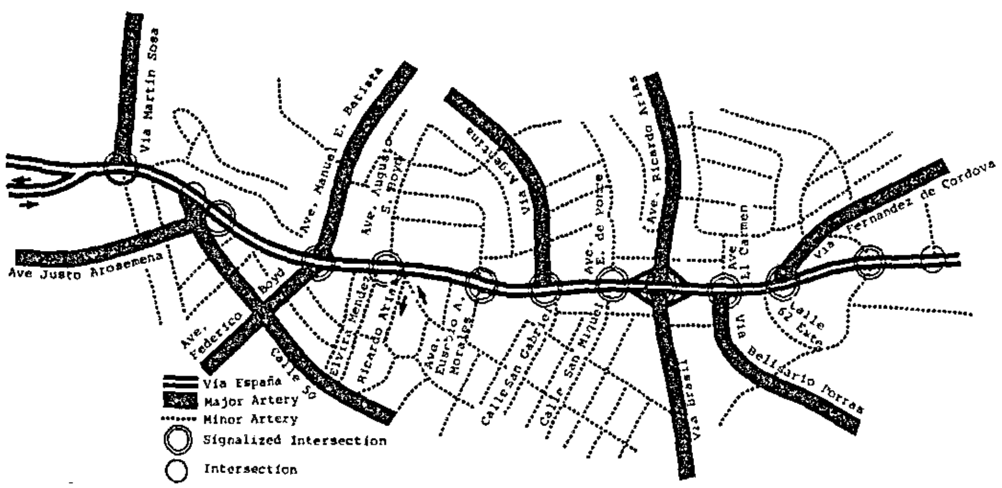


Fig. III-3-1 ROAD NETWORK ALONG VIA ESPANA

TABLE III-3-1 EXISTING INTERSECTIONS ALONG VIA ESPANA

No.	Name of Side Road	Station	Dist. (m)	Lane No.	R.O.W. (m)	Const. Line(m)	Control
1.	Via Martin Sosa	0+00	—	4	16.35	25.0	Signalized
2.	Calle 50	2+70	270	2	15.0	30.0	Non-Signalized
3.	Ave. Justo Arosemena	4+29	159	4	25.0	30.0	Signalized
4.	Calle 46 Venezuela	5+15	86	2	15.0	30.0	Non-Signalized
5.	Calle 47 Colombia	6+28	113	2	15.0	30.0	Non-Signalized
6.	Ave. Federico Boyd	8+50	238	4D*	25.0	45.0	Signalized
	Ave. Manuel E. Batista			4D*	25.0	45.0	Direction Control
7.	Calle Aquilino de La Guardia	10+09	159	2	15.0	25.0	Non-Signalized
8.	Calle Elvira Mendez	11+06	97	2	15.0	20.0	Non-Signalized
9.	Ave. Augusto S. Boyd	11+44	38	2	15.0	20.0	Signalized
10.	Ave. Ricardo Arias	12+07	63	2	15.0	25.0	Non-Signalized
11.	Calle C. Ortega	13+95	188	2	15.0	25.0	Non-Signalized
12.	Ave. Eusebio A. Morales	15+08	113	2	14.5	25.0	Signalized
	- DO -			2	15.0	25.0	Direction Control
13.	Via Argentina	17+62	254	4D*	25.0	30.0	Signalized
14.	Calle San Gabriel	18+30	68	2	15.0	20.0	Non-Siganalized
15.	Ave. E. de Ponds	20+38	208	2	14.0	20.0	Flashing Signal
	Calle San Miguel			2	15.0	30.0	
6.	Ave. Ricardo Arias	22+40	202	4D*	20.0	30.0	Signalized
	Via Brasil			4	20.0	30.0	
17.	Ave. El Carmen	24+94	254	2	15.0	21.0	Signalized
	Via Belisario Porras			4	20.0	30.0	
18.	Calle 62 Este	26+49	155	2	11.0	20.0	Non-Signalized
19.	Via Fernandez de Cordoba	27+16	67	4	20.0	30.0	Signalized
20.	Ave. 1 Norte(La Cantera)	30+78	362	2	20.0	30.0	Signalized
	Calle 62 A Este			2	12.0	20.0	
21.	Ave. Jorge A. Zarak	33+25	247	2	15.0	30.0	Non-Signalized

Note: *: Divided 4 lane

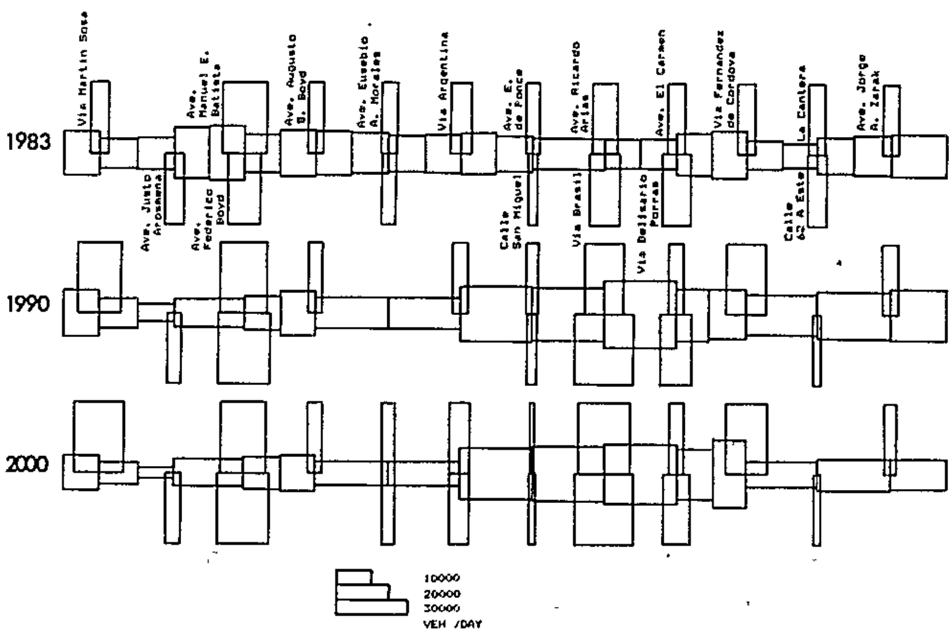


Fig. III-3-2 TRAFFIC DEMAND ALONG VIA ESPANA

The volume of traffic in each direction at intersections on Via Espana is shown in Fig. III-3-2. Presently, Federico Boyd Intersection has the heaviest traffic of about 114,000 vehicles per day, followed by Via Brasil/ Via Porras Intersection with about 80,000 vehicles per day. In the future, the volume of traffic moving through Federico Boyd Intersection will remain little changed, while that going through Via Brasil Intersection will double to about 150,000 vehicle per day, upon the opening of Corredor Norte. Traffic at Via Porras Intersection is also comparatively heavy and, together with Via F. Cordoba Intersection, about 110,000 vehicles per day is predicted.

3.1.2. Geometric Structure

1) Standard Cross Section

From the viewpoint of link capacity, Via Espana, as four-lane road, can accommodate the future traffic volume. However, intersections on Via Espana are located at average intervals of 300m or a minimum interval of 210m, and exclusive lane for left-turn traffic is needed at each intersection. Then those turning lanes could be added to the normal four lanes continuosly for that whole length and will compose a total of six lanes. As a result, center median will no longer be required to provide space for left-turn lanes, and, therefore, it can be reduced to the minimum width needed to separate traffic moving in opposite directions, namely 1.0m.

The section from Federico Boyd Intersection to Via J. Zarak Intersection, which represents three-fourths of the Project section, has a right-of-way of 40m wide in total and construction lines of 50m wide in total. The space outside the sidewalks is presently used for public parking on the road side and for private parking on the private land side (see Fig. III-3-3). In order that the improved road also have such a public parking space, a strip of 7.6m will be retained on both sides of the road to allow 30 degrees angle parking (see Fig. III-3-4).

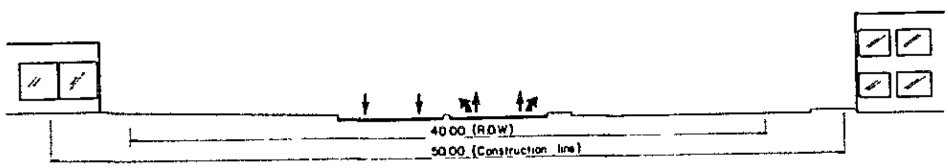


Fig. III-3-3 EXISTING CROSS SECTION OF VIA ESPANA(1)

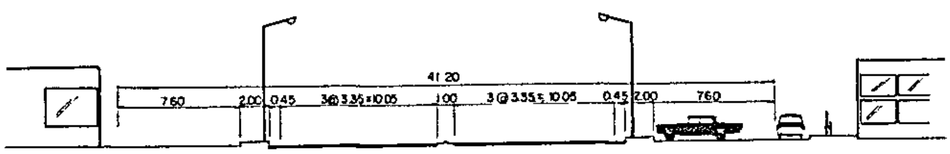


Fig. III-3-4 WIDENED CROSS SECTION OF VIA ESPANA(1)

In the section between Martin Sosa Intersection and Federico Boyd Intersection, the right-of-way is 18m wide and one side of the road is not utilized due to topographical condition at present (see Fig. III-3-5). Therefore, the road will be widened by expansion toward only one side (see Fig. III-3-6).

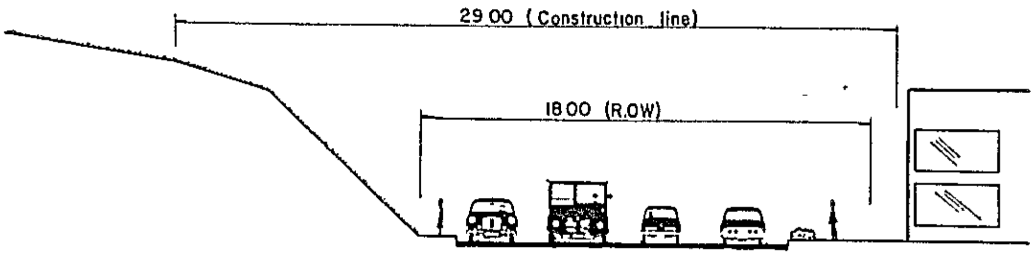


Fig. III-3-5 EXISTING CROSS SECTION OF VIA ESPANA(2)

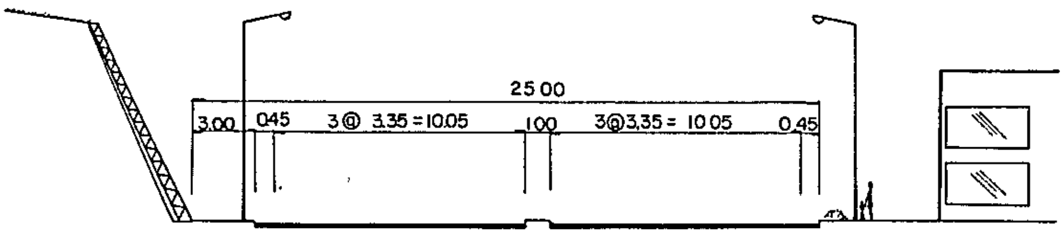


Fig. III-3-6 WIDENED CROSS SECTION OF VIA ESPANA(2)

2) Road Design

Two mutually reserved circular curves with radii of 250m and 200m are used in the horizontal alignment of the section between E.A. Morales Intersection and Via Argentina Intersection. This alignment does not conform with the standard in the sense that there is no transition curve between the two, but the alignment is not changed because the radii of circles of said two satisfy the minimum standard and any change is restricted by buildings on both sides of the road.

The project roads are fairly level with the maximum gradient of 2.8%, and their vertical alignment needs no improvement.

3) Intersection Remodeling

Intersection saturation rate in peak hours is shown by year and by remodeling project in Fig. III-3-7, as calculated following the Highway Capacity Manual procedure. Presently, intersections are saturated at the saturation rate of 1.2 to 1.3, as calculated. The remodeling of each intersection shall be accomplished in accordance with the signal system, shown in Fig. III-3-8 (1) through (2). Remodeling plan for each intersection is summarized below.

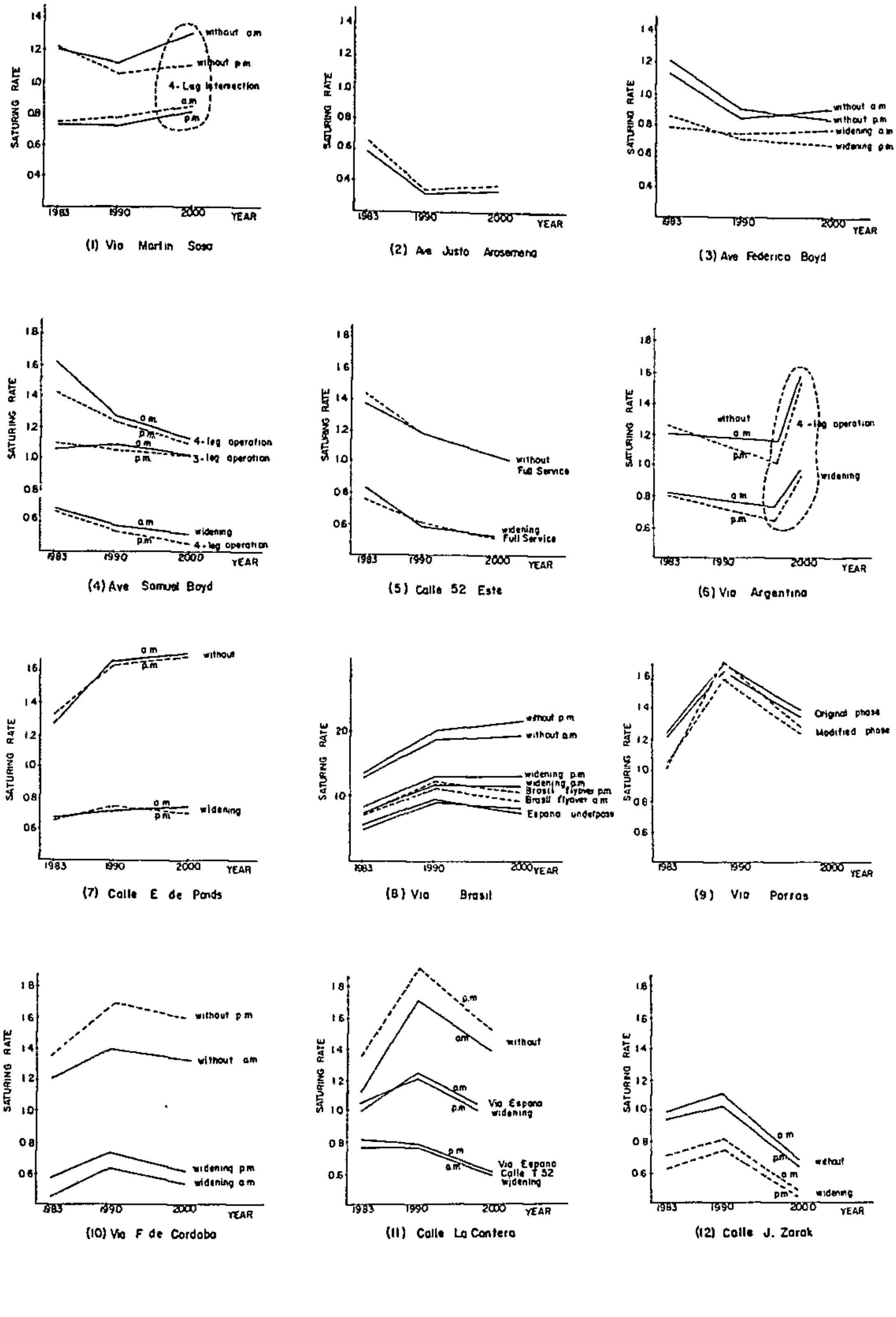
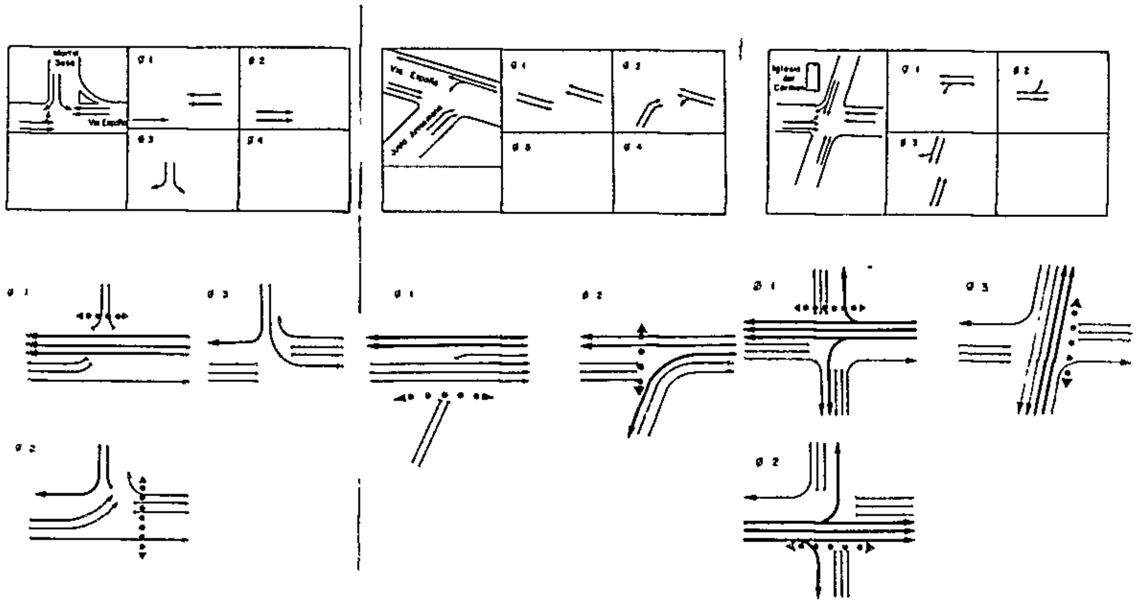


