1-2 VERTICAL ALIGNMENT

(1) Concept for Vertical Alignment

Corredor Sur can be divided into the section to be widened and the new construction section. For the widening section, the alignment should be adjusted to the existing profile in relation to the built-up area. For the new construction section, three alternatives were examined, considering the type of crossing with main access roads, the characteristics of the road, the drainage system and the surrounding development pattern. (see FIGURE V-1-1)

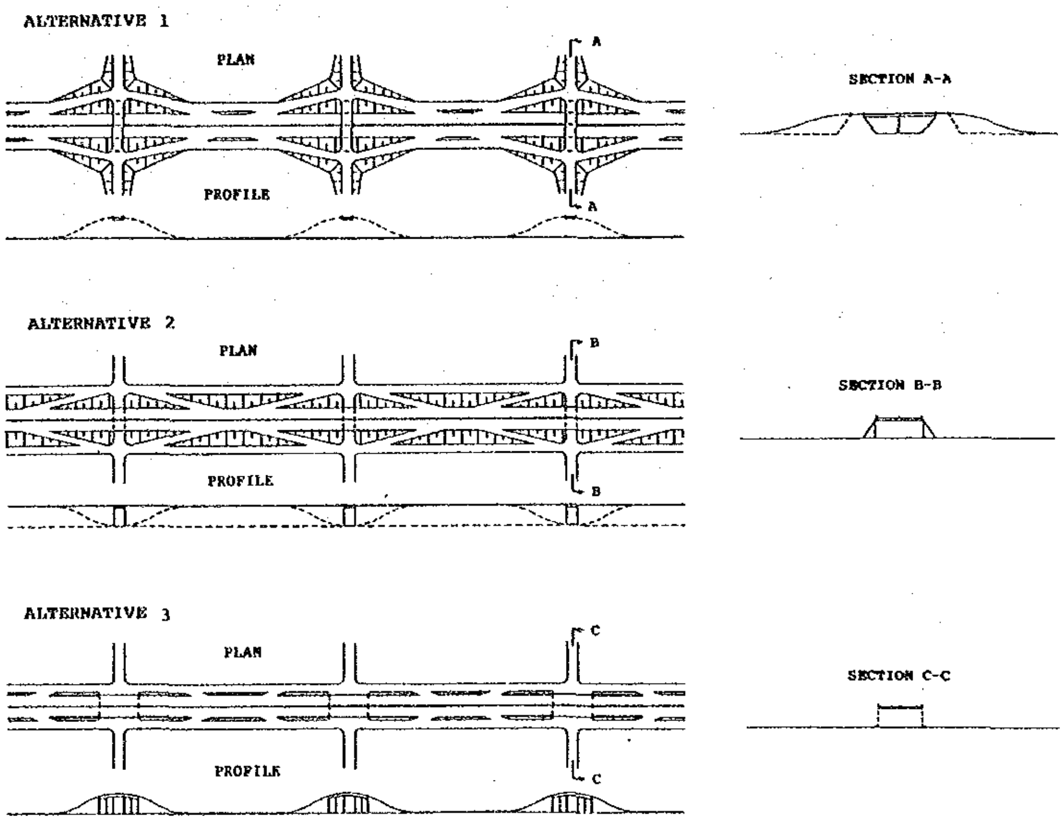


FIGURE V-1-1 ALTERNATIVE ROAD CROSSING TYPES AT CORREDOR SUR IN SUBURBAN AREA

(2) Vertical Alignment Alternatives of Corredor Sur in the Suburban Area

a. Alternative 1: Low embankment

The surface height of the carriage way of Corredor Sur will be the same as the future ground level which will be 2 or 3 meters higher than the existing ground. Main Access Roads cross above Corredor Sur.

b. Alternative 2: High embankment

The surface height of the carriageway of Corredor Sur will be 5 or 6 meters higher than the Main Access Roads' surface height and the future ground level in order to cross over them.

c. Alternative 3: Mixture of Low and High embankments

The vertical alignment will be the low embankment type in principle, however, Corredor Sur will pass over the Main Access Roads with the minimum geometric standard of vertical alignment.

(3) Comparison of Vertical Alignment Alternatives

From the view point of safety at high vehicle speeds required for Corredor Sur, Alternative 3 was eliminated because of its relatively poor geometric structure.

For the comparison between the low embankment type (Aletrnative 1) and the high embankment type (Alternative 2), the following items, such as roads, adjacent land use, tentative partial openings, width of the right-of-way, construction methods, construction costs and so on, were discussed.

a. Land use near intersections

In the case of Alternative 2, the area near direct access intersections with Main Access Roads can be easily developed. While, in the case of Alternative 1, the land should be filled to the same height as that of the raised Main Access Roads or a sloped access to to the Main Access Roads should be provided for the ease of entrance into the area near intersections.

b. Tentative partial opening

For the implementation of partial opening by stages, at the construction stage of Corredor Sur and the Main Access Roads, Alternative 1 is more convenient.

c. Width of the right-of-way

According to the type of embankment structure, the right-of-way secured for road construction for Alternative 1 is 15 % narrower than that for Alternative 2.

d. Construction method

Alternative 2 requires more materials for embankment than Alternative 1. A huge volume of materials, which is available from the rocky hills in the hinterland of Panama City, can be assumed to be in sufficient supply.

e. Construction cost

If the crossing for main access roads were provided at about 2 Km. intervals on Corredor Sur, the embankment cost of Alternative 1, which requires fewer materials, would be one half of the other, and the total construction cost of Alternative 1, including structure cost, is estimated at 12 % lower than that of Alternative 2.

From the above evaluation, Alternative 1 should be selected as the vertical alignment for Corredor Sur in the suburban area.

1-3 PAVEMENTS

1-3-1 Pavement Type

Concernig the pavement types used in Panama, cement concrete pavement is used more than asphalt concrete pavement. In the recent past, the road pavement, which MOP has been using, is mainly cement concrete or an asphalt overlay on the cement concrete pavement. The asphalt concrete pavement does not include bituminous treatment.

The cost comparison between cement concrete and asphalt concrete, as examined in the ESTAMPA II, indicates that the cement concrete pavements are more economical than the asphalt concrete pavements in the Panama Metropolitan Area.

For the above reasons, concrete pavement shall be specified for the roads. However, asphalt concrete pavement could be used in the low swamp areas where settlement is anticipated, such as in the Rio Juan Diaz and Rio Matias Hernandez basins, etc. As an exception, in the case of widening existing roads overlaid with asphalt concrete on cement concrete, asphalt concrete pavement should be applied in order to maintain the continuity of the surface condition.

1-3-2 Pavement Design Criteria

Various types of pavement shall be designed in accordance with the "Interim Guide for Design of Pavement Structures, 1972." of AASHTO. The various factors for pavement design were examined as follows:

(1) Regional Factor

AASHTO recommends a value within a range of 0.5 to 4.0 as a regional factor, according to the climate. The value of 1.0 is adopted in the Study for Panama , where the temperature rarely changes 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 traffic. AASHTO recommends the serviceability index of 2.5 for arterials and 2.0 for other roads. For the roads subject to the Study, which are arterials for accommodating a relatively large volume of traffic, the index of 2.5 is applied.

(3) Traffic Volume and Axle Load

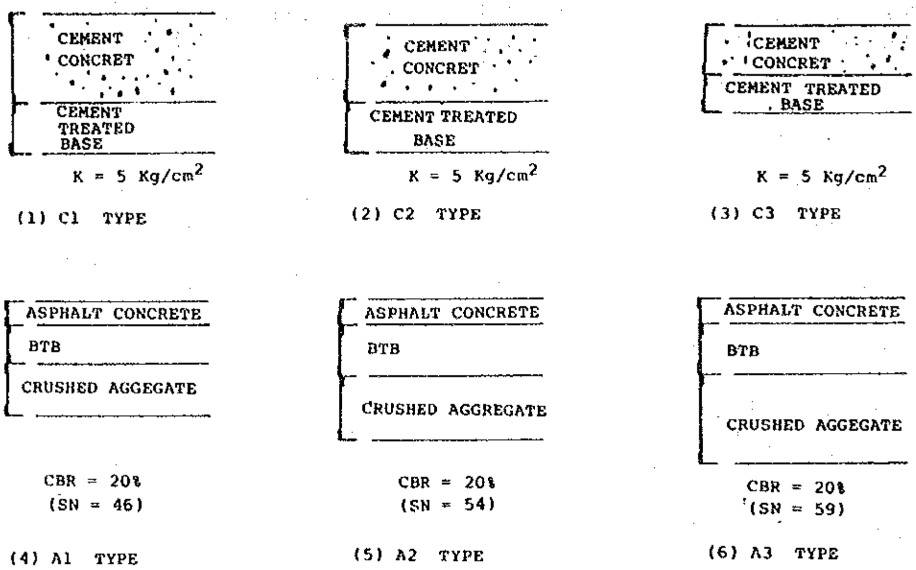
Traffic volume for a period of twenty years from the anticipated service year of 1990 shall be used. The traffic volume growth rate was calculated based on the the estimated traffic volumes for 1990 and for the year 2000. For the examination of the percentage of heavy vehicles, trucks and large buses which are categorized in the calculation of traffic volume estimation, were designated as heavy vehicles. Here, the vehicles mentioned above include those with the weight of five tons. For pavement design, four tons was determined as an average single axle load, which is the load indicated in the example of AASHTO as that assumed for a typical urban road.

(4) Subgrade

As for the asphalt pavement, the California Bearing Ratio (CBR) is used as the representative value of the bearing capacity of subgrade, as converted to a bearing coefficient (Soil Support Value). As for the cement concrete pavement, the K value of five kg/cm4 is used in the view of the fact 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 borrow pits. Where necessary, the subgrade shall be replaced in order to achieve these values.

1-3-3 Pavement Design

FIGURE V-1-2 gives the typical pavement element by calculating the required structural number (SN) for asphalt concrete pavement and the required thickness for cement concrete pavement, based on the traffic volume per route. For the conversion coefficients for calculating the required SN for the asphalt concrete pavement element, however, the values given in TABLE V-1-3 were used. The pavement summary per road is described as follows:



BTB Bituminous Treated Base Course

FIGURE V-1-2 PROPOSED PAVEMENT STRUCTURE

TABLE V-1-3 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) Corredor Sur

An improvement and expansion of the existing road between Cerro Ancon and ATLAPA is considered. The A-1 type is selected by considering the pavement joint with the existing road and road markings. Between ATLAPA and Rio Abajo Interchange there is a section of a new construction road, whose ground is also appropiate for using a cement concrete pavement. Therefore, the C-2 type cement concrete pavement is selected. The section between Rio Abajo and Don Bosco has a ground of riverwash stratum. Since a residual settlement of the ground after construction can be predicted, a flexible asphalt concrete pavement is required, so that the A-1 type asphalt concrete pavement has been chosen. Since the new construction section between Via Don Bosco and the Pan-American Highway passes through a hilly area, the use of the C-3 type cement concrete pavement is planned.

(2) Via E.T. Lefevre

Since this road considers the improvement and widening of the existing road, the use of the A-1 type asphalt concrete pavement was determined by considering the pavement joint with the existing road and road markings.

(3) Via San Miguelito-Chanis

There is a swamp between Corredor Sur and Villa Del Sol, while an expansion section of the existing road is planned between Villa Del Sol and Via Espana. For this reason, the use of the A-1 type asphalt concrete pavement is planned for these sections. Since there is a new construction road between Via Espana and Via Domingo Diaz, the C-3 type cement concrete pavement is adopted for use in this instance.

(4) **Via San Miguelito-Hipodromo**

The section between Corredor Sur and Via Espana is planned with the A-1 type asphalt concrete pavement, taking the ground settlement into consideration, while the C-3 type cement concrete pavement is planned for the section between Via Espana and Via Domingo Diaz.

(5) **Via Juan Diaz**

Similarly to Via. San Miguelito-Hipodromo, the section between Corredor Sur and Via Espana is planned with the A-1 type asphalt concrete pavement, while the C-3 type cement concrete pavement is planned for the section between Via Espana and Via Domingo Diaz.

(6) **Via Ciudad Radial**

Since the area between Corredor Sur and Via Ciudad Radial is a swamp, the A-1 type asphalt concrete pavement is planned for this area, while the C-3 type cement concrete pavement is planned for the section between Ciudad Radial and Via Domingo Diaz, considering the fact that this entire section will be newly constructed.

(7) **Via Don Bosco**

Since this road is a new construction on a hill, the C-3 type cement concrete pavement was selected for use throughout the route.

(8) **Corredor Sur Extension**

For the new construction section between Cerro Ancon and Ave. de los Poetas, the C-3 type cement concrete pavement was chosen, while the A-1 type asphalt concrete pavement was selected for the expansion and improvement section of Ave. de los Poetas.

1-4 DRAINAGE

1-4-1 Drainage Type

Since this project road is situated along the seashore, it crosses the existing drainage pipes at many points. In addition, it is necessary to conduct a study of drainage for the area located to the north of the proposed route of Corredor Sur.

(1) Sewer Drainage

The water drainage system in some parts of Panama City combines the storm sewer system with the sanitary sewer system and runs directly into a river or into the sea. Even in the rest of the City, where separated systems can be seen, no wastewater treatment plant is provided. The sewer drainage pipes most frequently seen are 80-inch diameter precast pipes which are reinforced at the site with concrete and buried underground almost at every road crossing at right angles to the proposed Corredor Sur route.

(2) Road Surface Drainage

The drainage pipes are generally buried under the sidewalks or medians to collect drainage water into drop inlets, which are then discharged directly into a river or into the sea. The drainage pipes are often used both as sewer pipes and storm sewer pipes.

(3) Rivers

The Rio Mataznillo and the Rio M. Hernandez are rivers which have been improved. For the former, the bank was reinforced with concrete and for the latter, the route of flow was diverted. The improvements for these rivers were based on the flood frequency for a span of 10 years or so; further studies need to be done using frequencies for a span of fifty years for the bridge design in this Study.

1-4-2 Drainage Design

(1) Sewer Drainage

The sewer drainage systems now in service have been planned so as to compensate the functions.

(2) Road Surface Drainage

Rainfall onto the road surface shall be collected into the drop inlets constructed between the shoulder and the sidewalk, and discharged safely into a river or into the sea. In the Study, 600 mm diameter pipes buried under the shoulder in parallel to the road, are planned.

(3) Drainage System in Area Behind Roads

The drainage systems in the areas behind roads shall be constructed with the structures crossing the roads. This study plans to carry out most such drainage by using the rivers crossing the roads.

Corredor Sur is located on a low land near the coast, so the rivers in the area are subject to a tidal effect. The study needs to consider these points:

a. Conditions of Examining the Cross Sections at River Crossing Points

(i) Flood frequency for a span of fifty years

(ii) Use of IHRE calculation method for estimating the stream volume in the 4.0 km^2 or more catchment area, as obtained from the correlation between the catchment area and the stream volume of the rivers in Panama.

(iii) Estimate of the stream volume in catchment areas of 4.0 km^2 or less from a rational formula, using a probable rainfall intensity derived from the Talbot's formula used in Panama

(iv) Calculating the velocity of flow, using Manning's formulas.

$$v = 1/n \ R^{2/3} * I^{1/2}$$

where: v = Velocity of flow
R = Hydraulic mean depth
I = Surface slope
n = Coefficient of roughness

(v) 0.5 m as an extra height of the embankment

(vi) An embankment height shall be determined for each river, taking into account the land use condition and ground height around the river crossing points.

b. Calculated Results

The planned width and embankment height as used in the calculation of each river are given in TABLE V-1-4. The proposed drainage facilities are given in TABLE V-1-5.

TABLE V-1-4 RIVER CROSS SECTIONS AT CROSSING POINTS WITH ROUTES

Name of River	Height of Dike	Width Dike	Width of River Bed	Stream Flow Velocity
Rio Mataznillo	4.5	23.0	12.0	4.0
Qbda. Santa Librada	4.0	20.0	14.0	4.0
Rio Abajo	4.5	30.0	21.0	8.0
Rio Matias Hernandez	5.9	43.0	37.0	2.5
Rio Juan Diaz	5.3	88.0	75.0	8.0
Qbda.la Gallinaza	-	5.0	5.0	3.3
Rio Tapia	-	19.0	10.0	3.3
Rio Juan Diaz (Access Road)	8.7	49.0	37.0	5.6

Source: ESTAMPA

TABLE V-1-5 PROPOSED DRAINAGE FACILITIES

Location			Catchment Area (Km2)	Flood Volume (M3 / sec)	Drainage Facilities
Corredor Sur					
STA.	31	Rio Mataznillo	11.1	* 267	Bridge
STA.	79	Qbda. Sta. Librada	4.6	153	Box Culvert 2 @ 10.0 x 3.5
STA.	97	Rio Abajo	22.5	240	Bridge L = 43.0
STA.	101	Rio M. Hernandez (1)	1.9	69	Box Culvert 6.0 x 3.5
STA.	114	Rio M. Hernandes (2)	21.0	230	Bridge L = 43.0
STA.	127	Hipodromo	1.7	62	Box Culvert 5.0 x 3.5
STA.	137	Torre de Radio	0.8	34	Box Culvert 4.5 x 3.0
STA.	145	Rio Juan Diaz	145.2	* 1250	Bridge L = 105.0
STA.	167	Ciudad Radial	1.2	49	Box Culvert 6.5 x 3.0
STA.	175	Qbda. Gallinaza (1)	3.75	112	Box Culvert 10 x 3.5
STA.	178	Qbda. Gallinaza (2)	2.1	70	Box Culvert 6 x 3.5
STA.	194	Rio Tapia	21.7	180	Bridge L = 30.0
STA.	201	Rio Tapia (B)	21.7	180	Box Culvert 6.0 x 3.0
STA.	206	Qbda.Mañanitas (1)	1.2	61	Box Culvert 6.0 x 3.0
STA.	213	Qbda.Mañanitas (2)	1.7	58	Box Culvert 6.0 x 3.0
Via E.T.Lefevre					
STA.	0	Qbda. Sta. Librada	1.0	36	Box Culvert 4.0 x 3.5
Via San Miguelito - Chanis					
STA.	12	Rio M. Hernandez	16.1	* 170	Bridge L = 35.0
STA.	19	Rio M. Hernandez	13.2	* 150	Bridge L = 35.0
Via Juan Diaz					
STA.	16	Juan Diaz	130.0	* 1100	Bridge L = 65.0
Via Don Bosco					
STA.	8	La Concepcion	1.7	55	Box Culvert 5.5 x 3.0

NOTE : * Calculated by the method of IRHE
Other Flood Volumes were calculated by Rational Formula.
Source: ESTAMPA

1-5 STRUCTURES

1-5-1 Design Criteria

Road structures in Panama are mostly designed by MOP based on the AASHTO Standard. The Study shall, in principle, conform to this as well. The principal design criteria are as follows:

(1) Load

1) Live Load

The AASHTO specifies three kinds of live loads, depending mainly upon the design traffic volume. Since the roads in the Study are arterial roads in the Panama Metropolitan Area, the heaviest load of HS20-44 (MS-18) shall be adopted.

2) Earthquake Forces

Although earthquakes do not occur frequently in Panama, they sometimes occur around the east of La Palma and the west of Puerto Armuelles. Earthquake forces are usually taken into consideration only in important structures in Panama City. This study shall also take earthquake forces into consideration and adopt a seismic coefficient of C = 0.06, the minimum in the AASHTO standard.

(2) Clearance

The AASHTO specifies a roadway width of 4.877 m (16 ft) (including the curbs) for horizontal clearance and a vertical clearance. Panama adopts 5.0 m for the vertical clearance of new bridges. The Study shall, in principle, adopt 5.0 m (See FIGURE V-1-3).

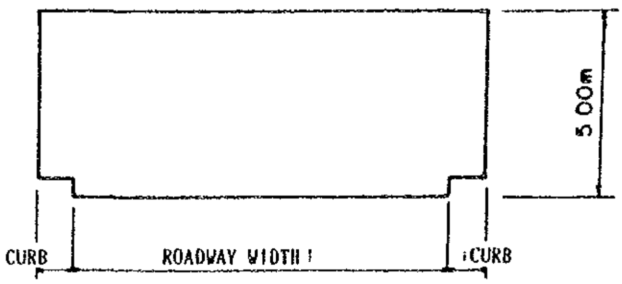


FIGURE V-1-3 BUILDING CLEARANCE

(3) Material Strength

The strength of concrete shall be determined by examination of the locality and the record of past work in Panama, and the strength of steel shall be determined in accordance with the ASTM. Each material strength is given in TABLE V-1-6.

TABLE V-1-6 STRENGTH OF MATERIALS

Material	Strength	Note
Concrete	f'c = 210 Kg/cm2	For Substructure
	f'c = 315 Kg/cm2	For Superstructure
	f'c = 350 Kg/cm2	For Prestressed Concrete
Reinforcing bar	fy = 2800 Kg/cm2	Grade 40
Prestressing Steel	fy = 190 Kg/cm2	Grade 270 - M183
Structural Steel	fy = 2520 Kg/cm2	A 36

Note: f'c: Specified Compressive strength of concrete at 28 days
fy : Specified yield strength of Reinforcing
Source: MOP

1-5-2 Type of Structures

This study includes bridges to be constructed both in the built-up area and the suburban area, and a revetment for the expansion of Ave. Balboa in the built-up area.

Bridges are planned to be constructed for grade separation at intersections in order to improve the intersections and for crossing rivers and streams, like Rio Juan Diaz.

Bridges should be cost effective, stable in structure and pleasing to look at. Concerning the cost aspects, it is necessary to consider maintenance costs in addition to construction costs. For safety , it is also necessary to ensure safety during construction as well as afterwards. As to environmental considerations, the presence of the bridges themselves shall not spoil the environment.

(1) Types of Bridges

The superstructures of the bridges can generally be classified into the reinforced concrete bridges (hereinafter called "RC bridge"), prestressed concrete bridges (hereinafter called "PC bridge") and steel bridges. The general applicable spans of each bridge are given in TABLE V-1-7. The RC bridge shall be applied only to small spans, while both the PC and steel bridges shall be applied to small, medium and long spans. The existing major bridges in Panama are shown in TABLE V-1-8.

TABLE V-1-7 BRIDGE TYPE AND STANDARD SPAN APPLICATION

	Type of Superstructure	Bridge Span (M)										
		0	10	20	30	40	50	60	70	80	90	100
RC	R.C. Simple T - Beam	=====	=====	=====								
	R.C. Hollow Slab (Voided Slab)	=====	=====	=====								
	R.C. Box Girder	=====	=====	=====								
PC	P.C. Hollow Slab			=====								
	P.C. Simple Composite Girder			=====	=====	=====	=====					
	P.C. Simple T - Beam			=====	=====	=====						
	P.C. Simple Box Girder				=====	=====	=====	=====				
	P.C. Continuous Box Girder				=====	=====	=====	=====	=====	=====	=====	
S	Steel Simple Composite Girder				=====	=====	=====					
	Steel Simple Box Girder					=====	=====	=====				
	Steel Continuous Girder						=====	=====	=====	=====	=====	

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

TABLE V-1-8 MAJOR BRIDGES IN PANAMA

(m)

Name	Completion year	Location	Type	Max. Span	Total Lenght
Las Americas	1962	Panama Canal	Cantiliver Steel trussed arch	343.00	1653.00
San Pablo	1925	Veraguas	Suspension	87.00	160.00
Chiriqui	1983	Chiriqui	Prestressed Concrete	96.00	196.00
Mamoni	1978	Panama	Prestressed Concrete	143.00	143.00
Bayano	1974	Panama	Cantiliver Steel Truss	110.00	326.00
Santa Maria	1925	Veraguas	Suspension	75.00	95.00
Santa Maria	1958	Herrera	Steel Truss	60.00	189.00
Chiriqui Viejo	1961	Chiriqui	Steel Truss	76.00	189.00

Source: MOP

Most of the small and medium-sized bridges are constructed as RC or PC bridges. Prestressed concrete has recently been adopted for the beams and slabs of buildings and other structures, including bridges.

For the comparision of the PC Composite Girder Type and the Still Plate Girder, the following items were discussed, such as construction costs, maintenance, materials, ease of work, and so on:

a. Materials

In Panama, the concrete market supply is sufficient but steel materials must be imported due to the lack of market supply. From the above material supply conditions, the PC bridge is more recommendable.

b. Maintenance

Since Corredor Sur runs along the seaside, erosion by rust is likely to take place in the case of steel bridges. Therefore, steel bridges require a higher maintenance cost due to necessities such as painting as compared to concrete bridges.

c. Influence for Substructure

The quantity of materials in the substructure of steel bridges can be estimated to be less than that of PC bridges, but there is a low seismic load in Panama so this difference is very small.

d. Bearing Capacity for Structures

Generally speaking, a concrete birdge is heavier than a steel bridge, such that it accordingly requires a large bearing capacity. However, at the project, there is the layer at 4 to 5 meters underground with a bearing value which is sufficient for the construction of a concrete bridge.

e. Ease of Work

For the steel bridge, the time required for the construction term and work on site, is little shorter than that for the PC bridge. In addition, the construction of PC bridges is generally done in Panama, thus contrctors in Panama have more construction experience with this type of bridge.

f. Construction Costs

Including the substructure cost, the PC bridge construction cost would be estimated to be 10% lower than that of steel bridge.

From the above evaluation, the PC bridge type will be adopted in principle for this study.

For the substructures, a slender form of a pier can be adopted, since the seismic load is low. In the Panama Metropolitan Area, rigid-frame piers using circular columns can be seen used for many bridges. This Study will adopt an oval shape, which offers less resistance to the water flow, for river bridges and a trapezium shape for piers where grade separations are to be made.

The following types of piles are in use in Panama at present:

a. Precast concrete pile 254 mm and 304.8 mm in diameter
b. Prestressed concrete pile 457.2mm^2
c. Cast-in-place concrete pile 600, 900, 1,200, 1,500 and 1,800 mm in diameter
d. H-shaped steel pile H-300 mm

Among the foregoing, RC piles (300 mm) and cast-in-place concrete piles (900 mm) are the most common in use. Since a comparative study conducted on piers resulted in the finding that the cast-in-place concrete piles are cheaper, this Study shall adopt the cast-in-place concrete piles.

(2) Types of Revetment

The ground in this area (between Maranon and Rio Mataznillo and between ATLAPA and E.T. Lefevre) is sand for the surface stratum, but a presence of base rock at MSL + 1 to -2.5m is considered to offer sufficient support for structures.

The actual revetment work in Panama includes those at the south side of the San Felipe point and along Ave. Balboa, both made of gravity-type concrete structures; both the L-shaped and caisson-type revetments are rarely seen. This is attributable to the fact that all the steel must be imported, resulting in higher costs, while there is an adequate supply of concrete inside the country.

As a result, the gravity type should be introduced and the gentle slope type will be adopted in order that it can be adapted for future recreational use.

1-6 TRAFFIC NOISE PROTECTION MEASURES

1-6-1 Measures and Effects

The traffic noise protection measures are considered as follows.

a. Suppression of the noise source power level
b. Driving speed restrictions
c. Installation of buffer zones
d. Installation of noise barriers

Estimating the effects under the respective methods from the respective corrective terms in the traffic noise forecast formulas results in the following:

(1) Suppression of the Noise Source Power Level

The effect of suppressing the power level of the noise source is a 1 dB(A) decrease in the noise level for every dB(A) suppression.

(2) Driving Speed Restriction

The traffic noise forecasting formula expresses 0.2 v (v = driving speed, km/h) in the correction term concerning the driving speed. Namely, the decremental effect to the noise level is calculated to be 2 dB(A) for every 10 km/h restriction in the driving speed. Furthermore, the driving speed relates to the mean vehicle head interval as well. Because the mean vehicle head interval is proportional to the driving speed, this correction term results in a 3 dB(A) rise in the noise level when the driving speed is halved. In other words, starting with a driving speed of 50 km/h, the noise level decreases by 2 dB(A) if the driving speed is reduced to 25 km/h, while it increases by 7 dB(A), if the driving speed is raised to 100 km/h.

