

**THE FEASIBILITY STUDY  
ON  
THE URBAN TRANSPORT PROJECT  
IN  
THE PANAMA METROPOLITAN AREA**

**ESTAMPA II**

**EXECUTIVE SUMMARY**

DECEMBER, 1984

MINISTRY OF PUBLIC WORKS  
THE REPUBLIC OF PANAMA

JAPAN INTERNATIONAL  
COOPERATION AGENCY





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|                     |     |
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## PREFACE

In response to the request of the Republic of Panama the Government of Japan decided to conduct a feasibility study on the Urban Transport Project in the Panama Metropolitan Area and entrusted the study to the Japan International Cooperation Agency (JICA). The JICA sent to Panama a study team headed by Mr. Takeshi Yoshida from 31 May 1983 to 24 September 1984.

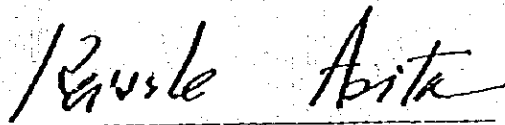
The team exchanged views with the officials concerned of the Government of the Republic of Panama on the Project and conducted a field survey in the Metropolitan Area.

After the team returned to Japan, further studies were made and the present report has been prepared.

I hope that this report will serve for the development of the Project and contribute to the promotion of friendly relations between our two countries.

I wish to express my deep appreciation to the officials concerned of the Government of the Republic of Panama for their close cooperation extended to the team.

December, 1984



Keisuke Arita

President

Japan International Cooperation Agency

# PROBLEM 1

Let  $f: \mathbb{R} \rightarrow \mathbb{R}$  be a function satisfying the functional equation  $f(x+y) = f(x) + f(y)$  for all  $x, y \in \mathbb{R}$ . Assume that  $f$  is continuous at the origin. Prove that  $f$  is linear, i.e.,  $f(x) = cx$  for some constant  $c \in \mathbb{R}$ .

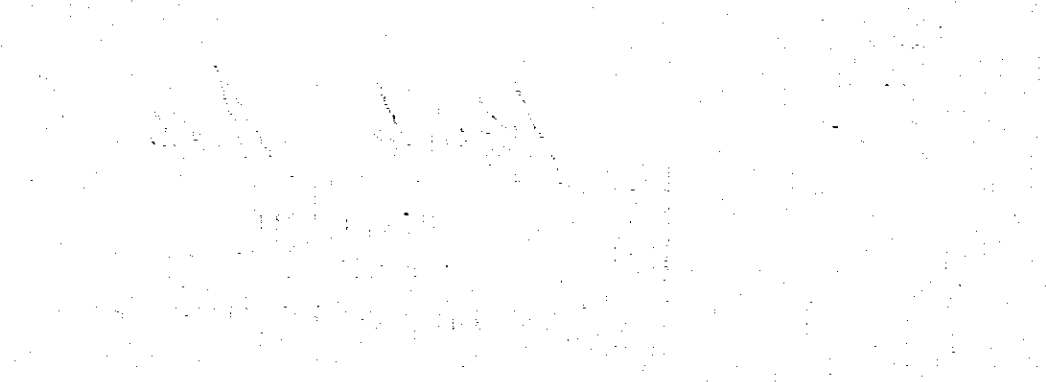
First, we show that  $f(0) = 0$ . Setting  $x = y = 0$  in the functional equation, we get  $f(0) = f(0) + f(0)$ , which implies  $f(0) = 0$ .

Next, we show that  $f$  is additive over the rationals. For any integer  $n$ , we have  $f(nx) = nf(x)$  for all  $x \in \mathbb{R}$ . This follows from the functional equation by induction.

Now, let  $r = \frac{p}{q}$  be a rational number, where  $p, q \in \mathbb{Z}$  and  $q \neq 0$ . Then  $f(rx) = rf(x)$  for all  $x \in \mathbb{R}$ . This is because  $f(q(rx)) = f(px) = pf(x) = qf(rx)$ .

Since  $f$  is continuous at the origin, we can take the limit as  $r \rightarrow 0$  to conclude that  $f(x) = cx$  for all  $x \in \mathbb{R}$ , where  $c = f(1)$ .

Therefore,  $f$  is a linear function.



The graph illustrates a function that is continuous and piecewise linear, consistent with the properties of a linear function.

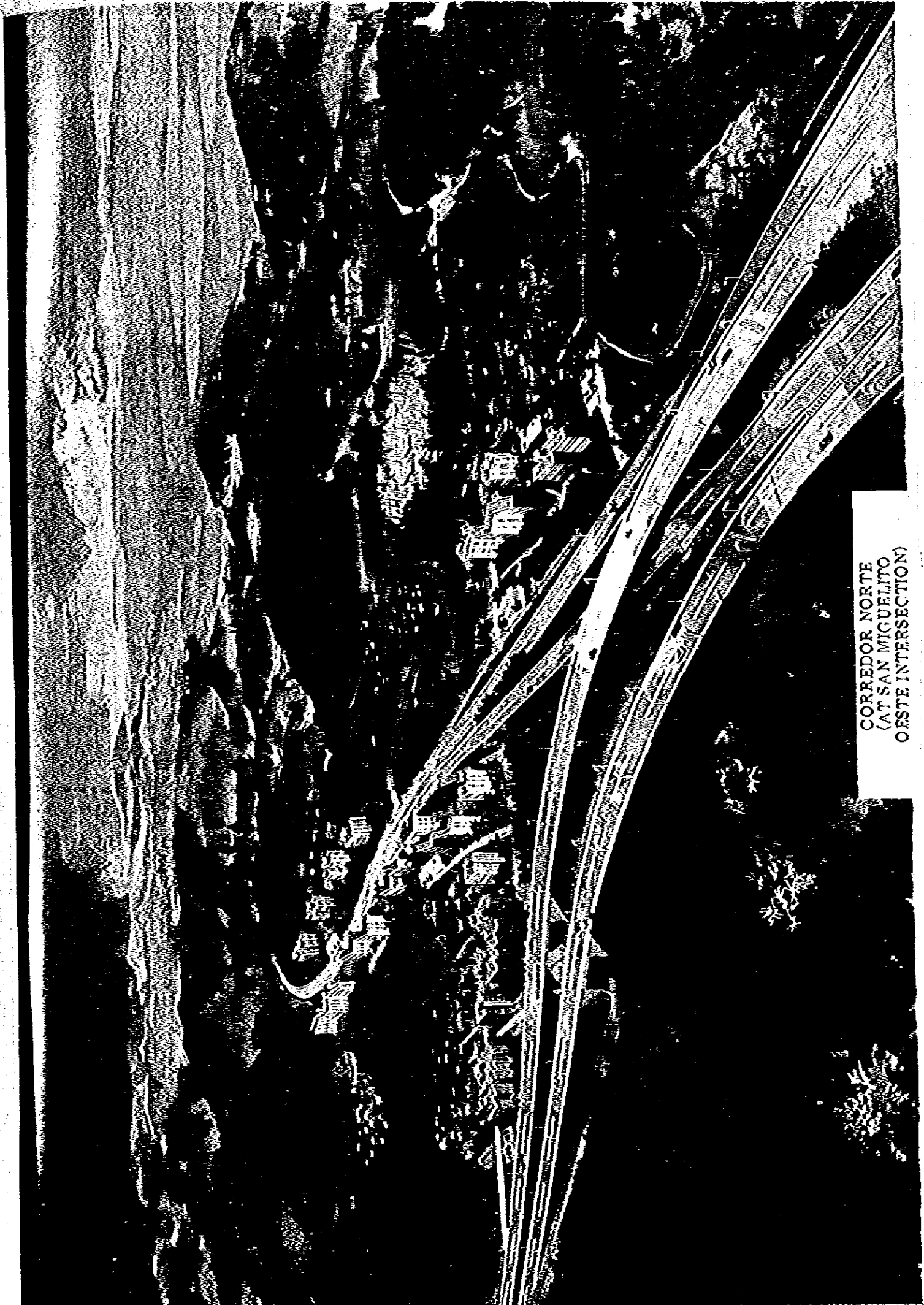
This function satisfies the conditions of the problem, demonstrating the relationship between continuity and linearity for additive functions.

The proof shows that the only continuous solutions to the Cauchy functional equation are linear functions.