Fig. III-3-7 INTERSECTION SATURATION RATES ALONG VIA ESPANA



(1) MARTIN SOSA (2) JUSTO AROSMENA (3) FEDERICO BOYD

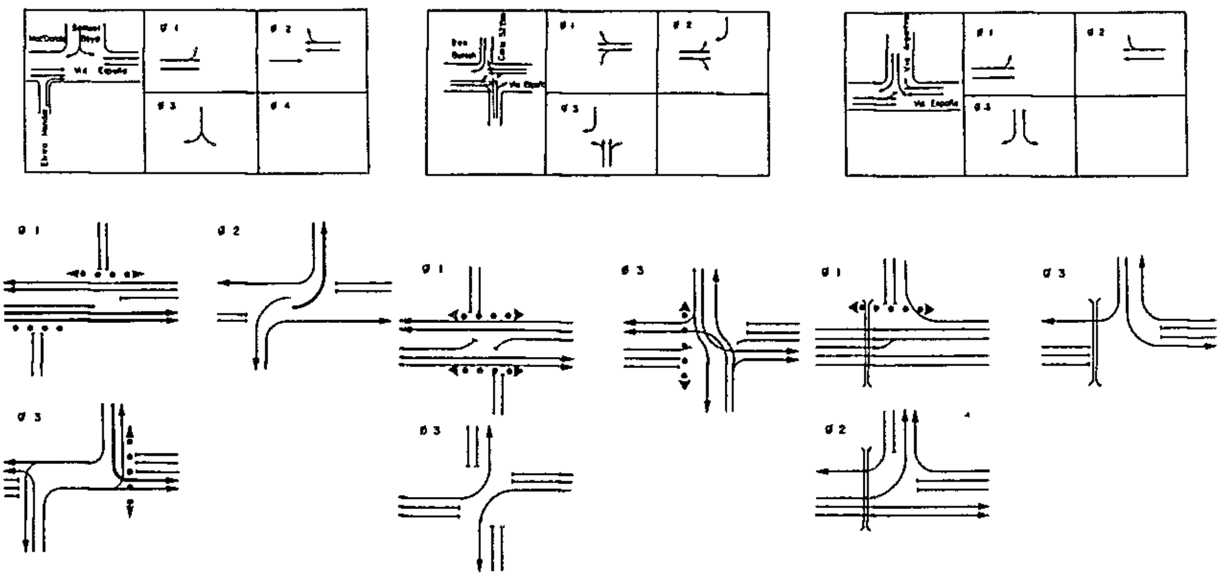
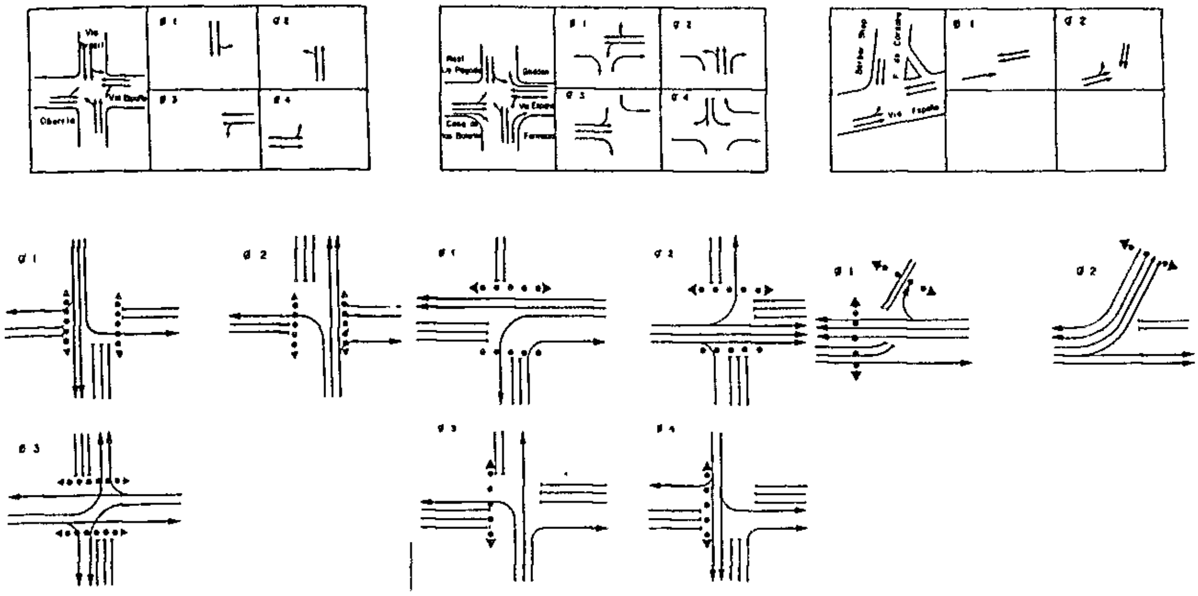
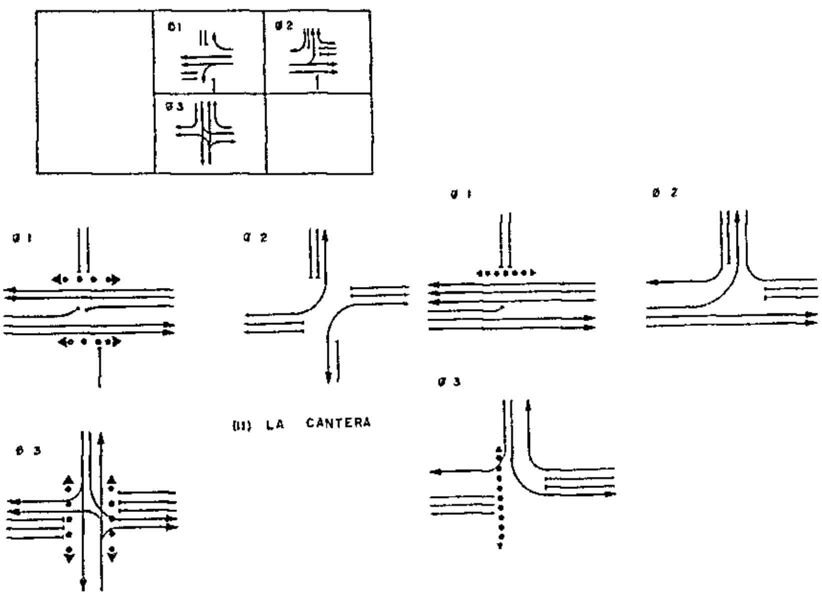


Fig. III-3-8 INTERSECTION SIGNAL PHASING ALONG VIA ESPANA(1)



(7) VIA BRASIL (8) VIA BELISARIO PORRAS (9) FERNANDEZ DE CORDOBA



(10) LA CONTERA (11) JORGE ZARAK

Fig. III-3-8 INTERSECTION SIGNAL PHASING ALONG VIA ESPANA(2)

(1) Martin Sosa Intersection

Presently, left turn traffic from Via Espana, Centro to Via Martin Sosa is bottleneck flow in peak hours. The installation of an exclusive left-turn lane for this traffic will increase the intersection capacity by 60%.

Desired in addition is the expansion of Via Martin Sosa, which has only two lanes with the exception of four lanes at the intersection approach, which seems to cause traffic congestion. The level difference of 60cm to 80cm between Via Espana and side road running parallel on the south of Via Espana shall be eliminated in the future by the installation of a retaining wall between the shoulder and the sidewalk.

(2) Justo Arosemena Intersection

Justo Arosemena Intersection and Calle 50, some 100m away, shall be planned as one combined intersection. Both intersections have a large capacity and can handle traffic with two signal phases, and, therefore, one lane of Via Espana shall be dedicated to left-turn traffic.

(3) Federico Boyd Intersection

The left-turn ratio of traffic entering the intersection on Via Espana from Centro is high at 35%, which is a cause for congestion at the intersection. Presently, left-turning from the crossing roads of Via F. Boyd and Via M. E. Batista is prohibited in order to increase the capacity of this intersection.

Because future demand for traffic flow in this direction is estimated to be low, this prohibition shall be continued. The expansion of Via Espana approach from the present 2-lane to 3-lane is expected to enlarge the intersection capacity by 40% to a level adequate in the future, provided that an exclusive right-turn lane will be installed at the approaches.

Via Federico Boyd and Via Manuel E. Batista form a staggered intersection, a curve with a radius of 50m is partially inserted, and the angle of intersection with Via Espana is small. Therefore, remedies for continuity, curve radius and angle are necessary to secure the smooth, safe and convenient traffic flow.

(4) Augusto S. Boyd Intersection

Ave. E. Mendez is connected with via Espana at its southern end and crosses with S. Boyd forming a staggered intersection, where signal control may not be implemented, and left turn traffic from Via Espana interferes straight flow on Via Espana through the intersection. This intersection is planned as a four-leg intersection with one unavoidable element of stagger, because of the buildings in the vicinity, because roads' discrepancy is only 40m, and the intersection is indispensable in view of distance from neighboring intersections.

(5) Eusebio A. Morales Intersection

This intersection shall be improved by rescinding the directional restriction and by easing the alignment of intersecting roads for a smoother flow of traffic.

(6) Via Argentina Intersection

Widening of Via Espana approach to a 3-lane road will improve the capacity of this 3-leg intersection by 40% to a level adequate in the future. ESTAMPA Masterplan recommended that this intersection be changed to a 4-leg intersection by the extension of Via Argentina by the year 2000, when at-grade intersection will be adequate in view of the estimated saturation rate of 1.0.

(7) E. de Ponce Intersection

A flashing signal is installed at this intersection, but in peak hours it is almost impossible to cross the intersection as average waiting time for traffic to cross Via Espana is calculated at 10.3 sec, and average arrival time for traffic on Via Espana is calculated at 2.4 sec (Fig. III-3-9). The present saturation will be eased and a capacity adequate in the future will be obtained by installing traffic signals and widening Via Espana.

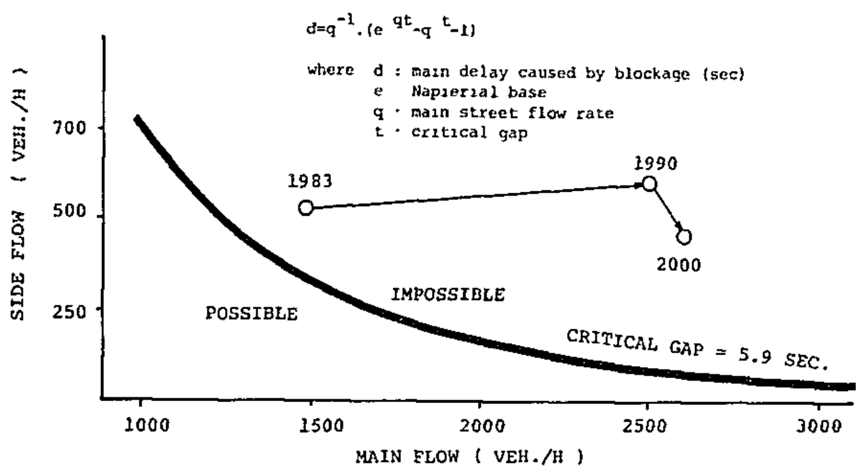


Fig. III-3-9 NON-SIGNALIZED INTERSECTION CAPACITY (E. DE PONCE)

(8) Via Brasil Intersection

Even with the widening of Via Espana approach to 3-lane and with traffic signal, this intersection will be saturated in 1990 at the saturation rate of 1.3. Further widening will not solve the problem, because:

a) If the width increment is dedicated to turning traffic, saturation at approach, which is determined by straight traffic, will not be changed.

b) If straight traffic is increased, continuity at exit will be a problem.

Thus, grade separation is recommended to secure the capacity needed in the future. Alternative grade separation plans are compared in Table III-3-2, from which the plan to make Via Espana an underpass is adopted for the following reasons:

a) To make Via Brasil either an overpass or underpass is judged difficult due to the presence of apartment houses, supermarkets, restaurants, and other buildings in the vicinity.

b) To make Via Espana an underpass is more desirable than to make it an overpass from the esthetic standpoint.