(3) Installation of Buffer Zones

The correction term can be expressed in terms of $-20 \log_{10} l$ for distance (l) from the noise source. Furthermore, the correction term for mean vehicle head interval also concerns the distance from the noise source. In other words, if the distance from the noise source is doubled, the decremental effect is about 3 dB(A).

(4) Installation of Noise Barrier

The refraction and attenuation levels by the means of a noise barrier vary, depending upon the construction, components of road cross-section, etc. The results derived from calculations on actually planned roads are given below. (Some example results were shown in FIGURE V-1-4, and the rest appear in APPENDIX-2)

This calculation result indicates a decremental effect of more than 6 dB(A) at 1.2 m above the ground with a 2 m-high sound insulating wall and more than 8.5 dB(A) with a 3 m-high wall, which is installed along the side of a 6-lane road, 40 m in width (between Ave. E.T. Lefevre and Ave. Cincuentenario).

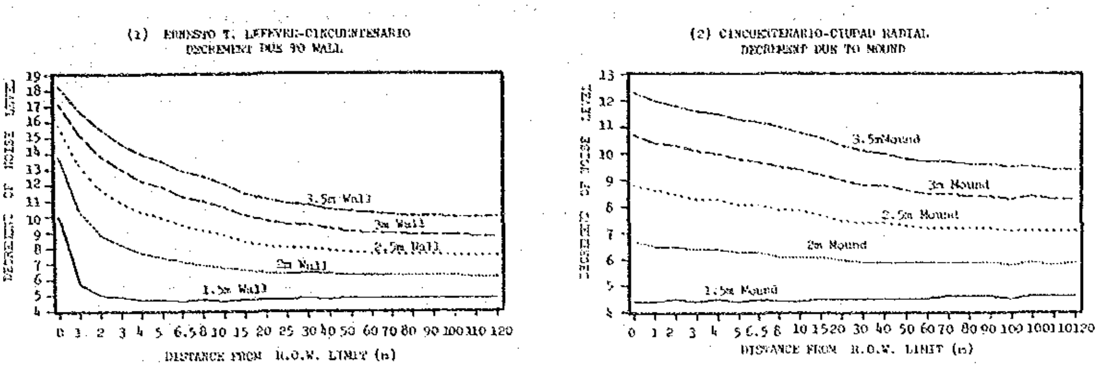


FIGURE V-1-4 DECREMENT DUE TO NOISE BARRIER

Next, installing a 2 m-high noise barrier along the side of a 4-lane access road, 30 m in width (Via. E.T. Lefevre), a flat house (3 m in height and 10 m in width) at a position 5 m away from the road edge, and a three-story building (9 m in height and 10 m in width) at the foregoing position results in a decremental effect of about 7, 10 and 20 dB(A), respectively, behind such structures at 1.2m above the ground.

Similarly, calculating the decremental effect on the access road (30 m in width) to the east of San Miguelito Chanis results in about 7, 9 and 18 or more dB(A), respectively.

1-6-2 Traffic Noise Forecast

Based on the results derived from the year 2000, traffic assignment volume, the forecast calculation of road traffic noise was conducted on Corredor Sur and the Main Access Roads, using peak-time coefficients, design speeds, ratios of large vehicle mix and planned road cross-sections, and the forecasting calculation formulas prescribed.

The forecasting time range was the peak time for all roads. The traffic volume, ratio of large vehicle mix and driving speeds at forecasting are as shown in TABLE V-1-9. The calculation result is given in FIGURE V-1-5 and APPENDIX-3, indicating that 6 points, or almost half the total of 13 points, exceeded 70 dB(A) at the road edge (1.2 m high of receiving point), and 2 points did so, even at a 10 m position away from the road edge (1.2 m in high receiving point).

1-6-3 Noise Impact Evaluation

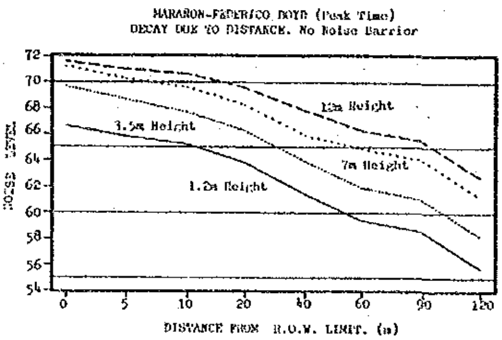
(1) Evaluation Standard

Environmental standards are prescribed for noise evaluation standards in the U.S., Japan, France, West Germany and other countries. The ISO (International Standard Organization) has recommended the noise evaluation method as follows:

TABLE V-1-9 CONDITION OF TRAFFIC NOISE FORECAST (PEAK HOUR)

	Road Section	Traffic Volume per hour	Ratio of Large Vehicles %	Velocity Km/h
Corredor Sur	Marañon - Federico Boyd	4,010	11.	50
	Federico Boyd - Brasil	4,026	9.	50
	Brasil - E.T. Lefevre	4,694	9.	50 / 60
	E.T.Lefevre - Cincuentenario	7,006	10.	60
	Cincuentenario - S.M. Chanis	4,996	10.	60
	S.M. Chanis - Ciudad Radial	5,720	10.	80
	Ciudad Radial - Don Bosco	3,204	9.	80
Main Access Roads	E.T. Lefevre	4,960	9.	50
	S.M. Chanis	1,354	6.	40
	S.M. Hipodromo	628	6.	40
	Juan Diaz	840	4.	40
	Ciudad Radial	1,810	10.	40
	Don Bosco	946	9.	40

Source: ESTAMPA



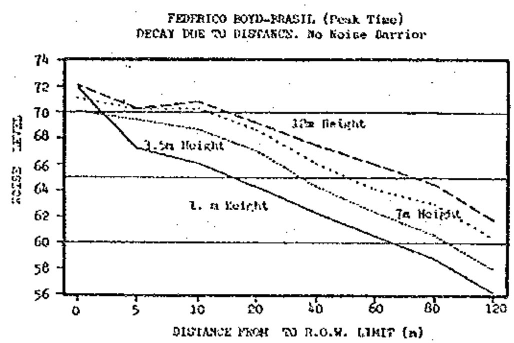


FIGURE V-1-5 RESULTS OF TRAFFIC NOISE FORECAST

1) Evaluation Noise Level (Lr)

To apply the evaluation of noise levels, the measured noise level is corrected by TABLE V-1-10 and the equivalent continuous noise level for fluctuating noise is given.

TABLE V-1-10 CORRECTIONS IN MEASURED SOUND LEVEL IN dB(A)

Characteristic Features of Noise		Correction dB (A)
Peak Factor	Impulsive Noise (e.g. from hammering)	+ 5
Spectrum Character	Audible Tone Components Present (e.g. whine)	+ 5
Duration of Noise with Sound Level L as Percentage of relevant time period	Between :	
	100 and 56	0
	56 and 18	- 5
	18 and 6	- 10
	6 and 1.8	- 15
	1.8 and 0.6	- 20
	0.6 and 0.2	- 25
	Less than 0.2	- 30

Source: ESTAMPA

2) Social Reaction Evaluation

ISO specifies 35 to 45 dB(A) as a noise level deemed favorable to the human life. The noise level derived from correcting the foregoing level by TABLE V-1-11, 12, and 13 shall be the general standard. By comparing the general standard and the evaluation noise level (Lr), the social reaction expected from TABLE V-1-14 shall be predicted and evaluated.

TABLE V-1-11 CORRECTIONS IN BASIC CRITERION BY PERIOD OF DAY

Period of Day	Correction to Basic Criterion dB (A)
Day time	0
Evening	- 5
Night time	- 10 to - 15

Source: ISO

TABLE V-1-12 CORRECTIONS IN BASIC CRITERION FOR RESIDENTIAL PREMISES OF EACH ZONE

Type of District	Correction to Basic Criterion dB (A)
Rural residential, zones of hospitals, recreation	0
Suburban residential, little road traffic	+ 5
Urban residential	+ 10
Urban residential with some workshops or with business or with main roads	+ 15

Source: ISO

TABLE V-1-13 ESTIMATED COMMUNITY RESPONSE AGAINST NOISE

Amount in dB(A) by which the rating sound level L exceeds Noise Criterion	Estimated Community Response	
	Category	Description
0	None	No observed reaction
5	Little	Sporadic complaints
10	Medium	Widespread complaints
15	Strong	Threats of community action
20	Very strong	Vigorous community action

Source: ISO

TABLE V-1-14 EVALUATION STANDARD ACCORDING TO ISO

Unit: dB (A)

Times / Type of Area	Day Time	Evening	Night time
Urban Residential Area (with Factories, Commerce, Main Roads)	50 - 60	45 - 55	35 - 50
Urban Area (Business, Commercial)	55 - 65	50 - 60	40 - 55

Source: ISO

(2) Evaluation and Recommendations

A comparison is given in TABLE V-1-15, between the reference daytime values (upper limit) under the foregoing ISO recommendations and the forecasting calculation results.

TABLE V-1-15 COMPARISON OF CALCULATION LEVEL WITH EVALUATION STANDARD

Results and Comparison	On R.O.W. Limit			10m beyond R.O.W. limit		
Road Section	Estimated Level	>65	>60	Estimated Level	>65	>60
Corredor Sur						
Maranon - Federico Boyd	66.	1.6	6.	65.	0.	5.
Federico Boyd - Brasil	71.	6.	11.	67.	2.	7.
Brasil - E.T. Lefevre	75.	10.	15.	68.	3.	8.
E.T. Lefevre - Cincuentenario	77.	12.	17.	70.	5.	10.
Cincuentenario - S.M.Chanis	69.	4.	9.	67.	2.	7.
S.M.Chanis - Ciudad Radial	73.	8.	13.	71.	6.	11.
Ciudad Radial - Tocumen	69.	4.	9.	68.	3.	8.
Main Access Roads						
Via Ernesto T. Lefevre	77.	12.	17.	69.	4.	9.
Via San Miguelito Chanis	69.	4.	9.	63.	2.	2.
Via San Miguelito Hipodromo	64.	0.	4.	58.	6.	1.
Via Juan Diaz	65.	0.	5.	59.	5.	0.
Via Ciudad Radial	72.	7.	12.	64.	0.	4.
Via Don Bosco	67.	2.	7.	61.	3.	1.

Note:
65 dB (A) : Evaluation Standard in Urban Area (business, commercial) on day time (upper limit of ISO's standard)
60 dB (B) : Evaluation Standard at Urban Residential Area (upper limit of ISO's standard)
Others : Exceed more than 10dB (A) Evaluation Standard
: Less than Evaluation Standard
Source: ESTAMPA

This comparison with the reference values under the ISO recommendations indicates that if a route is in an urban residential area, the forecasted values exceed the reference values by more than 5 dB(A) at the road edges of most roads, even at a point 10 m away from the road edge along all routes of Corredor Sur and Ave. E.T. Lefevre of a main access road. If a route is along an urban area, there are six points where the forecasted value exceeds the reference value by more than 5 dB(A) at the road edge and two points at a position 10 m away from the road edge. These are a result of the comparison with the reference values for urban residential areas and urban areas. Especially for siting a hospital, school, etc. requiring quietness, the standards would need to be lowered. Depending upon the land use along the routes, various measures as provided in paragraph I-5-1 need to be taken. Namely, measures need to be taken for the improvement sections such as to erect barriers and to construct commercial buildings along the routes, and, for the new construction sections, to install the buffer zones and to construct mounds. (See FIGURE V-1-6, APPENDIX-4) For reference purposes only, the noise level at 1.2m above the ground is given in TABLE V-1-9, if the foregoing measures are taken.

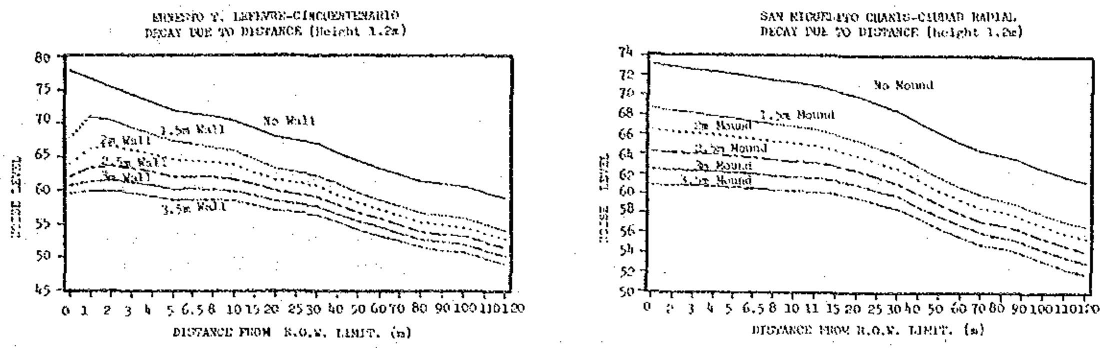


FIGURE V-1-6 DECAY DUE TO VARIOUS PROTECTION MEASURES

1-7 AUXILIARY FACILITIES

1-7-1 Streets Light

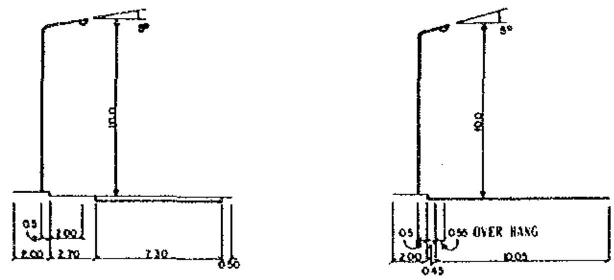
Road lights are installed either for the continuous lighting of the entire route or for spot lighting, according to the criterion of road surface brightness to the driver's eye. Road sections generally subject to continuous lighting and to spot lighting are shown in TABLE V-1-16.

TABLE V-1-16 APPLICATIONS OF STREET LIGHTING

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

Source: ESTAMPA

The footcandle of 0.5 to 1.0 cd/m2 is usually used as the criterion for road light installation. In view of the relatively heavy traffic on the project roads, the criterion of 1.0 cd/m^2 shall be used. Typical lighting installation arrangements on 2-lane and 3-lane roads are shown in FIGURE V-1-7.



2 LANE ROAD
35m STAGGERED OR ONE SIDE SPACING

3 LANE ROAD
35m STAGGERED OR ONE SIDE SPACING

FIGURE V-1-7 TYPICAL LIGHTING INSTALLATIONS

1-7-2 Guard Fences

In Panama Metropolitan Area, there are almost no guard fences installed along roads, except for Via. Juan Pablo II and other recently opened roads. However, guard fences shall be installed for traffic safety, depending on the roadside gradient or level difference, as shown in FIGURE V-1-8. Guard fences shall be installed also in front of obstacles facing the roadway such as bridge piers and handrails, as well as along sharp curves and in sections where pedestrian crossing is to be controlled.

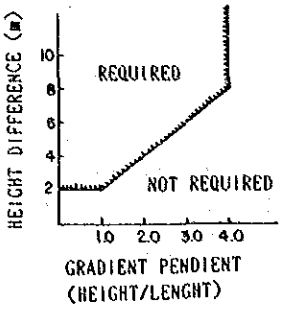


FIGURE V-1-8
APPLICATION OF GUARD FENCES

1-7-3 Traffic Signs

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

These signs are erected by the methods shown in FIGURE V-1-9. Regulatory and warning signs usually show a symbol on 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 hung overhead. In the case of 2-lane roads, road side installation is usually considered satisfactory since the signs can be seen by drivers in either lane. However, cantilever or overhead installation is desirable for roads with three or more lanes.

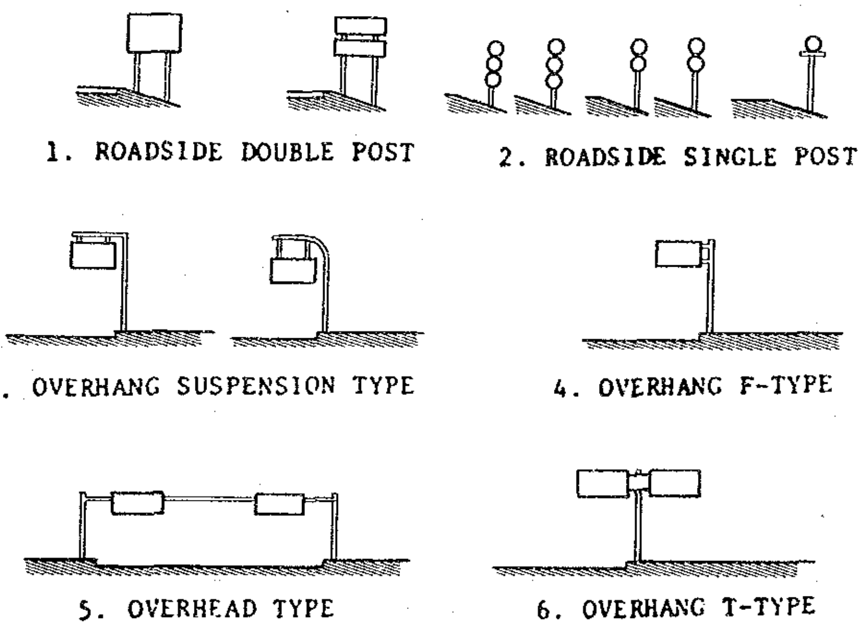


FIGURE V-1-9 VARIOUS TRAFFIC SIGN MOUNTINGS

1-7-4 Traffic Markings

The kinds of road markings are shown in TABLE V-1-17. These markings complement traffic signs in giving appropriate guidance to the driver at an intersection. Not only should they be installed at the time of road construction, but these markings should also be well maintained throughout the service life of the road.

TABLE V-1-17 VARIOUS TRAFFIC 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, Diverging and Merging. c. Bus stop d. No stopping zone	Diagonal and Chevron marks
3. Symbol	a. Lane use b. Direction guide c. Regulatory Signs	Arrow Characters Speed limit, no turn, Direction restriction, etc.
4. Curb Markings for parking restriction		
5. Reflector units	Studs, Chatter bar, Jiggle bars, cat's eye Delineators, etc.	

Source: ESTAMPA

1-7-5 Plantings

(1) Basic Policy

The lining of sidewalks with trees shall be achieved aiming at the improvement of the esthetic value of the road, the separation of the footpath from the roadway for pedestrian safety, the production of shade, provision of visual guidance, noise buffering, absorption of exhaust gas matters, and atmospheric purification. Tree planting on the center median and traffic islands aims at the esthetic improvement of the road, the enhancement of the partition effect between opposite roadways, light shielding, and visual guidance. Tree planting on the interchange aims to provide visual guidance along the ramp and at the traffic merging point. Slopes resulting from road construction shall be planted for the esthetic effect and as buffers between the road and the roadside area.

(2) Tree Varieties

In order for tree plantings to have a maximum effect and for the post-planting maintenance of trees to 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 resistance

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, the under-the-branch clearance should not be less than 5 m

The Panama Metropolitan Area has a savannah climate, which is a comparatively dry tropical climate, favorable for 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 an annual precipitation between 2,000 and 3,000 mm. Thus, trees root easily and grow fast in the area, as can be seen from the large variety of trees in the area. The urban sprawl phenomenon accompanied vigorous deforestation activities, however, and the Instituto de Recursos Nacionales Renovables (INRENARE) has been making efforts for environmental protection during the past decade. The characteristics of selected trees and shrubs are shown in TABLE V-1-18 and TABLE V-1-19.

TABLE V-1-18 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 levations
(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
Astronelia	8-12	8.5	Purple pink & White	Fast Growth	-	Adaptable to medium-lower elevations
Luca	7.5	5	Frail leaves & White flower	-	-	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
Panama Tree	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	-
Willow	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

Source: ESTAMPA

TABLE V-1-19 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-Dec.		Seeds	Secondary 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-Dec. Jan.-Feb.		Seeds & Slips	Border of forest 1,000 mts & over sea level
Manto de Jesus	2		Vine Red all year		Stiks	Argillaceous earth Alkaline & good drainage
Laureno	4		Yellow Oranges		Seeds & Slips	Open places humidity soil
Tabogans	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 Novio	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

Source: ESTAMPA

2. CORREDOR SUR I (BUILT-UP AREA)

2-1 LAND USE CONDITIONS

2-1-1 Present Land Use

(1) Section I: Via Cerro Ancon to Ave. Federico Boyd

The west end of this section begins with Via Cerro Ancon proposed by the ESTAMPA Masterplan, which is connected to the Maranon urban renewal area, and runs eastward through the built-up area. The principal land use is commercial and business, with a hospital (Santo Tomas Hospital), a group of parks (Urraca Park, Anayansi Park and Balboa Monument Park), and such recreational facilities as a yacht club. Roadside land and residential land behind it are gradually being turned into business and commercial facilities.

(2) Section II: Ave. Federico Boyd to Via Brasil

The west half of this section is a coastal road, with unused land along the route, but rapid development is under way in the inland area, with a large number of commercial buildings and high-rise apartment buildings being constructed. In the Paitilla area, in addition to a group of high-rise apartment buildings and hotels constructed after the mid-1970s, there has been an astonishing expansion in the construction of commercial facilities in recent years. This section has a concentration of facilities such as a large hospital (Paitilla Hospital), public and private elementary schools (ages 6 to 12) and high schools (13 to 18) along the seashore.

(3) Section III and IV: Via Brasil to Via E. T. Lefevre

Land use in this section characterized by the Paitilla Airport (Marcos A. Gelabert Airport), IDAAN wastewater pumping facility, IRHE power plant, a group of elementary and high schools, the ATLAPA International Convention Center, a large-scale hotel on the west side, and the extension of middle and upper class housing areas to the coastal line in the eastern half. Corredor Sur becomes a coastal road to the east of the convention center.

(4) Section V: Via E.T. Lefevre to Via Cincuentenario

The Panama Viejo historical area is situated along the seashore, while areas for housing and a cemetery (Jardin de Paz) of about 12 ha extend to connect with the inland area. Corredor Sur meanders into the Panama suburban area, through the cemetery and residential areas.

2-1-2 Future Land Use

All sections are situated in the built-up area, so that with the exception of a small quantity of unused land, urbanization has progressed along nearly the entire route. In future, some changes in land use may occur; however, although a certain sophistication in land use may be attempted, the likelihood of a big change in the current use of the land is small.

From the scenic, recreational, and tourist points of view, a green belt for pedestrians will be provided in the future, alongside Corredor Sur. The green belt will link Parque Monumento a Balboa, Parque Anayansi, the Yacht Club, and Parque Urraca. In order to provide for the green belt, it is recommended that a 10 to 20 meter wide land fill be made. Furthermore, for future prospects, it is expected that more expansion of the land fill along Corredor Sur toward Paitilla will also take place.

The removal of Paitilla Airport will create a vacant space of about 24.5 ha. This land is situated in such a location within the urban area that it constitutes very valuable space. For future land use, it will be advisable to maintain coherence with the surrounding educational, recreational and residential facilities.

The section between ATLAPA and Ave. E.T. Lefevre will be a marine route, with a water space between its causeway and the existing waterfront. Since Panama Viejo can be viewed from this area, it is expected to attract many sightseers. It is, therefore, desirable to land-fill the above water space in the future to provide restaurants, other commercial facilities and green space for tourists and residents. (See FIGURE V-2-1, V-2-2, V-2-3).

2-1-3 Remarks for Road Design

The land behind the western part of Corredor Sur up to and around Paitilla can be envisioned to have a high concentration of business and commercial facilities, so that traffic would be generated and attracted to this area. Therefore, sufficient consideration should be given to access control into Corredor Sur. The coastal line in this section is one of the most beautiful in Panama City, so that road planning must give due consideration to pedestrians and the scenery. In addition, facilities for crossing the road must be installed to allow pedestrians to reach the seashore safely. For the section between Paitilla and ATLAPA, a vehicle access control system has to be considered due to the heavy incoming and outgoing traffic between Corredor Sur and the commercial facilities.

For the section between ATLAPA and Rio Abajo, environmental considerations must be addressed to maintain better scenery by planting greenery in the marine transit portion and beside the neighboring cemetery and residential areas in the inland area.