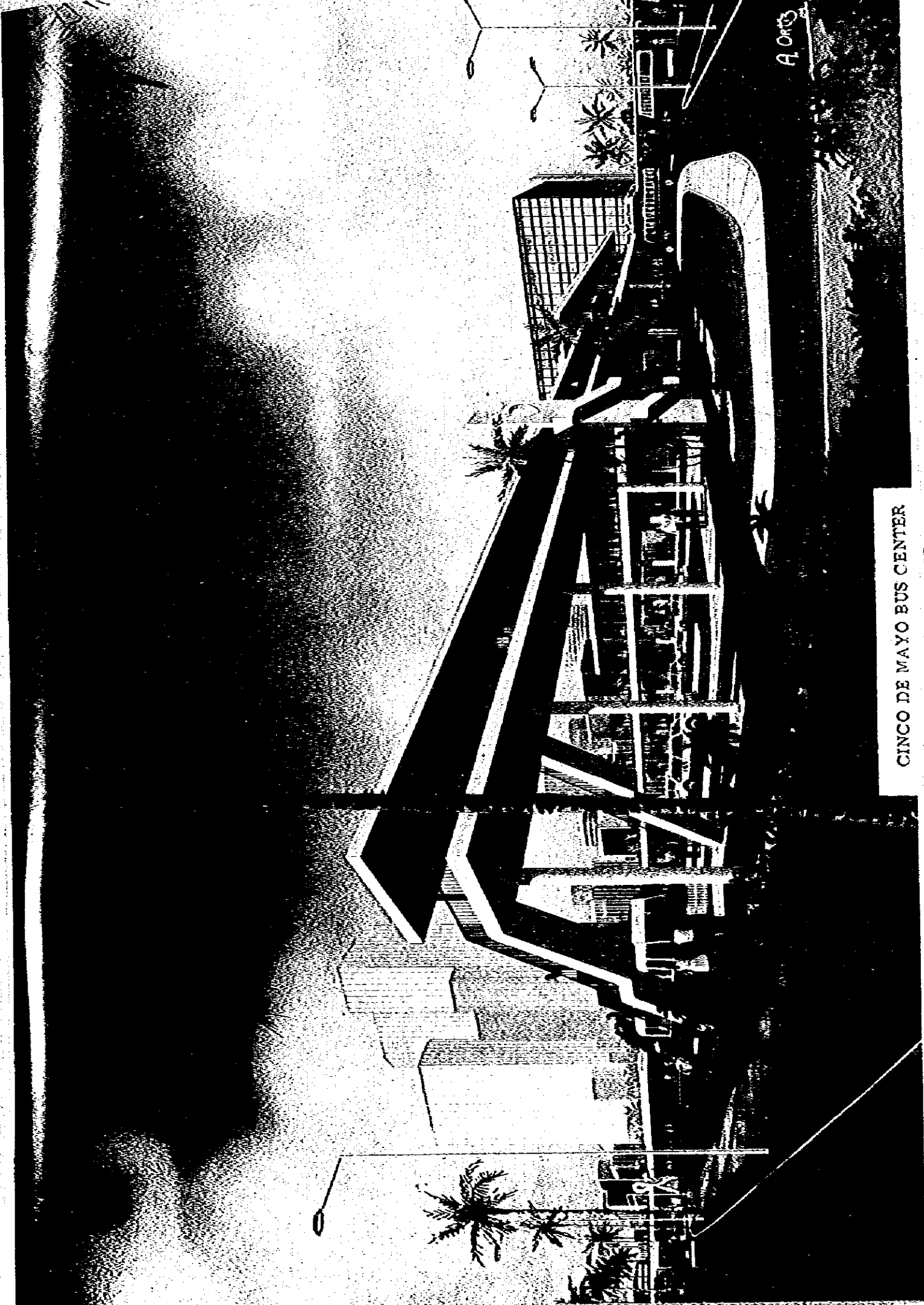






CORREDOR NORTE  
(AT SAN MIGUELITO  
OESTE INTERSECTION)





A 0013

CINCO DE MAYO BUS CENTER



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## Conclusions and Recommendations

### 1) New Road Projects

The early start of construction for opening in 1990 is recommended of Corredor Norte and arterial roads connecting thereto, to greatly mitigate traffic congestion in urbanized area and to support the Reverted Area development. The economic return by these projects is also significant.

As one of the most important roads in Panama Metropolitan Area with the estimated year 2000 traffic of 30,000 vehicles (or 50,000 vehicles in the busiest section) per day, Corredor Norte will allow traffic from Colon/San Miguelito ways to bypass the urbanized area for direct access to the downtown and will induce and accelerate orderly development of the Reverted Area. The total investment needed for the new roads of 20.2 kilometers is 77.6 million balboas, of which 41.6 million balboas will be by foreign currency. A high internal rate of return of 34.1% is expected from the new road projects as a whole.

Recommended is the completion of these projects during five years in the latter half of the 1980s. Should any of the projects be delayed into the 1990s for financial or other reason, the highest priority should be placed on the construction of Via El Paical Extension and Corredor Norte in the east thereof. Constructed the next should be the western half of Corredor Norte, followed by Via San Miguelito Oeste, Via Martin Sosa Extension, and Via Cerro Ancón Extension, in the order listed.

An administration project unit should be established within MOP for the implementation of these large scale road development projects in the metropolitan area.

### 2) Existing Road Improvement Projects

A high economy is not necessarily guaranteed as a result of the economic evaluation of the existing road improvement projects as a whole. The improvement effect of each section will depend on whether or not Corredor Norte has been constructed, and, therefore, isolated project implementation will be risky. San Miguelito Intersection should be grade-separated.

The existing road improvement projects will require a total investment of 57.8 million balboas, and their overall IRR is calculated at 10.7%. Justification for the improvement of each section largely depends upon whether or not Corredor Norte will be constructed.

If Corredor Norte will be opened in a near future, the widening and improvement of Via Espana is of no urgent need. If Corredor Norte will be constructed in a far future (such as the end of the century) or if it will not be constructed at all, this project will bring about a very substantial benefits (IRR = 33.6%).

Contrary to Via Espana, the construction of Via Cerro Ancón will be a very important project provided that the new road is to be built, but will not be feasible without the new road. The improvement of both Via Bolivar and Via El Paical will be essential for facilitating the better functioning of Corredor Norte, but little can be expected from their isolated implementation. The grade-separation of San Miguelito is an urgently needed project with an estimated IRR of 24.5%.



### 3) Bus Center Projects

The early construction is recommended of the four bus centers essential as urban public transport facilities to facilitate bus passenger convenience and bus rerouting. Their construction even with commercial funds will enable their viable operation, if public land in Cinco de Mayo and San Miguelito will be invested by the government with no requirement for repayment.

Excluding the cost of the government owned land, a total of 11.3 million balboas will be required for the construction of four bus centers: Cinco de Mayo, Universidad, San Miguelito, and Chanis. From them, a total revenue of about 1.5 million balboas can be expected in 1990, and, with an estimated IRR of 10.6%, a minimum level of profitability is guaranteed to enable their construction and operation with funds solely from commercial sources.

The indicated low profitability is because the amounts of fees to be charged the buses which will utilize the centers are held to a minimum level. In view of the public nature, bus centers should be operated as non-profit seeking business. Therefore, should greater government investment and or commercial loans with lower interest rates be available, that much more favorable conditions should be offered the bus operators and the tenants of the commercial facilities.

The centers should be operated by an independent entity but in close coordination with the government and bus operators for the best effects. A joint operation committee consisting of government and private representatives should be established as the highest decision making organ of the centers.

### 4) Bus Maintenance Center Project

The construction of a bus maintenance center will be indispensable to the improvement of bus service quality and of bus operation rate, and will facilitate the training and education of automobile mechanics and bus drivers, as well as bus owners. Initial investment by the government of the introduction of a soft loan will be mandatory, however, if the center is to be operated on a self-liquidating basis.

Just as bus centers, the bus maintenance center should also be operated as a non-profit seeking business for the improvement of public service. Its profitability becomes inevitably low (FIRR = 4.4%), if attractive conditions are to be offered to the prospective tenants of the bus repair center, parts supply center, and other facilities. In order to make this center at least self-liquidating, the following are recommended: (a) that the government invest in land and the cost of vehicle inspection center (1.1 million balboas), (b) that loans be obtained with as low an interest rate as possible (7% or lower per annum), and (c) that the tenants pay rentals in an amount corresponding to the repayment of a 15-year loan at the interest of 6% per annum and to partially defray the administration cost of the center operation.

The bus maintenance center operation entity will be responsible for offering desirable place of business to the tenants and for ensuring that the tenants offer a fine quality of service to the clients (bus operators). It is recommended that policy and other top-level decisions be made by the same or a similar joint committee as that of the bus centers.

## 1. Introduction

### 1) Study Development

In response to the request of the Government of the Republic of Panama, the Japanese government, through the Japan International Cooperation Agency, conducted the Urban Transport Study in Panama Metropolitan Area (called ESTAMPA).

ESTAMPA Phase I, which began to be studied in January 1981, and finalized in December 1982, presented ESTAMPA Masterplan. A lot of projects, proposed for the realization of ESTAMPA Masterplan such projects planned to implement by 1990 as the new road construction projects concerned to the development of the Reverted Area, urgent improvement projects of congested road, and bus facilities projects for improving public transport service were selected for the examination of the feasibility.

ESTAMPA Phase II is the second stage of ESTAMPA for the feasibility study of above mentioned projects. JICA Study Team stayed to conduct the Study in the Republic of Panama from May 1983 through September 1984.