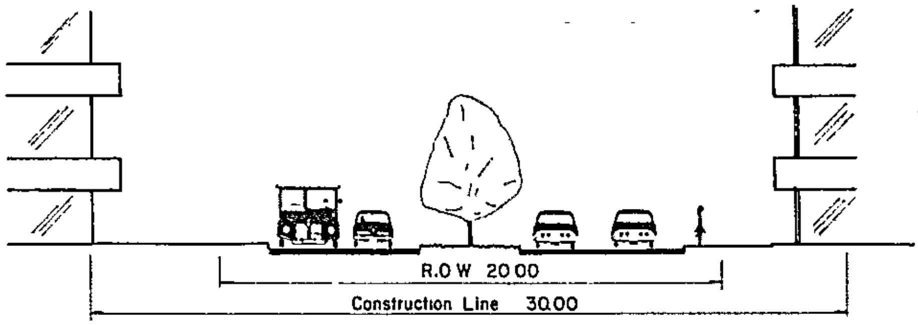


Fig. III-3-10 EXISTING CROSS SECTION OF VIA BRASIL

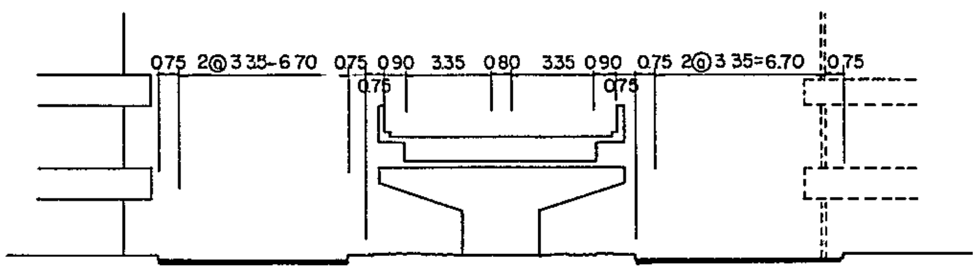


Fig. III-3-11 ALTERNATIVE CROSS SECTION FOR VIA BRASIL FLYOVER

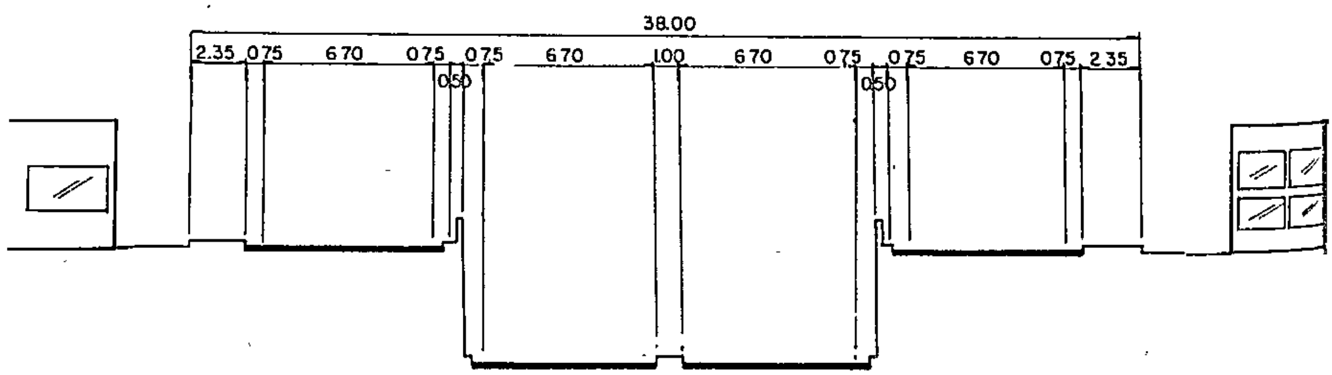


Fig. III-3-12 SELECTED CROSS SECTION OF VIA ESPANA UNDERPASS

TABLE III-3-2 COMPARATIVE EVALUATION OF VIA BRASIL INTERSECTION ALTERNATIVES

Description	Via Brasil Flyover	Via Espana Underpass
1. Intersection Saturation Rate		
1983	0.73	0.57
1990	1.24	0.99
2000	1.09	0.94
2. Affected Distance	302m	380m
3. Affected Building	2-Apartments (4 stories) 1-Restaurant 4-Commercial Buildings (2 stories)	None
4. Affected Side Roads	Ave. 9 - Ave. 9 Ave. K L. G. Fabrega	E. de Ponds - San Miguel
5. Drainage	No Special Drainage	Pump system for Drainage may be needed
6. Land Acquisition	12m for both sides	not needed
7. Main Structure	P.C. Composite Simple Girder 4@30.0=120.0m	P. C. Simple Girder 1@17.5m

Note: For cross sections, see Fig. III-3-1-10 and 11.

(9) Via Porras Intersection

Both Via Porras and Via Espana are already 6-lane on both sides of this intersection, but in the absence of continuity, the outside lanes are being used exclusively for right-turning. Dedicating center lanes to left-turning and using other lanes for straight and right-turning traffic by improving Via Espana will increase the intersection capacity by about 20%.

(10) Fernandez de Cordoba Intersection

Traffic from Centro, making left-turn from Via Espana onto Via Fernandez de Cordoba is bottlenecked. The dedication of two lanes to left-turn traffic will secure an adequate capacity for the future. Turning from Via Fernandez de Cordoba onto Via Espana in the direction of Tocumen produces a sharp angle of intersection, and, because a detour is possible by another road, the presently enforced directional restriction shall be continued.

(11) La Cantera Intersection

Although Via La Cantera was originally a housing area street, it is used as a detour between Via Espana from Tocumen and Via Porras. The widening of both Via Espana and Via La Cantera will provide an adequate capacity, but, in order for it to continue to function as a housing area streets, an adequate capacity will be realized on Via Espana by using a higher signal phase ratio for it, without widening Via La Cantera.

(12) Jorge Zarak Intersection

As shown in Fig. III-3-13 and Table III-3-3, left-turn traffic can cross into the intersection, which dose not have signals. Waiting time in peak hours, however, is expected to reach 41 seconds in 1990, and the installation of the traffic signals is desirable for the securing of a safe traffic environment.

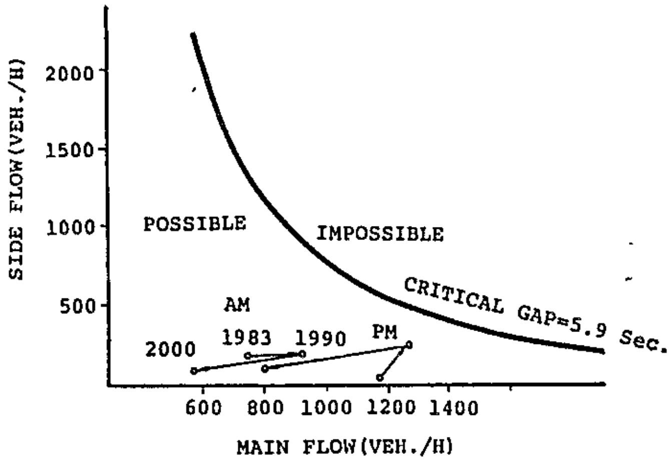


Fig. III-3-13 NON-SIGNALIZED INTERSECTION CAPACITY (AVE. J. ZARAK)

TABLE III-3-3 DELAY TIME AT AVE. J. ZARAK INTERSECTION

Year	Time	Main Flow (Veh./h)	Side Flow (Veh./h)	T1 (Sec.)	T2 (Sec.)	Total (Sec.)
(1) Via Espana to Ave. J. Zarak						
1983	AM	1023	141	4.8	5.9	10.7
	PM	752	190	2.7	3.1	5.8
1990	AM	1343	118	8.2	11.2	19.4
	PM	912	191	3.9	4.9	8.8
2000	AM	851	108	3.4	3.9	7.3
	PM	577	110	1.6	1.7	3.3
(2) Ave. J. Zarak to Via Espana						
1983	AM	1187	87	6.4	7.6	14.1
	PM	1039	140	5.0	6.2	11.2
1990	AM	1560	198	11.3	29.9	41.2
	PM	1265	231	7.3	13.7	21.0
2000	AM	989	102	4.5	5.2	9.7
	PM	801	119	3.0	3.3	6.3

NOTE: T1: Average waiting time
T2: Waiting time in que

3.1.3. Structures

The main structure in the project is for the grade separation of Via Brasil intersection, where either an overpass or an underpass of Via Espana is planned.

If an overpass is applied, a bridge is to be planned with a span of 30 meters. For this span, simple composite PC girders are economical and of the highest workability, involving little site work and offering the flexibility of adjusting the length of cantilever slab for curved bridge with a small radius.

If an underpass is applied, U-shaped retaining wall is to be installed at and near the intersection, and reverse T-shaped retaining wall is to be used where overburden does not cover heavily, provided that short span beams will be needed on the intersection. Pre-tension type PC concrete girders are to be used so as to minimize on-site work and the period of construction.

In comparison, there is no decisive difference between overpass and underpass. Overpass is usually advantageous due to the ease of work, but underpass work is relatively easy in this case due to the fact that soil down to about 5m depth is silty clay, whose N-value is 10 to 20 and whose excavation is easy, and due to the fact that right-of-way is as wide as 40m.

Then, the selection should be made from the standpoint of urban scenery. A bridge which will disturb the view of this central downtown, where Via Espana runs through, should be eliminated from consideration. In this view, grade separation of the intersection shall be achieved by an underpass.

Other structures in the project are the extension of culverts at two locations, where Rio Matasnillo and its tributary cross Via Espana, as required in relation to road widening.

3.1.4 Auxilliary Facilities

1) Pedestrian Facilities

A very important theme and element of the Via Espana Upgrading Project is the provision of adequate pedestrian spaces in the heavily commercialized roadside areas. Although the relesal of the entire strip from the road shoulder to the construction line for pedestrians will be ideal in view of the magnitude of the roadside commercial activities, the present practice of utilizing spaces in front of buildings for vehicle parking will have to be continued in view of the expected strong demand for roadside parking in the future. Thus, space between the roadway and the parking shall be preserved for pedestrians (see Fig. III-3-14). In the vicinity of bus stops, however, small parks will be created instead of the parking spaces for the benefit of passengers resting or waiting for the bus, in order that harmony will be maintained between pedestrian spaces and bus stop facilities along Via Espana, on which the number of bus routes are presently and will in the future be large. Continuos sidewalks shall be installed along and parallel to the road (Fig. III-3-15). On parking space side of sidewalk shall be evergreen trees planted in line, and on the roadway side, shrubs, in the achievement of well vegetated pleasant pedestrian spaces.

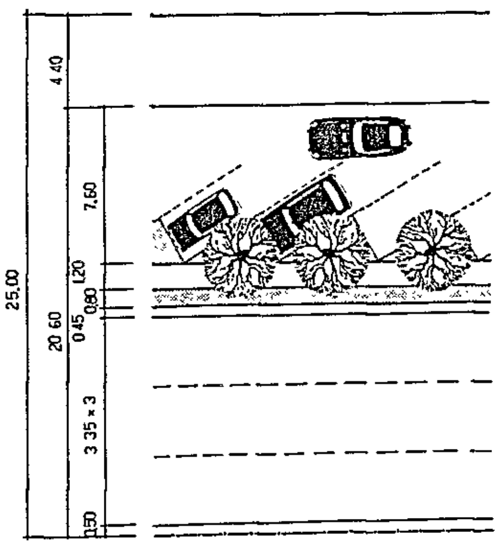


Fig. III-3-14 PEDESTRIAN AND PARKING SPACE ALONG VIA ESPANA

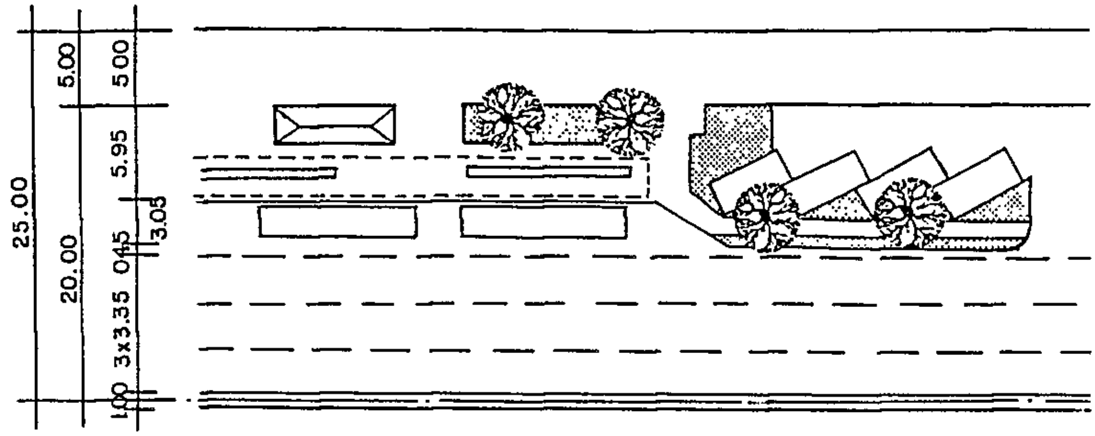


Fig. III-3-15 PEDESTRIAN AND PARKING SPACE NEAR BUS STOPS

Pedestrian crossings shall be installed at all intersections with signals on Via Espana for the safety and convenience of pedestrians. Also, where two neighboring intersections with signals are far apart from each other (near the bus stop on east of the National Bank), pedestrian signals shall be installed. As a result, Via Espana will have a pedestrian crossing about every 250 meters.

2) Parking Facilities

There were 1,351 toll and toll-free roadside parking lots in 1981. The number of roadside parking lots required in the year 2000 is forecasted to be 1,612 according the the calculation below. Since an estimated 267 existing parking lots will be sacrificed due to the widening of roads under this project, there should be a shortage of 528 roadside parking lots in the year 2000 (see Table III-3-4). However, as the extension between Via Brazil and Ave. Zarak already has many vacant lots, it is assumed that future demand for parking space along this extension will be absorbed by obligatory parking lots to be provided with new buildings, so that the demand for roadside parking lots is considered to show no increase. According to the ESTAMPA Masterplan, the shortage of parking lots in the year 2000 in the four PT zones of La Cresta, Urraca-Campo Alegre, Obrio and El Cangrejo, or zones 07, 08, 09 and 10, respectively (see Fig. III-3-16), was estimated at a total of 4,156 lots, while the shortage along Via Espana is estimated under the present Study to be 6.6% of this figure, or 261 lots.