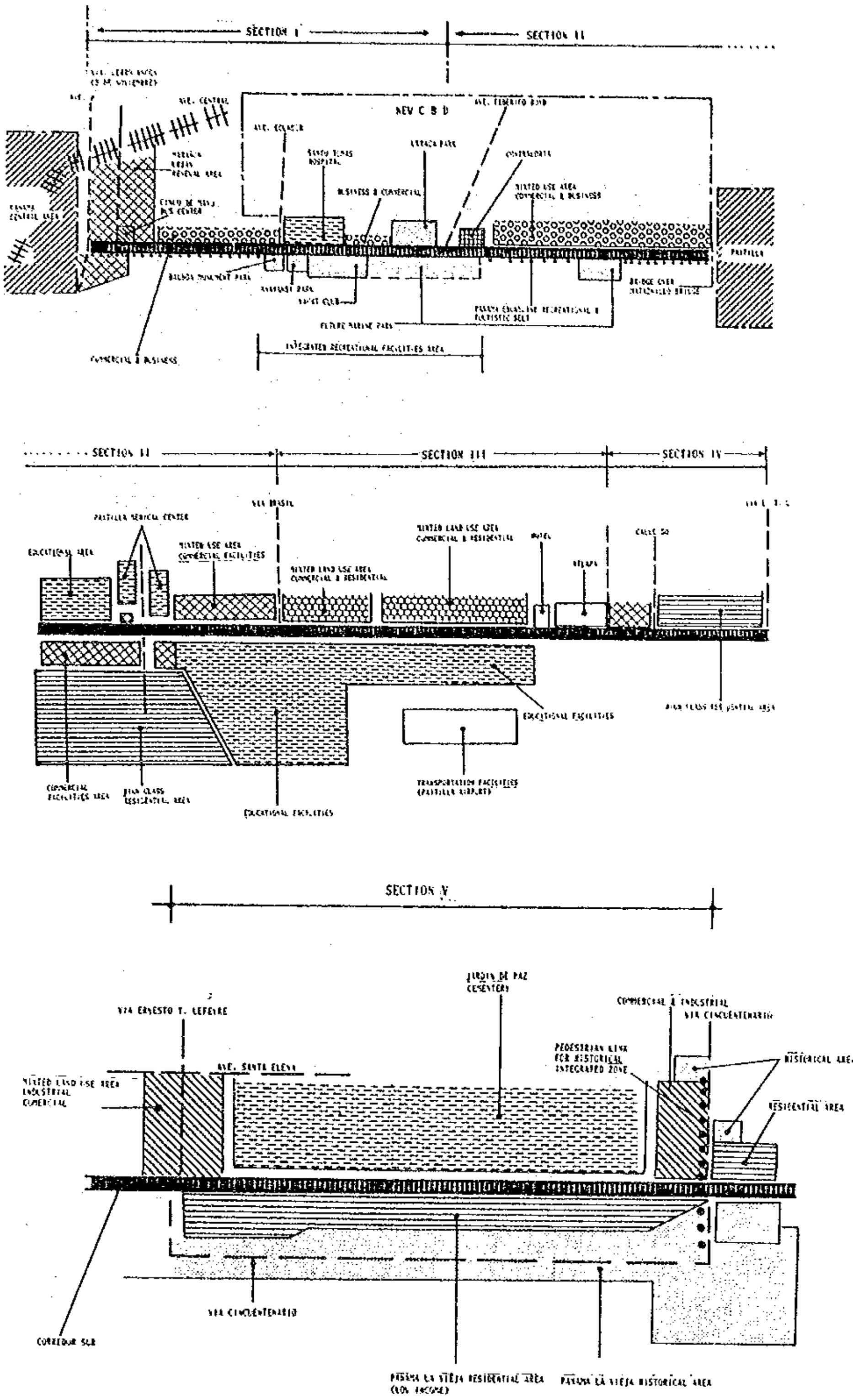


FIGURE V-2-1 FUTURE PROSPECTS AND MAIN ACTIVITIES ALONG CORREDOR SUR I

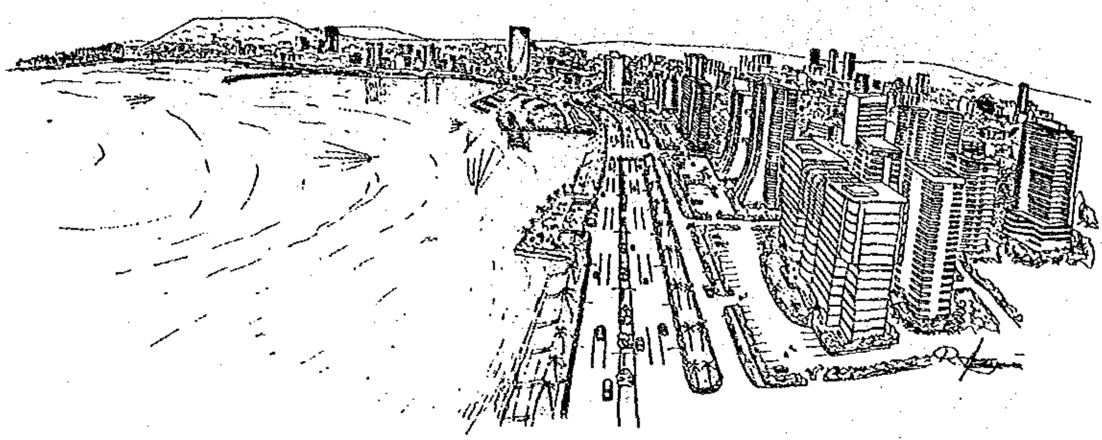


FIGURE V-2-2 FUTURE IMAGE SKETCH AT WATER FRONT (VIEW TOWARD WEST FROM PAITILLA)

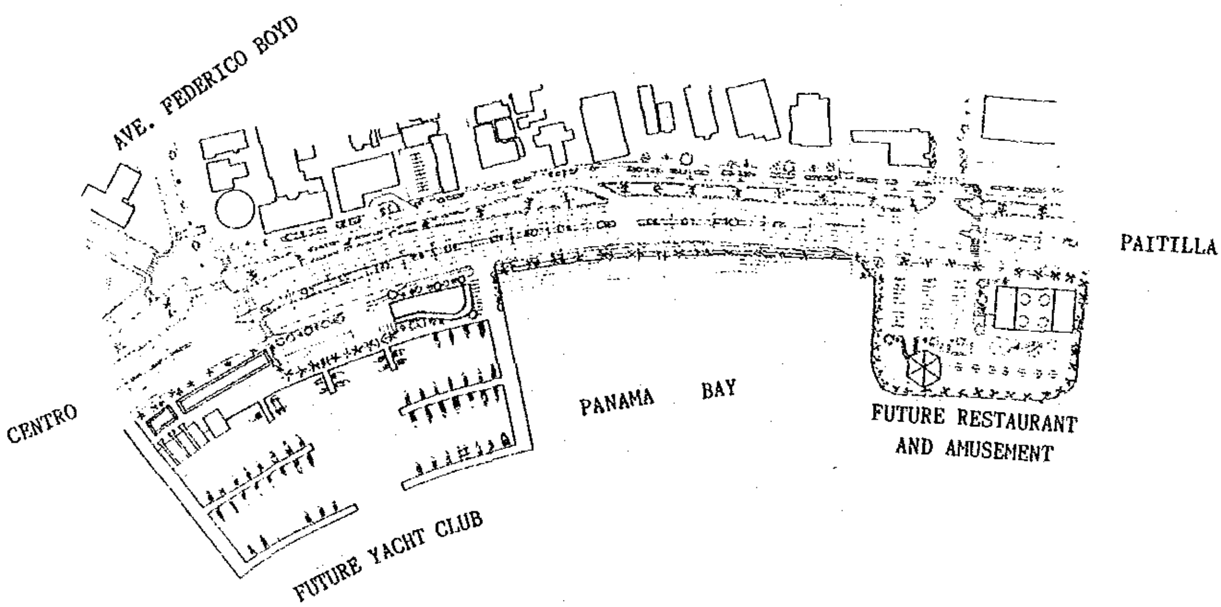


FIGURE V-2-3 FUTURE DEVELOPMENT MODEL PLAN ALONG CORREDOR SUR I

2-2 GEOMETRIC DESIGN

2-2-1 Cross Section Design

The section between Maranon and the Rio Abajo Interchange within Corredor Sur is already urbanized. The section between Maranon and ATLAPA, bordering with ATLAPA, is a widening and improvement of the existing road, while there is a new construction road section between ATLAPA and the Rio Abajo interchange. For this reason, the design speeds are 60 km/h between Maranon and ATLAPA and 80 km/h between ATLAPA and the Rio Abajo interchange.

Although the present land use varies somewhat in the built-up area as shown above, the traffic volume does not vary so much in this section, so that the same standards were applied for roadway and median throughout the route. For the purpose of improving the accessibility to land behind the roads, where heavy traffic will be generated and attracted, as well as for maintaining the present beautiful landscape between Maranon and Rio Mataznillo, the present 2-lane road toward Centro shall be utilized as a frontage road. The present median is used for installing the IHRE high voltage cable transmission towers, and simultaneously contributes greatly to the environmental buffer belt along the route. For this reason, this plan leaves the present median as it is, which is to be used as a planted belt to separate the frontage road from the trunk road.

Concerning the sidewalks, in principle, a width of 5.0 m was adopted on each side of the road in view of the frequency of sidewalk use and for ensuring intersection sight distance and the preservation of the surrounding environment and urban scenery. Furthermore, at points occupied by buildings but where sidewalks can be provided if narrowed down, a sidewalk with a width of 2.0m is to be provided.

In the section of the widening of Ave. Balboa and the new construction section between ATLAPA and Via E.T. Lefevre, the width of the sidewalk will be widened to accomodate recreational activities in case a resort area development along the seashore is realized.

Above all, the following alternative cross sections were proposed:

(1) Maranon - Rio Mataznillo

Two alternative cross sections were discussed herewith, based on the road function and minimum width for future traffic demand. (See FIGURE V-2-4)

a. Alternative 1.

This cross section shows the minimum width of shoulder for the sake of future traffic demand.

b. Alternative 2.

This cross section provides a stopping lane and sidewald 15 meters wide at the seaside for tourists.

Preparation of tourist facilities shall be made next to the road's

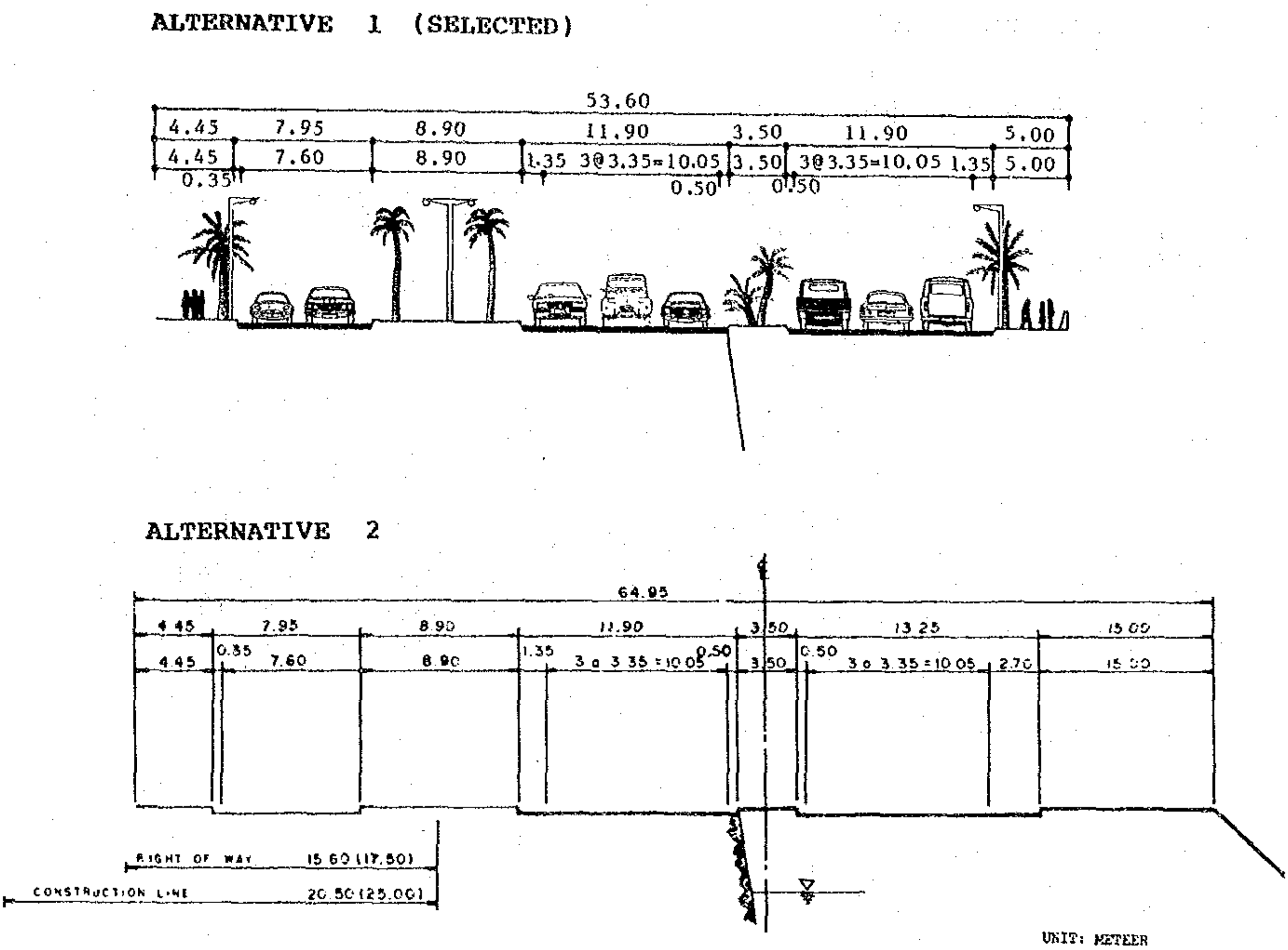


FIGURE V-2-4 TYPICAL CROSS SECTION OF CORREDOR SUR (MAÑANON-RIO MATAZNILLO)

edge. Hence, Alternative 1 was selected in conclusion, while a sloped type of bank structure was adopted for the future development of recreational activities.

(2) Rio Mataznillo—ATLAPA

Based on the consideration of the route which passes in this section through housing areas, a commercial area and an educational area, two types of alternative cross sections were examined here. (See FIGURE V-2-5)

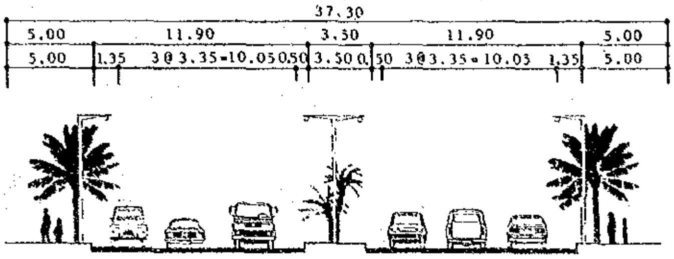
a. Alternative 1.

This cross section shows the minimum width of shoulder for the sake of future traffic demand.

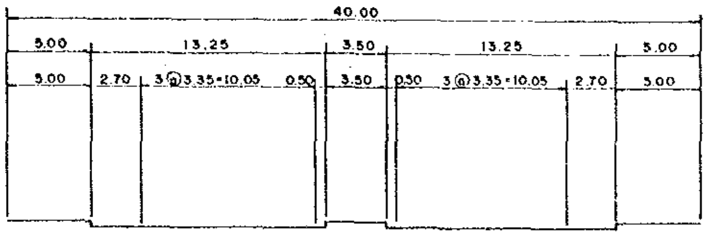
b. Alternative 2.

This cross section has stopping lanes for the use of roadside facilities.

ALTERNATIVE 1 (SELECTED)



ALTERNATIVE 2



UNIT: METER

FIGURE V-2-5 TYPICAL CROSS SECTION OF CORREDOR SUR (RIO MATAZNILLO- ATLAPA)

From the viewpoint of land acquisition, Alternative 1 was selected because it offers less difficulty than Alternative 2.

(3) ATLAPA—Rio Abajo Interchange

This route passes through both marine and inland areas. And this section is located between a suburban area in which the design speed is higher, and a built-up area where the speed is lower. (See FIGURE V-2-6)

a. Alternative 1.

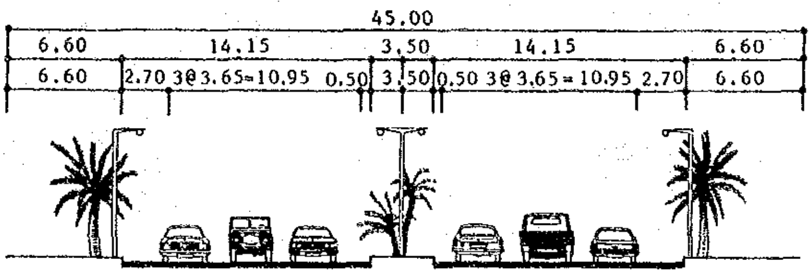
The concern was to provide enough carriage lane width for the design speed.

b. Alternative 2.

Carriage lane width was calculated as a minimum width, based on the traffic volume.

This section can be characterized as an acceleration or decceleration section for vehicle velocity; therefore, a wider carriage

ALTERNATIVE 1 (SELECTED)



ALTERNATIVE 2

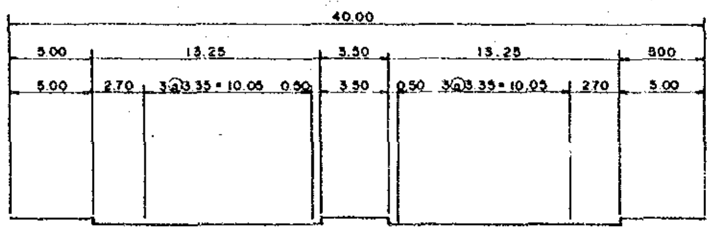


FIGURE V-2-6 TYPICAL CROSS SECTION AT CORREDOR SUR (ATLAPA-RIO ABAJO)

lane was adopted for the sake of a higher design speed. Consequently, Alternative 1 was selected.

2-2-2 Alignment Design

The section between Maranon and ATLAPA is a widening and improvement of the existing road, whose road alignment is greatly restricted by the current road alignment and existing buildings along the road route, etc. Between ATLAPA and the Rio Abajo interchange there is a new construction section, whose route selection shall be established based on the topography, historical areas to be preserved, scale, quality and quantity of existing buildings.

(1) Maranon - Rio Mataznillo

The route in this section will be expanded on both sides, leaving the center alignment of the road almost as it is now. The horizontal alignment was also established based on such control points as;

a. Preservation of the present beautiful road scenery.
b. Use of the present road toward Centro as a frontage road.

c. Securing space for elevating the Contraloria General intersection (between Ave. Balboa and F. Boyd).
d. IRHE high voltage cable transmission facilities.
e. Preservation of Balboa monumental statue and,
f. Use of existing lanes toward the international airport.

For this reason, the resulting shape of the road calls for its expansion as a whole towards the seaside from its present location.

(2) Rio Mataznillo - Via Brasil

This section is a widening of the existing road toward both sides, leaving the center alignment almost as it is now. A small radius of curve, R = 160 - 150, is adopted around Monumento a la Madre. Since the execution of this improvement greatly affects such existing buildings as high-rise apartments, buildings, large-scale commercial facilities, schools, hospitals, etc., such an improvement of the road alignment is not economical. Considering the present traffic jam in the Punta Paitilla area, the plan was made to align the structural center of elevation (2-lane toward Tocumen) in this area almost with the center of the existing road, to provide a vertical alignment under the viaduct so as to allow vehicle traffic, and to make its affecting the existing buildings unlikely. Based on the foregoing, the horizontal alignment was planned assuming such control points as a 32-story apartment building around STA 31 and the center of the existing road. The profile alignment was also planned to lie along the height of the existing ground.

(3) Via Brasil to ATLAPA

The route along this section is already occupied along one side with an IDAAN wastewater pumping facility, schools, IRHE power plant, etc., and built up with houses along the other side. Therefore, the road expansion affects both sides. For this reason, the road expansion can be planned toward one side only, yet since this would be unfair for either side of the road, the road center was planned as it is now. Where it greatly detours around the M.A. Gelabert Airport, the horizontal alignment is R = 70 - 80 m or smaller, and the vertical alignment is also 6% or larger, so that the risk of traffic accidents is also high. The detour extension is longer by about 300 m than the short-cut extension. For this reason, the horizontal alignment was planned as a short-cut alignment.

(4) ATLAPA to Via E.T. Lefevre

This section is a portion of filled in seashore. The horizontal alignment was planned with consideration given to:

a. The impact made on the houses and high-rise apartment buildings around STA 62 and STA 71,

b. An intersection angle between Via E.T. Lefevre and Via Cincuentenario and,

c. Preservation of the historic bridge over Quebrada Santa Librada.

The vertical alignment was also planned based on such control height as the existing ground height of Via Cincuente- nario and a height calculated by adding an extra allowance to the recorded high-water level in the Panama Bay, i.e. 3.8 meters.

(5) Via E.T. Lefevre to Rio Abajo Interchange

This section is a new construction road running through the built-up area. The horizontal alignment was planned with consideration of the position of Quebrada S.Librada, avoidance of dividing the Jardin de Paz cementery, preservation of Panama Viejo historic sites, and its effect on the school buildings. The vertical alignment was also planned with consideration given so as to agree with the building heights in the built-up area, to minimize its effects as much as possible.

2-3 INTERSECTION PLANNING

The analysis of signalized intersections for the Study was carried out based on the Highway Capacity Manual, Transportation Reseach Board, National Research Council, Washington D.C. 1985.

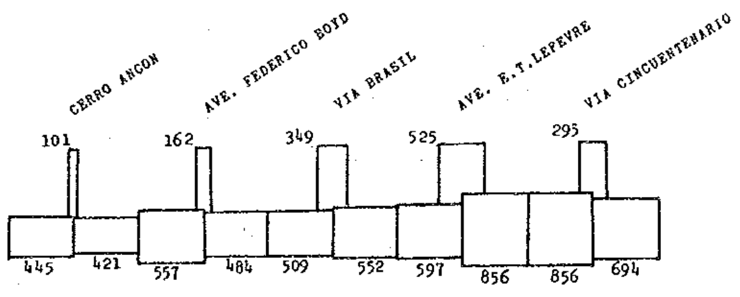
The basic formula for calculation of the saturation rate is shown as follows;

$$s = s_o N f_w f_{HV} f_g f_p f_{bb} f_a f_{RT} f_{LT}$$

Where:

- s = saturation flow rate for the subject lane group, expressed as a total for all lanes in the lane group under prevailing conditions, in vphg;
- s_o = ideal saturation flow rate per lane, usually 1,800 pcphgpl;
- N = number of lanes in the lane group.
- f_w = adjustment factor for lane width; 12-ft lanes are standard;
- f_{HV} = adjustment factor for heavy vehicles in the traffic stream;
- f_g = adjustment factor for approach grade;
- f_p = adjustment factor for the existence of a parking lane adjacent to the lane group and the parking activity at that lane;
- f_{bb} = adjustment factor for the blocking effect of local buses stopping within the intersection area;
- f_a = adjustment factor for area type;
- f_{RT} = adjustment factor for right turns in the lane group;
- f_{LT} = adjustment factor for left turns in the lane group.

The traffic volume on Corredor Sur and the minor arterial roads connected thereto in the built-up area is given in FIGURE V-2-7. The results of the analysis of five intersections are summarized bellow. Between Ave. Federico Boyd and Via Brasil, more strictly speaking, the issues around the section between Rio Mataznillo and Monumento a la Madre are picked up in paragraph 5-2 "Access Control Systems" of Part III "Road Planning," but they are summarized here again. Furthermore, the ratio of peak-time traffic volume vs. daily traffic volume is as follows:



UNIT : 100 PCU

FIGURE V-2-7 FUTURE TRAFFIC DEMAND ON MAJOR INTERSECTIONS ALONG CORREDOR SUR (BUILT-UP AREA)

a. 8% = Intersections of Via Cerro Ancon, Ave Federico Boyd and Via Brasil
b. 9% = Intersections of E.T.Lefevre and Cincuentenario

(1) Via Cerro Ancon Intersection

This is a starting point of 6-lane Corredor Sur. Since Via Cerro Ancon is also planned as a 6-lane road, the traffic capacity is sufficient. The demand of the Maranon bus center planned around here can also be met. It is preferable to control this section by signals. The results of analysis indicates that the saturation rate in this intersection falls within 0.7 at maximum, so that this intersection can sufficiently withstand the demand, including the traffic in this intersection as well.

(2) Ave. Federico Boyd Intersection

This intersection will be hard to control by means of traffic signals due to the heavy traffic congestion, such as can be deduced from the traffic saturation rate of 1.58. (See TABLE V-2-1). The left turn traffic from Centro especially, creates problems.

TABLE V-2-1 TRAFFIC MANAGEMENT ALTERNATIVES AT AVE. FEDERICO BOYD INTERSECTION

Type		Traffic Flow	Signal Operation			Saturation Flow Rate
			Phase 1	Phase 2	Phase 3	
	Non Improved Intersection					0.59 ~ 1.58
A	Improvement of At Grade Intersection					0.47 ~ 0.83
B	Grade Separation (From Tocumen to Panama)					0.30 ~ 0.77
C	Grade Separation (From Panama To Tocumen)					0.30 ~ 0.97
D	Grade Separation (Panama From/to Tocumen)					0.36
E	Grade Separation (from Panama To El Carmen)					0.62 ~ 0.83

Source: ESTAMPA

The following methods for solution of the above problems were examined.

a. Type A : Improvement of at-grade intersection
b. Type B : Elevated Corredor Sur over Ave. Federico Boyd
(Elevation will be made only for 2 lanes for the traffic to Centro.)
c. Type C : Elevated Corredor Sur over Ave. Federico Boyd
(Elevation will be made only for 2 lanes for the traffic to Tocumen.)
d. Type D : Elevated Corredor Sur over Ave. Federico Boyd
(4 lane traffic for both directions will be elevated)
e. Type E : 1 lane elevated traffic road for the left turn traffic from Centro direction to Ave. Federico Boyd

The sketch plans are shown in FIGURE V-2-8 and the results of comparison for various types are shown in TABLE V-2-2.

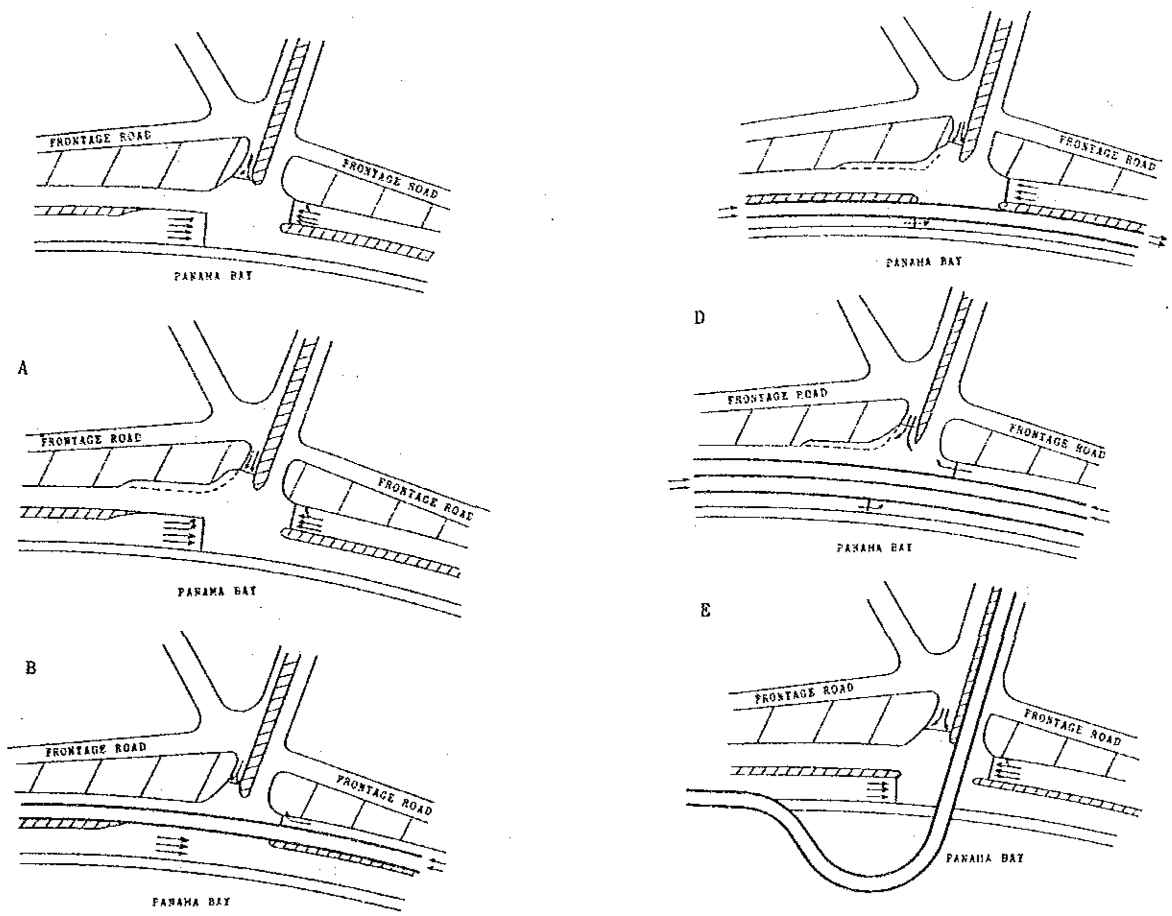


FIGURE V-2-8 SKETCHES OF AVE. FEDERICO BOYD INTERSECTION

TABLE V-2-2 COMPARISON OF TRAFFIC MANAGEMENT ALTERNATIVES AT AVE. FEDERICO BOYD INTERSECTION

Item	Overpass from Tocumen to Centro	Overpass from Centro to El Carmen
1. Description	2-Lane Overpass	1-Lane Overpass
2. Intersection Saturation Rate	0.30 - 0.77	0.62 - 0.83
3. Land Requirement	Within R.O.W.	More Than + 5.0 M (ONE SIDE) (FIGURE V - 2)
4. Compensation	None	Necessary
5. Bridge	P.C. Simple Composite Girder 5 x 30.0 M = 150.0 M	P.C. Simple Composite Girder 40.0 M + 3 x 30.0 M = 130 M
6. Approach Gradient	7 %	7 % & 3 %
7. Formwork	Not Needed	Not Needed
8. Detour During Construction	(1) Easy for Ave. Balboa (2) Easy for Ave. Federico Boyd	(1) Easy for Ave. Balboa (2) Fair for Federico Boyd
9. Bus Operation	Fair	Fair
10. Pedestrian Service	Fair	Fair
11. Cost	Same	Same

Source: ESTAMPA

As a result, type A was selected as an intersection type which will cause less compensation for houses along the road and whose construction cost can be estimated to be less expensive.

(3) Via Brasil Intersection

From the saturation rate shown in TABLE V-2-3 it can be readily understood that a traffic jam occurs, if this section is operated by signal control only. Measures must, therefore, be taken to solve this problem. The aspect of how to control the left-turn traffic onto Via Brasil from Centro direction of Corredor Sur must be considered. The left-turn traffic onto Corredor Sur from the Via Brasil is now prohibited. Since the forecasted result indicates a relatively high demand that cannot be ignored, it is necessary to provide a longer green-time of the signal to this traffic flow. No grade separation for the foregoing left-turn traffic can, however, be planned, because of the problem of land availability. Hence, a grade separation of Corredor Sur may be looked into.

The following 4 types for the method of traffic management at an intersection were examined.

a. Type A : Improvement of at-grade intersection
b. Type B : Elevated Corredor Sur over Via Brasil (2 lane elevated road for traffic to Centro only)
c. Type C : Elevated Corredor Sur over Via Brasil (2 lane elevated road for traffic to Tocumen only)
d. Type D : Elevated Corredor Sur over Via Brasil (4 lane traffic in both directions will be elevated.)