### 2) Scope of Study

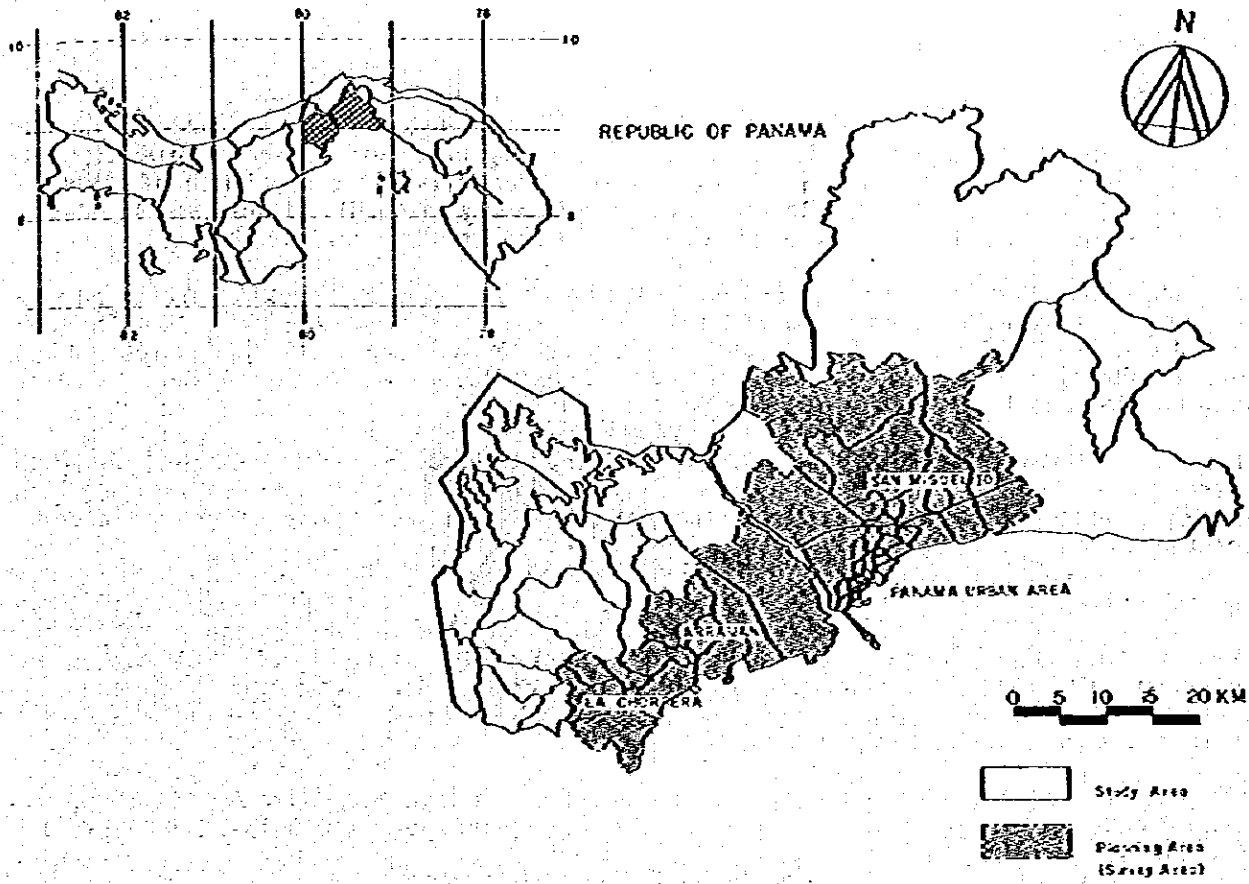
The feasibility of the following projects has been studied:

- (1) New Road Construction Projects: Corredor Norte,  
Via El Paical Extension  
Via Martin Sosa Extension  
Via Cerro Ancón Extension  
Via San Miguelito Oeste.
- (2) Existing Road Improvement Projects: Via Espana  
Via Simon Bolivar  
Via El Paical  
Via Cerro Ancón  
San Miguelito Intersection.
- (3) Public Transport Facility Projects: Bus Center Project: Cinco de Mayo Bus Center  
Universidad Bus Center  
San Miguelito Bus Center  
Chanis Bus Center.  
Bus Maintenance Center Project.

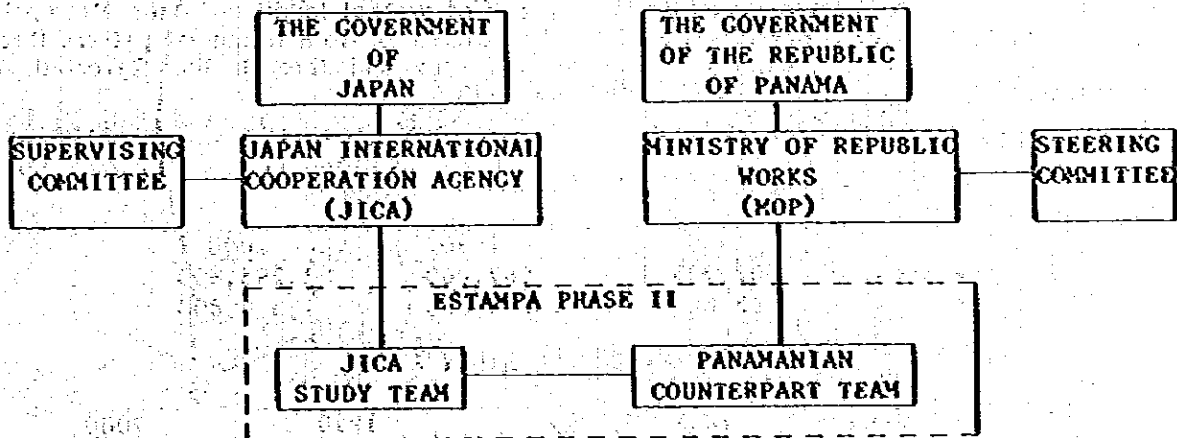
For the purpose of this Feasibility Study, the Study Area of the Panama Metropolitan Area Urban Transport Study is considered the Planning Areas, as was for ESTAMPA Masterplan. The subject projects conforming to the year 2000 conditions shall be completed by 1990.

### 3) Study Organization

JICA placed its Study Team of 12 experts under a Supervising Committee. The Government of the Republic of Panama has formed a counterpart team under the Ministry of Public Works (MOP), and the both teams, unified as the ESTAMPA Team, have worked jointly. MOP has organized a Steering Committee consisting of representatives of the relevant ministries and agencies in order to facilitate the progress of the study.



**PANAMA METROPOLITAN AREA**



**ORGANIZATION FOR THE STUDY**

## 2. Socioeconomic Background

### 1) A Profile

The Republic of Panama is an isthmian nation extending east-west between Costa Rica and Colombia, having a national territory of 77,082 square kilometers and a population of 1,830,000 (1980). It has a marine tropical climate with dry season (January to April) and rainy season (May to December), when most of the annual precipitation of about 2,000 millimeters is realized.

Located in the middle of the nation and facing the Pacific, Panama Metropolitan Area is an area around Panama City with a land space of 3,580 square kilometers, extending about 80 kilometers east-west and about 50 kilometers north-south, and a population of 730,000 (1980). Projects subject to this Feasibility Study are to be implemented in Panama urban area and the Reverted Area (Corregimiento Ancon) adjacent thereto.

The Panama Metropolitan Area is bordered by the Gulf of Panama to the south and hilly terrain to the north and is divided in the center by the Panama Canal running north and south. The region where the projects will be implemented is the flat land comprising Panama urban area and the adjacent hilly area.

### 2) Economic Framework

Panama City is the political, economic, and cultural center of the nation and, due to its geographical position as the meeting point of the North and South American Continents has long been a nodal point of international transport. It is the Pacific entrance to the Panama Canal. In recent years, it has grown as the international finance center.

The population of the Metropolitan Area has increased rapidly from 350,000 to 730,000 during the past two decades and is predicted to increase to 1,010,000 by 1990 and further to 1,330,000, or 1.8 times the present, by the year 2000.

The Metropolitan Area's industrial structure is heavy on tertiary industries, which employ 160,000 or 74% of the total population at work of 220,000. Employment is expected to increase to 340,000 by 1990 and to 490,000, or 2.3 times the present, by the year 2000, when tertiary industries will still represent 81%.