TABLE III-3-4 PARKING DEMAND AND SUPPLY BALANCE

Zone	Existing Parking Space	Effective Parking Space after Widening	Future Space Parking Demand	Balance
07	50	21	78	-57
08	354	281	634	-353
09	231	123	261	-138
10	476	434	414	20
Sub-Total	1111	859	1387	-528
13	130	121	121	0
14	110	104	104	0
Sub-Total	240	225	225	0
Total	1351	1084	1612	-528

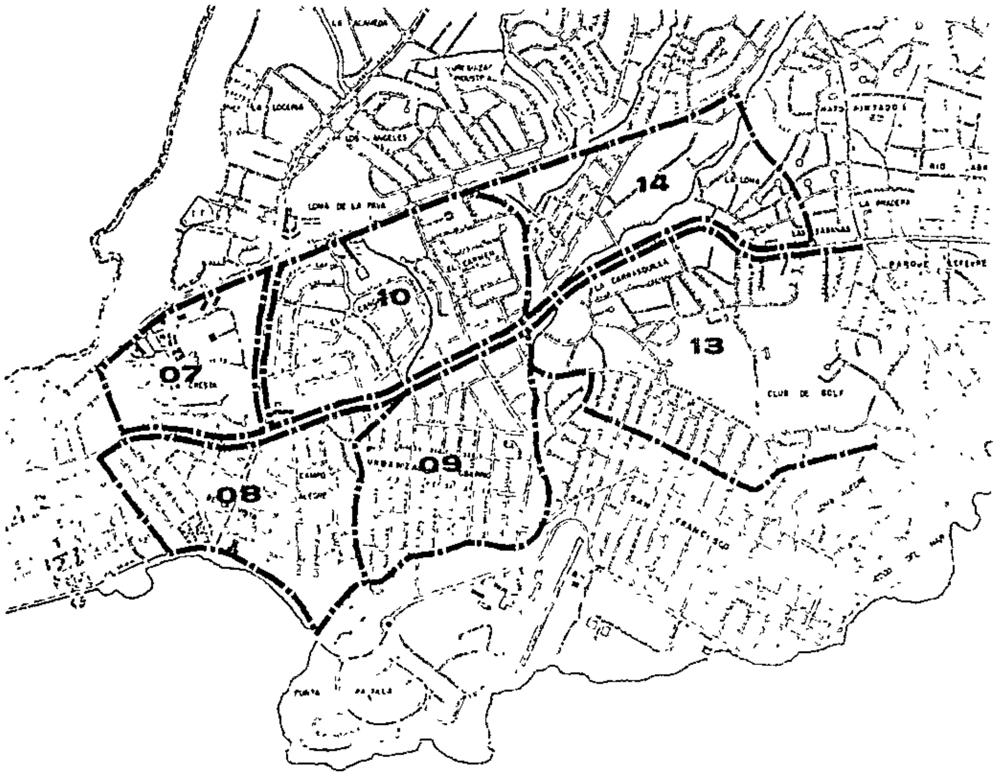


Fig. III-3-16 ADJACENT ZONES ALONG VIA ESPANA

(a) Increase of Incoming Trips Along the Via Espana

The number of trip flowing into Via Espana is expressed as (commercial floor space along Via Espana / commercial floor space in zones 07-10) x number of trips into zones 07-10. Commercial floor space is expressed as commercial land space x average ratio of floor space to land space. Since commercial land space along the Via Espana was 29.0ha. in 1981 and the average ratio of floor space to land space 300%, commercial floor space along the Via Espana in 1981 was 87ha. This is projected to expand to 166.4ha. (41.6ha. x 400%), or a increase of 1.913 times, in the year 2000.

Calculated in the same way, commercial floor space in zones 07-10 amounted to 105.9ha. (70.6ha. x 150%) in 1981 and is projected to expand in 305.25ha. (122.1ha. x 250%), or an increase of 1.913 times, in the year 2000.

Thus, since the number of incoming trips in zones 07-10 was 93,865/day in 1981 and is projected to be 163,060/day in the year 2000 according to the ESTAMPA Masterplan, or a growth of 1.737 times, the increase of incoming trips along Via Espana during 1981 to 2000 comes to 1.153.

(b) Along Via Espana Increase of Roadside Parking

According to the ESTAMPA Masterplan, passenger car usage will increase 1,082 times during 1981 - 2000. Since incoming person-trips along Via Espana will increase 1,153 times during the same period, the increase of roadside parking along Via Espana, expressed as growth rate of passenger car usage x growth rate of incoming person-trips.

(c) Demand for Parking Space Along Via Espana

There were 1,111 parking lots aslong Via Espana in zones 07-10 in 1981, but there will be a need for 1,387 lots in the year 2000 at the same time, the need for parking space along Via Espana running through the project sections of zones 13 and 14 will be 225 lots in the year 2000, assuming that even if the number of parking lots decreases due to road widening the demand will be met, in view of the current low rate of parking space usage and the small amount of development planned for this area. As a result, the demand for parking lots in the year 2000 is established as 1,612.

3) Bus Bay

Since many bus routes converge on the Via Espana, the bus traffic ratio can be expected to remain high hereafter. Therefore, even after road widening, it is necessary to provide bus bays for loading and unloading passengers so that the general flow of traffic is not obstructed.

3.2 Via Bolivar

3.2.1 Land Use and Access Condition

1) Present Roadside Land Use

The roadside land use is characterized by the presence of many public facilities like schools, hospital, and government offices. The road is trimmed on the south by the Social Insurance Hospital, the National University of Panama, the Panama Technologic University, private schools (primary to high), distribution warehouses, and automobile related service industries, each of which usually occupies a block (400m to 500m roadside). On the north, in the vicinity of Via Martin Sosa, Rio Curundu wings close to Via Bolivar, between which is a new university facility and an adjacent squatter area. From Panama University to Via Ricardo J. Alfaro are the university facilities and government offices, and beyond Via Ricardo J. Alfaro are a beverage plant, MIVI-owned land (17 hectares) for housing development project, and automobile related service industries.

2) Future Prospect

Squatter clearance will be subject to Government action. While the characteristics of the roadside land use will be kept constant in the future, the presence of public facilities, which, together with the presence of a Natural Park in the hinterland, will create a desirable environment for the location of additional educational and other public facilities.

3) Remarks for Road Plan

Presently observed on Via Bolivar, where bus passengers concentrate attracted by hospitals and universities, is undesirable competition between buses and other vehicles. Therefore, it will be essential that improved bus stop facilities be provided for the smoother flow of the presently congesting bus traffic and that sidewalks and other roadside pedestrian spaces be provided for their safety.

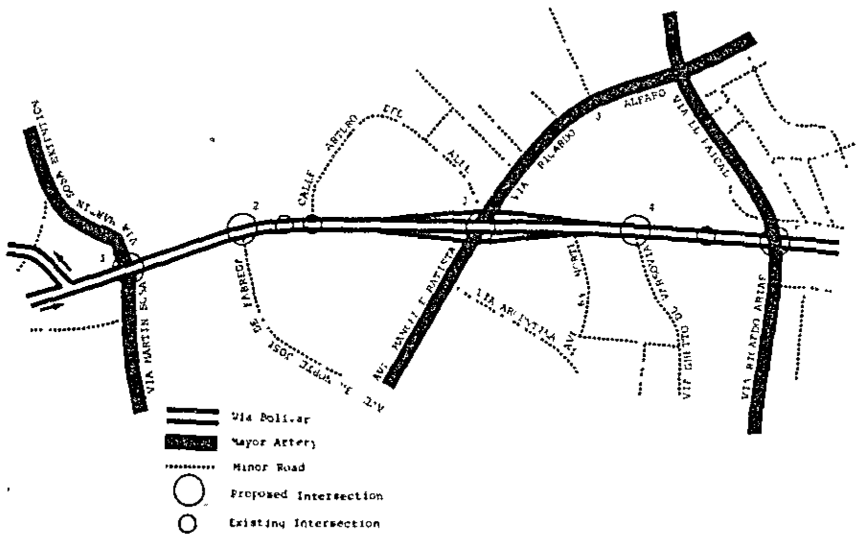


Fig. III-3-17 ROAD NETWORK ALONG VIA BOLIVAR

4) Intersections

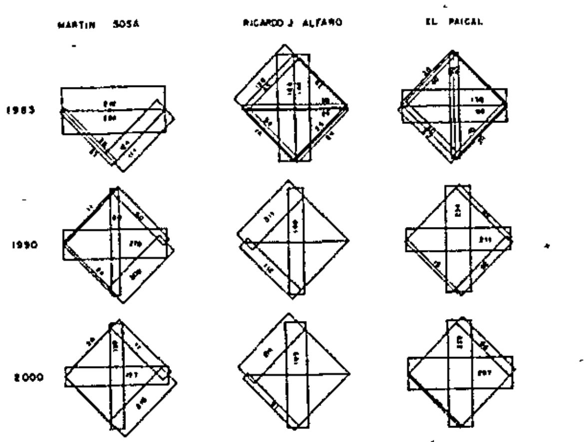
Arterials which cross Via Bolivar are (a) Via Martin Sosa, (b) Via Ricardo J. Alfaro, and (c) Via El Paical. Intersections (a) and (c) have signals, while under the viaduct of intersection b) is a rotary. Other locations at which Via Bolivar is intersected are shown in Table III-3-5. Of them, Ave. Jose D. Fabrega is an entrance to the Panama University and the Social Insurance Hospital, on which demand will remain in the future, but in other parts the intersection intervals are too short. Therefore, intersection with Via Varsovia will be established instead of Depositos Gago intersection. (See Fig. III-3-17).

TABLE III-3-5 EXISTING INTERSECTIONS ALONG VIA BOLIVAR

No. Name of Side Road	Station	Dist. (m)	Lane No.	R.O.W. (m)	Const. Line(m)	Control
1. Via Martin Sosa	00+00	---	2	22.9	25.0	Signalized
2. Ave. Jose de Fabrega	4+00	400	2	20.0	30.0	Non-Signalized
3. Calle Arturo del Valle	6+47	247	2	20.0	30.0	Non-Signalized
4. Ave. Manuel E. Batista	12+52	605	4D	25.0	45.0	Non-Signalized
Via Ricardo J. Alfaro			4D	32.0	60.0	Rotary
5. Depositos Gago	20+28	776	--	--	--	Non-Signalized
6. Via Ricardo Arias	22+48	220	4D	20.0	30.0	Signalized
Via El Paical			2	20.0	30.0	

Note: D in Lane No.: Divided

Presently an average daily traffic of 145,000 vehicles enter the intersection with Via Martin Sosa, and the rate of left-turn vehicles from Via Bolivar onto Via Martin Sosa reaches 37%. At intersection with Via Ricardo J. Alfaro, straight traffic on Via Bolivar enjoys the grade separated structure, but under the viaduct the volume of traffic entering the intersection is presently 128,000 vehicles per day, many of which are turning traffic between Via Ricardo J. Alfaro and Via Bolivar for Centro, causing traffic congestion. At intersection with Via El Paical, traffic on this road is predicted to increase by about four times from the present 8,400 vehicles per day to 22,400 when Corredor Norte will be opened for service (See Fig. III-3-18).



UNIT: 100 VEH./DAY

Fig. III-3-18 TRFFIC DEMAND ALONG VIA BOLIVAR

3.2.2 Geometric Design

1) Standard Cross Section

The cross section adopted by MOP for its plan of widening to a 6-lane road for the section between intersection with Via Martin Sosa and intersection with Via Ricardo J. Alfaro will be used as the standard cross section for this project. As against its right-of-way and construction line both of 60.96m (200 feet), the project road has an overall width of 33m, leaving a surplus 14m strip each on both sides of the road. Between Via Martin Sosa and Via Varsovia, these strips are used as roadside slopes, and between Via Varsovia and Via El Paical, the spaces are combined on one side of the road and used as parking space and a marginal road, which were constructed applying Valorizacion System (See Fig. III-3-19). The project will follow this present arrangement (see Figs. III-3-20 and III-3-21).

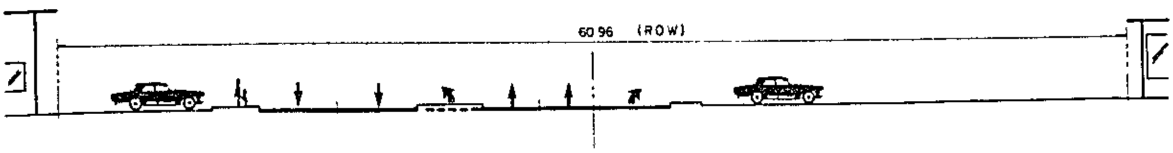


Fig. III-3-19 EXISTING CROSS SECTION OF VIA BOLIVAR

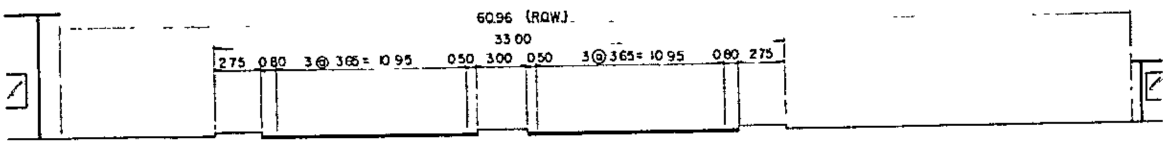


Fig. III-3-20 WIDENED CROSS SECTION OF VIA BOLIVAR

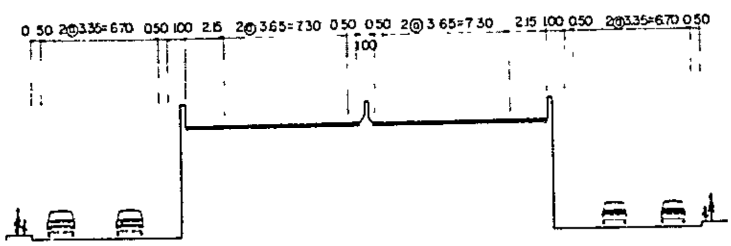


Fig. III-3-21 EXISTING FLYOVER SECTION ON VIA BOLIVAR

2) Road Alignment Design

The horizontal alignment includes two curves with the radii of 500m and 6000m, respectively, which pose no particular problem. Discrepancy between the center line, which is placed right on the center of right-of-way, from the project starting point up to Via Ricardo J. Alfaro intersection, and the center line off the center of right-of-way, near the ending point, will be smoothed out. The vertical alignment will follow that of the existing road with the maximum gradient of 4.3%, which poses no particular problem.

3) Intersection

(1) Via Martin Sosa Intersection

A trumpet type interchange is now under construction by MOP, whose loop ramp will be utilized to form a half-cloverleaf interchange in the future, when Via Martin Sosa is extended up to Corredor Norte according to the study.

(2) Ricardo J. Alfaro Intersection

A rotary type intersection is judged to be inadequate at this junction, because the congestion rate as calculated assuming such intersection will far exceed 1.0 in peak hours (see Table III-3-6).

TABLE III-3-6 VOLUME-CAPACITY RATIO OF ROTARY INTERSECTION

Year	Volume Capacity Ratio	
	AM	PM
1983	6.3	5.0
1990	4.5	8.8
2000	3.4	4.6

NOTE, V = 108 x W x (1+e/W) x (1-p/3) / (1+W/z)

Where, W : Width of roadway in the weaving section(ft)

e : Average of the entry width (ft)

l : Length of the weaving section (ft)

z : Proportion of weaving traffic to total traffic in the weaving section

Assuming an intersection with signals and two left-turn lanes at each approach and assuming that right-turn is allowed at all times, saturation rate is and will be in the future 1.0 (see Fig. III-3-22), and, thus, sufficient capacity will be available. However, in this case, vehicles in waiting queue will interfere the flow of traffic moving straight on the other road, unless the queue lane is kept long enough. This problem would be solved if left-turn lane is designed to have an inner turning movement, but the presence of viaduct piers in an oblique orientation prevents the achievement of an adequate radius of curvature. Therefore, this intersection will be one with inner flow of path and be signal controlled.