TABLE V-2-3 **TRAFFIC MANAGEMENT ALTERNATIVES AT VIA BRASIL INTERSECTION**

Type		Traffic Flow	Signal Operation			Saturation Flow Rate
			Phase 1	Phase 2	Phase 3	
	Non Improved Intersection					0.44 -- 2.51
A	At Grade Intersection					0.44 -- 0.98
B	Grade Separation (Elevated for Panma)					0.44 -- 0.86
C	Grade Separation (Elevated for Tocumen)					0.44 -- 0.96
D	Grade Separation (Elevated Both Directions)					0.75

Source: ESTAMPA

The saturation rate in Type C is not very different from that on the case of no improvement at-grade. This is because more signal green-time can be secured from Centro toward Tocumen, even if such a 3-way intersection is controlled by signals.

The sketch plans of each intersection are shown in FIGURE V-2-9 and the results of comparison are examined in TABLE V-2-4. From the above examination, Type B and D were selected as the more desirable traffic management systems. It is conceivable that Type B has a higher priority than the other.

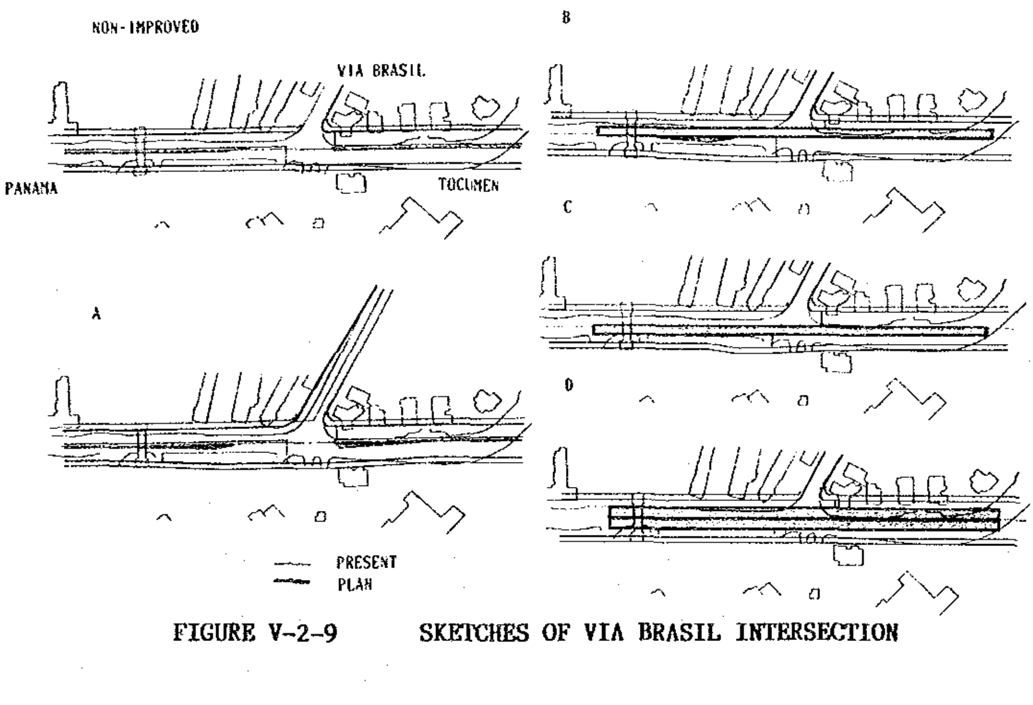


FIGURE V-2-9 **SKETCHES OF VIA BRASIL INTERSECTION**

TABLE V-2-4 COMPARISON OF TRAFFIC MANAGEMENT ALTERNATIVES AT VIA BRASIL INTERSECTION

		A	B	C	D
1	Description	At Grade	2-lane Overpass	2-lane Overpass	4-lane Overpass
2	Intersection Saturation Rate	0.44 0.98	0.44 0.86	0.44 0.96	0.95
3	Land Requirement	Min + 6.1m x 50m + 3.35m x 130m	Min + 3.35m x 130m	Min + 3.35m x 130m	Min + 1.3mx2x400m
4	Compensation	Large	Small	Small	Large
5	Bridge	-	P.C. Composite Girder 5 x 30 m	P.C. Composite Girder 5 x 30 m	P.C. Composite Girder 5 x 30 m x 2
6	Approach Gradient	--	7 %	7 %	7 %
7	Formwork	-	Not Needed	Not Needed	Not Needed
8	Detour During Construction	-	Easy	Easy	Fair
9	Bus Operation	Fair	Fair	Fair	Good
10	Pedestrian Service	Fair	Fair	Fair	Good

Source: ESTAMPA

(4) Via E.T. Lefevre Intersection

Among all other major intersections on Corredor Sur in the built-up area, the maximum traffic volume is generated and concentrated in this Via E.T. Lefevre intersection. Since Corredor Sur is the route that leads out to the seashore from ATLAPA and runs through andaround the present intersection between Via Cincuentenario and Via E.T. Lefevre to enter inland, Corredor Sur is not only crossing Via E.T. Lefevre, but also Via Cincuentenario. To cross on the same level these neighboring roads disturb the road functions of Corredor Sur, and also results in crossing the roads with mass traffic from every other direction, so that system of control at grade is tremendously difficult.

If the Via E.T. Lefevre intersection should depend on signal control, the saturation rate would exceed 1.0 to reach 1.3 to 2.9 in three of four approaches.

In the case of introducing a signalized control system, the following number of traffic lanes will be required at each access to the intersection:

a. Traffic from Centro on Corredor Sur:
 9 lanes (2: right turn, 7: left turn and straight)
b. Traffic from Tocumen on Corredor Sur:
 9 lanes (1: right turn, 2: left turn, 6: straight)
c. Traffic from Via Espana on Via E.T. Lefevre:
 5 lanes (1: right turn, 3: left turn, 1: straight)

From the above examination, it will be an extremely and unrealistically huge intersection from the view point of traffic management.

The through traffic on Corredor Sur is to be controlled by grade-separation, while the traffic at the intersections with Cincuentenario and Via E.T. Lefevre will be controlled at grade, thus interconnecting each other by providing surface roads at both sides of the grade-separated intersections with Corredor Sur, since the foregoing two connecting roads are close to each other as shown in the schematic map of FIGURE V-2-10.

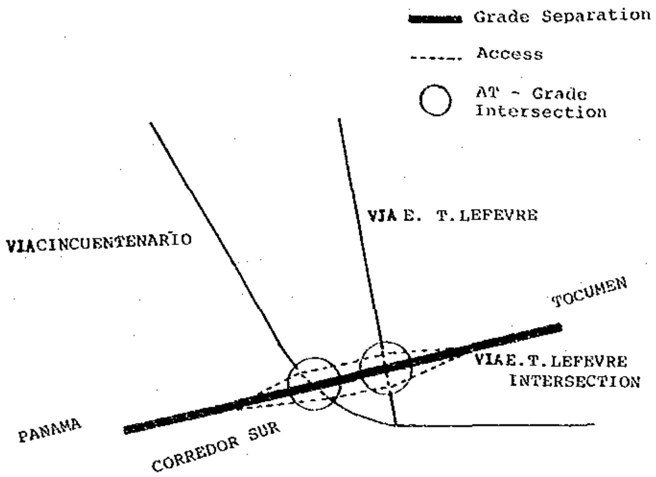


FIGURE V-2-10 SCHEMATIC MAP OF VIA E. T. LEFEVRE INTERSECTION

For controlling of mass traffic in the surface intersection between E.T. Lefevre and the road connecting to Corredor Sur, signal control must be implemented. However, the analysis results in the saturation rate changing from below 1.0 to reach 0.6 to 0.9 in the foregoing three approaches.

The plan of intersection with grade separation road is shown in FIGURE V-2-11.

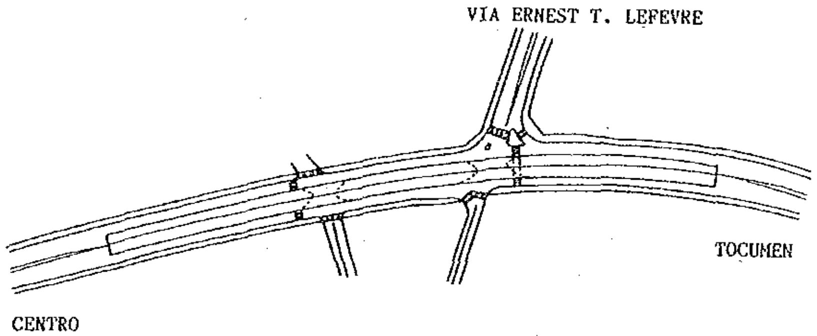


FIGURE V-2-11 SKETCH OF VIA E. T. LEFEVRE INTERSECTION

(5) Via Cincuentenario Intersection

This intersection is where Corredor Sur, coming out to the seashore from ATLAPA, passes through the intersection with Via E.T. Lefevre to enter inland, and it again crosses Cincuentenario when it runs into the suburban area. Since the Panama Viejo historic site preservation plan around there holds a policy that Via Cincuentenario may be banned in future, it crosses Corredor Sur at-grade, but the central separation belt on Corredor Sur was determined not to be opened in order to prevent passing at right angles.

Such traffic management of Via Cincuentenario results in requiring an alternative road and intersection in place of the existing Cincuentenario intersection. The traffic analysis at this point needs to be examined. Now, suppose that a study is made by using the forecasted traffic volume in the Cincuentenario intersection. It is difficult to control it on the surface by signals, i.e. the saturation rate exceeds 1.0 to reach 1.0 to 3.5 at all approaches. This is attributable to the fact that Via Cincuentenario is a 2-lane road, thus contributing to the traffic jam. If through traffic on Corredor Sur is controlled by a grade-separated intersection, the saturation rate becomes 0.3 to 0.8 in the surface intersection controlled by signals. Anyway, this grade-separated intersection sustains the road functions of Corredor Sur.

Owing to such results in this grade-separated intersection, it can be assumed that the same result may perhaps appear in the alternative intersection as well. The grade separation sketch plan is shown in FIGURE V-2-12.

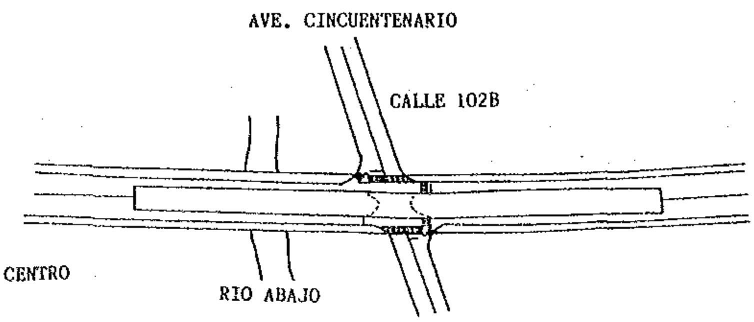


FIGURE V-2-12 SKETCH OF RIO ABAJO INTERSECTION

(6) Intersection Improvement between Rio Mataznillo and Monumento a la Madre

As already discussed concerning an access control system of this section in the former Chapter III-5-2-1, the introduction of the method of the continuous elevated road solves the problems.

The issues in this section consist of a mass traffic demand from the Punta Paitilla area and especially the services to the commercial area. Because of a bad road alignment, a drastic measure is required in order to meet the road functions of Corredor Sur. TABLE V-2-5 gives a comparison among the following four Alternatives.

TABLE V-2-5 TRAFFIC MANAGEMENT BETWEEN RIO MATAZNILLO AND MONUMENTO A LA MADRE

Alternative / Item	A	B	C	D
	Widening	Grade Separation (for Centro)	Grade Separation (for Tocumen)	Grade Separation (both for Centro and Tocumen)
1 Service to Smooth Traffic for Corredor Sur	Fair	Good	Good	Excellent
2 Signalized Control Point	3 Points	1 Point	1 Point	0
3 Service to Commercial Area Along Corredor Sur	Fair	Fair	Good	Good
4 Service to Generated/ Attracted Traffic of Punta Paitilla	Fair	Fair	Good	Good
5 Pedestrian and Bus Service	Fair	Good	Good	Good
6 Compensation Cost	Large	None	None	Large
7 Construction Cost	Small	More Than A	More Than A	More Than B and C

Source: ESTAMPA

a. Alternative A : A case of at-grade intersection
b. Alternative B : A case of grade-separating through traffic on Corredor Sur toward Centro
c. Alternative C : A case of grade-separating, as in Alternative B above, but toward Tocumend.
d. Alternative D : A case of grade-separating through traffic in both directions on Corredor Sur

In the case of at-grade intersection improvement the saturation rate of Corredor Sur will be 1.28 - 1.30 and that of the crossing road will be 0.95 - 1.03. However when one lane is added to the direct lane of Corredor Sur, the saturation rate can be within 1.00. As a result, from the economic viewpoint, Alternative A was selected because the construction cost of Alternative A will be cheaper than the others. The sketch plan of intersection improvement at Monumento a la Madre is shown in FIGURE V-2-13.

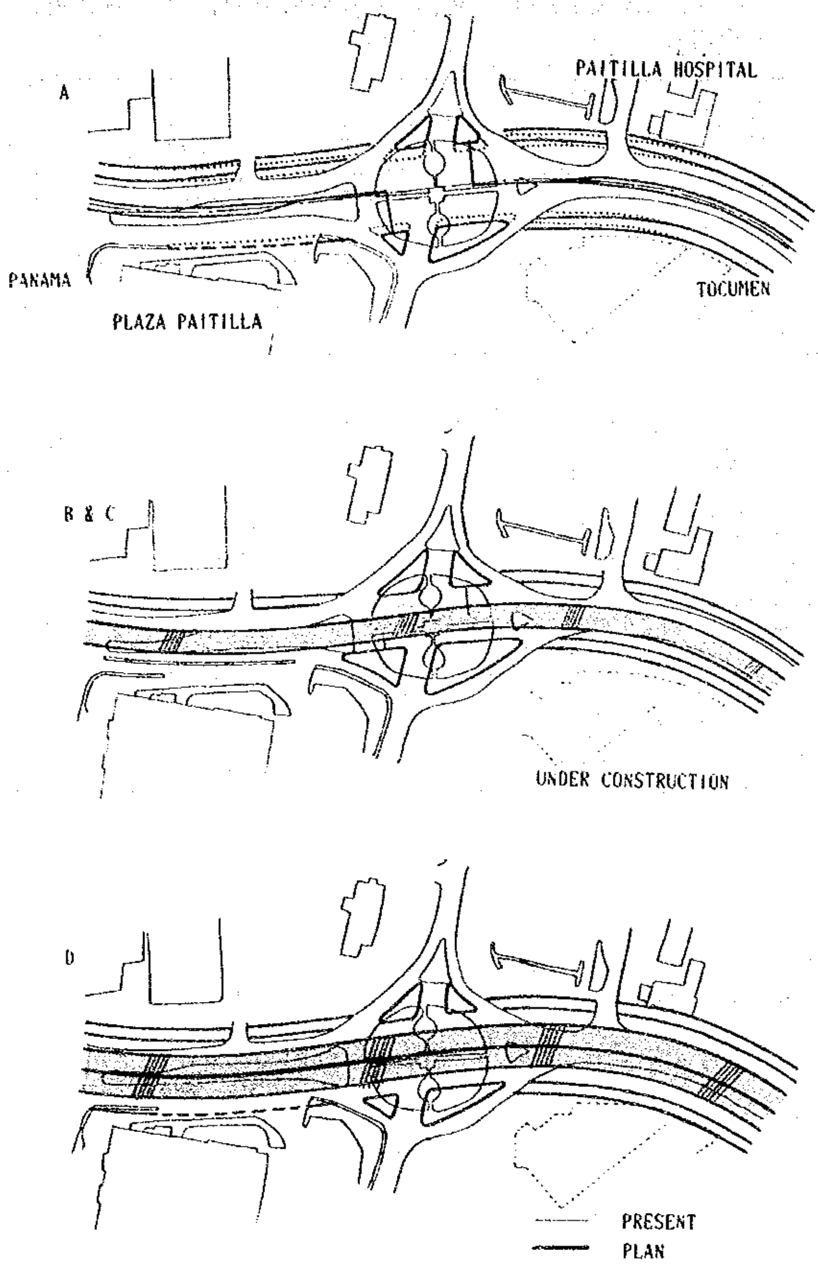


FIGURE V-2-13 ALTERNATIVE PLANS OF MONUMENTO A LA MADRE INTERSECTION

2-4 STRUCTURES

Main bridges related to Corredor Sur in the built-up area are as follows:

a. Rio Mataznillo bridge
b. Via. Brasil interchange bridge
c. Via. E.T.Lefevre viaduct
d. Rio Abajo interchange bridge

Bridges crossing a river are Rio Mataznillo bridge and Rio Abajo interchange bridge, while all other bridges are those planned for the purpose of improving the intersections with grade separations.

Concerning the superstructure type of the bridges, a type with less work at the site should be adopted, because would be very difficult to construct it by excluding off local traffic on the existing road at the construction points. For the substructures, wall and rigid-frame types can be considered. The former is characterized by less formwork and an easier construction method than the latter, so that the wall type shall be adopted. This area faces the Panama Bay, so that carefull attention needs to be given to the scenery. The height of beam should, therefore, be aligned at a constant when possible, and also the pier form would be unlikely to spoil the scenery.

(1) Rio Mataznillo Bridge

The existing bridge should be reconstructed in order to adjust the structure to the proposed vertical and horizontal alignment and also to the new width of carriageway. The design should be made, considering the river cross section and high water level, and the rigid frame type of concrete was adopted for the bridge structure.

(2) Via Brasil Interchange Bridge

This bridge is at the same T-shaped intersection as the Ave. Federico Boyd interchange bridge, whose topographic conditions are the same as the foregoing intersection as well. This bridge shall, therefore, be planned at 30m in the span with the PC composite beams at 150m in the total bridge length.

(3) Via. E.T.Lefevre Viaduct

This overpass is planned to cross over Ave. Cincuentenario and Via. E.T. Lefevre. Since the distance between these two intersections is 150m or shorter, this bridge results in a continuously elevated viaduct, thus reaching about 350m in the total length.

The maximum span is determined by the traffic flow in the intersection. If the wall type is adopted as the substructure, the maximum span is more than 50 m, considering the vertical clearance.

For this reason the PC box type or the steel type shall be adopted as the superstructure. The former is difficult to construct and the latter is more expensive than the others. Therefore, the PC composite type will be adopted as the superstructure, which can shorten the clear span length down to 40m by using Gerber's type.

(4) Rio Abajo Interchange Bridge

This bridge is planned to cross Rio Abajo and to grade-separate the intersection between Calle 102 B Este and Corredor Sur. Since the distance between this intersection and Rio Abajo is about 80m, it is planned as a continuous grade separation.

The column span shall be 43.0m based on the Rio Abajo renovated cross section and traffic flow in the intersection, thus resulting in 189.0m in the total bridge length. The superstructure type is planned with the PC composite girder.

3. CORREDOR SUR II (SUBURBAN AREA)

3-1 LAND USE CONDITIONS

3-1-1 Present Land Use

For the present land use of Corregimiento of Juan Diaz, the development of industrial facilities and large-scale private housing areas, such as La Pulida, Cerro Viento, Villa Flor, El Golf, etc. from the north side, is now under way along Via Domingo Diaz. Along Via Jose A. Arango, the land is primarily used for the residential and industrial facilities, and a racetrack as a recreation facility. Unused land can be seen here and there. Around the mangrove area, there is a wide extension of unused land, but housing development has recently progressed slowly from Ave. Jose Arango. The characteristic housing development consists of the large private housing development seen at the west end of Juan Diaz, Don Bosco, Acacia, Bello Horizonte, Anayansi, Ciudad Radial, etc. at the east end of Juan Diaz.

In this area, two big rivers, the Rio Matias Hernandez and the Rio Juan Diaz, run from the north to enter the Panama Bay in the south. The latter river is often flooded during the rainy season, so this must be kept in mind in relation to the developmement of a housing area.

Around the intersection with Pan American Highway at the east end of Corredor Sur, the following installations are located: the Tocumen campus of the Panama Technological University, the agricultural practice facilities of the University of Panama, a hotel, etc. Recently built commercial facilities are located around the intersection between Ave. Jose Arango and Via Domingo Diaz, and this area is turning into the commercial nucleus of the Pedregal area.

3-1-2 Future Land Use

Along Via Domingo Diaz, large-scale housing development projects are expected to continue in the future together with the construction of commercial facilities to support the former. The industrial area designated for this section also extends along the south side of the route. Along Ave. Jose Arango, an increasingly large number of roadside location-oriented businesses that began in conjunction with the expansion of the housing area are located. Any undeveloped land that remains will be used for housing. The expansion of the housing area will spread out near the mangrove area.

The total population in the three Corregimientos of Juan Diaz (zones 23 and 24), Pedregal (zone 25) and Jose Domingo Espinar (zones 33 and 34) will be about 300,000 in the year 2000, and capitalizing on this commerical potential, a big shopping center will be constructed around the intersection between Via San Miguelito-Hipodromo and Corredor Sur. Additional recreational facilities will also be completed to make the section into a suburban-type nucleus of shopping and recreation. Small-scale businesses will be located along the intersections between Corredor Sur and each Main Access Road.

(See FIGURE V-3-1, V-3-2, V-3-3)

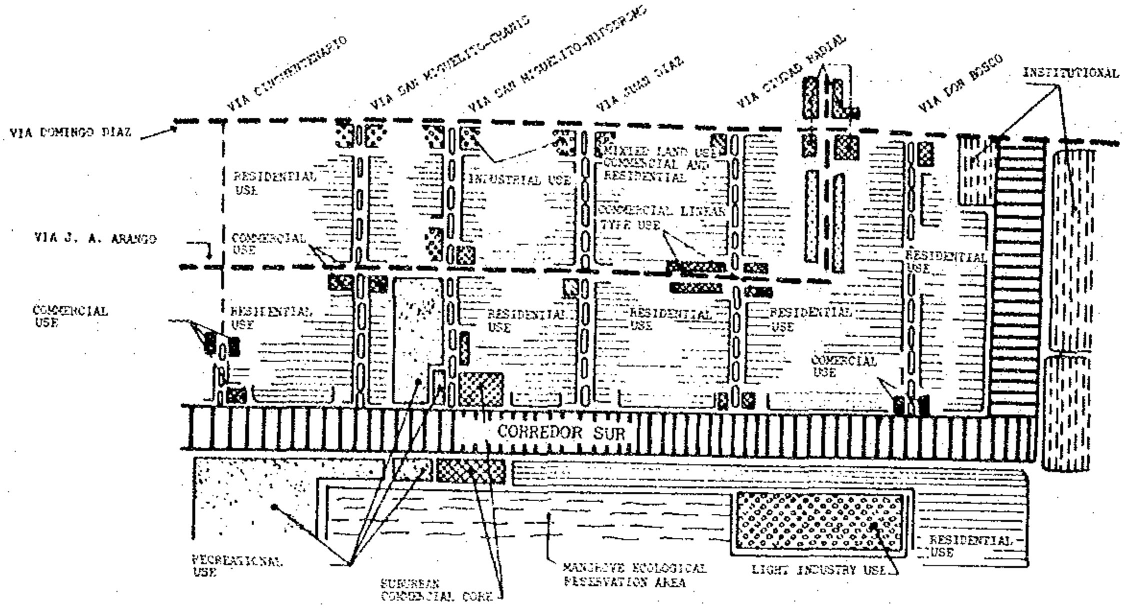


FIGURE V-3-1 FUTURE PROSPECTS AND MAIN ACTIVITIES ALONG CORREDOR SUR II

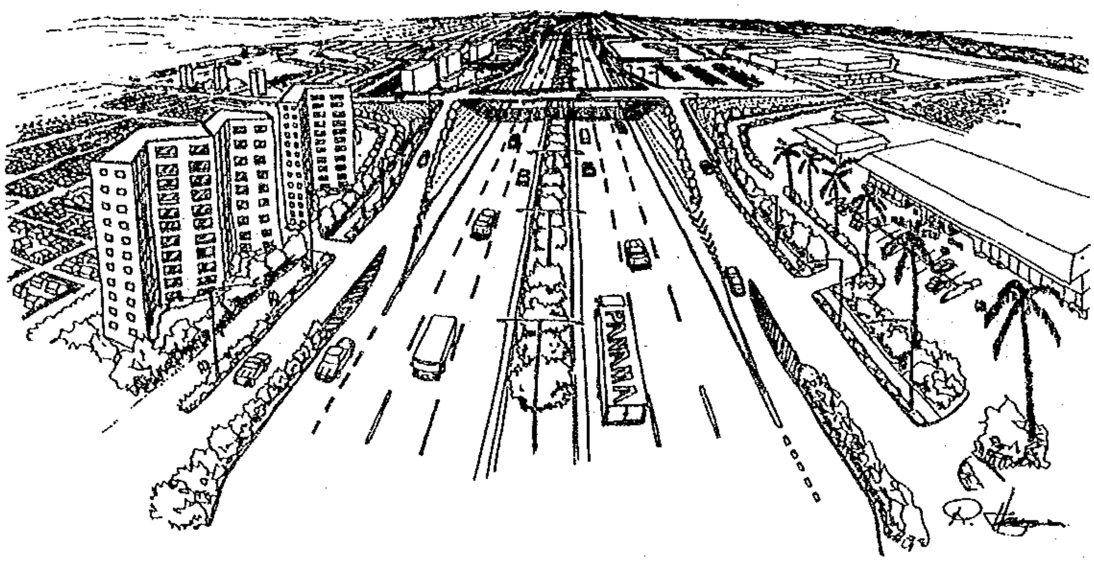


FIGURE V-3-2 FUTURE IMAGE SKETCH OF CORREDOR SUR II AT JUAN DIAZ

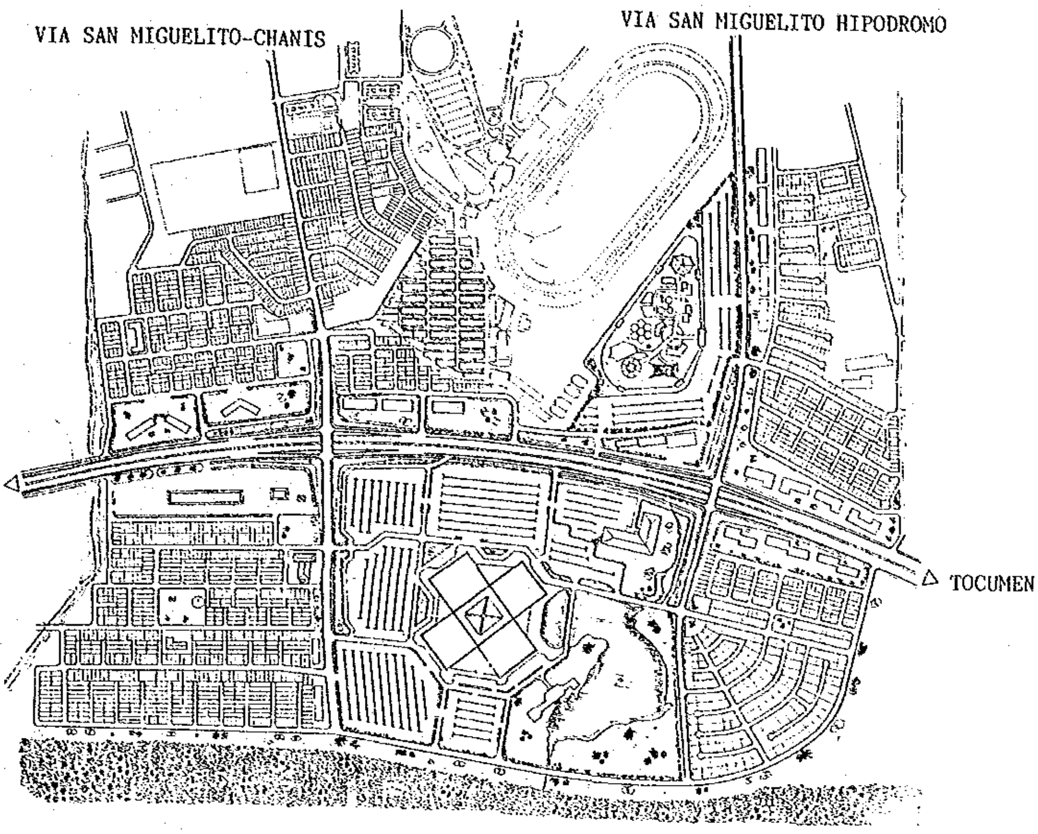


FIGURE V-3-3 FUTURE DEVELOPMENT MODEL PLAN ALONG CORREDOR SUR II

3-1-3 Remarks for Road Design

Since it is planned that Corredor Sur will have residential facilities along its entire route in this section, except for the commercial facilities around Hipodromo, consideration must be given to the protection of a pleasant environment for the residential areas. For the connections between the local roads along the route and Corredor Sur, a major trunk road, it is advisable to ensure proper access control, taking into account the aspects of securing a high-speed traffic flow on Corredor Sur and enhancing the living environment within the residential areas along the route.