### 3) Land Use

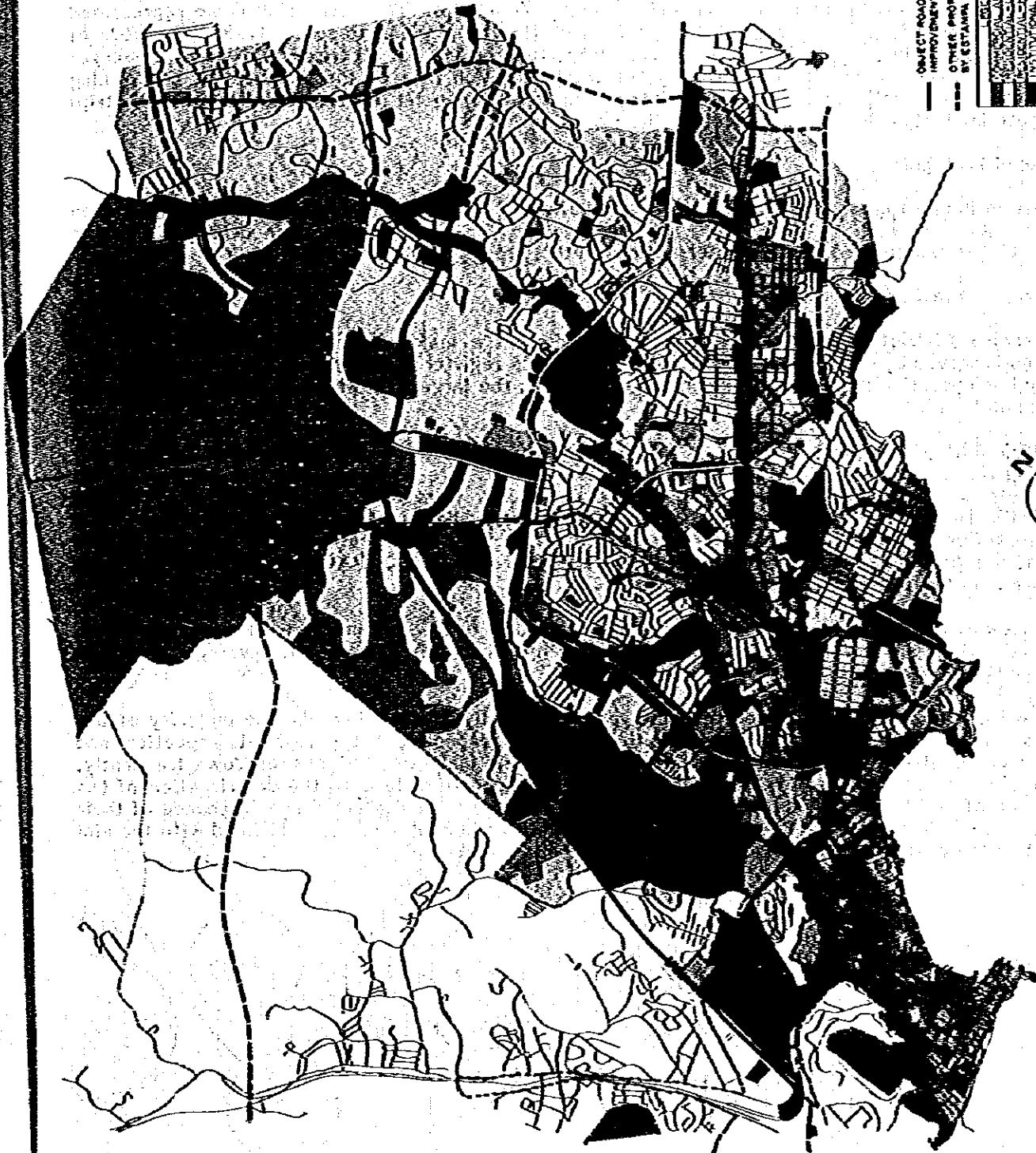
As population and economic activities have concentrated in the Metropolitan Area, the expansion of its urban area has been very rapid. The urban area, which is now about 2.5 times the size in the 1960s, is predicted to further expand from the 12,800 hectares in 1980 to 20,000 hectares or 1.6 times by the year 2000. The reverse "T" formed by Pan American Highway and Transistmica adjoining thereto at a right angle represents the pattern of spread of present land use in the Metropolitan Area. Future development efforts are to transform this reverse "T" to a triangular pattern through the outward expansion of the existing Panama Urban area and through the Reverted Area development, thereby creating nuclei of living in all directions.

#### PLANNED POPULATION

| AREA          | YEAR | 1980    | 1990      | 2000      |
|---------------|------|---------|-----------|-----------|
| Planning Area |      | 707,725 | 987,000   | 1,298,800 |
| Study Area    |      | 732,840 | 1,013,000 | 1,334,800 |

#### EMPLOYMENT IN THE STUDY AREA

| INDUSTRIAL SECTOR        | YEAR | 1980     | 1990     | 2000     |
|--------------------------|------|----------|----------|----------|
| Primary                  |      | 8,155    | 7,155    | 6,430    |
| Secondary                |      | 49,020   | 67,755   | 87,410   |
| (of which manufacturing) |      | (29,680) | (41,110) | (53,760) |
| Tertiary                 |      | 162,355  | 265,550  | 400,320  |
| TOTAL                    |      | 219,530  | 340,460  | 494,160  |



BAHIA DE PANAMA



- OBJECT ROAD CONSTRUCTION AND IMPROVEMENT BY THE STUDY
  - OTHER PROPOSED PROJECTS BY ESTADIA MASTERPLAN
- | LEGEND    |                            |
|-----------|----------------------------|
| [Pattern] | AGRICULTURE AND PASTORAL   |
| [Pattern] | AGRICULTURE - LOW DENSITY  |
| [Pattern] | AGRICULTURE - HIGH DENSITY |
| [Pattern] | INDUSTRIAL AND SERVICES    |
| [Pattern] | RECREATIONAL AND TOURISM   |
| [Pattern] | UNASSIGNMENT               |
| [Pattern] | NATURAL RESERVATION AREA   |
| [Pattern] | BORDER OF REVERTED AREA    |

FUTURE LAND USE (2000)

### 3. Present Traffic and Bus System

#### 1) Person Trip

The person-trip survey conducted in 1981 revealed that those concerning the Metropolitan Area were 1,470,000 trips in total, of which 96% was intra-area trips. Trips for going home represented the most (44%), followed by trips for going to work (18%) and going to school (16%). By mode of transport, public buses represented the largest proportion, or 34%, of all trips, followed by passenger cars (27%). The substantial gap between the trip generation rate of the members of car owning families of 3.39 trips and such rate of the members of non-car owning families of 1.93 trips characterized trip behavior in the Metropolitan Area.

#### 2) Road Transport

Within Panama urban area, traffic is heavy chiefly on east-west arterial roads, such as Via Simon Bolivar, Avenida Balboa, Via Espana, and Via Ricardo J. Alfaró, and a fair degree of traffic congestion is experienced at major intersections on these roads during peak hours.

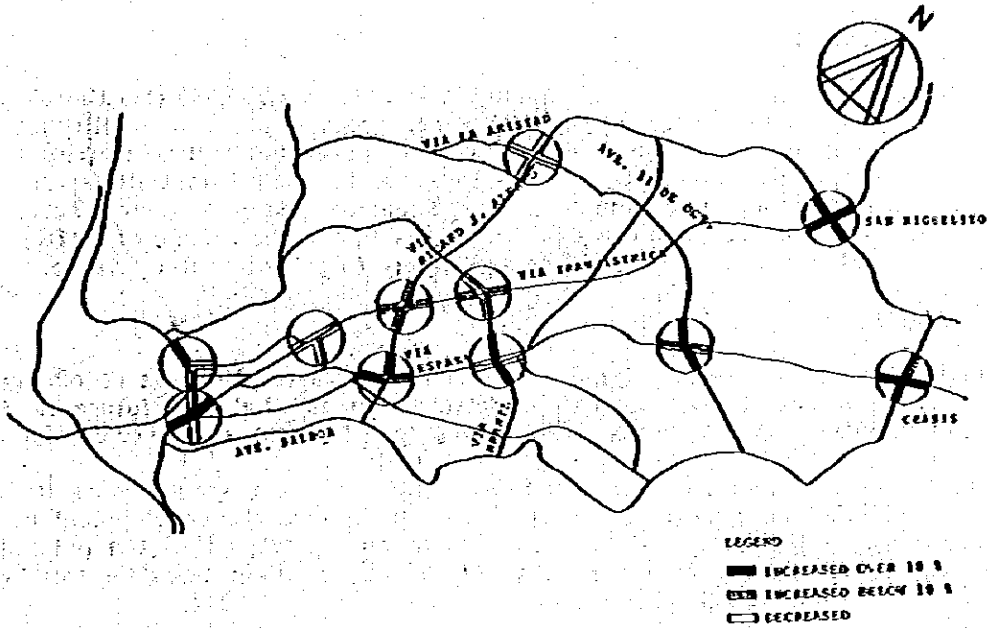
#### 3) Present Status of Bus System

Panama District and San Miguelito District represent a major demand for bus trips, and the demand is served by city buses. Of the total 1,127 buses registered at present, 910 are operational. Public bus operation organizations number four in total, the largest of which is SICOTRAC, owning 85% of all buses.