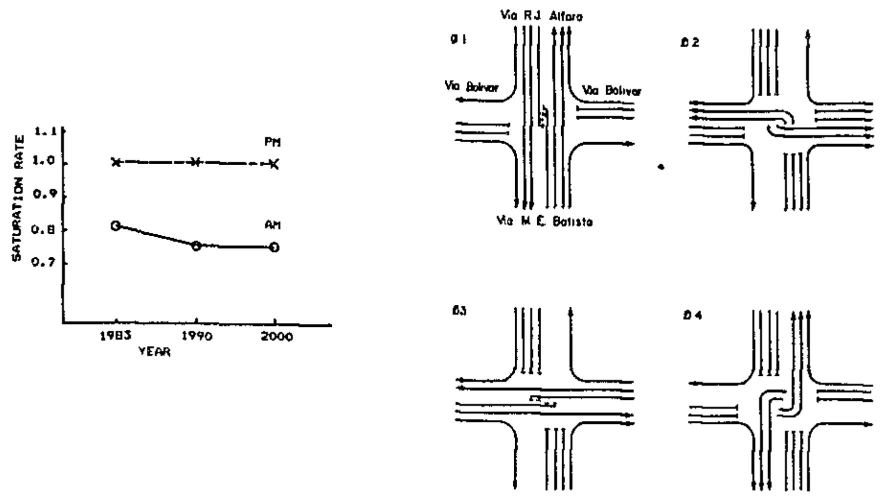


Fig. III-3-22 SATURATION RATE AND SIGNAL PHASING AT RICARDO J. ALFARO INTERSECTION

(2) El Paical Intersection

The at-grade intersection capacity will be increased by about 20% by the widening of both Via Bolivar and Via El Paical, but when Corredor Norte is opened for use, saturation rate is estimated at 1.3, which means that the increased capacity will still be inadequate (see Fig. III-3-23). In order to secure the required capacity, the grade- separation of this intersection is proposed. For grade separation, only overpass alternatives are compared, because of the disadvantages of underpasses that (a) the ground is hard and excavation will be costly, and (b) the surrounding area is not one where overpasses are allowed from the viewpoint of land use.

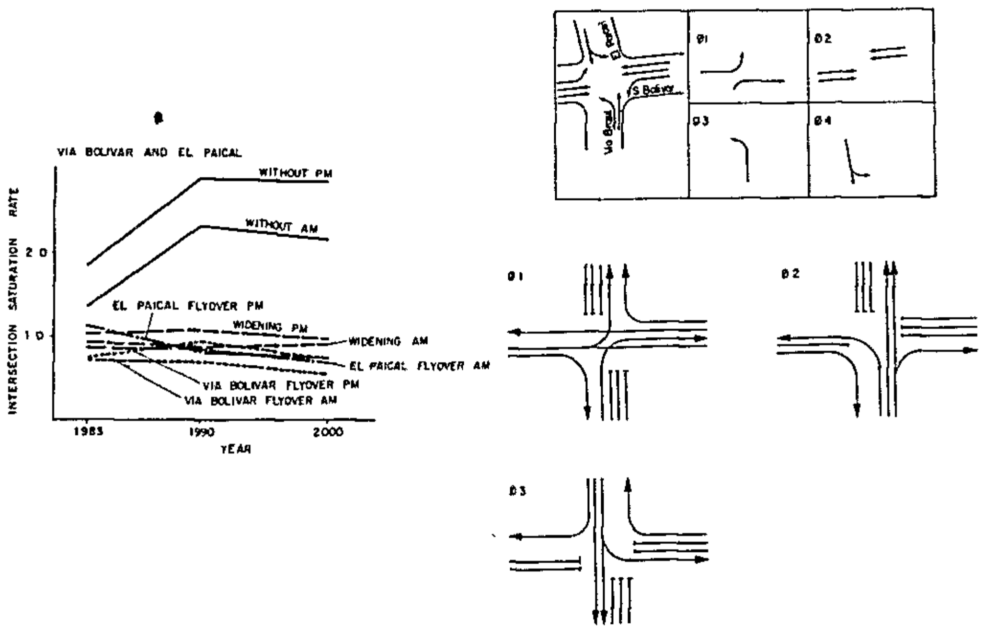


Fig. III-3-23 SATURATION RATE AND SIGNAL PHASING AT EL PAICAL INTERSECTION

Among the overpass alternatives, Via Bolivar will be elevated to overpass Via El Paical, because of the following reasons: a) approach to Via El Paical will have a sharp curve of a radius of 120m and an overpass is not technically desirable, (b) the widening of Via Brasil for the purpose of grade separation will be difficult due to the presence of buildings on both sides, and (c) an adequate right-of-way is secured for Via Bolivar. The standard cross section will be as shown in Fig. III-3-24.

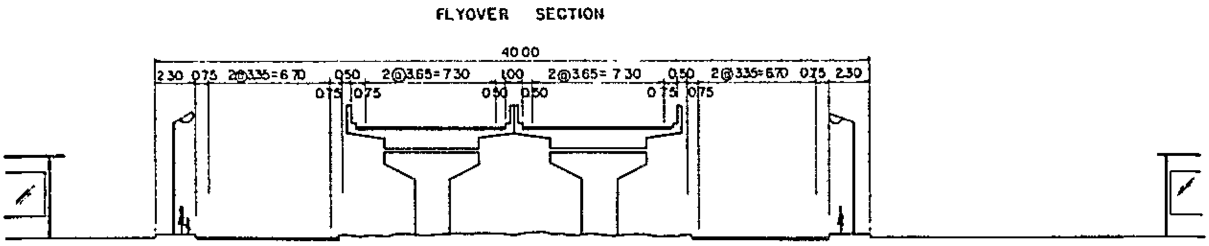


Fig. III-3-24 VIA BOLIVAR FLYOVER CROSS SECTION

3.2.3. Structures

An overpass is recommended for the grade separation of Via Bolivar intersection because rocks are expected and thus, excavation for making an underpass will be expensive. The boring test data obtained near the intersection site indicates the existence of a sandy silt with an N-value of 73 to 100 down to 7.0m, covered by an embanked soil with an N-value of 3-10 from the surface down to 1.7m, and rocks are exposed on cut surface at the location near Colegio la Salle.

Governed by the path of traffic flow within the intersection, the maximum span will be 35m. The bridge length will be about 140m for the reasons of the gradient of the existing ground and planned vertical alignment. In the approach, span can be shorter, but the same span length will be used for the entire length in consideration of the bridge's appearance. The superstructure will be of simple composite PC girder type, which can be made in factory and will involve little on-site work.

3.3. Via Cerro Ancon

3.3.1. Land Use and Access Condition

1) Present Roadside Land Use

This road project will be explained in three sections: (a) Ave. Balboa - Ave. Central, (b) Ave. Central - Ave. Jose Fco. de La Ossa, and (c) the remainder up to previous Albrook Airfield.

In Section Ave. Balboa to Ave. Central, the process of urban development on one side of the road has been different from the process on the other. This section also goes through Maranon Renewal Area(See chapter IV-1-4-1 "(1) Cinco de Mayo Bus Center"). MIVI building and museums, a municipal swimming pool, an inter-urban bus terminal, and a former beer brewery building line the road leaving plenty of vacant lots.

Section Ave. Central to Ave. Jose Fco. de La Ossa contains Congress Building (Palacio Justo Arosemena) and a park at the foot of Ancon hill (Cerro Ancon). On the east of the road is an apartment house area.

Section Jose Fco. de La Ossa to previous Albrook Airfield (Corredor Norte) is in the Reverted Area, where a motor pool and communication facility used for canal purposes still remain and traffic police (DNTTT) facilities are located. The west side of the railroad is the housing area called Area of Civil Coordination, where canal workers live.

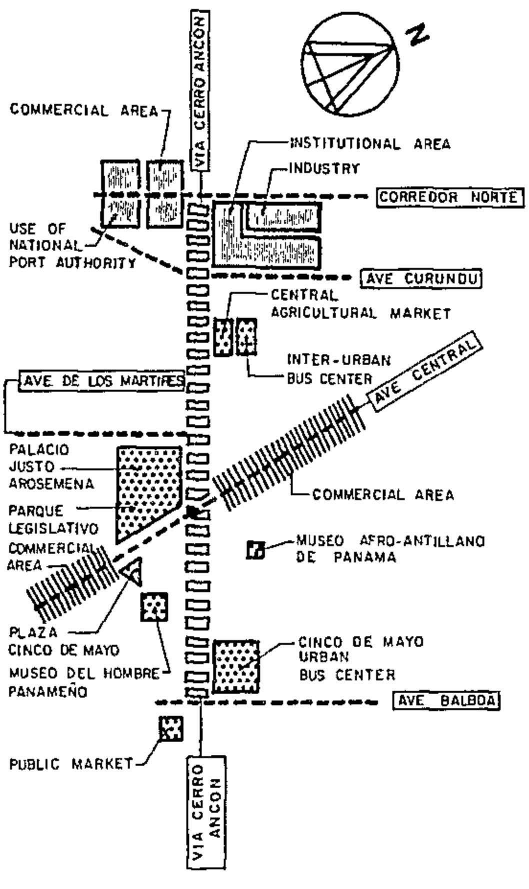


Fig. III-3-25 FUTURE PROJECTS AND MAIN ACTIVITIES ALONG VIA CERRO ANCON

2) Future Prospect

An urban bus center (Cinco de Mayo Bus Center) is planned for establishment in Maranon Renewal Area. An inter-urban bus terminal and a central agricultural market are already under construction in the Reverted Area. Previous Airfield is designated as a priority development area under the government plan for the establishment of institutional and commercial facilities related to port, and the plan will be materialized soon.

3) Remark for Road Plan

Diverse kinds of activities will be located along this road, according to an overall consideration of various plans (see Fig. III-3-25). In order to form a pedestrian network covering such activities, care should be used so as to secure adequate space to develop sidewalks, pedestrian paths, green belts and spots, particularly so that the flow of people in Ave. Central area will not be discountinued by the 6-lane road.

4) Intersection Allocation

Arterial network along Via Cerro Ancon is shown in Fig. III-3-26. Ave. Frangipani and Ave. Nacional are a pair of one-way streets located at the end of Via Bolivar, and Ave. Central and Ave. B - Ave. Peru are, likewise, treated as one intersection.

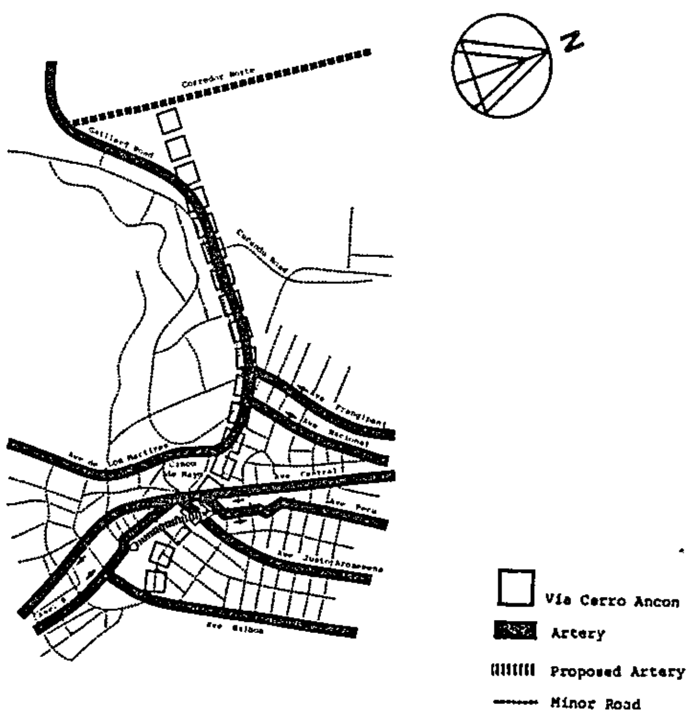


Fig. III-3-26 ROAD NETWORK ALONG VIA CERRO ANCON

At the intersection with Ave. De los Martires, which is an entrance to Pan American Highway, traffic in the direction of Via Cerro Ancon - Ave. De Los Martires is the major flow at present. However, by the completion of Via Cerro Ancon, major flow will be on Via Cerro Ancon. Thus, the intersection shall be designed as one with three legs: Via Cerro Ancon as the main road and Ave. de Los Martires as the side road. The intersection arrangement is shown in Table. III-3-7.

TABLE III-3-7 EXISTING INTERSECTIONS ALONG VIA CERRO ANCON

No. Name of Side Road	Station	Dist. (m)	Lane No.	R.O.W (m)	Const. Line(m)	Control
1. Ave. Balboa	0+00	--	4D*	31.2	41.0	Non-Siganlized
-DO-			4D*	31.2	41.0	Direction Control
2. Calle 18 Este	1+06	106	2	13.0	22.0	Non-Signalized
3. Calle 19 Este	1+86	80	2	13.0	22.0	Non-Signalized
4. Calle 22A	2+62		2	15.0	29.0	Non-Signalized
-DO-				15.0	29.0	
5. Calle 21 Este	3+40	78	2	15.0	21.0	Non-Signalized
6. Ave. Justo Arosemena	4+18	78	4	13.0	21.0	Non-Signalized
7. Ave. Central	4+84	66	4	25.0	29.0	Non-Signalized
-DO-			4	25.0	29.0	
8. Ave. de los Martires	6+95	211	4	21.0	21.0	Non-Signalized
9. Ave. Nacional	9+85	290	6D*	30.0		Signalized
10. Ave. Frangipani to Gorgas Hospital	10+80	95	2	30.0	31.0	Signalized
			3		31.0	
11. Ave. Ascanio Villalaz	16+59	579	2			Signalized

Note: ,D in Lane No.: Divided

In the year 2000, a traffic of 30,000 to 40,000 vehicles per day is expected to flow on Gaillard Road to Ave. B intersection (see traffic demand estimate for the year 2000 in Fig. III-3-27). Intersection with Ave. De Los Matires will have the heaviest traffic flowing into the intersection, 104,000 vehicles per day or about twice the present level. The second heaviest is 103,000 vehicles per day or about 1.2 times the present level at Cinco de Mayo intersection.