3-2 GEOMETRIC DESIGN

3-2-1 Cross Section Design

This section was planned by dividing it into a 6-lane section between Rio Abajo interchange and Ciudad Radial and a 4-lane section between Ciudad Radial and Pan American Highway, based on the traffic volume. Either section is a high standard road requiring a high speed as mentioned in the road functions, whose design speed is 80km/h. For this reason, the plan was made to correspond with the high speed using a 1-lane width of 3.65m and to secure 2.7m in the shoulder width available to secure a lane.

Although the housing development also started here and there along this section, most parts remain undeveloped. According to the basic concept of future land use around the roads, however, housing development in the year 2000, shall take place in almost all the areas, because this area is flat. For this reason, the plan was designed to adopt a width allowing a frontage road to be constructed throughout the route, for the purpose of securing a width for environmental preservation facilities for the residential area along the route in the future, as well as to control the concentration of access traffic from the areas along the route and to allow for a smooth traffic flow running through Corredor Sur, in consonance with the housing development.

Based on the foregoing, the typical cross section between the Rio Abajo interchange and Ciudad Radial is given in FIGURE V-3-4. The typical cross section between Ciudad Radial and the Pan-American Highway is given in FIGURE V-3-5. Furthermore, the cross section at interchanges shall be wider due to the construction of ramps and structures for slopes.

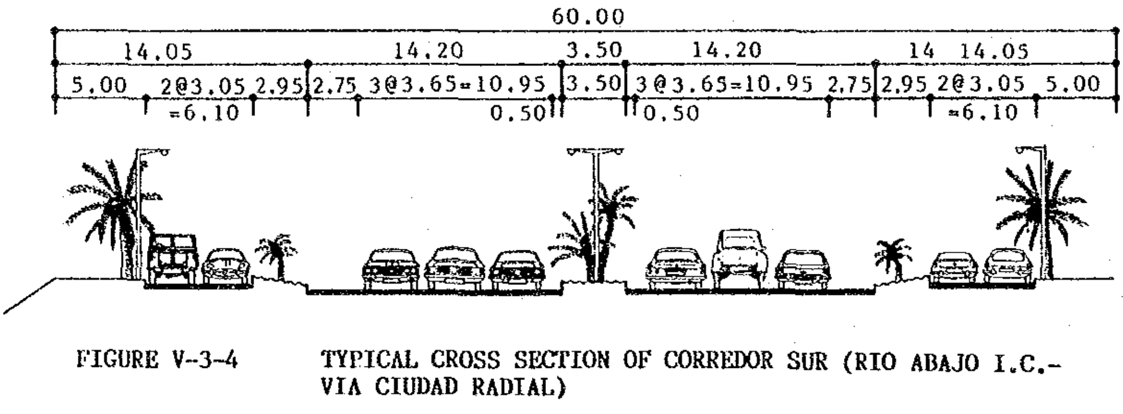


FIGURE V-3-4 TYPICAL CROSS SECTION OF CORREDOR SUR (RIO ABAJO I.C.-VIA CIUDAD RADIAL)

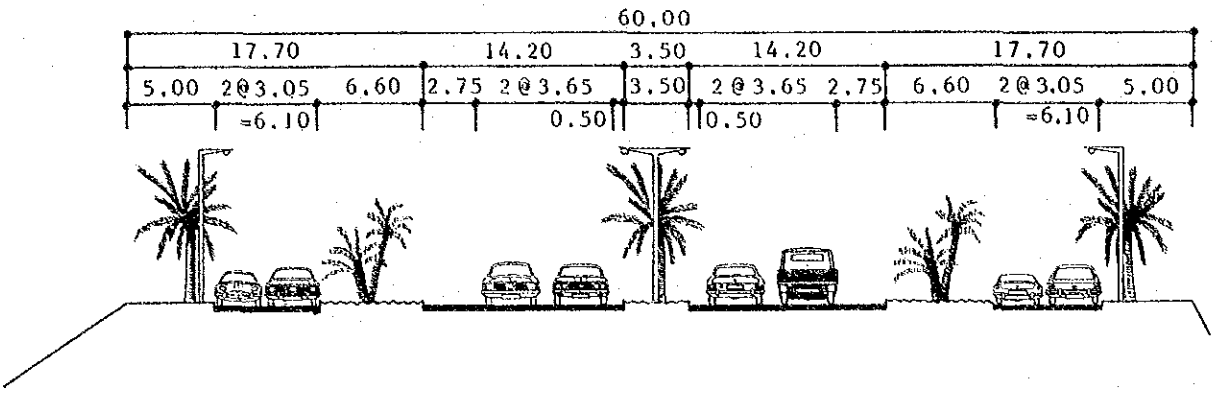


FIGURE V-3-5 TYPICAL CROSS SECTION OF CORREDOR SUR (VIA CIUDAD RADIAL - PAN AMERICAN HIGHWAY, TOCUMEN)

3-2-2 Alignment Design

(1) Horizontal Alignment Design

This section can topographically be divided into a swamp between the Rio Abajo interchange and Don Bosco and a hill between Don Bosco and the Pan-American Highway, but the land conditions remain mostly unused. For this reason, the road horizontal alignment can be selected relatively freely. The selection of a road horizontal alignment,it can be assumed, is restricted by the following:

1) The Rio Abajo Interchange

The present intersection section between Via Cincuentenario and Corredor Sur has the historical Panama Viejo area around the intersection. Since it is planned to prohibit vehicles from entering the park area of Panama Viejo in the future, this interchange was proposed at the intersection with Calle 102 B Este. Because of this, the route position was selected, taking into account the ease of land acquisition at the Interchange.

2) Existing Housing Development Area

Since a private housing development is planned around STA's 101 and 103, the alignment that was established is unlikely to intersect it.

3) Development Restricted Area in the Mangrove Area

Around an area between STA's 106 and 109 is an area where the development is restricted by MIVI. The route selected along the border is unlikely to cut into it to a great extent.

4) Ultimate Minimization of Effect to the Existing Structures

The study was made on the likely effects on the existing residential area around STA 108, to radio antennas and farmers' houses around STA 134 and to the Universidad Tecnologica buildings around STA 212.

5) MIVI Planned Roads

There is a road construction scheduled by MIVI. The route was planned to agree with this road's route.

6) Connection with the Pan American Highway

The route direction was determined, when taking into account the continuity of the connection between the end of Corredor Sur and the Pan American Highway.

(2) Vertical Alignment

Since the route is situated on a swamp, the route alignment was planned taking into account the following:

a. Determination of river crossing points by calculating an extra height against flood level and the height of the beam.

b. To take into account the flood level and drainage slope for all other sections.

c. 0.2% at minimum in the road cross section slope, providing for the road surface drainage.

3-3 INTERSECTION PLANNING

Five main access roads -- Via San Miguelito-Chanis, Via San Miguelito-Hipodromo, Via Juan Diaz, Via Ciudad Radial and Via Don Bosco -- are connected to Corredor Sur in the suburban area, thereby forming intersections. Since Corredor Sur is also connected with the intersection of Via Domingo Diaz and the Pan American highway in Tocumen, the total number of principal intersections totals six. FIGURE V-3-6 gives the daily traffic volume on the foregoing roads.

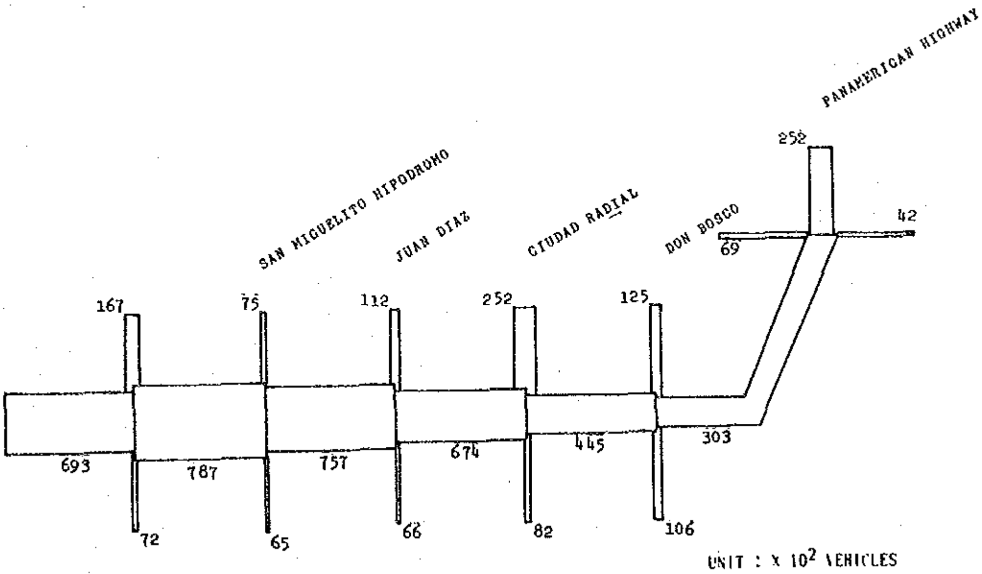


FIGURE V-3-6 FUTURE TRAFFIC DEMAND AT MAJOR INTERSECTIONS ALONG CORREDOR SUR II

Furthermore, the ratio of peak-time traffic volume vs. daily traffic volume shall be set to 8%. In the traffic flow through Corredor Sur and the Main Access Roads, especially in a mass traffic road such as between Via San Miguelito-Chanis and Via Ciudad Radial, frequent refraction traffic can easily be assumed, because of a small amount of traffic generated at the south side of Corredor Sur.

The traffic volume at each intersection is calculated in APPENDIX-5.

(1) Via San Miguelito-Chanis Intersection

This intersection features frequent turning traffic, as mentioned above, the directions of which are the right-turn from Corredor Sur between San Miguelito-Chanis and Tocumen, and the left-turn from the Main Access Roads.

If it is operated as a signal intersection, therefore, suppressing the saturation rate below 1.0 in the foregoing left-turn flow, the saturation rate changes from 1.0 to 1.3 at maximum on Corredor Sur. For the left-turn traffic on Corredor Sur, the traffic volume is small, but an additional lane is provided. A big traffic jam does not occur at this moment as above, but the through-trunk traffic on Corredor Sur shall be dispersed of by a grade-separated intersection, taking the road functions of Corredor Sur into consideration. This results in 0.5 for the saturation rate of the principal traffic flow.

(2) Via San Miguelito-Hipodromo Intersection

Although the traffic demand on Via San Miguelito-Hipodromo is relatively low, and signal control is possible at a surface intersection, whose saturation rate ranges from 0.5 to 0.9, an overpass above Corredor Sur is planned in order to secure smooth traffic flow of Corredor Sur.

(3) Via Juan Diaz Intersection

Although the signal control is possible as at-grade intersection, Via Juan Diaz will pass over Corredor Sur to secure the smooth traffic flow.

(4) Via Ciudad Radial Intersection

The traffic volume in this intersection with Corredor Sur becomes smaller than that in the foregoing three intersections. The highest traffic demand among all other Main Access Road, however, is experienced in this Main Access Road at the north side of Corredor Sur. The turning traffic increases in this intersection, especially the left-turn flow on Corredor Sur from Centro and the right-turn flow on this access road from the north.

This intersection is the point where the 6-lane section of Corredor Sur changes to a 4-lane section. Taking this into consideration, the controlling by signals as a surface intersection results in the saturation rate of the principal traffic flow in either section exceeding 1.0 to reach 1.1 to 1.9. The turning traffic shall, therefore, be controlled at grade by grade-separating the intersection for the through trunk traffic on Corredor Sur. This results in 0.7 at maximum in the saturation rate in the at-grade intersection.

(5) Via Don Bosco Intersection

Signal control will be possible as at-grade intersection with saturation rate ranges from 0.6 to 0.9, however, Via Don Bosco is planned to pass over Corredor Sur in order to secure the smooth traffic flow.

(6) Pan American Highway Intersecion

This intersection is the end of Corredor Sur, crossing Via Domingo Diaz to connect to the Pan American Highway.

Signal control is possible as at grade intersection. The resulting saturation rate ranges from 0.5 to 0.7.

3-4 STRUCTURES

Corredor Sur II (suburban area) plans include three river- crossing bridges and five interchange bridges, as follows:

a. Rio Matias Hernandez bridge
b. Rio Juan Diaz bridge
c. Rio Tapia bridge
d. Via San Miguelito-Chanis Interchange bridge
e. Via San Miguelito-Hipodromo Interchange bridge
f. Via Juan Diaz Interchange bridge
e. Via Ciudad Radial Interchange bridge
g. Via Don Bosco Interchange bridge

For the river crossing bridges, a superstructure type should be adopted without using any formwork. For the bridges to be constructed for the grade separation at intersections, the span can be determined based on the traffic flow in the intersections.

(1) Rio Matias Hernandez bridge

This bridge crosses Rio Matias Hernandez perpendicularly. The improved river crossing section requires a bridge in the span of 43 m. The superstructure type is planned with PC composite beams.

(2) Rio Juan Diaz Bridge

The Rio Juan Diaz improved cross section results in a total bridge length of about 105m(3x35m). The bridge is planned using PC composite beams on three spans.

(3) Rio Tapia Bridge

This bridge will be planned with the PC composite type with 30m span length, crossing Rio Tapia at about 53-deg. askew.

(4) Main Access Road Intersection Bridges

Five intersection bridges would have the same span and bridge length because all the Main Access Roads and Corredor Sur cross at 90-degrees. PC composite beams shall be adopted for the structure and the bridge length would be 50m (2 x 25m).

4. MAIN ACCESS ROADS

4-1 VIA ERNESTO T. LEFEVRE

4-1-1 Land Use Conditions

(1) Present Land Use

Land along Via E.T. Lefevre is already developed, with houses and commercial/business facilities mixed together. In particular, in the area toward the seashore where the road crosses Corredor Sur, there are light industries such as for the furniture and leather industries, and warehouses.

(2) Future land Use

Although no big change can be expected in the present land use, more concentrated and complex use of the land may develop from around the intersections with Via Espana, Ave. Santa Elena and Corredor Sur.

(3) Remarks for Road Design

Since the existing road runs through areas with an excellent environment, road improvement needs to be executed without spoiling this condition. Thought should also be given to providing parking spaces for the commercial and business facilities along the route.

4-1-2 Geometric Design

(1) Number of Lanes and Design Speed

This road is one of the few trunk roads, connecting between the north and south areas of Panama City and situated in the existing urban area with daily traffic volume of about 50,000 to 60,000 vehicles. For this reason, it was planned as a 4-lane road with a design speed of 60km/h.

(2) Cross Section Design

Since this is a road within the urban area, the lane width was selected as 3.35m, while the shoulder width was selected as 1.55m, because this is a trunk road which large vehicles use. The median was selected as 2.5m in width, taking into account the minimum width of left-turn lane. The sidewalk width was selected to be 5.0m, as standard, taking into account the preservation of the living environment in the area and the future land use along the route. However, where buildings are already constructed, this width can be tentatively narrowed down to 2.0m at minimum. This plan is given in FIGURE V-4-1.

(3) Alignment Design

Expansion and improvements are required for the existing road. Both sides along the route contain buildings such as houses and commercial facilities. For this reason, the alignment shall meet the existing road

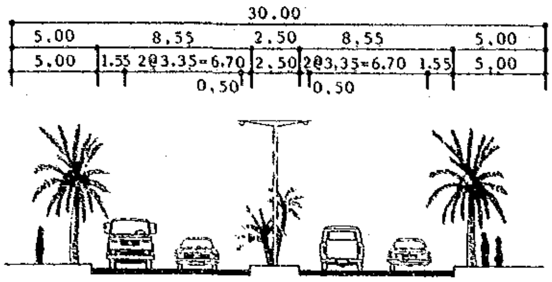


FIGURE V-4-1 TYPICAL CROSS SECTION OF VIA E. T. LEFEVRE

alignment, and the alignment center coincide with the existing road center to avoid being unfair to the property owners on both sides. Concerning the grade separation of the intersection with Via Espana, the plan was made to reduce R down to R = 200 so that it may minimize the effect on the existing structures located on the crossing section. The vertical alignment is planned to be the same as the present alignment, because the existing road is to be widened.

4-1-3 Intersection Planning

Via E.T. Lefevre crosses such arterial roads as Via Espana, Ave. S. Elena and Via *Cincuentenario, including* Corredor *Sur* (See *FIGURE* V-4-2, APPENDIX-4).

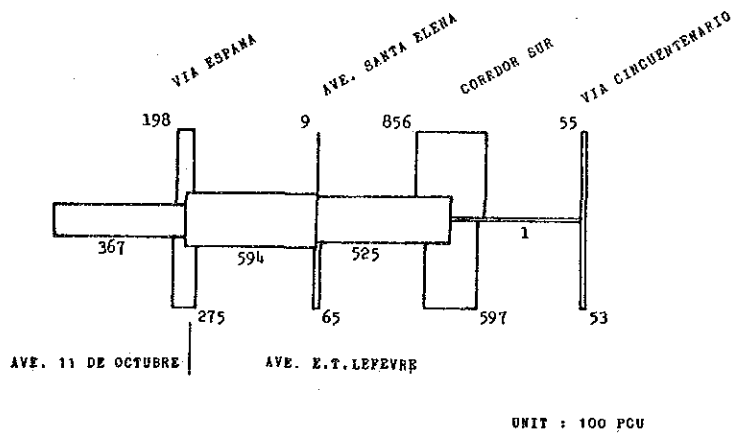


FIGURE V-4-2 FUTURE TRAFFIC DEMAND ON VIA E. T. LEFEVRE AT MAJOR INTERSECTIONS

1) Intersection with Via Cincuentenario

Since Corredor Sur reduces the traffic flow to a very low traffic volume on the intersection of Via E.T. Lefevre with Via Cincuentenario, control is possible without signals.

2) Intersection with Corredor Sur

The planning of this intersection was described in paragraph 2-3 "Intersection Planning on Corredor Sur Intersections (with E.T. Lefevre)."

3) Intersection with Ave. Santa Elena

The traffic volume on Ave. S. Elena is low, but since the traffic volume on Via E.T. Lefevre is high, it is impossible to control the traffic without signals, so it is necessary to control this intersection with signals, at grade. With signal control, this intersection can be operated with a saturation rate of between 0.1 to 0.9.

4) Intersection with Via Espana

Controlling this intersection by signals as an at-grade intersection results in a saturation rate of between 0.5 to 2.2, exceeding 1.0 in most directions. Because of the traffic volume, measures must be taken to control the traffic flow on either Via E.T.Lefevre or Via Espana.
A grade-separated intersection at the Via Espana side reduces the traffic volume less than that on Via E.T. Lefevre, so that there is no effect to the through traffic (signal control of the surface intersection, even if it is implemented, results in 0.5 to 1.9 in the saturation rate). Grade-separating the intersection at the Via. E.T. Lefevre side allows signal control to be applied in the surface intersection as well, of which saturation rate results in 0.4 to 0.9. The grade-separated intersection shall be provided with a 4-lane road, of which a sketch plan and standard cross section are shown in FIGURE V-4-3.

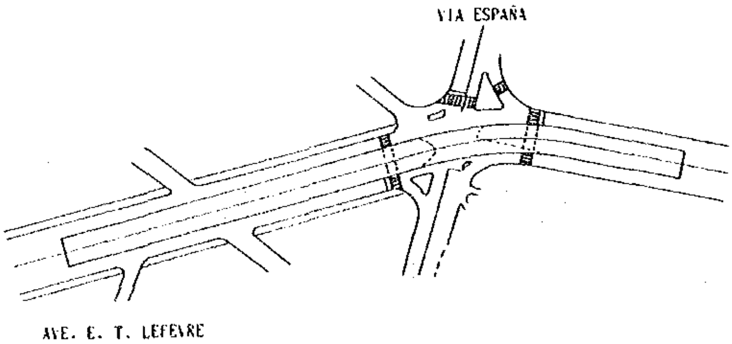


FIGURE V-4-3 INTERSECTION PLAN OF VIA E.T. LEFEVRE WITH VIA ESPANA

4-1-4 Structures

There is a bridge planned for the grade separation at the intersection with Via Espana and Via E.T.Lefevre.

In view of the traffic flow line and the vertical clearance, the minimum span length is planned to be no less than 45 m. Considering the ease of construction and the detour during construction, the suitable superstructure will be planned using the PC composite type, which can shorten the clear span length down to 40 m by using the Gerber's type similar to the E.T.Lefevre viaduct.

4-2 VIA SAN MIGUELITO-CHANIS

4-2-1 Land Use Conditions

(1) Present Land Use

Between Via Domingo Diaz and Ave. Jose A. Arango, there is a housing area consisting of about 1,000 houses on the east side, and on the west side there are furniture factories and hospitals. Although commercial facilities are located at certain parts of the area to the south of Ave. Jose A. Arango, a housing area extends in both sections for about 1km toward the planned route of Corredor Sur, and the remaining 1km is unused land on both sides.

(2) Future Land Use

The use of land in the section between Via Domingo Diaz and Ave. Jose A. Arango will remain the same, while the residential area to the south of Ave. Jose A. Arango will expand into the currently unused area. Around the intersection with Corredor Sur, local service-oriented commercial facilities, supported by the nearby large-scale housing area, will be located.

(3) Remarks for Road Design

Since nearly the entire roadside area is adjacent to residential areas, there is an especially called for need to consider the environment. For the sections to be developed as a residential area in the future, housing construction should be planned with enough extra space to facilitate the foregoing considerations.

4-2-2 Geometric Design

(1) Number of Lanes and Design Speed

This is a north-south arterial road to be connected to San Miguelito Central in the future, but the route is situated in the existing housing development area. This route also connects with Corredor Sur and other east-west arterials roads, and simultaneously runs into the residential areas, so that the traffic service function to the local area is great. For this reason, this road was planned as a 4-lane road at a design speed of 60km/h.

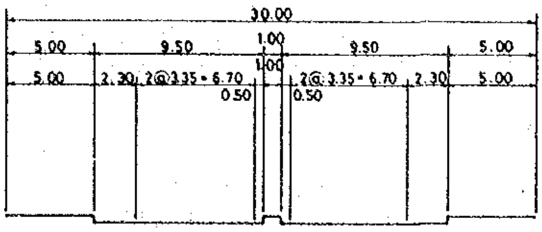
(2) Cross Section Design

Two alternative cross sections were proposed for the road which passes through the residential development area:
(See FIGURE V-4-4)

a. Alternative 1.

The median of 2m wide and the stopping lane of 2.3m wide on the shoulder are provided.

ALTERNATIVE 1



ALTERNATIVE 2 (SELECTED)

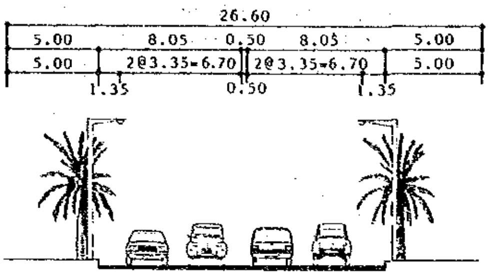


FIGURE V-4-4 TYPICAL CROSS SECTION OF VIA SAN MIGUELITO-CHANIS, VIA CIUDAD RADIAL

b. Alternative 2.

The road width is planned as a sum of the widths of the necessary cross section components.

Due to the anticipated difficulty of land acquisition before the construction, Alternative 2 was selected.

(3) Alignment Design

1) Routing

The road crosses two east - west arterials roads such as Via Espana and Via Domingo Diaz.

2) Horizontal Alignment

This route was planned based on the following conditions, taking into account the plan to further extend the road northward from Via Domingo Diaz:

a. To use this road for driving through the residential area in this region, because there is no alternative road but the existing road of Calle 114 Este (between STA 3 and Via Espana).

b. To minimize the effect of this road construction to the existing factory buildings around the Domingo Diaz intersection as much as possible.

c. Northward extension from Domingo Diaz to be planned so that the alignment through Villa Lucre area may be used.

3) Vertical Alignment

Because it crosses many roads and close to existing buildings, this route was planned conforming to the present alignment.

4-2-3 Intersection Planning

Via San Miguelito Chanis crosses such principal arterial roads as Via Domingo Diaz and Via Espana, including Corredor Sur. FIGURE V-4-5 gives the traffic volume in the principal intersections. Furthermore , the ratio of peak-time traffic volume vs. daily traffic volume is set to 8%.

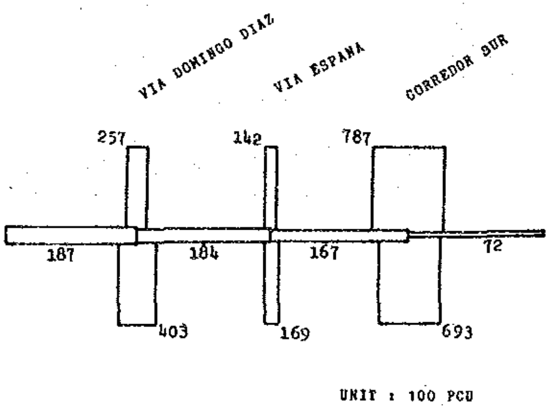


FIGURE V-4-5 **FUTURE TRAFFIC DEMAND ON VIA SAN MIGUELITO-CHANIS AT MAJOR INTERSECTIONS**

1) Intersection with Corredor Sur

The planning of this intersection was described in paragraph 3-3 of Chapter V "Intersection Planning" on Corredor Sur Intersection (with Via San Miguelito-Chanis).

2) Intersection with Via Espana

Signal control is possible with an intersection at grade. The saturation rate along the principal direction is between 0.6 to 0.8.

3) Intersection with Via Domingo Diaz

Signal control is possible with an intersection at grade. The saturation rate along the principal directions is in 0.7 to 0.9.

Intersections given in Items 2) and 3) above as Via Espana and Via Domingo Diaz shall be provided with an additional lane for left-turn .

4-2-4 Structures

Bridges are planned to be constructed at two points where this access road crosses Rio Matias Hernandez. The improved river crossing section is about 20m in length. Since the crossing angle between the planned road and the river is about 50-deg., the column span required is of about 35m. For this reason, PC composite beams were selected.

4-3 VIA SAN MIGUELITO-HIPODROMO

4-3-1 Land Use Conditions

(1) Present Land Use

The surrounding area of the road is currently completely undeveloped. While on the south side, for about 700m, houses and factories are located sporadically on both sides. The area to the south of Ave. Jose A. Arango is unused land up to Corredor Sur, after passing the section surrounded by a racetrack ground and factories.

(2) Future Land Use

The portion to the north of Ave. Jose A. Arango will be a residential area on the east side and a factory area on the west side, as designated by the zoning regulations. Around the intersection with Ave. Jose A. Arango, there are service establishments for the local inhabitants, and the residential area will extend beyond the factory area on the east side of this road. A large-scale commercial facility to serve the residential areas of Juan Diaz, La Pulida, Pedregal, and Tocumen will be located around the intersection with Corredor Sur.

(3) Remarks for Road Design

Similarly, as with the other main access roads to Corredor Sur, since this access road connects to residential areas, sufficient consideration needs to be given to the surrounding environment. Around the intersection with Corredor Sur, consideration must also be given to the incoming and outgoing of vehicles, which may increase due to the establishment of a large-scale commercial facility (suburban-type shopping center).