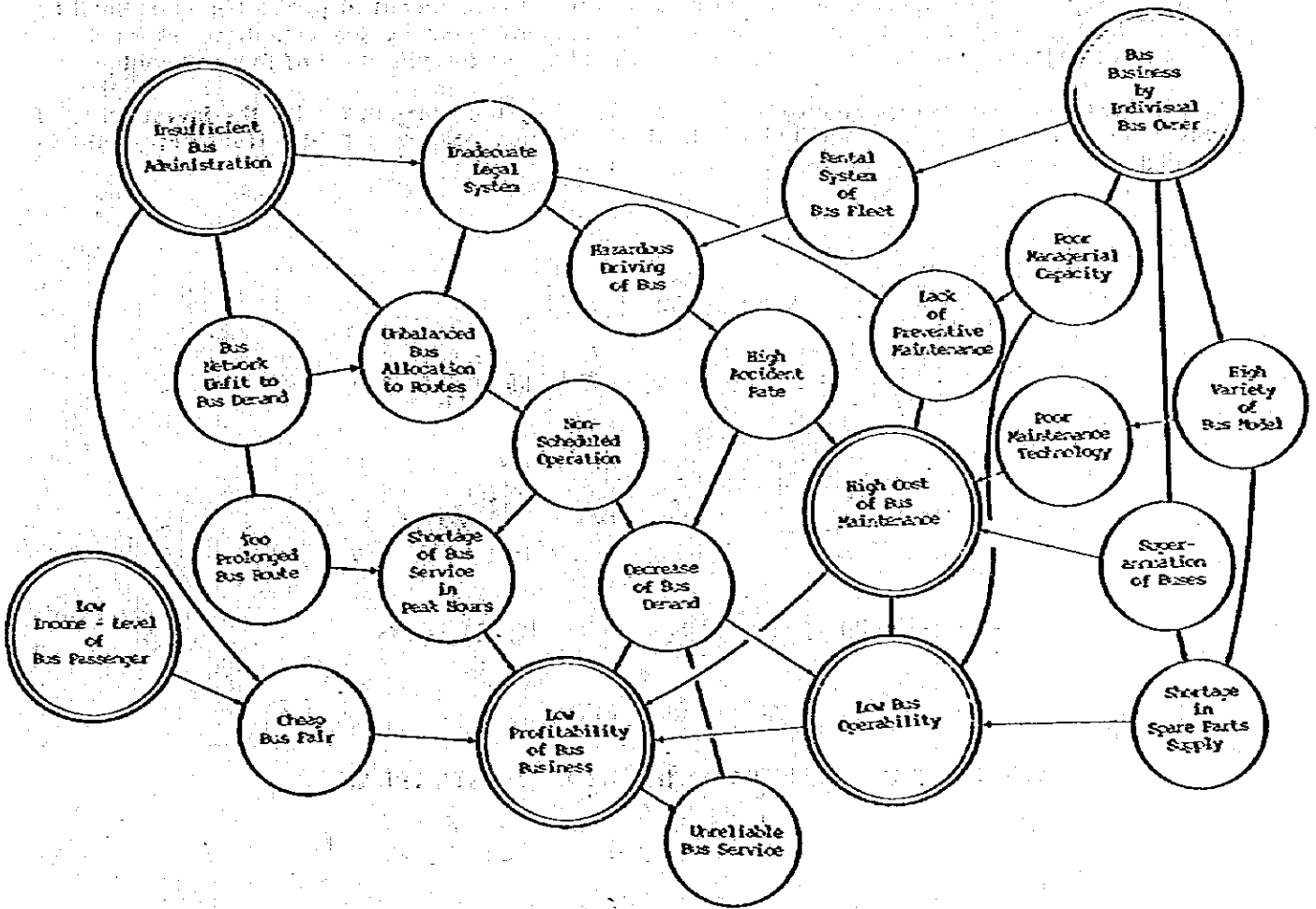
SICOTRAC is a syndicate of bus owners and drivers and attempts to protect their interests by handling route applications, government negotiations for bus fare revisions, and fuel supply service, and controls the orders of bus arrivals to and departures from each piquera (the suburban bus terminal). Diverse arrangements are made between the bus owner and the driver, but under the most representative arrangement the bus is rented to the driver for a fixed fee and the driver defrays bus operation expenses excluding the costs of repair and insurance. SICOTRAC prohibits the ownership of more than two buses by any individual member.

In view of the fact that most bus passengers are members of low-income, non-car owning families, bus fares, which are government controlled, have been left unrevised for years. Average fare is 22 cents per ride.

Because the fare-bearing ability of passengers is generally low and because the majority of bus owners own only one bus and have a limited financial capacity, the periodical inspection and preventive maintenance of buses are inadequate. The poorly maintained buses breakdown frequently, depressing bus operation rate and bus service level, which, in turn, lead to the deterioration of bus business profitability. With smaller profits, bus owners all the more neglect the maintenance of their buses. The establishment of bus centers and a bus maintenance center has been planned with the aim of cutting the chain of this vicious cycle.



CHANGE IN TRAFFIC VOLUME DURING 1981 AND 1983



INTER-RELATIONSHIP OF BUS SYSTEM PROBLEMS

#### 4. Transport Demand Forecast and Traffic Network Masterplan

##### 1) Future Transport Demand

O-D trips are predicted to increase from the 1,430,000 in 1980 to 2,230,000 (1.5 times) and further to 3,140,000 (2.1 times) by the year 2000, as population increases and people's mobility rises as more people own cars. Trip Increase will be small in Panama urban area but will be striking in suburban areas. By the mode, passenger car utilization rate is expected to rise substantially as car ownership multiplies. Major flow of traffic will be from Juan Diaz, Tocumen, and other eastern suburbs, as well as from San Miguelito, Las Cumbres, and other northern suburbs, and the volume of traffic will be 2.5 times the present at the threshold to Panama urban area where these flows will converge.

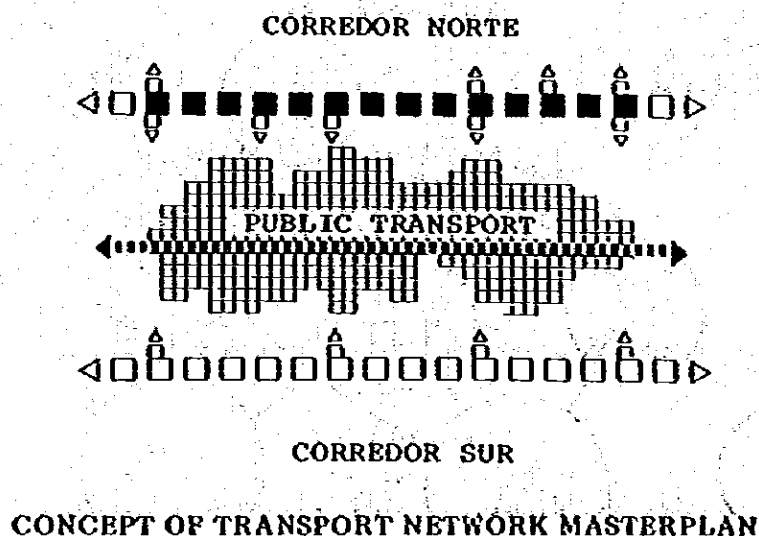
##### 2) Traffic Network Masterplan

A future traffic network masterplan (known as ESTAMPA Masterplan) was recommended as a result of the study of a number of alternative networks in the light of future land use and development patterns, population distribution, transport demand forecast, and other considerations.

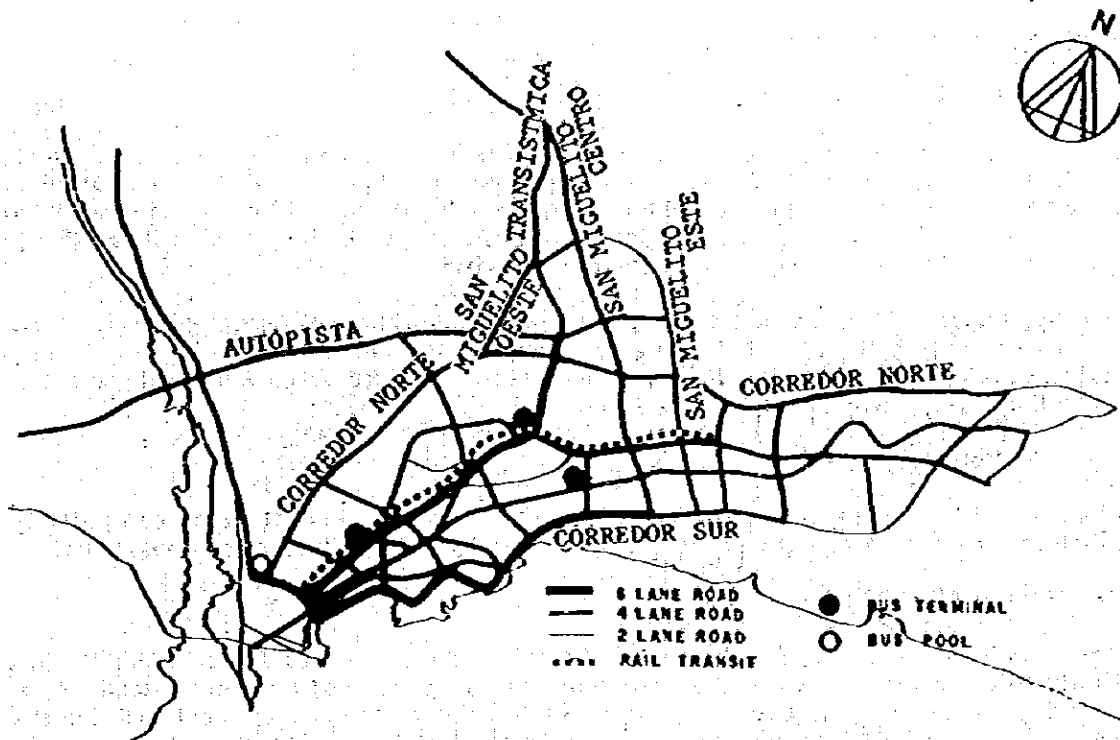
With the development of Pan American Highway, Autopista, and Transistmica Highway, the formation of the masterplan network in the urban area will require the development of Corredor Norte and Corredor Sur as the east-west "side rails" of a ladder shape skeleton pattern and the development of Via Cerro Ancón, Via Brazil (Via El Paical), and Via Once de Octubre as the north-south dispersion roads, or the "ladder rungs".