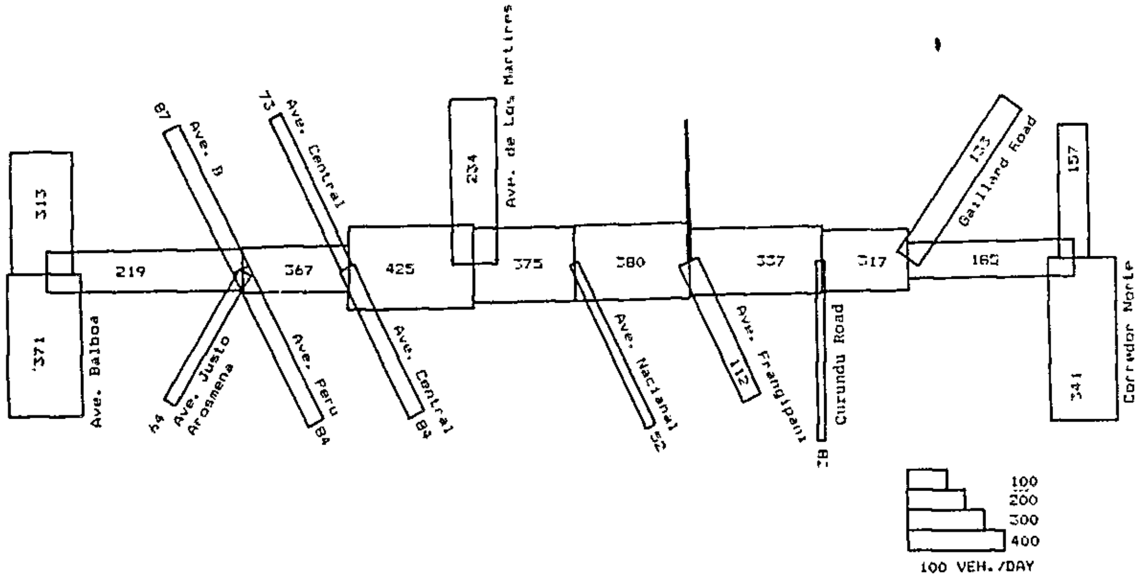


Fig. III-3-27 TRAFFIC DEMAND ALONG VIA CERRO ANCON IN THE YEAR 2000

5) Maranon Area Route Plan

In Calidonia, east of Maranon Renewal Area, five streets run parallel to each other between Ave. Peru and Ave. Balboa along the coast forming square blocks. Ave. Central runs diagonally, however, and causes the following effects affecting block formation in Maranon Area:

a) Block orientation changes to be come parallel to Ave. Central rather than to Ave. Peru.

b) The number of parallel streets is forced to be fewer because of the narrower space between Ave. Central and Ave. Balboa.

The choice inevitable from a) above is between the two block orientations and that from b), which streets are to be retained for Maranon Renewal Area.

As for choice, a) one possibility is to extend Via Cerro Ancon from Cinco de Mayo to Ave. 12 de Octubre/ Ave. Balboa Intersection in line with the block orientation in Calidonia, and the other possibility is to extend Via Cerro Ancon from Cinco de Mayo to Ave. 3 de Noviembre/ Ave. Balboa Intersection with emphasis on the existing block orientation. The heterogenous block area size and shapes to result from the former plan will constitute limitations to future development planning, and the latter is adopted.

As for b), Ave. Justo Arosemena is retained as the arterial of the area, because it is central of the five parallel streets, joins with Calle 50, and is of service for a long distance. Also, Calle 19 is to be retained as the access to Cinco de Mayo Bus Center, because the interval between Ave. Justo Arosemena intersection and Ave. Balboa intersection is otherwise too long at 420m.

Because any further sub-division of blocks in Maranon Area will restrict the present formulation of Maranon Renewal Plan by MIVI, only the above mentioned streets will be considered for intersection. Any additional local road will be subject to the future progress of development.

3.3.2 Geometric Design

1) Standard Cross Section

On one side of the section from Gaillard Road to Ave. Frangipani are the Central Agricultural Market and the motor pool of the Canal Commission, and on the other side runs the Panama Railway track, whose terminal is Ancon Station in front of the Market (see Fig. III-3-28).

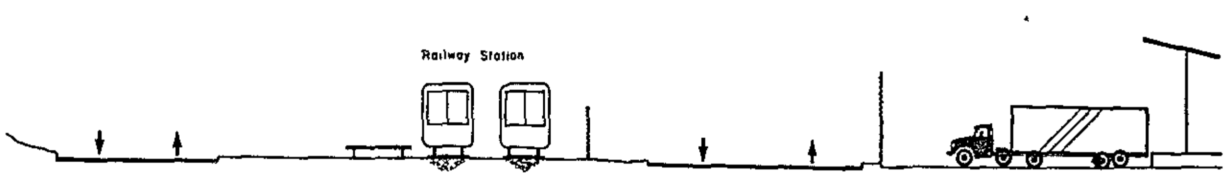


Fig. III-3-28 EXISTING CROSS SECTION OF VIA CERRO ANCON(1)

Because the space kept by the Market on Gaillard Road side is planned as a space for turning trucks, relocation of the Market will have to be considered if the space needs to be cut in further. The motor pool is used for Canal operation.

In view of this situation and for the following reasons, standard cross section of this road section will be that which utilizes the right-of-way of Panama Railway (see Fig. III-3-29):

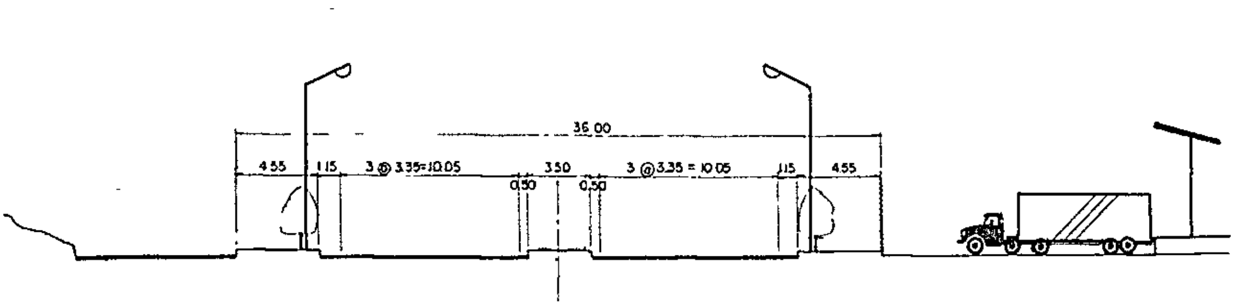


Fig. III-3-29 WIDENED CROSS SECTION OF VIA CERRO ANCON(1)

a) A newly constructed container yard has been in operation in Albrook area, and Ancon Station is no longer as important as it used to be as the freight station for unloading goods for the Market.

b) The function of Ancon Station may be absorbed by Balboa Heights Station in view of the fact that the train branches off to the container yard from a point between the two stations.

In the section from Ave. Nacional to Ave. de Los Martires, Calle M runs along the road, with a grade difference, (see Fig. III-3-30) and the other side of the road is subject to land limitation. Standard cross section for this road section will utilize Calle M (see Fig. III-3-31).

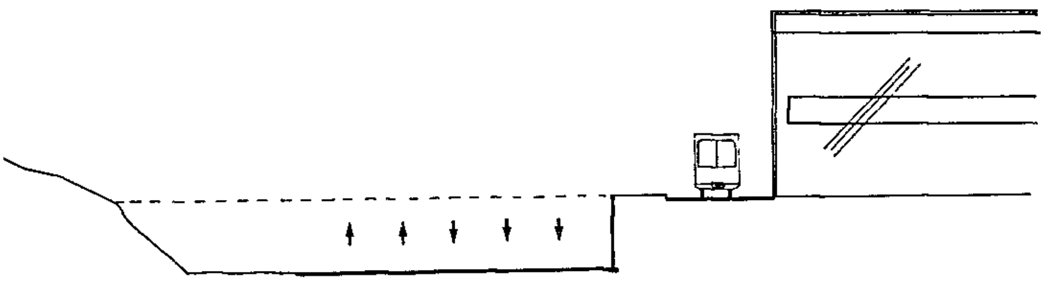


Fig. III-3-30 EXISTING CROSS SECTION OF VIA CERRO ANCON(2)

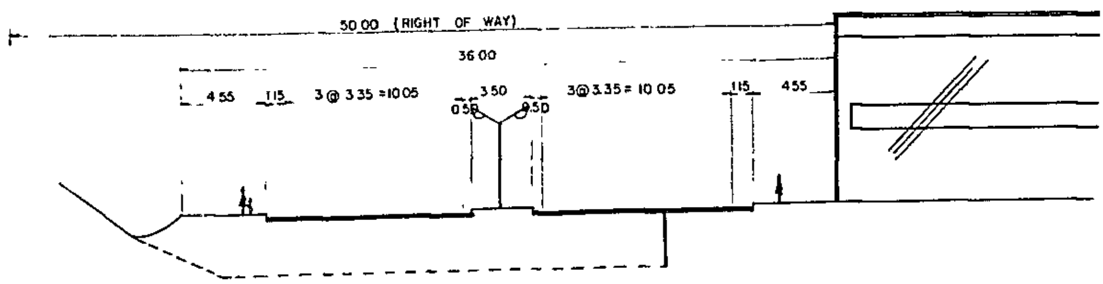


Fig. III-3-31 WIDENED CROSS SECTION OF VIA CERRO ANCON(2)

2) Road Alignment

At the Cinco de Mayo Intersection, the horizontal alignment is designed with two reversed circular curves with a radius of 200m. Although this alignment is off the standard in that no transition curve is placed between said two circles, the alignment shall not be corrected because the radii of two circles are within the standard range and because of the limitation due to the presence of Fiduciario Bank building and the built-up area along Ave. Central.

This is a flat land, and vertical alignment design involves no particular problem. The height of Via Cerro Ancon will be brought to the same height as Calle M, which runs parallel, in order to facilitate access from roadside areas.

3) Intersection Plans

Peak hour traffic volume in each direction at major intersections is shown in Fig. III-3-32. A part of Via Cerro Ancon will be newly constructed and, therefore, no comparison can be made with the existing situation. Traffic flow will substantially change even on the existing roads after improvement. Therefore, intersections shall be studied in the light of traffic flow estimated for the year 2000. The signal phases applied to each intersection is shown in Fig. III-3-33.

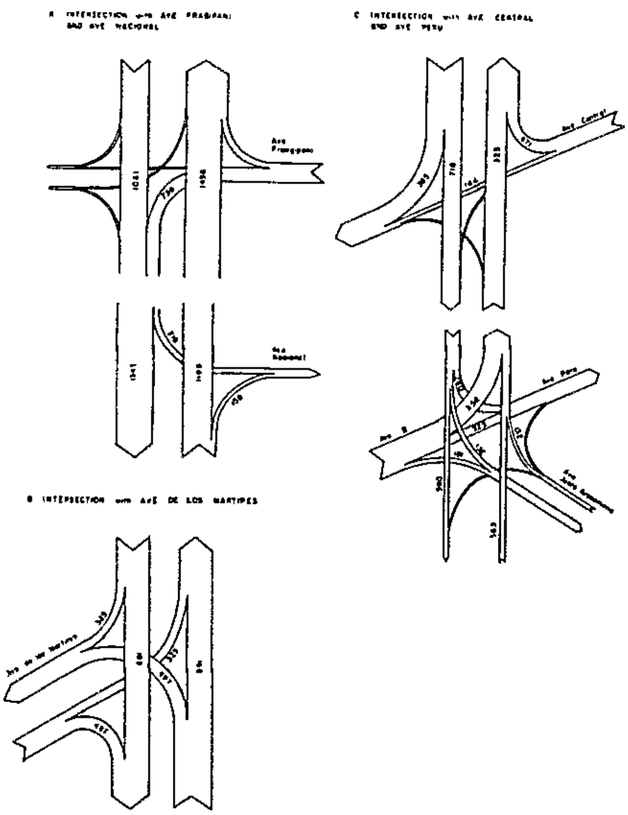


Fig. III-3-32 PEAK HOUR TRAFFIC FLOW AT MAIN INTERSECTION ALONG VIA CERRO ANCON

(1) Ave. Balboa Intersection

Straight traffic on Ave. Balboa in the direction of Centro will become critical. Traffic on Ave. 3 de Noviembre, which will be improved to a part of Via Cerro Ancon, is presently allowed only to make right-turn so as not to hinder this straight flow of traffic, and saturation rate is calculated at 0.86. The plan is to make this a 4-leg intersection by connecting Ave. Eloy Alfaro, which comes from the public market nearby.

(2) Cinco de Mayo Intersection

This intersection will become an irregular 7-leg intersection with the connection of Ave. Justo Arosemena, but, because Ave. Central and Ave. B are one-way streets, the number of approaches to the intersection will be five. The intersection saturation rate is calculated at 0.89, but some degree of traffic congestion is expected. Saturation rates for various phases will be about the same, and the widening of any single approach will not result in a substantial improvement of the capacity.

The longest distance within the intersection will be about 150m, and, therefore, the all-red time used to clear all traffic off the intersection will have to be eight seconds and five seconds, respectively, on each phase. Traffic turning left from Ave. Central and from Ave. B will follow the outer circle path of flow, and sufficient queueing spaces will be needed. Two left-turn lanes are needed at the approaches of these roads.

(3) Ave. de Los Martires Intersection

The ratio of turning traffic to all traffic entering this intersection is high at 23%. To provide for this, two exclusive left-turn lanes on Via Cerro Ancon for traffic from Centro and two each right-turn and left-turn lanes on Ave. de Los Martires will be necessary. The intersection capacity will be adequate in view of the saturation rate calculated at 0.86. Exclusive right-turn lane on Via Cerro Ancon for traffic from the direction of Corredor Norte will be laid along the existing road and will be designed with a gentle curve of a 90m radius.

(4) Ave. Frangipani/Ave. Nacional Intersection

With the addition of an access to the inter-urban bus terminal which DINTRAT is planning to establish behind the Central Agricultural Market, this intersection will become an irregular 6-leg intersection. However, because Ave. Frangipani and Ave. Nacional are one-way streets and Ave. Roosevelt is only a local street with light traffic, the intersection capacity will be adequate for the traffic, with saturation rate of 0.85. In planning this intersection, the following points are taken into consideration.

a) Traffic entering the intersection from Ave. Frangipani should stop before Calle M so as not to hinder buses entering and leaving the terminal, but to do so will entail a long crossing distance of about 100m at maximum. Therefore, at least five seconds of all-red time will be needed in the signal phase for clearing the intersection of all traffic.

b) A sufficient queueing space must be provided for traffic making left-turn from Ave. Cerro Ancon, which will follow the outer circle path of flow.

c) In order to improve the intersection capacity, an all-time exclusive right-turn lane should be provided on Via Cerro Ancon for traffic from Centro.

(5) Curundu Road Intersection

Straight traffic on Via Cerro Ancon will represent 90% of traffic entering the intersection, and the volume of turning traffic will be small. The capacity will be adequate with the saturation rate of 0.54.