4-3-2 Geometric Design

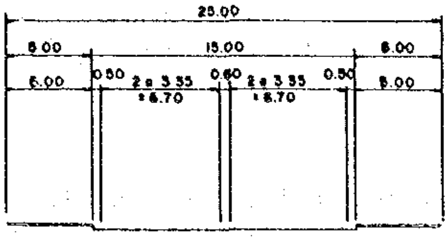
(1) Number of Lanes and Design Speed

This road is one of the many north-south roads interconnecting with the east-west trunk roads, and functions as a service road to the local areas along this route. The traffic volume is less than that on some roads in parallel with this road, but this is a trunk road in the network. This was, therefore, planned as a 4-lane road with a design speed of 60 Km/h.

(2) Cross Section Design

Two alternative cross sections were proposed for the road which passes through the future residential area.(See FIGURE V-4-6):

ALTERNATIVE 1



ALTERNATIVE 2 (SELECTED)

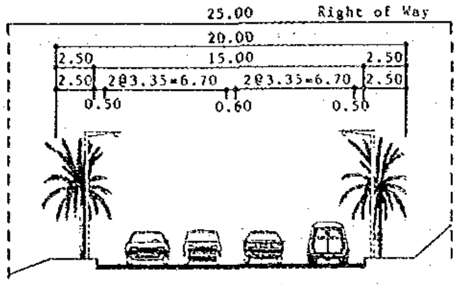


FIGURE V-4-6 TYPICAL CROSS SECTION OF VIA SAN MIGUELITO-HIPODROMO, VIA JUAN DIAZ, VIA DON BOSCO

a. Alternative 1.

Wider sidewalks were provided for the sake of environmental protection for the residential area, as a buffer zone function.

b. Alternative 2.

The main theme of this alternative is to secure the carriage way width for expected traffic volume, as for the trunk road.

The traffic volume of this road cannot be expected to be very large at an early period after the completion of construction. This means also, that there will be little impact on the environment. Alternative 2 was, therefore, selected for the first stage. However, a 25 m width of R.O.W. should be secured for the sake of future environmental protection.

(3) Alignment Design

1) Routing

This route crosses Via Espana around the Hipodromo and runs into Domingo Diaz from Calle 122 Oeste of the Villa Ines housing development area.

2) Horizontal Alignment

This route was selected based on the following conditions, taking into account the plan to further extend the road northward from Via Domingo Diaz:

a. To take into account the radio antennas around the area between STA's 4 and 5.

b. To determine the alignment with care given to the facilities and factory buildings in the Hipodromo around the area between STA's 9 and 10.

c. Use of the existing road of Calle 122 Oeste

d. Continuity with the northward extension and connecting road

3) Vertical Alignment

The vertical alignment was planned so that the elevation difference would be as small as possible, in order to affect the road intersections and existing buildings in the smallest possible way.

4-3-3 Intersection Planning

Via San Miguelito-Hipodromo crosses principal arterial roads such as Via Domingo Diaz and Via Espana, including Corredor Sur. FIGURE V-4-7 gives the traffic volume in the principal intersections. Furthermore , the ratio of peak-time traffic volume vs. daily traffic volume is set to 8%.

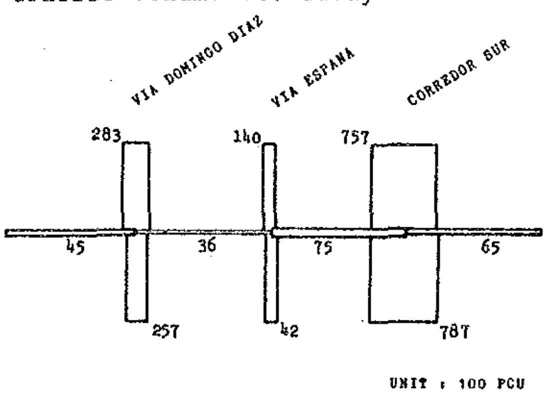


FIGURE V-4-7 **FUTURE TRAFFIC DEMAND ON VIA SAN MIGUELITO-HIPODROMO AT MAJOR INTERSECTIONS**

1) Intersection with with Corredor Sur

The planning of this intersection was already described in paragraph 3-3 of Chapter V "Intersection Planning on Corredor Sur."

2) Intersection with Via Espana

Signal control is possible with an intersection at grade. The saturation rate along the principal directions goes from 0.2 to 0.4.

3) Intersection with Via Domingo Diaz

Signal control is possible as at grade intersection. The saturation rate along the principal directions goes from 0.4 to 0.9.

Such intersections given in Items 2) and 3) above as Via Espana and Via Domingo Diaz shall be provided with an additional lane for left-turn.

4-4 VIA JUAN DIAZ

4-4-1 Land Use Conditions

(1) Present Land Use

Between Via Domingo Diaz and Ave. Jose A. Arango, there are factories at the north end and a residential area in the remaining area. To the south of Ave. Jose A. Arango, houses are located sporadically over a distance of about 500m, but the area of about 1km up to the route of Corredor Sur is left unused.

(2) Future Land Use

Around the intersections with Ave. Jose A. Arango and with Corredor Sur, there will be commercial facilities along the route. The remaining area will be a residential area for single-family houses, except for the industrial area around Via Domingo Diaz.

(3) Remarks for Road Design

Since the environment of the residential areas is the main concern, consideration should be given to planting greenery and improving the scenery within the right-of-way.

4-4-2 Geometric Design

(1) Number of Lanes and Design Speed

The function of this road is to service the local area as well as to interconnect with the east-west trunk roads, in the same way as other main access roads to Corredor Sur. Most of the traffic is providing services to the local areas, whose size is not so great. Therefore, the road was planned as a 4 - lane road with a design speed of 60 Km/h.

(2) Cross Section Design

Since the road functions, future traffic demand and road side land use of this road are similar to ones of Via San Miguelito-Hipodromo, the same typical cross section of San Miguelito-Hipodromo can be adopted for this road (See Figure V-4-6).

(3) Alignment Design

1) Routing

This route runs through the housing development area of San Fernando almost parallel with the Rio Juan Diaz from Corredor Sur and across Via Espana, from where the existing road of Calle 130 Este is used in the housing development area of Altos Del Hipodromo to enter Via Domingo Diaz.

2) Horizontal Alignment

This route was planned with consideration given to the following buildings, taking into account the plan to further extend the road northward from Via Domingo Diaz:

a. Houses in San Fernando around the area between STA's 7 and 12

b. School buildings around STA 13 around the intersection with Via Espana

c. Leather factory buildings around STA 14

d. Houses in Altos Del Hipodromo (between STA's 14 and 18)

e. IHRE substation (at STA 19)

f. Car-battery factory buildings (at STA 20)

3) Vertical Alignment

Since this is a road within the existing urban area, the vertical alignment was planned to meet the topography so as to minimize the effect to the surrounding buildings.

4-4-3 Intersection Planning

Via Juan Diaz crosses principal arterial roads such as Via Domingo Diaz and Via Espana, including Corredor Sur. FIGURE V-4-8 gives the traffic volume in the principal intersections. Furthermore , the ratio of peak-time traffic volume vs. daily traffic volume is set to 8%.

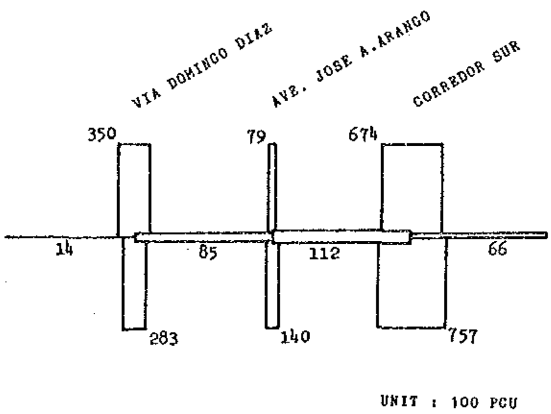


FIGURE V-4-8 FUTURE TRAFFIC DEMAND ON VIA JUAN DIAZ AT MAJOR INTERSECTIONS

1) Intersection with Corredor Sur

See paragraph 3-3 of Chapter V "Intersection Planning."

2) Intersection with Via Espana

Signal control is possible with an intersection at grade. The saturation rate along the principal directions ranges from in 0.3 to 0.6.

3) Intersection with Via Domingo Diaz

The signal control is possible with an intersection at grade. The saturation rate along the principal directions ranges from in 0.2 to 0.9.

Such intersections given in Items 2) and 3) above as Via Espana and Via Domingo Diaz shall be provided with an additional lane for left-turn.

4-4-4 Structures

A bridge to cross the Rio Palomo, which is a branch stream of the Rio Juan Diaz, is planned. Since this bridge crosses the river nearly at right angles, the span is planned to be 30m. PC composite beams shall be used for the superstructure type.

4-5 VIA CIUDAD RADIAL

4-5-1 Land Use Conditions

(1) Present Land Use

This road, to the north of Via Domingo Diaz, is connected to a road within the large-scale housing area of Villa Flor. Between Via Domingo Diaz and Ave. Jose A. Arango, there is a area of flooding from the Rio Juan Diaz which is currently an uninhabitable area. To the south of Ave. Jose A. Arango, this road runs through the center of Ciudad Radial, and the roadside is already developed as a housing area.

(2) Future Land Use

Athough an industrial land use can be envisioned in the future around the intersection with Via Domingo Diaz, the uninhabitable area will remain as it is, unless improvements to the Rio Juan Diaz are introduced. Around the two intersections with Ave. Jose A. Arango and with Corredor Sur, where the entrance to Via Ciudad Radial will be located, a commercial land use will be established.

(3) Remarks for Road Design

Since this road runs mainly through a housing area, consideration should be given to the surrounding environment. Furthermore, since this road will run through the center of Ciudad Radial, it may be desirable to design a roundabout in order to maintain the radial form present in that development.

4-5-2 Geometric Design

(1) Number of Lanes and Design Speed

The road is to be an arterial street of the north-south direction with a rather large traffic volume , so it is planned as a 4-lanes street with a design speed of 60 Km/h.

(2) Cross Section Design

Since road functions, future traffic demand and road side land use of this road are similar to ones of Via San Miguelito-Chanis, the same typical cross section of Via San Miguelito-Chanis can be adopted for this road (See Figure V-4-4).

(3) Alignment Design

1) Routing

This route is aligned to run through the existing residential area of Ciudad Radial from Corredor Sur, to cross Via Jose A. Arango, then, to run northward to cross the Rio Juan Diaz and to reach Via Domingo Diaz.

2) Horizontal Alignment

This route was planned taking into account the plan to further extend the road northward from Via Domingo Diaz. The following aspects were taken into consideration for the selection of the road route:

a. To expand and improve Calle E in accordance to the status quo of Ciudad Radial.

b. Its effect on the buildings around Via Espana

c. To make the crossing with the Rio Juan Diaz as near perpendicular as possible.

d. The directional angle connecting with San Antonio

3) Vertical Alignment

Since this is a road within the existing urban area, the vertical alignment was planned to meet the topography as much as possible, taking into account its effect on the surrounding buildings.

4-5-3 Intersection Planning

Via Ciudad Radial crosses principal arterial roads such as Via Domingo Diaz and Via Jose A. Arango, including Corredor Sur. FIGURE V-4-9 gives the traffic volume in the principal intersections. Furthermore, the ratio of peak-time traffic volume vs. daily traffic volume is set to 8%.

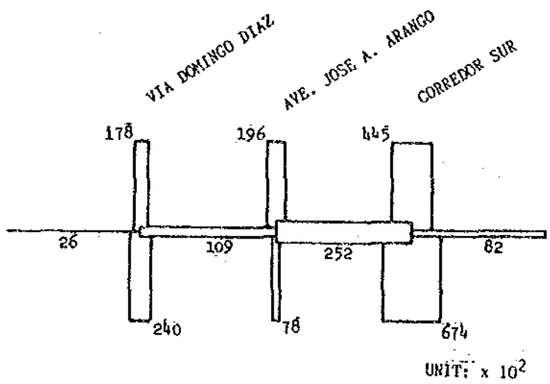


FIGURE V-4-9 FUTURE TRAFFIC DEMAND ON VIA CIUDAD RADIAL AT MAJOR INTERSECTIONS

1) Intersection with Corredor Sur

See paragraph 3-3 of Chapter V "Intersection Planning."

2) Intersection with Via Jose A. Arango

Signal control is possible with an intersection at grade. The saturation rate along the principal directions ranges from 0.4 to 0.7.

3) Intersection with Via Domingo Diaz

Signal control is possible with an intersection at grade. The saturation rate along the principal directions ranges from 0.2 to 0.6.

Such intersections given in Items 2) and 3) above as Via Jose A. Arango and Via Domingo Diaz shall be provided with an additional lane for left-turn.

4-5-4 Structures

A bridge that crosses the Rio Juan Diaz at nearly a right angle is planned. The improved river cross section determines the total bridge length. Since the left bank of the present river cross section is slightly graded, while the right bank has about 70-deg. in the grade, the right bank needs to be terraced. The total bridge length was planned to be 65m. PC composite beams shall be adopted for the superstructure type.

4-6 VIA DON BOSCO

4-6-1 Land Use Conditions

(1) Present Land Use

This route, planned to the south of Via Domingo Diaz, will run straight through the two large-scale collective housing areas of Don Bosco and Altos de las Acacias. The roadside is where development has been rapidly progressing recently, extending southward. The area around the intersection with Via Domingo Diaz is undergoing new commercial development.

(2) Future Land Use

Around the intersection between Via Don Bosco and Via Domingo Diaz commercial development can be assumed in spite of the zoning regulation for industry. In all other areas, housing development will progress toward the intersection with Corredor Sur, where roadside commercial establishments will be located, as in all other main access roads.

(3) Remarks for Road Design

Since this road runs through a large-scale housing area where development is progressing in an orderly fashion, it will be necessary to give this road the characteristic of a subtrunk road rather than a local road in a residential area. In other words, there is need to study the implementation of access controls on local roads in the residential areas.

4-6-2 Geometric Design

(1) Number of Lanes and Design Speed

The function of this road is to service the Don Bosco area, as well as to interconnect with Corredor Sur and Via Domingo Diaz. Since the vehicle trips are mainly for providing services to the local area, a 4-lane road will suffice. Therefore, the road was planned as a 4-lane road with a design speed of 60 Km/h.

(2) Cross Section Design

Since the road functions, future traffic demand and road side land use of this road are similar to ones of Via San Miguelito-Hipodromo. The same typical cross section as of San Miguelito-Hipodromo can be adopted for this road (See FIGURE V-4-6).

(3) Alignment Design

1) Routing

Although there is now an existing road within the Don Bosco urban area, it is a 2-lane road, of which expansion and improvement to a 4-lane road would affect the existing buildings. The route was, therefore, planned to directly connect with Corredor Sur and Calle Florida, taking into account the further northward extension of this road.

2) Horizontal Alignment

This road almost connects directly with Corredor Sur and Calle Florida and also to Via Domingo Diaz to have a near perpendicular intersection with Via Domingo Diaz around STA 21, which was determined so as not to affect the factory buildings around there.

3) Vertical Alignment

The vertical alignment was planned with consideration given to the intersection with Via Domingo Diaz and to the ground floor elevation of factory buildings around there.

4-6-3 Intersection Planning

Via Don Bosco crosses the principal arterial road of Via Domingo Diaz, including Corredor Sur. FIGURE V-4-10 gives the traffic volume in the principal intersections. Furthermore, the ratio of peak-time traffic volume vs. daily traffic volume is set to 8%.

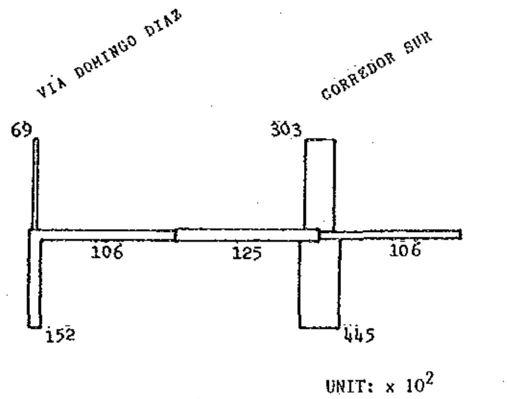


FIGURE V-4-10 FUTURE TRAFFIC DEMAND ON VIA DON BOSCO AT MAJOR INTERSECTIONS

1) Intersection with Corredor Sur

See paragraph 3-3 of Part V "Intersection Planning."

2) Intersection with Via Domingo Diaz

Signal control is possible with an intersection at grade. The saturation rate along the principal directions ranges from 0.1 to 0.8. This intersection of Via Domingo Diaz shall be provided with an additional lane for left-turn.

5. CORREDOR SUR EXTENSION

5-1 LAND USE CONDITIONS

5-1-1 Present Land Use

(1) Land Use and Population

Corredor Sur Extension road runs through north and south near the centers of the Corregimientos of San Felipe, El Chorillo and Santa Ana. San Felipe is a wall-surrounded city constructed at the end of the 17th century, and the present Panama City extended toward Santa Ana and Chorillo, making this the center.

In the San Felipe area, the residential area now extends over almost all the area, where public facilities are located sporadically, including the Presidential Office and churches. Most of the houses are two or three-story wooden houses built at the beginning of the 20th century, occupying about 82% of the total area. The gross population density is 290 persons/ha, which is considered a high rate.

The Santa Ana area contains old commercial facilities along the route of Ave. Central. The gross population density is about 350 persons/ha. The land behind the road has multiple uses, such as houses, small shops, etc. MIVI renewal project of this area after 1974 has already constructed about 30 medium and high-rise public housing units. A large proportion of the old, decaying wooden houses still remain, however.

In El Chorrillo, medium and high-rise dwellings constructed pursuant to the redevelopment projects can be seen, together with the aged wooden houses, the headquarters of Guardia Nacional,and public facilities such as schools and a cemetery, etc. The gross population density in this area is about 500 persons/ha, the highest density in Panama.

(2) Roadside Conditions

1) Building Use and Conditions

Corredor Sur Extension road starts from the west end of Corredor Sur, which is at the intersection with the present Calle 3 de Noviembre. The section from the east end up to Ave. B contains car repair shops and high-rise communal houses. The planned route between Ave. B and Ave. Central contains general retail stores, wooden sheltered parking lots, etc. Between Ave. Central and the seashore of Chorrillo is a route running north and south through the block interpositioned between Calle 14 Oeste and Calle 15 Oeste. The existing buildings are constructed partly of concrete. There are old wooden buildings almost over all sections, which are mainly two or three storied buildings, and buildings of mixed commercial and residential use.

The seashore, from the south end of Calle 14 Oeste up to Ave. de los Poetas, is built-up with medium-rise housing for low-income people, which were constructed in the 1970's, and such public facilities as elementary and junior high schools, parks, etc., and high-rise buildings for low income people.

2) Land Property

The land for constructing the high and medium-rise housing now in progress in the renovation area is, for instance, bought by the Banco Hipotecario to enable the work to proceed. The most common situation is that the section along Calle 14 Oeste is mostly privately owned land, while in the section along the seashore, the land is mostly owned by the government.

(3) Existing Urban Renewal Projects

1) Background of Urban Renewal Projects

The urban renewal project areas in relation with the Corredor Sur Extension road can be divided into three areas : Santa Ana area, Chorillo Este area and Chorillo Oeste area (See FIGURE. V-5-1). The urban renewal project areas are designated by MIVI when it is deemed "necessary to promote, renovate, change the patterns, and reconstruct the areas by reasons of buildings being damaged, unsanitary, deteriorated or by any other social or economic reason." Any development within the areas so designated, whether public or private, requires the prior approval by MIVI. The transfer or rent of any real estate also requires approval by MIVI.

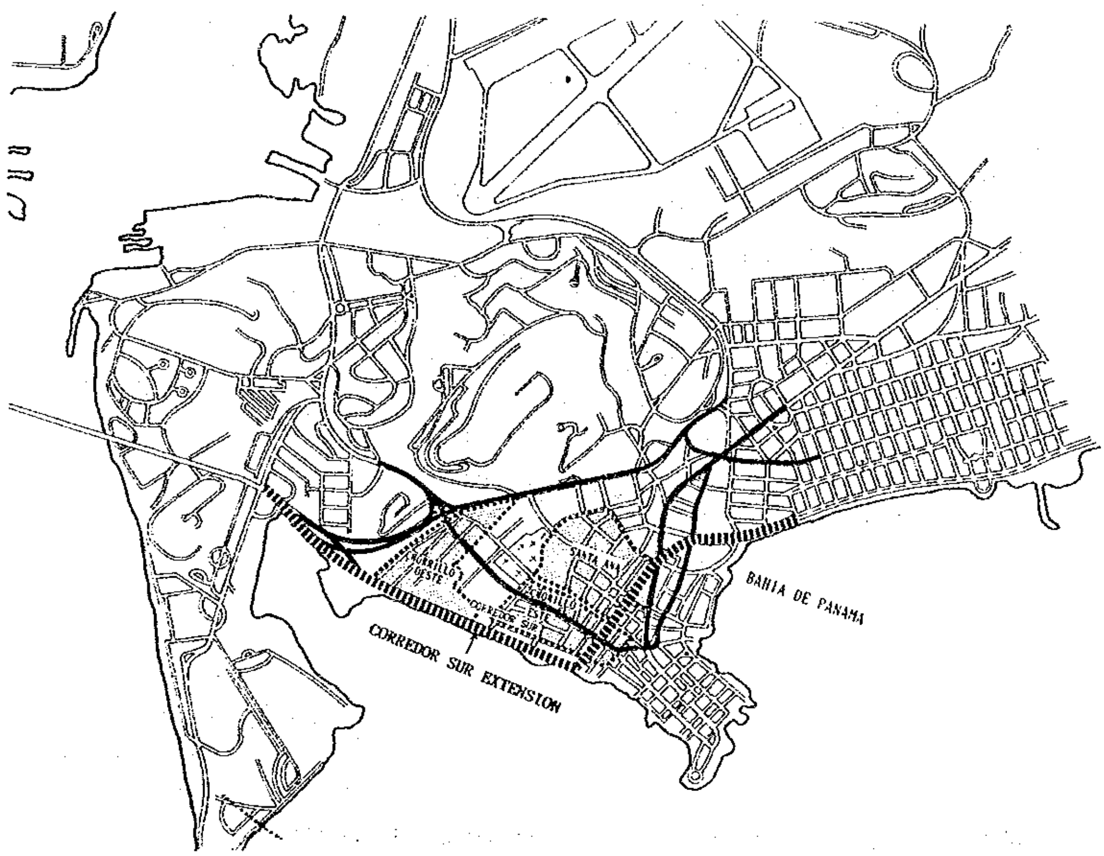


FIGURE V-5-1 URBAN RENEWAL PROJECTS AND CORREDOR SUR EXTENSION

The Chorrillo Oeste area and Santa Ana area were designated Urban Renewal Areas on December, 1973 and August, 1981, respectively. The Chorrillo Este area is now under plan; the work is scheduled to start in 1988. The principal purpose of renewing the foregoing three areas is to construct medium and high-rise housing for low income people, the replacement of old houses, and the control of the traffic within the areas.

2) How to Proceed with the Urban Renewal Projects

The Banco Hipotecario Nacional, established in 1973, executes the work in accordance with the plans determined by MIVI. Namely, under MIVI plans, the Banco Hipotecario Nacional issues national bonds to the city banks or foreign financial institutions to secure the funds, buys the land, constructs the houses for low income people, and provides them with rental housing. This results in the ownership of land and houses by the Banco Hipotecario Nacional. The housing land for low income people, which is owned by the Banco Hipotecario Nacional, is now being extended gradually in both the urban renewal project areas of Santa Ana and Chorillo. (See FIGURE. V-5-2)

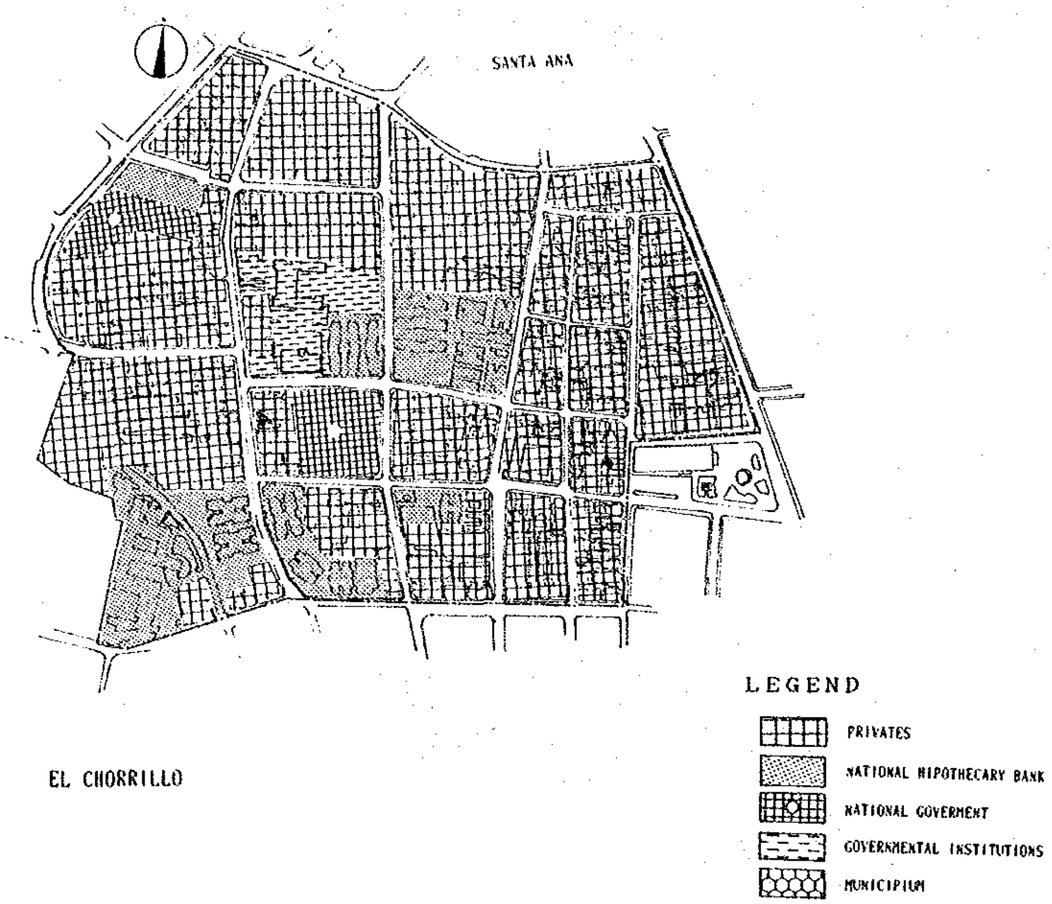


FIGURE V-5-2 (1) LANDOWNERS IN URBAN RENEWAL AREA OF SANTA

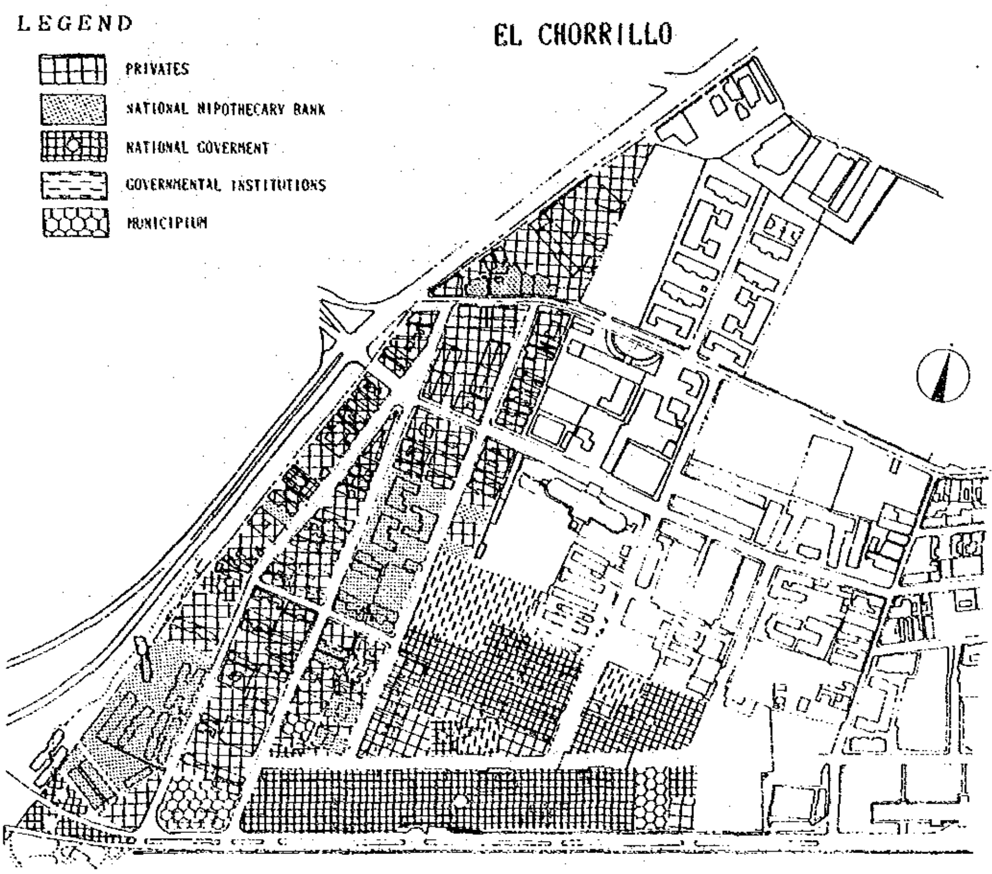


FIGURE V-5-2 (2) LANDOWNERS IN URBAN RENEWAL AREA OF EL CHORRILLO

5-1-2 Future Land Use

For studying the future land use along these routes, the descriptions shall be made by dividing this section at each intersection between Via Cerro Ancon and Ave. Central, between Ave. Central and Ave. A., and between Ave. A and Ave. de los Martires. The land use along each route is shown in FIGURE V-5-3, V-5-4, V-5-5.