Certain regulatory controls on car ownership and utilization, as well as a policy to simulate the improvement of public transport service, will be required in view of the future trend of transport demand. Via Bolivar, Via Espana, and other roads which traverse the urban area will function as the axes of public transport, while, in the distant future, introduction of railroad from Centro to east of San Miguelito has been proposed. Short and medium range improvement of public transport shall be achieved through the improvement of mechanical quality of buses by the establishment of a bus maintenance center and through bus system improvement by the establishment of four bus centers.

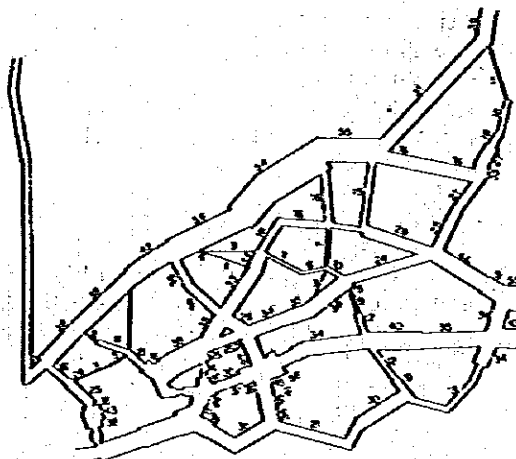
This traffic network is expected to be fully developed by the year 2000, with the investments of about 350 million dollars in roads and of about 335 million dollars in public transport facilities including the railroad system.



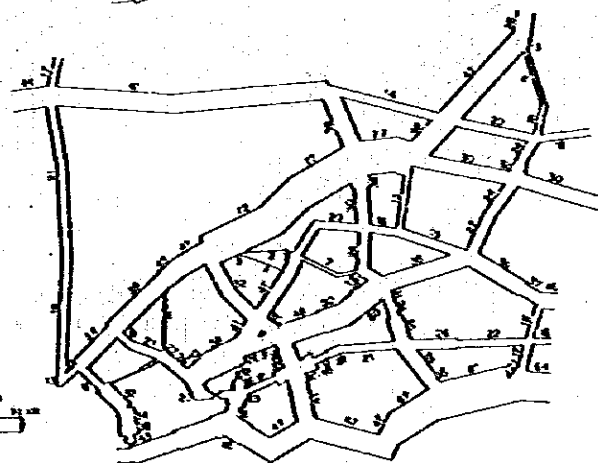




**TRANSPORT NETWORK MASTERPLAN YEAR 2000**



**YEAR 1990**



**YEAR 2000**

**FUTURE TRAFFIC DEMAND ON ROAD NETWORK**

## 5 Corredor Norte - Function and Route Selection

### 1) Local Land Use and Road Function

As the east-west axis for the northern part of Panama urban area, Corredor Norte is to accommodate the large volume of traffic flowing from San Miguelito, Colon, and other northern origins and to prevent it from traversing the area by directing it onto El Palcaal and other north-south dispersion roads for direct access to the central business district. In future when it is extended east, it will function as a bypass road for a large volume of traffic flowing from the Tocumen way.

Generally, the roadside areas are under plans for development. Development particularly of the Reverted Area in the north of the built-up area is important in that it will become a focal point of future urban development. Corredor Norte, which traverses the Reverted Area, will be a trunk road essential to the development of the Reverted Area.

### 2) Route Selection

In Albrook and Los Andes, both near the terminal points of the road, the road can possibly follow various different routes. Alternative routes in such areas have been studied as discussed below.

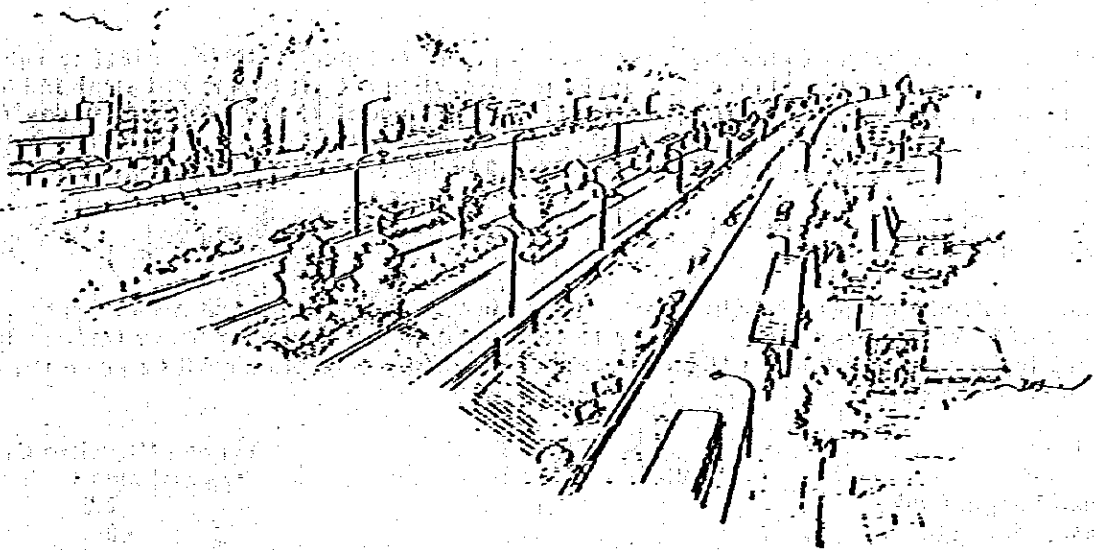
#### (1) Alternatives in Albrook

Demand has been increasing for the early utilization of the previous Albrook Airfield in view of its proximity to the central area and the availability of a large area of flat vacant land. As a result, it is increasingly expected that Corredor Norte will function as the development axis for that area. Thus, the original plan for the road to go through the natural park for a substantial distance must now be reviewed, and various possible routes of the road in the area must be studied together with the locations where the road can be connected with Via Cerro Ancon and Gaillard Road.

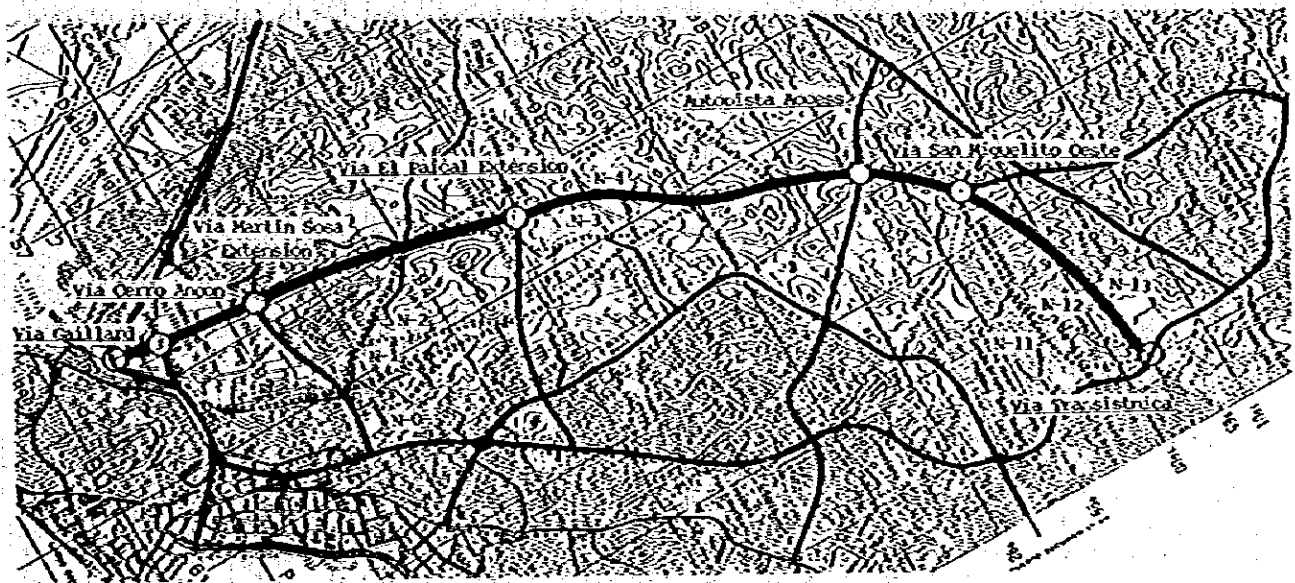
A total of six alternative routes have been considered: three (N-0, N-1 and N-2) which will traverse the park and utilize Via Curundu as expanded, two (N-4 and N-5) which will utilize previous airfield runway and partially go through the military area, and one (N-3) which will avoid both the park and the military area but will utilize the existing road. Alternative N-4, which will utilize the runway, has been selected for the reason that the previous Albrook Airfield will be developed soon and construction costs will be lower.

#### (2) Alternatives in Los Andes

Although it will terminate at the point connecting with Transistmica, as far as the present study is concerned, Corredor Norte is to be extended east beyond that point to reach Pedregal/Tocumen in the future. If such an extension follows the route that goes through the area dense with houses in the north of Samaria, the connecting point must occur in the housing development area of Los Andes. However, hills with outcrops of rocks continue from the intersection with San Miguelito Oeste to Los Andes housing area, and on the hillside are slums. In this section, three alternative routes have been considered: N-11, which will make a long detour in south; N-12, which will also go through the same gorges but will bypass the lake of Los Andes on its west and go through the Los Andes housing area; and N-13, which will utilize the ranges of Cerro Oscuro and go through the Los Andes housing area. Alternative N-13 has been selected because of the better topographical condition, less construction cost, and less numbers of houses affected by the route.