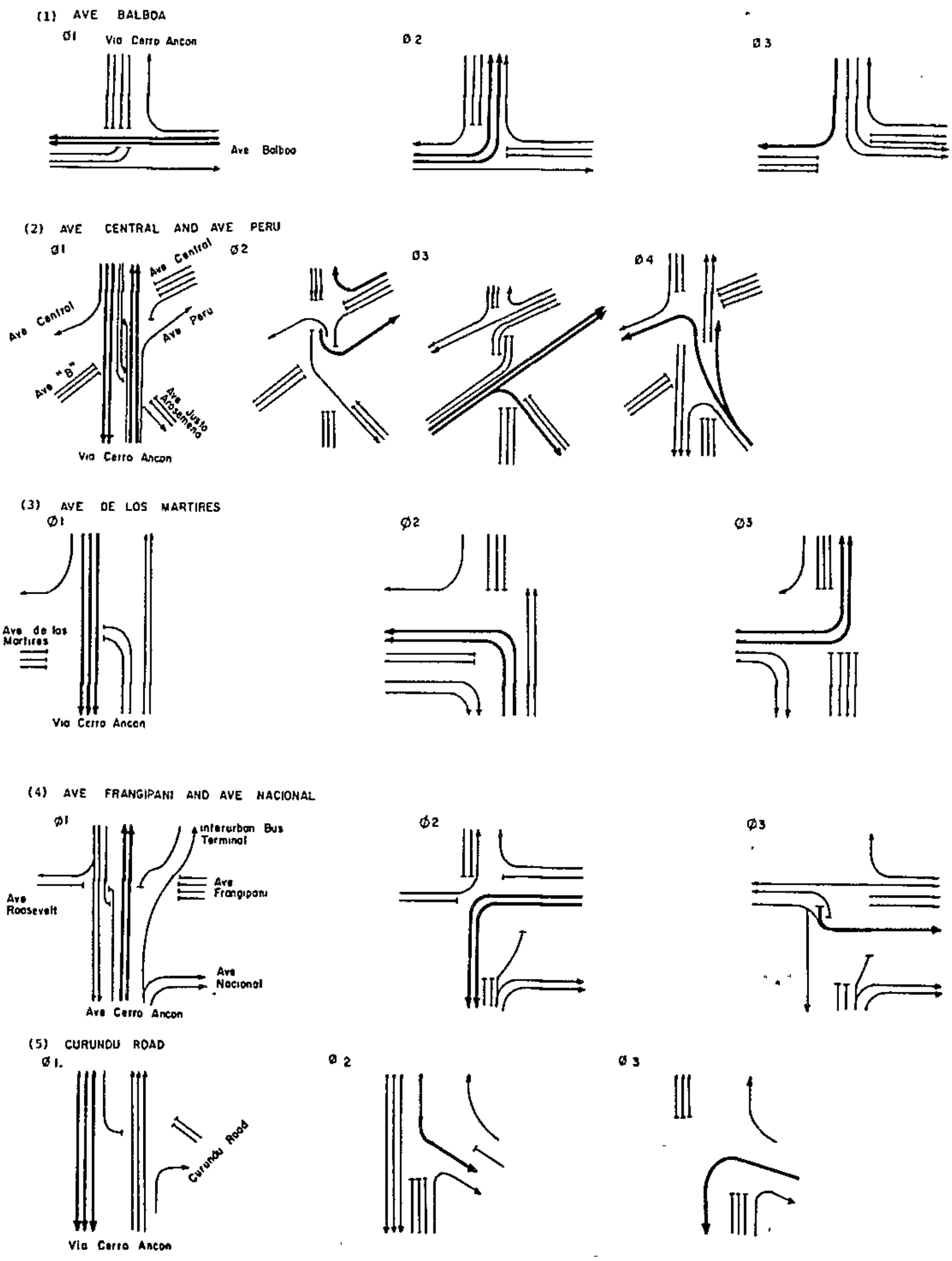


Fig. III-3-33 SIGNAL PHASING AT INTERSECTIONS ALONG VIA CERRO ANCON

3.4 Via El Paical

3.4.1. Land Use and Access Condition

1) Present Roadside Land Use

Automobile related service industries are seen on both sides of Via El Paical in the area close to Transistmica. Approaching Via Ricardo J. Alfaro,the land on the east side of the road gradually specializes as a housing area, while hills on west of the road is retained by MIVI for future housing development. In the north of Via Ricardo J. Alfaro, restaurants, warehouses, and other commercial facilities are situated. Neat housing lots cover the area toward Rio Curundu, forming a medium density area of 1 or 2 story single family houses.

2) Future Prospect

Roadside type commercial activities will gradually expand from El Dorado area to the large vacant space existing near Via Ricardo J. Alfaro Intersection to form a developed commercial area because of the intersection of two major roads.

3) Remarks for Road Plan

Via El Paical was connected to Curundu Road in Albrook upon the completion of Juan Pablo II in 1983. When Corredor Norte and Via El Paical Extension is completed, traffic on Via El Paical will further increase. Increase of commercial functions along this road is predicted, but, as for those which will remain as residential areas, the installation of buffer green belts and other environmental measures will become necessary.

4) Intersections

Via El Paical is a 2-lane undivided road. Because both sides of the road are used for housing purposes, the roadside areas are divided into relatively small blocks, and a total of eleven intersections exist at the average intervals of 180m within the project section of about two kilometers. Of the 11 intersections, intersections with Via Bolivar and with Via Ricardo J. Alfaro are intersections of two major roads and are to have signals. The remaining nine intersections will not have signals. These existing intersections are listed in Table III-3-8.

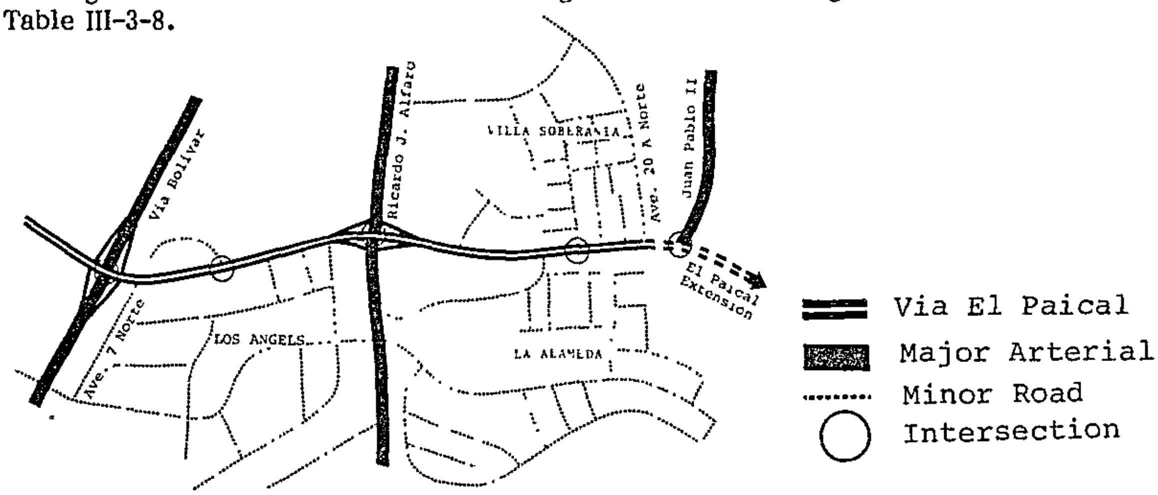


Fig. III-3-34 ROAD NETWORK ALONG VIA EL PAICAL

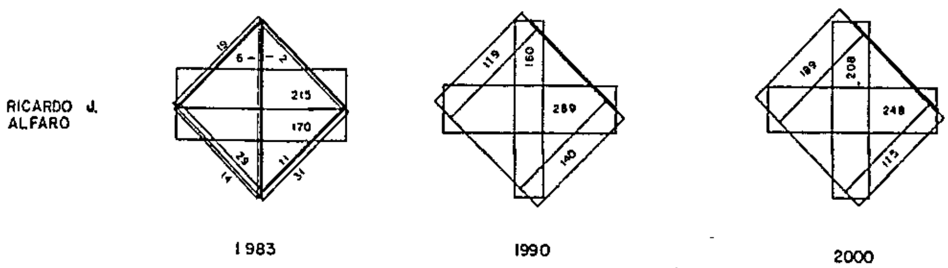
TABLE III-3-8 EXISTING INTERSECTIONS ALONG VIA EL PAICAL

No.	Name of Side Road	Station	Dist (m)	Lane No.	R.O.W	Const. Line(m)	Control
1.	Ave. Simon Bolivar	0+00		4D	60.96	60.96	Signalized
	-DO-			4D			
2.	Ave. 7 Norte	0+80	80.0	2	15.0	20.0	Non-Signalized
	-DO-			2	15.0	20.0	
3.	Ave. 7 Norte	2+82	202.0	2	11.0	20.0	Non-Signalized
4.	Calle 9A Norte	3+91	109.0	2	11.0	20.0	Non-Signalized
5.	Calle 10A Norte	4+71	80.0	2	10.0	20.0	Non-Signalized
6.	Ave. 11A Norte	5+43	72.0	2	15.0	20.0	Non-Signalized
7.	Via Ricardo J. Alfaro	6+40	97.0	4D	32.0	60.0	Signalized
	-DO-			4D			
8.	Ave. 17A Norte	8+56	216.0	2	10.0	20.0	Non-Signalized
9.	Calle 62B Oeste	10+54	198.0	2	10.0	20.0	Non-Signalized
10.	Ave. 19A Norte	11+41	87.0	2	15.0	20.0	Non-Signalized
11.	Ave. 20A Norte	11+98	57.0	2	10.0	13.0	Non-Signalized

Note: D in Lane No.: Divided

In the future, intersections of two major roads will continue to be, but between them is a long distance of about one kilometer with a continuos center median preventing road crossing. For providing service to housing areas on both sides of Via El Paical, the distribution of intersections shall be arranged as shown in Fig. III-3-34.

Upon the opening of Corredor Norte, traffic on Via El Paical is estimated to increase by four times from the present 7,500 vpd to 28,000 vpd in 1990. As for Via Ricardo J. Alfaro, which presently has a heavy traffic, the volume of traffic entering or leaving this road will not change much in the future, but straight traffic will decrease while turning traffic will increase. Traffic entering or leaving that intersection will increase from the present 109,000 vpd to 136,000 vpd by 1990, and 152,000 vpd by the year 2000. See Fig. III-3-35 for average daily traffic data.



UNIT: 100 VEH./DAY

Fig. III-3-35 TRAFFIC FLOW AT INTERSECTIONS ON VIA EL PAICAL

3.4.2 Geometric Design

1) Standard Cross Section

The existing right-of-way of Via El Paical is 20m wide from Via Bolivar to Via Ricardo J. Alfaro and 15m wide in Villa Soberania Area from Via Ricardo J. Alfaro to Rio Curundu. Construction line is of a 30m width throughout the entire extension of the road. In Villa Soberania, (on the west side of Via El Paical) houses are built inside the construction line and close to the right-of-way.

In this situation, two standard cross sections are possible for improving Via El Paical as a 4-lane road. One is that which will generally fit the existing right-of-way space (see Fig. III-3-36). The other is one which will provide a sidewalk and shoulder as a buffer zone between the road and roadside houses and a center median wide enough to be able to install an exclusive left-turn lane for the smooth flow of traffic (see Fig. III-3-37). In the future, Via El Paical will have a heavy traffic as a major north-south street through Panama urban area, and as such, it should have a suitable cross sectional structure. Therefore, the latter cross section will govern the plan in the long run, but, in view of the difficulty of land acquisition needed for its implementation, the former cross section may be used for the time being, despite the possible impact of a large volume of traffic upon the roadside houses.

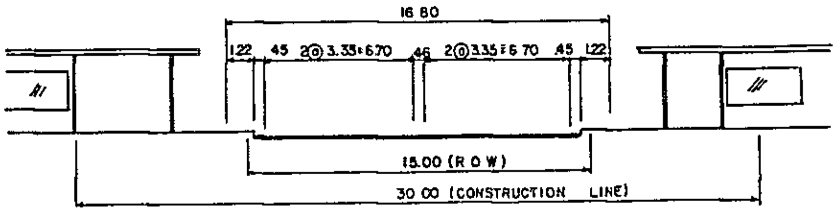


Fig. III-3-36 SHORT TERM CROSS SECTION OF VIA EL PAICAL

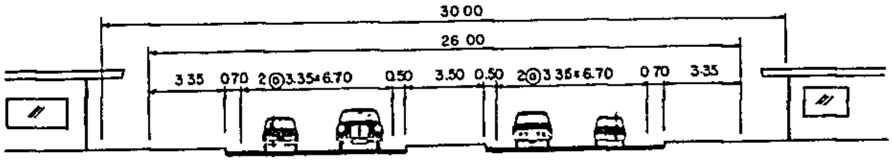


Fig. III-3-37 LONG TERM CROSS SECTION OF VIA EL PAICAL

An undesirable small curve with a radius of 120m exists at Via El Paical/Via Bolivar intersection. A transition curve will be inserted to the extent permissible from building situation in the area. In the section near Via Ricardo J. Alfaro intersection, Via El Paical will be widened toward the unexploited land owned by MIVI, rather than toward the other side of the road where houses exist.

In Villa Soberania Area, widening of the road toward Villa Soberania side, requiring compensation for 10 houses, is believed the more economical than to La Alameda side (25 houses) or to both sides (35 houses). However, because it is known to the Municipal Office that houses are built beyond the construction line and close to the right-of-way, despite application to build outside the construction, the road shall be widened toward La Alameda side.

The existing vertical alignment in Villa Soberania constitutes a crest of gradients of 5.7% and 6.6% which, although within the tolerable range in terms of gradient, shall be corrected in order to achieve a more desirable sight distance. Level difference between the existing and corrected vertical alignment will be about 1m at the most, which will not disturb access to the housing area.

3) Intersections

(1) Ricardo J. Alfaro Intersection

Via Ricardo J. Alfaro's access to this at-grade intersection, initially conceived of as a 4-lane road consisting of three straight traffic lanes and one exclusive left-turn lane, will have a calculated saturation rate of 1.35 in the year 2000 (see Fig. III-3-38 for saturation rates for various years and for each alternative). Also, this approach will be short of achieving a smooth continuity with the normal section of Via Ricardo J. Alfaro; therefore, grade separation will be necessary.