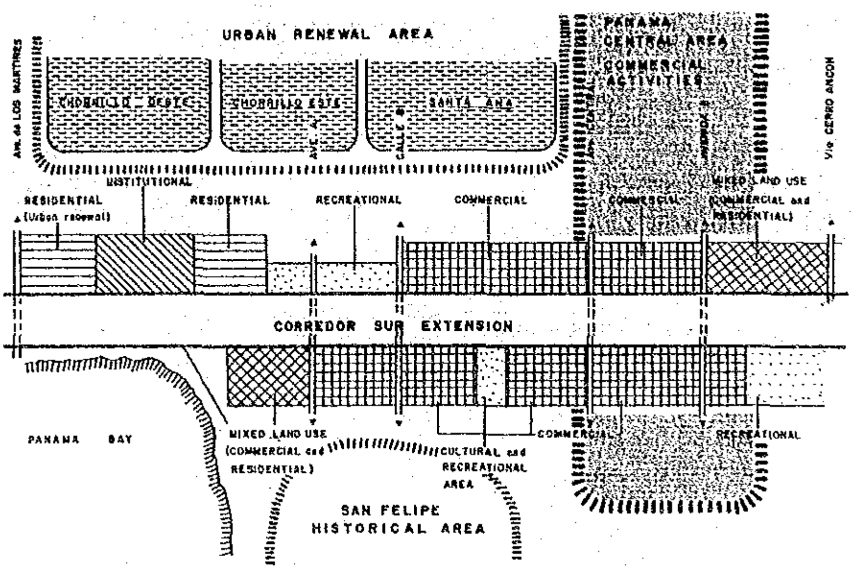


FIGURE V-5-3 FUTURE LAND USE ALONG CORREDOR SUR EXTENSION

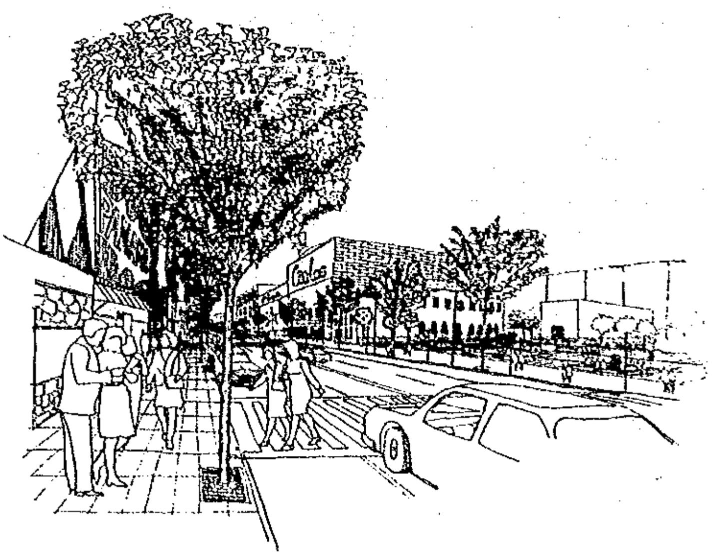


FIGURE V-5-4 FUTURE IMAGE SKETCH OF CORREDOR SUR EXTENSION IN SANTA ANA AREA

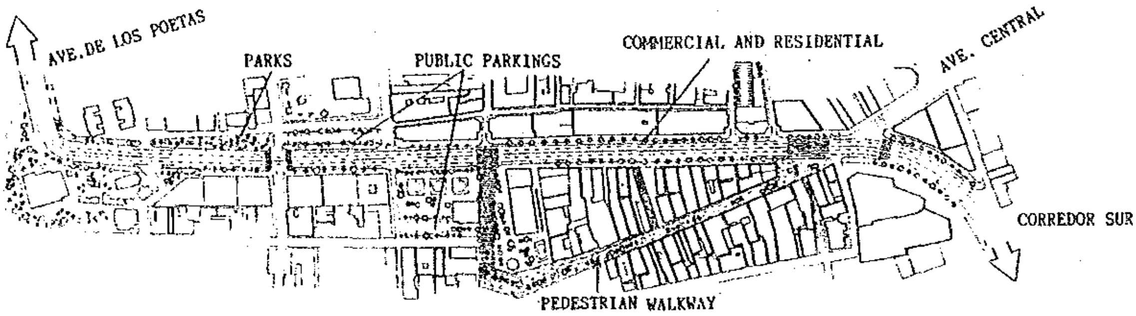


FIGURE V-5-5 FUTURE DEVELOPMENT MODEL PLAN ALONG CORREDOR SUR EXTENSION IN SANTA ANA AREA

(1) Via Cerro Ancon to Ave. Central

This section, with the background of the existing commercial concentration, will contain commercial facilities both along the route and behind the land. The area around Via Cerro Ancon will be a residential and commercial mix, and the area around the seashore is planned to be used as a recreation area as considered in the ESTAMPA II.

(2) Ave. Central to Ave. A

The present commercial activities along Ave. Central can be expected to extend to the route of Corredor Sur as soon as Corredor Sur is completed. Half a block extending from the Calle 14 Oeste to Calle 15 Oeste will be used for the new structure of the road, the remaining width is about 20m. This remaining land from Ave. Central up to Calle B shall also be used for commercial facilities. The remaining land along Calle 15 Oeste from Calle B to Ave. A, a narrow space of 10 to 15 m, shall be planned either as a green area or a public parking lot.

(3) Ave. A to Ave. de los Martires

The section from the intersection between Calle 14 Oeste and Calle A toward the seashore is expected to contain nearly the same public facilities or communal houses along the seashore as the present land use.

5-1-3 Improvement of Surrounding Areas

(1) Existing Urban Problems

The local road network in the Santa Ana and Chorrillo area is basically a "grid pattern" with 6m to 12m wide roads. It is conceivable that the existing road network pattern and road width can function properly in the future land use in the area. For the improvement of environmental conditions, it is necessary to examine the proper solution for fire prevention, the outbreak of crime and the deteriolation of the streetscape, and so on.

(2) Improvement Method

To improve living conditions, more space for pedestrians should be provided by introducing the regulation of set-backs and minimun building heights for roadside buildings. This will maintain the comfortable pedestrian environment and also the safe environment for the dwelers by allowing a veiw down the length of the whole street. Also, providing the integrated parking space for incoming people will also assist the above goals.

For the purpose of acceleration of urban renewal, especially for the building construction, private money needs to be introduced for the implementation of the projects. For instance, some private entities could acquire one or two bottom floors for commercial use and the floors above could be destined for public use as dwellings provided by the goverment. This would mean that the expediture of the public sector would be reduced and, also,that an economically effective use of land would be made, especially along Corredor Sur Extension, where commercial activities can be located in the first or second floor of buildings.

5-2 GEOMETRIC DESIGN

5-2-1 Cross Section Design

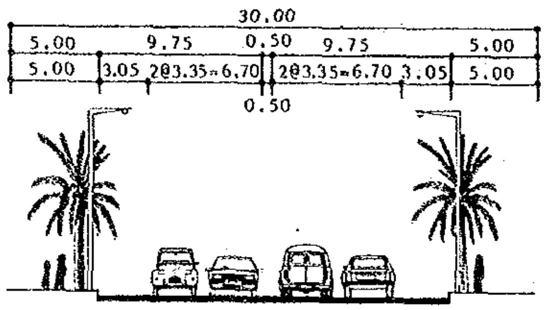
The vehicle trips in this section are mainly entering the present Centro area, where the traffic is jammed. Namely, this is a road that services the commercial activities around there. Based on these road functions and traffic volume, the road was planned as a 4-lane road with a design speed of 40 km/h.

This route can broadly be divided into a new road construction section between Cerro Ancon and Los Poetas and an improvement and expansion section of Ave. de los Poetas, based on the present road network conditions.

(1) New Construction Section

Future commercial activity can be expected; therefore, a 5 m wide sidewalk was recommended. Concerning the carriageway, two alternatives were proposed (See FIGURE V-5-6):

ALTERNATIVE 1 (SELECTED)



ALTERNATIVE 2

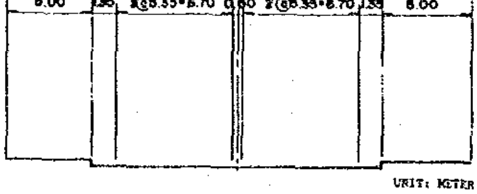


FIGURE V-5-6 TYPICAL CROSS SECTION OF CORREDOR SUR EXTENSION (ROAD WIDENING SECTION)

a. Alternative 1.

A 3.05 m wide shoulder was secured for the temporary parking in connection with road side commercial activities.

b. Alternative 2.

A 1.35 m wide shoulder was provided, which exerts a small influence on the main flow of the carriage way.

From the view point of future expected land use along the road, a wider shoulder is more convenient for newcomers to this area. Consequently, Alternative 1 was selected.

(2) Improvement and Expansion Section

In the present urban area of Ave. de los Poetas, there are many monuments. The route has an almost straight alignment along the sea. For this reason, the typical cross section in this section was planned as shown in FIGURE V-5-7, which has 3.5m wide median where monuments can be placed. Since the expected traffic volume needs a 4-lane road, the route along the inland side of the existing road shall be used as it is now, while the seaside is planned to be expanded to 5.0m, taking into account the passage of pedestrians.

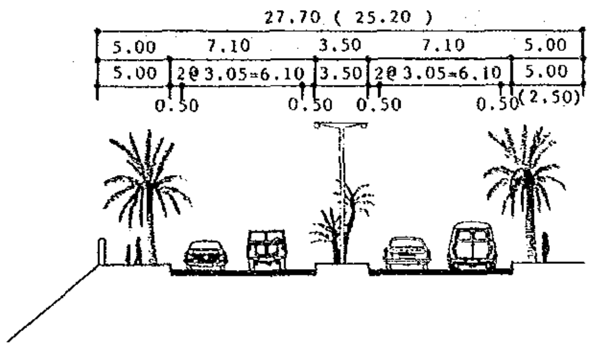


FIGURE V-5-7 TYPICAL CROSS SECTION OF CORREDOR SUR EXTENSION (SEASHORE SECTION)

5-2-2 Alignment Design

This is a road that runs through a highly-concentrated area of Centro, i.e. a commercial area ranging from Ave. Balboa to Centro. This road crosses Ave. B and Ave. Central to reach Ave. los Poetas via the block interpositioned between Calle 14 and Calle 15. Between Calle 14 and Ave. de los Martires it is planned to expand and improve the existing road of Ave. de los Poetas.

The horizontal alignment was planned to connect at R = 80m to the intersection with Ave. Central and at R = 23m to the intersection between Calle 14 and Ave. de los Poetas.

The lane width was planned with consideration given to the following.

a. The starting point of Corredor Sur Extension wasplanned to align with the center of Corredor Sur.

b. The road center was planned to be positioned so that the sidewalk edge of this road may be aligned with that of Calle 14, leaving as much space at the Calle 15 side as possible.

c. To leave the church building around STA II and the 12-story apartment building constructed by the MIVI as they are now.

d. To leave the green area at the front of the MIVI-built apartment building as a buffer zone.

e. To connect to Ave.de los Poetas at the front of a school around STA 15.

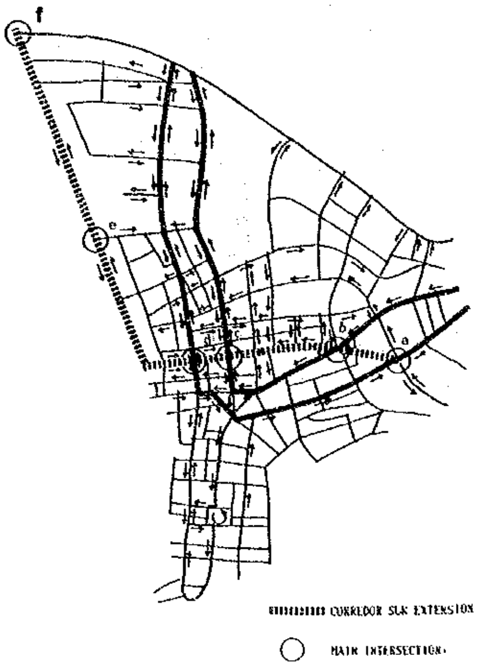
f. To align the future road edge with the existing road edge, and to expand the road cross section toward the seaside to meet the design cross section.

The vertical alignment was planned to conform to the present ground, minimizing the effect on the surrounding buildings as much as possible

Although the widening of Calle 14 is considered, the Corredor Sur Extension project should be carried out in close coordination with the progress of surrounding urban renewal projects. There is a possibility that alternatives for new structures and routes may be made depending on the design of these surrounding projects. Also there is the possibility of approaching the final design, through the trial of experimental one way traffic control and the partial improvement of streets, for instance, Calle 14 and 15, and Ave. A and Calle B in this area.

5-3 INTERSECTION PLANNING

Corredor Sur Extension is a trunk road of a road network composed of complicated one-way roads in Area Centro. The following five points (See FIGURE V-5-8) are subject to be considered:



a. Ave. B intersection
b. Ave. Central intersection
c. Calle B intersection
d. Ave. A intersection
e. Calle 21 intersection

FIGURE V-5-8 LOCATION OF INTERSECTIONS ON CORREDOR SUR EXTENSION

Furthermore, at present, the road is now completed so that two-way traffic is flowing, especially between Calle 18 and Calle 12 in Calle B. FIGURE V-5-9 gives the traffic volume in the principal intersections of Corredor Sur Extension, indicating that the traffic volume in the intersections of Calle B, Ave. A and Calle 21 is less than that in the other intersections. Taking into account that the estimated traffic demand shall be more than as forecasted, due to a moving traffic within Area Vieja, bus traffic requirements and intersections with the trunk roads, it is proposed to control the traffic by signals. The saturation rates in the intersections using signal control are the following.

a. Ave. B intersection	0.4 to 0.9
b. Ave. Central intersection	0.5 to 0.9
c. Calle B intersection	0.3 to 0.8
d. Ave. A intersection	0.1 to 0.7
e. Calle 21 intersection	0.1 to 0.8

Therefore the principal intersections of Corredor Sur Extension allow the traffic operation by signal control to be carried out . Under the road conditions planned as above, the traffic volume can be dealt with without any additional lane, especially for turning traffic.

Intersection plan is shown in FIGURE V-5-10.

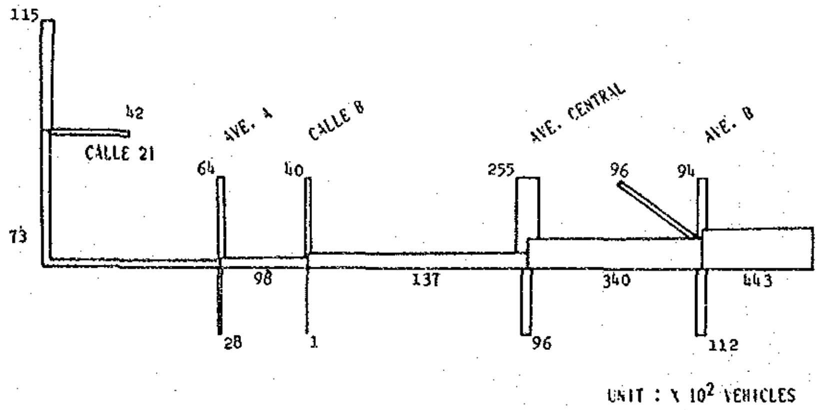


FIGURE V-5-9 FUTURE TRAFFIC DEMAND ON CORREDOR SUR EXTENSION AT MAJOR INTERSECTIONS

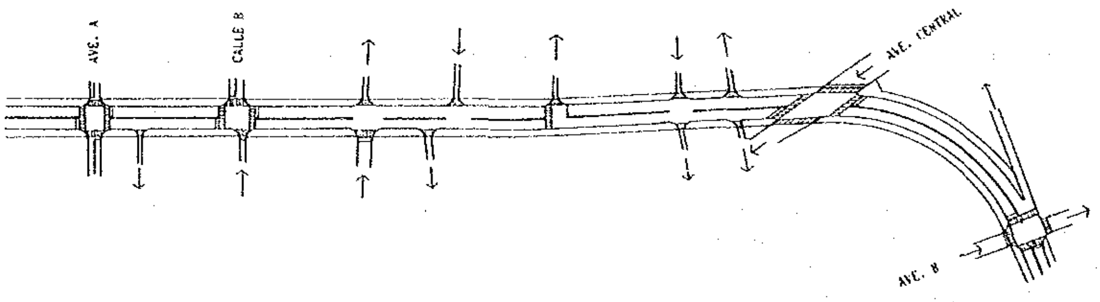


FIGURE V-5-10 INTERSECTION PLAN OF CORREDOR SUR EXTENSION

6. COST ESTIMATION

6-1. PROJECT COST

6-1-1. Preconditions for Project Cost Estimation

(1) Contract Method

MOP usually introduces international bids for the large scale projects and the insufficient period projects. Inter-national bids would be considered as a precondition for this Corredor Sur project.

(2) Construction method

Although the present MOP practice is one of using nearly all manual work in local road improvement, the heavy equipment method is applied generally in large construction work such as the Autopista. Therefore, under said assumption of international bidding, cost estimation assumes a construction method utilizing the most efficient assortment of modern heavy equipment.

(3) Base Year for Cost Estimation

Cost Calculation is based on the material costs, labor costs and machinery costs estimated for the period of August 1987.

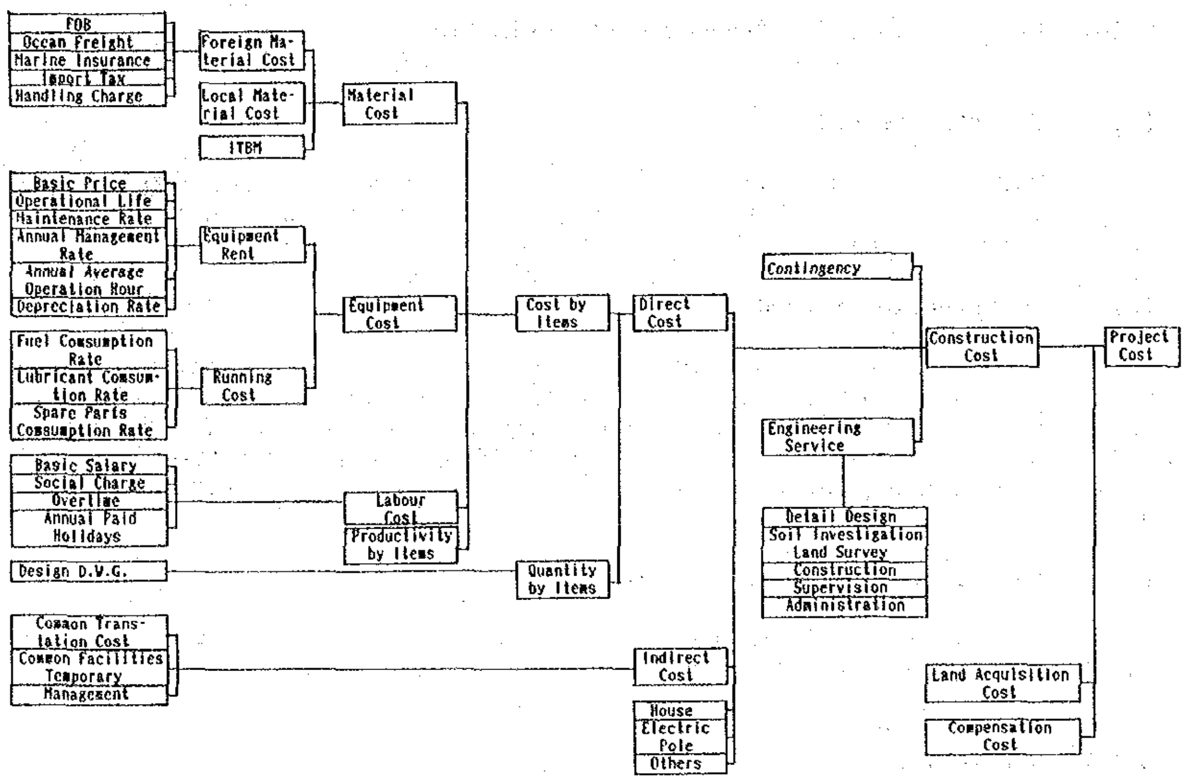
6-1-2 Estimation Method

Following the generally used estimation concept, each construction cost item (e.g. earthwork, foundation work, pavement, etc.), consisting of materials, machinery, and labor cost components, is calculated as the product of unit price and quantity. These cost items are added to total direct construction cost. Then, added to the direct cost is indirect cost, consisting of temporary facilities cost, field office maintenance cost, and overhead-each prorated to the individual direct cost items. The total of direct and indirect cost, thus obtained, gives the unit contract price of each cost item. Total direct and indirect construction cost plus engineering service cost and allowances for contingencies are called as total construction cost. The Total Project Cost consists of total construction cost, compensation cost, and land acquisition costs (see FIGURE V-6-1 for the cost estimation process).

(1) Labor Cost

Labor was classified into five categories, such as driver, foreman, operator, skilled and unskilled labor. The average unit wage for each category was calculated, based on "Lista de Materiales de Construccion : CAPAC, Dec.1986"

Labor cost includes the social charges like social insurance, retirement fund, educational insurance bonus, vacations, national holidays, license fee, overtime charges, weather interference and so on. These charges amount to 55 % of the base wage for full-time workers of private companies. (See TABLE V-6-1, TABLE V-6-2)



COST ESTIMATION PROCESS

FIGURE V-6-1 COST ESTIMATION METHOD

TABLE V-6-1 SOCIAL CHARGES AND OVERTIME PAYMENT

Description	Rate per Salary (%)
Social Insurance	9.75
Retirement Fund	5.67
Educational Insurance	1.25
Bonus 1/	9.81
Vacation	11.35
National Holidays	4.00
Liscence Fee	2.62
Overtime	2.01
Interference by Rain	8.61
Total	55.07

Note : 1/ Expressed as Thirteenth Month.

TABLE V-6-2 COST DATA FOR LABOR COSTS

No.	Classification	Unit	Foreign (Us $)	Local (B/.)
1	Driver	Hr.	0.00	3.49
2	Foreman	Hr.	0.00	4.73
3	Operater	Hr.	0.00	4.73
4	Skilled Labour	Hr.	0.00	2.33
5	Unskilled Labour	Hr.	0.00	2.64

SOURCE : CAPAC and ESTAMPA Estimate

(2) Machinery Cost

Machinery cost was broken down into rental and operation cost. The machinery rental cost was estimated in accordance with the base price of the machine, its operational life, residual value, annual operation hours, and annual maintenance rate. While the machinery operation cost consisted of fuel consumption, lubricant and spare parts. The machinery basic price was referred to the interview data obtained from Panamanian dealers and from prices in Japan. The hourly machinery cost calculated from the numbers of the machinery operation life and the annual operation hours which were taken from the rental calculation table for construction equipment in Japan, submitted by The Japan Mechanization Association, do not differ very much from those of the construction equipment lease rates prevailing in Panama (Aug. 1987). (See TABLE V-6-3)

(3) Material Cost

Prices for the main construction materials were obtained from Construction Materials Price List (CAPAC Dec. 1986) and data from Panamanian dealers, to which the 5 % sales tax (Impuesto de Transferencia de Bienes y Muebles : ITBM) was applied, except for the fuels which are exempted from this tax. Those material prices which are unavailable in Panama were assumed based on prices of similar materials and the price of said materials in Japan.

Materials can be classified into imported articles and domestic articles. Most domestically manufactured products are processed from imported raw materials (for instance, gasoline, and diesel oil are refined from imported crude oil and reinforcement bars are fabricated from imported ingot), and a few are made completely from domestic raw materials.

The price of materials for which raw materials are available in Panama such as sand, aggregate, and cement, represent no raw material cost but mostly the cost for operation of equipment or the plant for their processing. Therefore, a certain part of these domestically available construction material prices is assumed to include a foreign currency portion of 60 percent.