PERSPECTIVE VIEW OF CORREDOR NORTE



ROUTE LOCATION AND INTERSECTIONS  
OF CORREDOR NORTE

## 6. Corredor Norte - Preliminary Design

### 1) Traffic Volume

The section set off by Via Cerro Ancón and Via El Paical is expected to see a traffic volume of 34,000 to 47,000 vehicles per day in the year 2000. In the section set off by Via El Paical and Via San Miguelito Oeste, traffic volume is estimated to reach a maximum of 77,000 vehicles per day flowing into Panama urban area from Colon way. Then, the section set off by Via San Miguelito Oeste and Transistmica Highway is anticipated to have a traffic of 30,000 vehicles per day flowing to and from east of Panama.

### 2) Geometric Design

The Gaillard Road - Via San Miguelito Oeste section located in the Reverted Area shall be given a design speed of 80 kilometers per hour in order to accommodate a fast moving heavy traffic. In view of the steep topography, the Via San Miguelito Oeste - Transistmica section shall be given the design speed of 60 kilometers per hour.

| ITEM                | Gaillard Road<br>-Via San Miguelito Oeste | Via San Miguelito Oeste<br>-Transistmica Highway |
|---------------------|---|--|
| Road Length (km)    | 9.5                                       | 2.7  |
| Design Speed (km/h) | 80  | 60   |
| Number of Lane      | 4   | 4  |
| Lane Width (m)      | 3.65                                      | 3.65   |
| Shoulder Width (m)  | 2.75                                      | 2.75   |
| Median (m)          | 16.0                                      | 8.50   |
| Pedestrian (m)      | 2.0                                       | 2.0  |
| Right of Way (m)    | 80.0                                      | 60.0   |

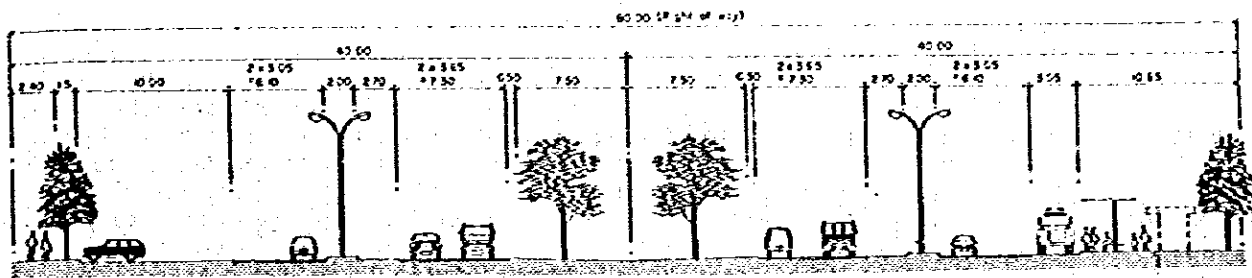
### 3) Intersections

All the crossings/connections of principal arterial roads with Corredor Norte shall be 3-leg intersections which, according to the ESTAMPA Masterplan, will be expanded to 4-leg configurations by the year 2000 except for the intersections crossing Via Martin Sosa Extension and Via El Paical Extension, respectively.

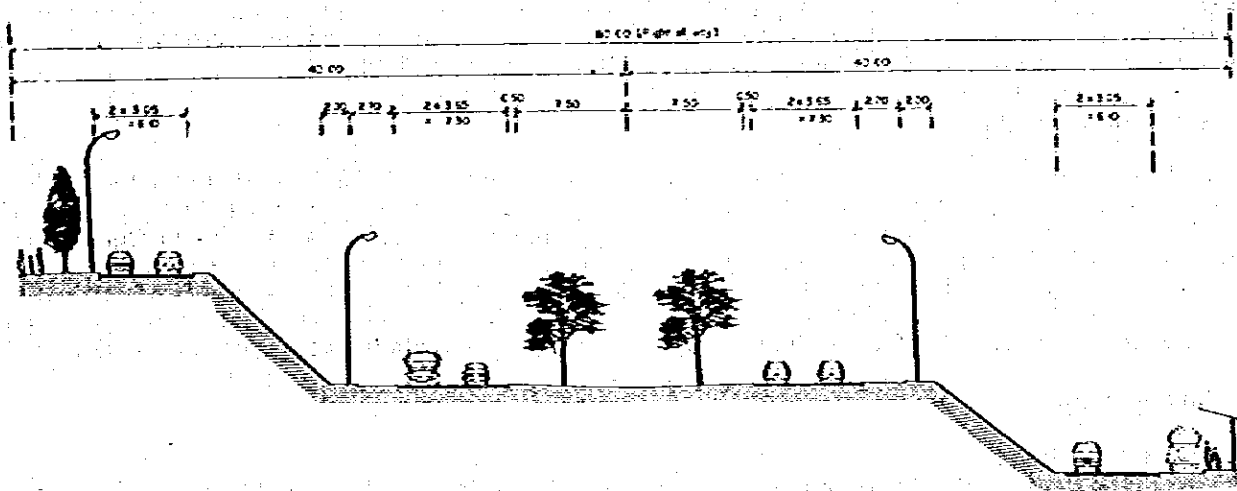
|                                      |   |
|--------------------------------------|---|
| Gaillard Road Intersection           | 3-leg at-grade  |
| Via Cerro Ancón Intersection         | 3-leg at-grade (for future grade separation)                        |
| Via Martin Sosa Intersection         | 3-leg at-grade  |
| Via El Paical Extension Intersection | 3-leg at-grade  |
| Via El Paical Extension Intersection | Trumpet type interchange  |
| Autopista Access Road Intersection   | Diamond interchange   |
| San Miguelito Oeste Intersection     | Direct "Y" type interchange   |
| Transistmica Road Intersection       | 3-leg at grade (for future modification into a diamond interchange) |

### 4) Construction Cost and Evaluation

The construction cost is estimated at 40.1 million balboas, of which 54% will be in foreign currencies and 6.1%, land cost. The internal rate of return (IRR) of all the new roads to be constructed with Corredor Norte as the major axis is an extremely high 34.1%. Dividing Corredor Norte into the section east of Via El Paical Extension and the section west thereof, the former shows an IRR of 34.3% and the latter, 16.2%. This indicates that its connection with Via Transistmica will result in an appreciable benefit improvement.



TYPICAL CROSS SECTION AT ALBROOK AIR FIELD



TYPICAL CROSS SECTION AT MOUNTAINOUS AREA  
(WITH FRONTAGE ROAD)

FINANCIAL COST OF CORREDOR NORTE

Unit: 1,000 Balboas in 1983 price

| DESCRIPTION  | Foreign Portion | Local Portion | Land Cost    | Total         |
|--------------|-----------------|---------------|--------------|---------------|
| Road         | 14,930          | 11,251        | 2,467        | 28,648        |
| Bridges      | 1,593           | 1,481         | -            | 3,074         |
| Engineering  | 2,340           | 1,170         | -            | 3,510         |
| Contingency  | 2,829           | 2,085         | -            | 4,914         |
| <b>TOTAL</b> | <b>21,693</b>   | <b>15,987</b> | <b>2,467</b> | <b>40,147</b> |

## **7. Via El Paical Extension, Via Martin Sosa Extension and Via Cerro Ancon Extension**

### **1) Local Land Use and Road Function**

Via El Paical, Via Martin Sosa and Via Cerro Ancon, as they presently exist, are arterial roads running through Panama urban area north to south. As such, their future extension connecting with Corredor Norte will be effective for the diversion of traffic from the latter for direct access into Panama urban area. Particularly, Via Cerro Ancon Extension and Via Martin Sosa Extension, which will go through the flat area of the Reverted Area, where urbanization is expected to progress rapidly, will become arterial roads to connect the newly developed area with the urban area. Via El Paical Extension will run through the natural park to be constructed in the Reverted Area.

### **2) Traffic Volume**

Of the three, the heaviest traffic of 32,000 vehicles per day in the year 2000 is expected on Via El Paical Extension, which will be the first arterial by which traffic from the north of Panama City will flow from Corredor Norte into Panama urban area. In addition to the function of collection/diversion of traffic to and from Corredor Norte, Via Martin Sosa Extension and Via Cerro Ancon Extension will be arterial roads connecting Albrook Area to be newly developed with Panama urban area, and as such, will have an estimated traffic of 18,000 to 20,000 vehicles per day.

### **3) Geometric Design**

In consideration of the fact that these three roads are important north-south axes, they will be multi-lane roads with design speed of 50Km/h and lane width of 3.35m. The Via El Paical and Via Martin Sosa Extensions shall have the same geometry, while specifications of the Via Cerro Ancon Extension shall be conformed to those of Via Cerro Ancon. However, the route of Via El Paical Extension through the natural park shall be selected so as to require minimum amounts of soil cutting and embankment, and the road structure shall incorporate banks in order to protect the park from traffic noise, detrimental effects to its scenery, and other undesirable impacts upon its functions.