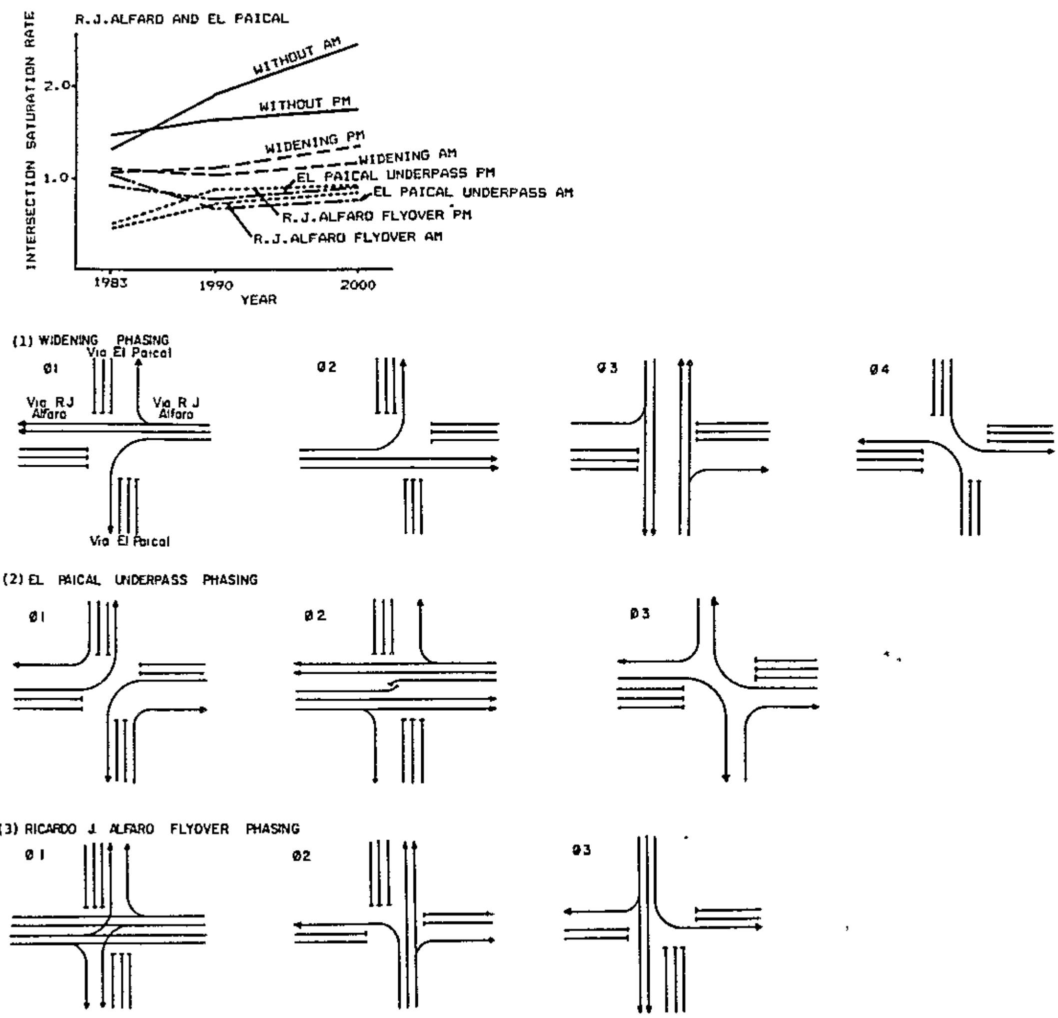
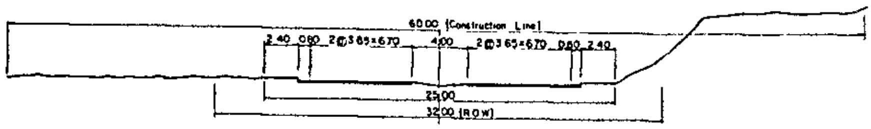
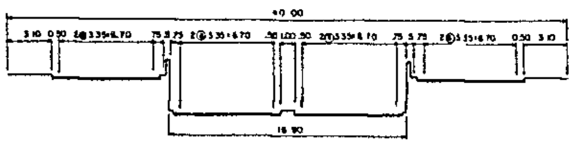


Fig. III-3-38 SATURATION RATE AND ALTERNATIVE SIGNAL PHASING AT RICARDO J. INTERSECTION

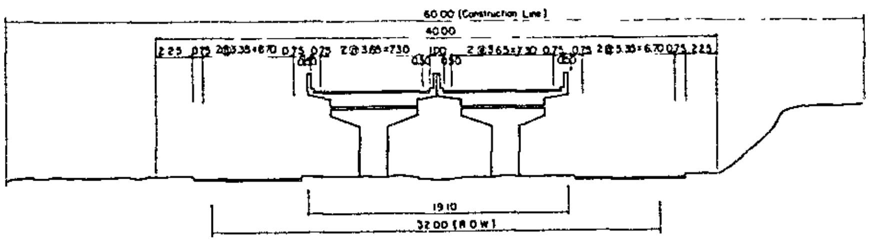
This grade separation shall be achieved by Via El Paical underpassing Via Ricardo J. Alfaro for the reasons of its higher desirability from the standpoint of road network, little problem in handling traffic during the construction work, and less land space problem, as revealed through the comparison of this plan against the alternative of Via Ricardo J. Alfaro overpassing Via El Paical (see Fig. III-3-39 for the standard cross sections of the two alternatives and Table III-3-9 for their comparison).



(a) EXISTING CROSS SECTION OF VIA RICARDO J. ALFARO



(b) VIA EL PAICAL UNDERPASS SECTION



(c) VIA RICARDO J. ALFARO FLYOVER SECTION

Fig. III-3-39 ALTERNATIVE TYPICAL CROSS SECTIONS AT RICARDO J. ALFARO INTERSECTION

(3) Other Intersections

At no other intersection will Via El Paical cross other major roads. All other intersections have and will have light traffic and, therefore, a sufficient capacity. Table III-3-10 gives the volume of traffic that can cross the intersection without signals.

TABLE III-3-9 COMPARATIVE EVALUATION OF GRADED INTERSECTIONS WITH RICARDO J. ALFARO

Description	Via El Paical Underpass	Via R. J. Alfaro Flyover
1. Saturation Rate		
1983 am	1.05	0.45
pm	0.44	0.49
1990 am	0.66	0.74
pm	0.77	0.83
2000 am	0.79	0.82
pm	0.87	0.09
2. Additional Land required	25m (under development) 20m (MIVI Area)	8 m (Development)
3. Affected Build	None	1 Flat 1 Movie Theater
4. Main Structure	PC Precast Beam L=17m	PC Composite Girder 5 @ 30.0=150.0
5. Detour During Construction	No special detour Is needed	Temporary detour route Is needed
6. Flyover/underpass Section Length	317m	394m
7. Affected Side Road	None	Calle 62 Oeste
8. Drainage	Pump System may be Drainage Pipe L=150.0	None

TABLE III-3-10 SIDE FLOW AND DELAY TIME ALONG VIA EL PAICAL

SECTION	VIA BOLIVAR - R. J. ALFARO			R. J. ALFARO - LA AMISTAD		
Year	Main Flow veh./h.	Av. Delay Time sec.	Possible Side Flow veh./h.	Main Flow veh./h.	Av. Delay Time sec.	Possible Side Flow veh./h.
1983	7368	2.1	1706	10876	4.5	808
1990	22786	21.3	168	27881	37.0	97
2000	32367	59.1	60	30273	47.5	75

Note: PHF= 0.9 CRITICAL GAP= 5.0 sec.

3.4.3. Structures

Via Ricardo J. Alfaro/Via El Paical intersection shall be grade-separated by making Via El Paical a semi-underground road underpassing Via Ricardo J. Alfaro.

This intersection occurs on a hillside slope: Via Ricardo J. Alfaro slopes down toward San Miguelito with the gradient of 1.5% to 2.5%, while Via El Paical inclines toward Corredor Norte generally by 4% but with a steeper 8% to 10% gradient near the intersection. Soil down to 1.0m is embankment and further down to 11.0m is silty sand with N-value ranging from 50 to 100.

Given these conditions, possible alternatives for grade separating the intersection are (1) Via Ricardo J. Alfaro overpassing Via El Paical by a bridge and (2) Via El Paical underpassing Via Ricardo J. Alfaro. In the case of overpass, from the reasons of the paths of traffic flow within the intersection, the maximum span will be 30m and the bridge length will be 150m. For the superstructure, simple composite PC girder type is advantageous from the reasons of economy and facility of construction. The underpass system will require a short span bridge of 17m long and 70m wide at the intersection, and for the semi-underground portion, U-shape and reverse-T shape retaining walls.

Traffic volume on Via El Paical is presently light and can be blockaded during the construction work, but not on Via Ricardo J. Alfaro; therefore, the alternative of underpasss will facilitate easier provision of a detour for traffic during construction. An overpass will be undesirable because of effect of traffic noise to many houses existing near the intersection. Thus, the alternative of underpass is adopted.

3.5. San Miguelito Intersection

3.5.1. Land Use and Accesss Condition

1) Present and Future Roadside Land Use

San Miguelito District has rapidly grown as a residential area since the 1960s and had a population of 157,000 in 1980. The housing development took place in three ways: (a) houses for low income earners developed by MIVI under the names of Torrijos Carter, Roberto Duran and Santa Librada, (b) houses built by private developers, and (c) squatter sheds on hillside slopes such as in Area de Paraiso, Amelia Denis de Icaza and Samaria.

In San Miguelito District, large scale residential developments are forcasted but has not yet been done in La Pulida Area and Cerro Viento Area along Via Domingo Diaz, and in Los Andes No.2 along Via Transistmica. The former two will form a new city with a population of 100,000 in the future according to ESTAMPA Masterplan.

As a result, new residential development will spread toward the area along Via Domingo Diaz and population will gravitate toward east.

A plateau stands close to the intersection in its northwest corner, while flat land extends in three other corners. In addition to sporadic wood workshops and glass processing factories, single family houses stand side by side and cover a wide area. Near the intersection are restaurants, supermarkets, service stations, and other commercial facilities. In the future, a bus center will be constructed and population of San Miguelito district will be doubled as estimated by ESTAMPA Masterplan. It is, therefore, believed that the intersection area will grow as one of the commercial nucleus of San Miguelito District.

The remodelling of this intersection will bring no particular direct impact upon the vicinity. However, certain pedestrian facility across the intersection will have to be considered for use by the neighborhood inhabitants and bus passengers at the same time of improvement of intersection.

2) Road Network and Traffic Volume

Transistmica is the only road which connects northern Panama with the built-up area, and it has no detour route, Via Domingo Diaz is the trunk road which connects eastern Panama with the built-up area. For this reason, traffic from Transistmica converges on the intersection and morning peak hour coefficient is relatively high at 12% (in 1983). On the other hand, peak hour coefficient for Via Domingo Diaz is a normal 9% (1983), because of the presence of a major road connecting it with Via Espana which runs parallel to it.

The volume of traffic entering into San Miguelito Intersection will change substantially twice in the future. The first occasion will be when Corredor Norte in the Reverted Area is opened and connected with Transistmica. The traffic flowing from Transistmica into San Miguelito Intersection will be absorbed by Corredor Norte, and the intersection traffic will decrease. Subsequently the intersection traffic will resume, but when Corredor Norte is extended up to Pedregal area, it will again decrease because traffic flow from Tocumen area will be absorbed by Corredor Norte. The volume of traffic entering the intersection and the volume of traffic in each direction at each of these stages are shown in Figs. III-3-40 and III-3-41.

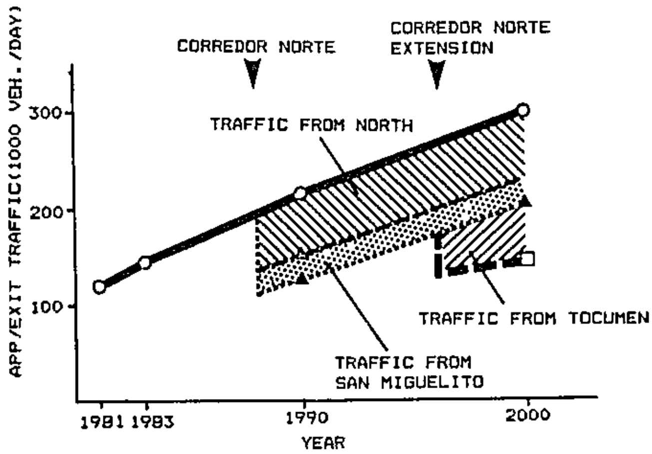
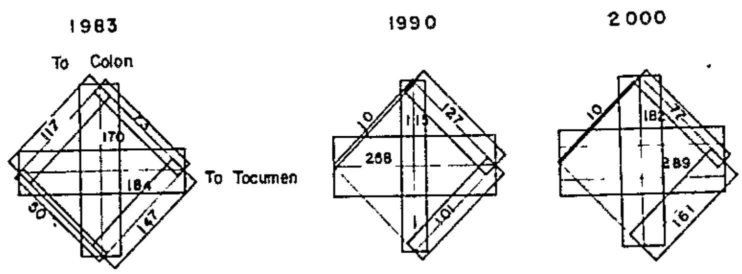


Fig. III-3-40 TRAFFIC DEMAND AT SAN MIGUELITO INTERSECTION



UNIT: 100 VEH./DAY

Fig. III-3-41 TRAFFIC FLOW AT SAN MIGUELITO INTERSECTION

Although the present saturation rate of San Miguelito Intersection is already up to the limit as calculated at 1.2 in morning peak hour, demand is predicted to increase in the future, and improvement of the intersection is desirable. The addition of one traffic lane each, as an improvement alternative, to Transistmica - Via Bolivar and Via Domingo Diaz - Via Ricardo J. Alfaro, which presently are 4-lane roads consisting of two straight traffic lanes and one each exclusive right-turn and left-turn lane, will result in some improvement of saturation rate but not in an adequate improvement of the capacity(see Fig. III-3-42).

Corredor Norte within the Reverted Area will involve no particular land acquisition problem, but land acquisition for Corredor Norte extention will require certain time period. The saturation rate calculated under the assumption that Corredor Norte extension will not be completed by the year 2000 is worse than the present rate of 1.3, even with the road widening as discussed in the above. Thus, the grade separation of San Miguelito Intersection is recommended.

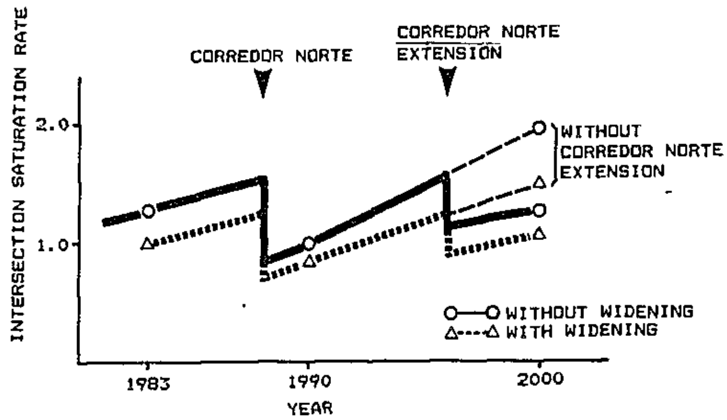
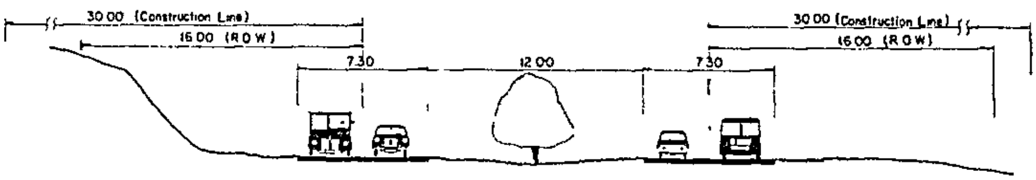
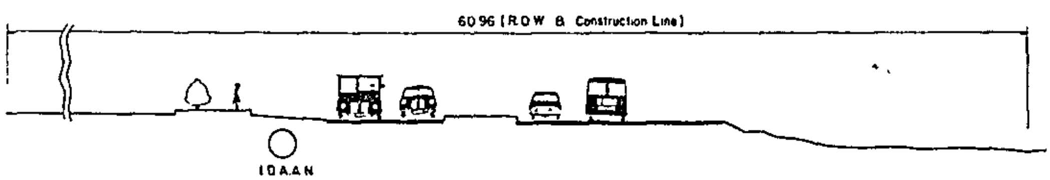


Fig. III-3-42 SATURATION RATE OF WIDENING SOLUTION

The right-of-way and construction line of Transistmica are both 30.48m from its center line, while those of Via Ricardo J. Alfaro are 16.0m and 30.0m, respectively, from the center lines of the existing divided carriageways (see Fig. III-3-43). These right-of-way widths are adequate for their widening or grade separation. Standard cross sections for widening and grade separation are shown in Fig. III-3-44.



(a) VIA RICARDO J. ALFARO



(b) TRANSISTMICA

Fig. III-3-43 EXISTING CROSS SECTIONS AT SAN MIGUELITO INTERSECTION