The foreign currency portion for the imported materials was assumed from the data of import tax rates as per "Arancel de Importacion, 1987", market price and handling charges. (See TABLE V-6-4)

TABLE V-6-3 COST DATA FOR CONSTRUCTION EQUIPMENT

No.	Equipment Name	Basic Price	Operational Life	Annual Operated Hour	Maintenance Rate (%)	Annual Manage (%)
1	Agg. Spreader 2.3m	1500	3	530	40.00	5.00
2	All Casing Exc. D120	279000	5	900	50.00	7.00
3	Apron Feeder 30t	67000	9	1000	45.00	5.00
4	Asphalt Plant 60t	779000	6	850	60.00	7.00
5	Asp. Finisher 3m	74500	7	550	50.00	7.00
6	Back Hoe 0.6 m3	102000	5	1200	55.00	7.00
7	Batching Plant	350000	7	950	60.00	7.00
8	Belt Con. 0.35 * 10m	1500	2	600	55.00	5.00
9	Belt Con. 0.6 * 15m	14900	4	600	55.00	5.00
10	Bulldozer 11t	81400	6	900	65.00	7.00
11	Bulldozer 21t	158000	6	900	65.00	7.00
12	Casing Tube	8000	2	1360	50.00	7.00
13	Compressor 4.6 m3	20000	6	1000	50.00	5.00
14	Compressor 9.6 m3	90000	6	1000	50.00	5.00
15	Concrete Cutter 0.3m	1800	3	680	25.00	5.00
16	Conc. Breaker 30 Kg.	460	2	960	20.00	5.00
17	Conc. Breaker 800 Kg.	30000	3	840	25.00	5.00
18	Conc. Bucket	2700	5	560	55.00	5.00
19	Conc. Finisher 5.5m	98000	7	530	35.00	7.00
20	Conc. Spreader 2.3m	115000	7	530	35.00	7.00
21	Crawlor Crane 35t	212000	7	1000	70.00	7.00
22	Diesel Hammer 1.25t	35000	4	800	60.00	7.00
23	Diesel Hammer 2.5t	55000	4	800	60.00	7.00
24	Distributer 4kl	15000	6	530	40.00	7.00
25	Dump Truck 11t	54000	4	1550	60.00	10.00
26	Dump Truck 2t	12000	4	1000	55.00	10.00
27	Dump Truck 6t	26600	4	1200	60.00	10.00
28	Earth Oager 0.45	34700	4	950	35.00	7.00
29	Engine Pump 4In	1330	6	740	110.00	5.00
30	First Tube	5000	2	1360	50.00	7.00
31	Grout Mixer	3000	6	600	55.00	7.00
32	Grout Pump	3600	6	600	55.00	7.00
33	Hammer Craw	3000	1	1360	50.00	7.00
34	Hammer Grab	21000	2	1360	50.00	7.00
35	Hand Hammer 1.1m3	1200	2	1280	20.00	5.00
36	Hidro-Shovel 0.6m3	155000	7	1200	60.00	7.00
37	Line Marker 90 kg	4000	4	850	30.00	5.00
38	Mac. Roller 12t	44000	7	750	50.00	7.00
39	Motor Grader 3.7m	92400	6	850	50.00	7.00
40	PC Jack	10500	5	2000	75.00	10.00
41	Road Sweeper 1.8m	83000	5	950	50.00	7.00
42	Soil Compacter 0.05t	1200	3	800	45.00	5.00
43	Soil Compacter 0.2t	2500	3	800	45.00	5.00
44	Soil Mixing Plant 15	157000	6	1200	50.00	7.00
45	Spray Gun	21900	5	1440	85.00	7.00
46	Sprayer 0.3kl	1300	3	1360	25.00	5.00
47	Surf. Vibrater 1.5*0	1800	4	530	65.00	5.00
48	Tendem Roller 10t	43600	7	650	45.00	7.00
49	Tire Roller 15t	51000	7	750	50.00	7.00
50	Tremine Tube	300	2	1085	45.00	5.00
51	Truck 5t	24000	4	1250	55.00	10.00
52	Truck 8t	36000	4	1400	55.00	10.00
53	Truck Crane 11t	180000	7	900	35.00	7.00
54	Truck Crane 16t	280000	7	1000	35.00	7.00
55	Truck Crane 5t	119200	7	900	35.00	7.00
56	Truck Crane 70t	690000	7	1000	35.00	7.00
57	Truck Crane 90t	889600	7	1000	35.00	7.00
58	Truck Mixer 3m3	43000	5	950	45.00	7.00
59	Vibrater	670	3	1280	35.00	5.00
60	Vib-Hammer 30kv	33000	4	800	60.00	7.00
61	Vib-Roller 3.5t	31700	7	600	45.00	7.00
62	Water Pump 5.5kw	1400	5	1280	110.00	7.00
63	Watering Cart 5.5kl	37000	5	1000	50.00	7.00
64	Wheel Loader 1.4m3	67000	6	1200	60.00	7.00

Source: ESTAMPA

TABLE V-6-4 COST DATA FOR CONSTRUCTION MATERIALS

Material Name	Sales Unit		Unit Price Foreign (US dollars)	Unit Price Local (Balboas)
Anchorage	1.00	Set	120.60	24.93
Asphalt 80-100	1.00	ton	201.88	110.14
Asphalt Emulsion-2	1.00	ton	282.09	153.91
Asphalt Emulsion-4	1.00	ton	252.33	137.67
Cement	1.00	ton	63.60	47.70
Concrete Pole	1.00	PCS	102.91	77.18
Concrete Admixture	1.00	kg	2.82	0.45
Control Box	1.00	Set	446.62	349.41
Crusher Run	1.00	CUM	5.17	3.89
Curing Material	1.00	SQM	2.01	0.21
Curing Material	1.00	Kg	4.21	1.38
CV Cable 14A	1.00	LM	5.91	4.43
Diesel Oil	1.00	gal	0.71	40.476
Explosive	1.00	Kg	6.42	3.49
Ex-Joint	1.00	LM	181.80	0.00
Fertilizer	1.00	sac	16.50	8.97
Filler	1.00	CUM	2.00	1.10
Gasoline	1.00	gal	1.18	80.792
Guard Rail	1.00	LM	30.00	22.50
Hard Wood 10.5*10.5	1.00	CUM	115.99	83.98
Hard Wood .15*.15	1.00	CUM	259.43	172.95
Heavy Oil	1.00	gal	0.67	0.37
Joint Material	1.00	SQM	10.70	5.35
Joint Sealer	1.00	kg	2.00	1.00
Kerosene	1.00	gal	0.67	0.37
Lamp HH-400	1.00	PCS	271.00	108.30
Log 7.5*1.8	1.00	CUM	11200.00	16800.00
Log 9.0*7.0	1.00	CUM	11200.00	16800.00
PC Sheath D65	1.00	LM	2.01	0.42
PC Steel D12.7	1.00	ton	2412.00	498.60
PVC Conduit	1.00	LM	1.44	1.07
Reinforced Earth	1.00	SQM	100.00	30.00
Reinforcement	1.00	ton	425.86	319.38
Release Material	18.00	Lit	1.84	0.09
RC Pile D250	1.00	LM	30.03	12.03
RC Pipe D1050	1.00	LM	98.11	73.58
RC Pipe D1200	1.00	LM	147.90	110.90
RC Pipe D1500	1.00	LM	162.35	163.19
RC Pipe D300	1.00	LM	5.73	4.30
RC Pipe D600	1.00	LM	27.16	20.36
RC Pipe D750	1.00	LM	39.82	29.87
RC Pipe D900	1.00	LM	56.43	38.57
Sand	1.00	CUM	8.59	4.10
Scaffolding	1.00	PCS	12.06	0.60
Screened Crusher	1.00	CUM	8.46	4.02
Seed	1.00	kg	7.00	3.80
Sheet Pile	1.00	ton	977.76	733.33
Signal	4.00	set	7000.00	3937.50
Slip Bar R19*600	1.00	PCS	1.36	1.02
Slip Bar R25*650	1.00	PCS	2.47	1.85
Sod 1	1.00	SQM	0.00	4.18
Stabilizer	1.00	PCS	139.31	103.99
Steel Form 0.3*1.5	1.00	PCS	17.09	3.53
Steel H300	1.00	ton	425.86	319.38
Steel Wire #10	1.00	ton	950.00	554.00
Steel Wire #20	1.00	ton	937.67	46.88
Taper Pole	1.00	PCS	836.00	557.60
Tie Bar D16*1000	1.00	PCS	1.74	1.31
Traffic Paint	1.00	gal	10.71	8.03
Traffic Sign 3'	1.00	Set	71.20	40.05
Traffic Sign 4'* 6'	1.00	Set	427.00	240.00
Water Stop	1.00	LM	18.60	10.13
Wood Plate 4*0.24	1.00	CUM	390.00	292.50

Source:ESTAMPA

(4) Indirect Cost

Common temporary work cost includes transportation of commonly used heavy equipment and field plants, mobilization and demobilization cost, installation and removal of such temporary facilities as power supply, underground water conservation, safety facilities, quality and progress control, utilities, and field office maintenance. Field management cost includes wages, office supplies, and other expenses incurred at field offices, while general administration overhead is that which is incurred at the contractor's head office.

Unlike direct construction cost, these indirect costs can vary substantially from one contractor to another, and a number of assumptions must be made for their estimation. Therefore, for the simplicity of the estimation, the ratio of indirect cost to direct cost in previously implemented projects is used. The foreign currency portion and the local currency portion of indirect costs are estimated at 18% and 14% of the direct costs, respectively, or 32% combined (see Table V-6-5).

TABLE V-6-5 INDIRECT COST COMPONENTS

Description	Foreign Portion	Local Portion	Total
1. Common Temporary Facilities			
1-1 Transportation	1.06	0.12	1.18
1-2 Mobilization and Demobilization	0.38	1.07	1.45
1-3 Temporary Facilities	0.40	0.60	1.00
1-4 Environment Control	0.20	0.30	0.50
1-5 Safety Facilities	0.12	1.08	1.20
1-6 Public Services Charge	--	1.00	1.00
1-7 Quality Control	0.44	0.44	0.88
1-8 Field Office Maintenance	3.32	5.50	8.82
2. Field Management	3.40	9.22	12.62
3. General Management	11.40	—	11.40
Total	18.12	14.72	32.84

Note: Unit; Percent of the direct Cost
Source: ESTAMPA

(5) Engineering Cost

The cost of design and construction supervision is estimated assuming that such work will be contracted out, following the usual MOP practice to do so in the case of large projects. Based on previous experiences in Panama, the engineering service cost is estimated at 10% of the total of direct and indirect cost. Of the estimated engineering cost, 80% is allocated to the foreign currency portion, and 20% to local.

An additional 2% of total direct and indirect costs is added to the local currency portion to cover the administration cost of MOP for bid processing and contracting.

(6) Contingency

Contingency consists of both physical contingency which includes unexpected costs such as for unexpected rock excavation or work delay by unusual weather, and price contingency, which includes price escalation beyond and above anticipated price inflation.

The factors of price increase as well as price contingency in excess thereof, are considered only for the projects subject to financial analysis and, therefore, not considered for road projects, as a rule, where the cost is estimated at August 1987, prices and disbursed each year. Physical contingency was estimated at 15 % of the total construction cost plus the engineering fee in reference to past experiences.

(7) Compensation and Land Acquisition Costs

Contents of Compensation Cost are land acquisition cost for road construction, indemnification cost for demolished houses, and also for relocation cost of existing public facilities.

Information for estimating unit costs for land acquisition and compensation for demolished houses and relocated public facilities is available from two major sources: the tax assessment data of Ministerio de Hacienda, which is revised occasionally, and the actual market price reported in newspapers. The market land prices seem to be four to six times higher than the tax assessment. Market land price is illustrated in FIGURE V-6-2.

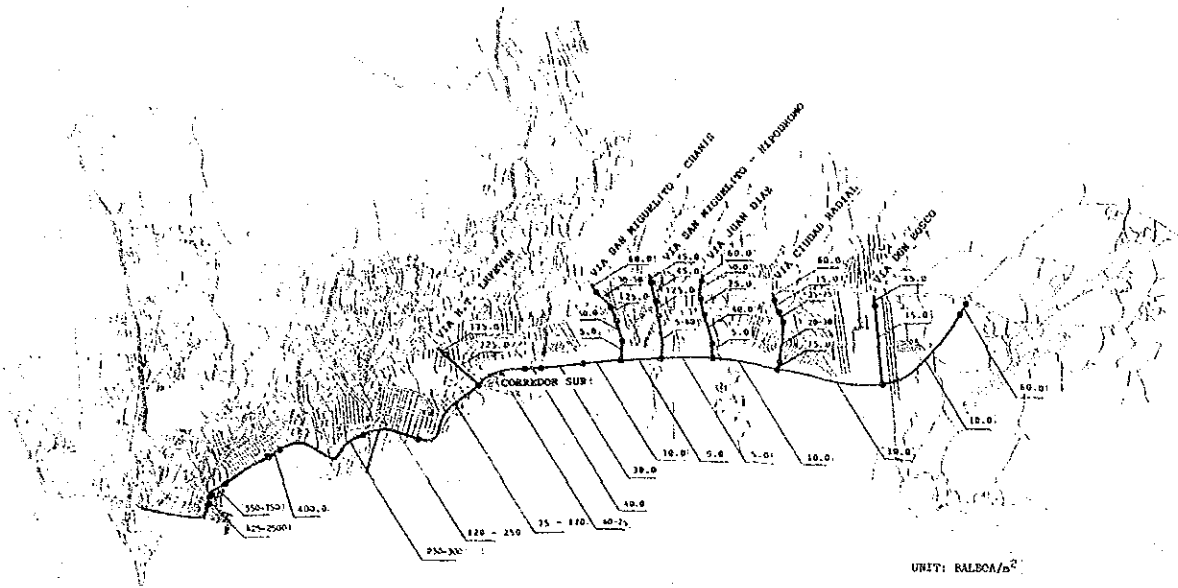


FIGURE V-6-2 LAND UNIT COST ALONG CORREDOR SUR

It is often the case that some portion of the road construction cost is paid by beneficiaries alongside these roads, under the application of the land regulation known as the "Valuation System". Even though this system can be applied to some portions of the route, it was not taken into account in the compensation cost, but rather the cost of the market price of land was adopted. For Corredor Sur Extension, land prices in the renovation area of Santa Ana and Chorrillo, frozen since 1979, by Law #95 of Oct. 14, 1973, were adopted.

Building compensation cost was calculated by means of the market construction costs obtained from newspapers and other sources. (See TABLE V-6-6). Compensation cost for removal and relocation of electric poles and high tension electric poles were estimated from the experience of MOP's past works and information from IRHE(See TABLE V-6-7).

TABLE V-6-6 COMPENSATION COSTS ACCORDING TO BUILDING STRUCTURES

(BALBOAS/M2)

DESCRIPTION	CONSTRUCTION	DEMOLITION	TOTAL
Reinforced Concrete	400.0	60.0	460.0
Cement, Block, Wood	300.0	30.0	330.0
Wood	200.0	15.0	215.0

Source:ESTAMPA

TABLE V-6-7 REMOVAL COSTS FOR ELECTRIC POLES

(BALBOAS/PLACE)

Description	Removal Cost
High Tension Pole	50,000
Electric Pole	1,000

Source: ESTAMPA

(8) Quantity of Construction and Cost Items

Quantity of construction works was estimated from preliminary design drawings such as plans,cross sections and a general view of structures by section.

Cost items and units were counted out by work items instead of individual materials; for instance, pavement works were counted at the unit price per square meter.

For actual cost estimation, each cost item is conceived of in three stages: plant products, site products, and work items. The work items conform with cost items for unit price contracting. Plant products and site products are the items of the breakdown of each work item. Specifically, plant products are materials produced and delivered by a field plant, such as asphalt mixture. Asphalt mixture is placed, compacted and finished into a surface course, which is a site product. Work item is, for example, a pavement consisting of site products: an aggregate sub-base course, a stabilized bituminous base course, and an asphalt surface course.

The unit price of each work item, such as per square meter in the case of pavement, is multiplied by the quantity calculated through designing, in estimating each cost item. For existing road upgrading projects, which are to be accomplished in urban areas where the use of heavy construction equipment will possibly be restricted, the type of pavement chiefly accomplish by hand is added as a cost item.

Plant product items, site products items, and work items are listed in Table V-6-8.

TABLE V-6-8 ITEMS OF PLANT PRODUCTS, SITE PRODUCTS AND WORKS

(1) PLANT PRODUCTS

		Unit Price		
		Foreign (US Dollars)	Local (Balboas)	
Description	Unit		Financial	Economic
Screened Aggregate	CUM	13.54	7.07	6.32
BT Aggregate	CUM	61.74	26.73	21.61
Asphalt Concrete	CUM	69.38	30.90	24.84
Concrete	CUM	44.71	24.21	21.36

Source: ESTAMPA

(2) SITE PRODUCTS

Description	Unit	Unit Price: Foreign (Us Dollars)	Unit Price: Local (Balboas) Financial	Unit Price: Local (Balboas) Economic
Structure Excavation	CUM	6.29	4.47	3.69
Equipment Backfil	CUM	1.04	0.95	0.86
Wood Forming	SQM	1.95	20.06	19.94
Steel Formin	SQM	5.96	15.89	14.92
Reinforcing	ton	512.58	528.87	314.98
Staging	CUM	4.56	4.02	3.80
Support	CUM	6.58	5.01	4.68
Structural Concrete	CUM	55.61	45.99	38.57
PC Concrete	CUM	55.95	44.27	37.73
Erection 70t	ton	109.24	5.22	4.61
Erection 90t	ton	117.35	4.40	3.84
Prestressing	ton	3979.49	2734.50	1951.43
CCP D900	LM	147.92	127.88	108.23

Source:ESTAMPA

(3) WORKS

Description	Unit	Unit Price: Foreign (Us Dollars) Financial	Unit Price: Local (Balboas) Economic	
Clearing and Grubbing	SQM	0.65	0.20	0.19
Cutting	CUM	3.30	0.79	0.73
Embankment	CUM	6.56	1.60	1.48
Concrete Pavement 25	SUN	18.94	11.14	9.09
Asphalt Pavement A-1	SQM	22.71	10.13	8.40
Asphalt Pavement A-2	SQM	22.96	15.80	12.81
Sidewalk Pavement	SQM	6.47	3.70	3.06
Concrete Curb	LM	4.17	3.04	2.68
RW-3m	LM	221.88	230.64	179.88
RW-5m	LM	361.32	369.19	284.60
RW-7m	LM	579.44	577.85	446.39
C-Bx 2*2	LM	663.80	695.77	542.75
C-Bx (2+2)*2	LM	1311.15	1378.21	1074.13
C-Bx (2.5+2.5)*2.5	LM	1751.92	1817.73	1416.19
Markings	KM	251.77	222.69	148.28
Traffic Sign	KM	3326.73	3258.15	2436.96
Lighting (30m)	LM	44.65	33.73	22.05
Lighting (35m)	LM	38.35	28.97	18.94
Guard Railing	LM	32.56	24.39	12.22
Overlay	SQM	4.01	1.80	1.46
P-D1500	LM	262.47	222.40	195.91
P-D1200	LM	240.73	164.28	144.41
P-D900	LM	106.53	67.74	59.22
P-D600	LM	63.75	42.07	36.71
Frontage Road	SQM	22.71	10.13	8.40
Median	SQM	8.97	14.20	12.48
Slope Protection	SQM	36.97	56.48	45.80

Source: ESTAMPA

(9) Unit Section of Construction

Projects were divided into a certain number of unit sections for the sake of cost estimation and project evaluation, shown in FIGURE V-6-3. They must not be confused with unit sections for actual construction work execution to be determined with due consideration to project priority, work volume, and other factors.

a. Each unit section will be connected with other roads in such a way that it can be opened for service and produce benefits without having to wait for the completion of other sections.

b. Each unit section will consist of smaller unit elements to enable the formulation of various alternative works programs for project implementation, and the section cost is estimated based on such elements.

The outline of each section is summarized as shown in Annex 3.

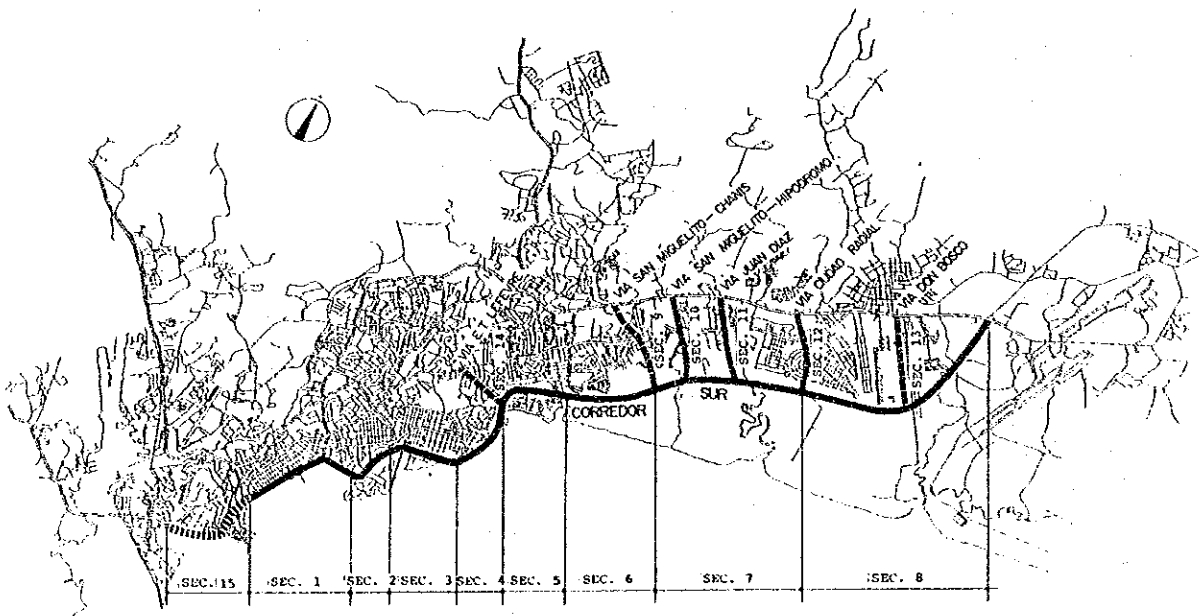


FIGURE V-6-3 UNIT SECTIONS FOR COST ESTIMATION, IMPLEMENTATION SCHEDULE AND EVALUATION

6-1-3 Result of Cost Estimation

(1) Total Project Cost

The costs, disregarding price escalation and price contingency of each route and each unit section, were estimated based on the August 1987, prices shown in TABLE V-6-9. Total project cost reaches 258.1 million balboas, in which 84.8 million balboas are for Corredor Sur in the built-up area (Maranon - Rio Abajo), 85.4 million balboas for Corredor Sur in the suburban area (Rio Abajo - Panamerican Highway), 59.0 million balboas for the Main Access Roads, and 28.9 million balboas for Corredor Sur Extension (Maranon - American Bridge).

TABLE V-6-9 SUMMARY OF FINANCIAL COSTS OF ROAD PROJECTS

Unit: 1,000 Ba

Section	Length (km)	Construction Foreign	Construction Local	Construction Total	Foreign (%)	Local (%)	Land	Compen-sation	Total	Per km
Corredor Sur I (Built-up Area)										
Section 1 (Maranon - Mataznillo)	2.987	7,092	5,318	12,410	57.1	42.9	2,559	0	14,970	5,012
Section 2 (Mataznillo - Brasil)	1.347	1,938	1,377	3,315	58.5	41.5	4,729	1,335	9,379	6,963
Section 3 (Brasil - ATLAPA)	1.466	2,149	1,434	3,583	60.0	40.0	4,773	1,941	10,296	7,024
Section 4 (ATLAPA - E.T.Lefevre)	2.140	8,064	5,808	13,872	58.1	41.9	1,644	63	15,579	7,280
Section 5 (E.T.Lefevre - Rio Abajo)	1.802	5,122	3,526	8,648	59.2	40.8	4,593	9,251	22,493	12,482
SUB-TOTAL	9.742	24,365	17,463	41,828	58.3	41.7	18,298	12,590	72,716	7,464
Corredor Sur II (Suburban Area)										
Section 6 (Rio Abajo - Chanis)	2.249	8,180	4,401	12,581	65.0	35.0	3,305	0	15,886	7,064
Section 7 (Chanis - Ciudad Radial)	3.792	14,822	7,797	22,619	65.5	34.5	1,973	0	24,593	6,485
Section 8 (Ciudad Radial-Panamericana)	5.667	14,205	8,472	22,677	62.6	37.4	5,590	0	28,268	4,988
SUB-TOTAL	11.708	37,207	20,671	57,878	64.3	35.7	10,868	0	68,746	5,872
TOTAL	21.450	61,572	38,134	99,706	61.8	38.2	29,166	12,590	141,462	6,595
Main Access Roads										
Section 9 (San Miguelito - Chanis)	2.388	3,578	2,309	5,887	60.8	39.2	1,158	881	7,926	3,319
Section 10 (San Miguelito - Hipodromo)	2.208	3,297	1,816	5,113	64.5	35.5	3,181	329	8,624	3,906
Section 11 (Juan Diaz)	2.315	2,959	1,781	4,740	62.9	37.1	1,791	472	7,003	3,025
Section 12 (Ciudad Radial)	2.355	4,018	2,404	6,422	62.6	37.4	1,476	513	8,411	3,571
Section 13 (Don Bosco)	2.385	2,973	1,839	4,812	61.8	38.2	1,317	0	6,130	2,570
Section 14 (E.T.Lefevre)	1.620	3,001	2,228	5,229	57.4	42.6	3,868	2,752	11,849	7,314
SUB-TOTAL	13.271	19,826	12,378	32,204	61.6	38.4	12,791	4,947	49,942	3,763
Corredor Sur Extension										
Section -15	2.210	2,456	1,670	4,126	59.5	40.5	6,003	17,618	27,746	12,555
TOTAL	36.931	83,854	52,181	136,035	61.6	38.4	47,960	35,155	219,150	5,934
Engineering Fee		10,883	5,441	16,324	66.7	33.3			16,324	
Contingency		14,211	8,643	22,054	62.2	37.8			22,854	
GRAND TOTAL COST	36.931	108,948	66,266	175,214	62.2	37.8	47,960	35,155	258,328	6,995

Source: ESTAMPA

Total project cost consists of the compensation costs and road construction cost. Only the construction cost of it shows the total amount of 175.2 million balboas. The breakdown of the amount is a follows,

a. Corredor Sur (built-up area) 53.9 million balboas
b. Corredor Sur (Sub-urban area) 74.5 million balboas
c. Main Access Road 41.5 million balboas
d. Corredor Sur Extension 5.3 million balboas

The largest amount is found in the sections between Ciudad Radial and the Pan American Highway with 4 lanes road of Corredor Sur; it's cost is 34.7 million balboas. Next, the cost of the 6-lane Corredor Sur between Rio Abajo and Ciudad Radial, which amounts to 31.1 million balboas.

The cost of Corredor Sur between Maranon and Rio Mataznillo (3.0

Km), and that of the section between ATLAPA and Via E.T. Lefevre (2.1Km), including land reclamation work, are respectively 18.5 and 19.6 million balboas.

The total costs for compensation and land acquisition of 82.9 million balboas account for 32 % of the total project cost. These costs for Corredor Sur Extension amount to 23.6 million balboas, which comprises 81% of the total section project cost (28.9 million balboas).

In the section of Corredor Sur between E. T. Lefevre and Rio Abajo, the compensation cost adds up to 13.8 million balboas, which represents 55.4 % of the total construction cost (25.0 million balboas).

(2) Contents of Direct Construction Cost

Direct Construction Cost was accumulated with each cost of machinery, materials and labor. Total direct construction cost is estimated at 103.0 million balboas, of which 45.5% would be composed of the construction materials. Also, cost of labor and equipment were accounted as 16.9% and 37.7% of total direct construction cost, respectively.

Direct construction cost of bridges was estimated at 17.3 million balboas which accounts for 17.0% of total direct construction cost.

(3) Currency Portioning

The ratio of the foreign currency portion to the total project cost is estimated at 42.2 % for all projects. A ratio of 35.5% can be calculated for the Corredor Sur project in the built-up area and 43.5% for the suburban area. A foreign portion of 39.9% is estimated for the Main Access Roads and 8.8 % for Corredor Sur Extension.

In case the compensation cost should be excluded, then the ratio of the foreign currency portion to total construction cost would be 62.2 % for all projects, 59.2 % for Corredor Sur project in the built-up area, 62.3 % for that of the suburban area, 62.1 % for the main access road projects and 60.3 % for Corredor Sur Extension project.

The comparatively low foreign currency portion of the Corredor Sur project in the built-up area is a direct result of the nature of the work, which requires much manual labor with limited use of heavy equipment.

(4) Cost Per Kilometer

The section of Corredor Sur between Via E. T. Lefevre and Rio Abajo and Corredor Sur Extension, including large compensation costs, indicates 13.9 and 13.1 million balboas for the cost per kilometer of road widening, respectively. This is about 1.8 times more expensive than the average road construction cost of 7.0 million balboas per kilometer.

The section of Corredor Sur between Maranon and Rio Mataznillo and between ATLAPA and E. T. Lefevre, including land reclamation works, is figured at a cost of 6.2 and 9.1 million balboas kilometer, respectively.

The section of Main Access Road of Via E.T. Lefevre, including the cost of the Via Espana intersection improvement, is estimated at a cost of 8.1 million balboas per kilometer.

The section of Corredor Sur between Rio Abajo and Ciudad Radial, which has 6 lane roads with frontage roads on both sides, is expected to reach an average cost of 8.4 million balboas per kilometer.

The section of Corredor Sur between Rio Mataznillo and ATLAPA, which consist of widening of the existing road, and between Ciudad Radial and the Pan American Highway, which has a 4-lane road with frontage roads on both sides, and 5 Main Access Roads in the suburban area is estimated at an average respective cost of 6.1, 7.7, and 3.9 million balboas per kilometer.