### **4) Intersections**

#### **(1) Via Cerro Ancon Extension**

The crossing of Corredor Norte and Gaillard Road with Via Cerro Ancon Extension shall be by a 3-leg at-grade intersection.

#### **(2) Via Martin Sosa Extension**

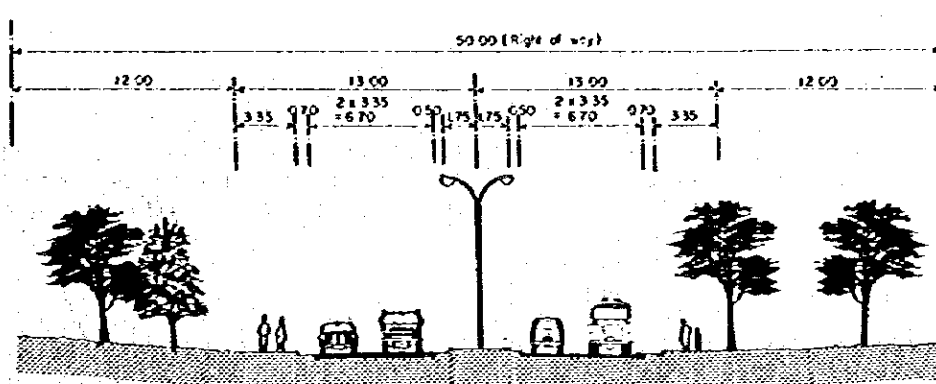
Via Martin Sosa Extension shall have connections with Via Bolivar, Via Bella Vista, Via Crundu, and Corredor Norte. The current trumpet type configuration of the Via Bolivar Intersection shall be changed to a half cloverleaf type interchange, and other connections shall be by at-grade intersections.

#### **(3) Via El Paical Extension**

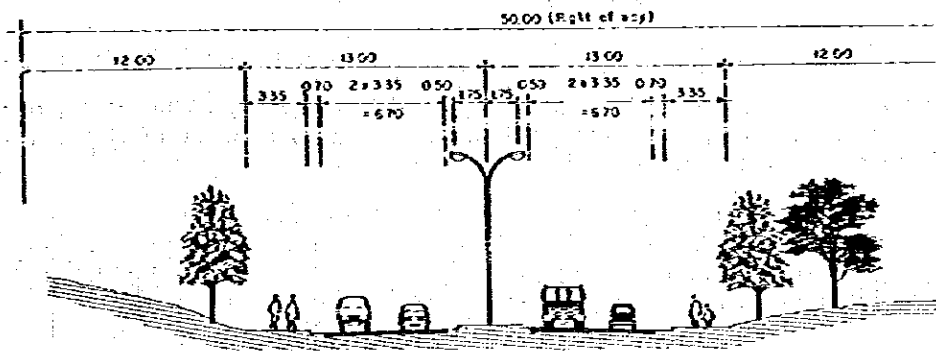
A trumpet type interchange shall be used for the connection of Via El Paical Extension with Corredor Norte. Connections with La Amistad and with Juan Pablo II shall be an at-grade intersection.

### **5) Construction Cost and Evaluation**

The construction costs are estimated at 2.3, 6.0 and 0.5 million balboas for Via El Paical Extension, Via Martin Sosa Extension and Via Cerro Ancon Extension, respectively. The evaluation of these three sections, assuming the existence of Corredor Norte, resulted in Via El Paical Extension showing the highest economy, followed by Via Martin Sosa Extension and Via Cerro Ancon Extension.



TYPICAL CROSS SECTION OF VIA MARTIN SOSA EXTENSION



TYPICAL CROSS SECTION OF VIA EL PAICAL EXTENSION

| ITEM                | Cerro Ancon Ext. | Martin Sosa Ext. | El Paical Ext. |
|---------------------|------------------|------------------|----------------|
| Road Length (km)    | 0.4              | 2.1              | 1.7            |
| Design Speed (km/h) | 50               | 50               | 50             |
| Numbers of Lane     | 6                | 4                | 4              |
| Lane Width (m)      | 3.35             | 3.35             | 3.35           |
| Shoulder Width (m)  | 1.15             | 0.70             | 0.70           |
| Median (m)          | 4.50             | 4.50             | 4.50           |
| Pedestrian (m)      | 4.45             | 3.35             | 3.35           |
| Right of Way (m)    | 50               | 50               | 50             |

FINANCIAL COST

| NAME OF ROAD              | DESCRIPTION | Unit: 1,000 Balboas in 1983 price |               |           |       |
|---------------------------|-------------|-----------------------------------|---------------|-----------|-------|
|                           |             | Foreign Portion                   | Local Portion | Land Cost | Total |
| VIA MARTIN SOSA EXTENSION | Road        | 2,073                             | 1,481         | 319       | 3,873 |
|                           | Bridges     | 448                               | 410           | -         | 858   |
|                           | Engineering | 353                               | 177           | -         | 530   |
|                           | Contingency | 431                               | 310           | -         | 741   |
|                           | TOTAL       | 3,306                             | 2,378         | 319       | 6,003 |
| VIA EL PAICAL EXTENSION   | Road        | 1,104                             | 703           | -         | 1,807 |
|                           | Engineering | 145                               | 72            | -         | 217   |
|                           | Contingency | 187                               | 116           | -         | 303   |
|                           | TOTAL       | 1,436                             | 892           | -         | 2,328 |
| VIA CERRO ANCON EXTENSION | Road        | 246                               | 142           | -         | 388   |
|                           | Engineering | 31                                | 16            | -         | 47    |
|                           | Contingency | 42                                | 24            | -         | 66    |
|                           | TOTAL       | 319                               | 182           | -         | 501   |

## 8. Via San Miguelito Oeste

### 1) Local Land Use and Road Function

Via San Miguelito Oeste shall originate from Corredor Norte, proceed north across Autopista, and terminate at Transistmica Highway. With the exception of flat land at the both terminal points, the route shall run through tree-covered rugged hills with relatively low development potentials in view of the topography. The major function of this road will be to allow traffic to bypass presently congested San Miguelito Area and Transistmica Highway.

### 2) Traffic Volume

The section between Transistmica Highway and Autopista will provide for traffic between northern Panama/Colon way and Panama City, as well as for traffic to and from Autopista, which leads to west of Panama. Expected volume of traffic in this section is 43,000 vehicles per day (year 2000). Expected in the section between Autopista and Corredor Norte is 48,000 vehicles per day (year 2000), almost all of which will be the traffic bypassing San Miguelito Area.

### 3) Geometric Design

The same road width as Corredor Norte shall be given Via San Miguelito Oeste, in view of the expected heavy traffic. However, its roadways shall be separated in most of its sections so as to minimize the volume of earthwork in areas with hilly topography.

#### GEOMETRIC ITEMS OF VIA SAN MIGUELITO OESTE

|                     |      |
|---------------------|------|
| Road Length (km)    | 4.0  |
| Design Speed (km/h) | 60   |
| Number of Lane      | 4    |
| Lane Width (m)      | 3.65 |
| Shoulder Width (m)  | 2.75 |
| Median (m)          | 16.0 |
| Pedestrian (m)      | 2.0  |
| Right of Way (m)    | 60.0 |

### 4) Intersections

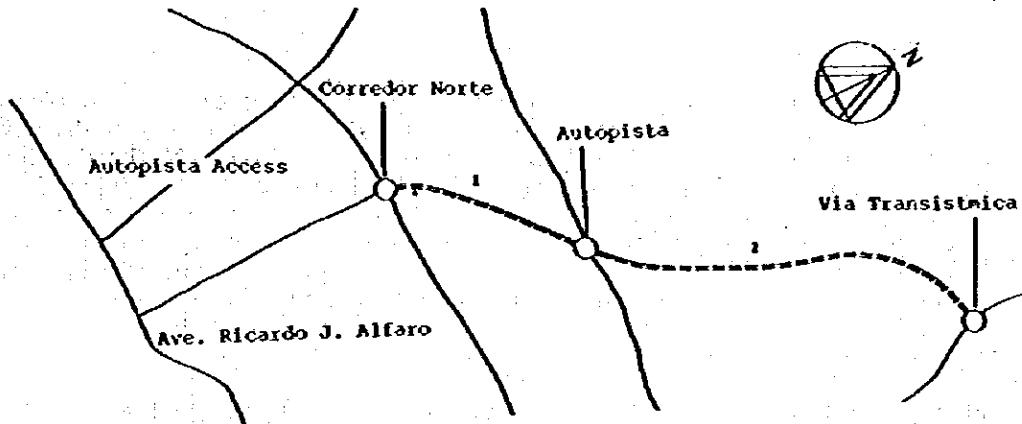
The volume of traffic on Via San Miguelito Oeste will be greater than that on any of the said three arterial roads intersecting therewith and will further increase upon its future extension toward east. In meeting this future demand by the grade-separation of intersections, the following plans are conceived of:

|                             |   |
|-----------------------------|---|
| Corredor Norte Intersection | "Y" type interchange  |
| Autopista Intersection      | In view of the fact that the Autopista Project is presently being suspended, no practical configuration but merely elevated alternative is suggested. |
| Transistmica Intersection   | A 3-leg at-grade intersection (for future alteration into a modified direct-ramp interchange).  |

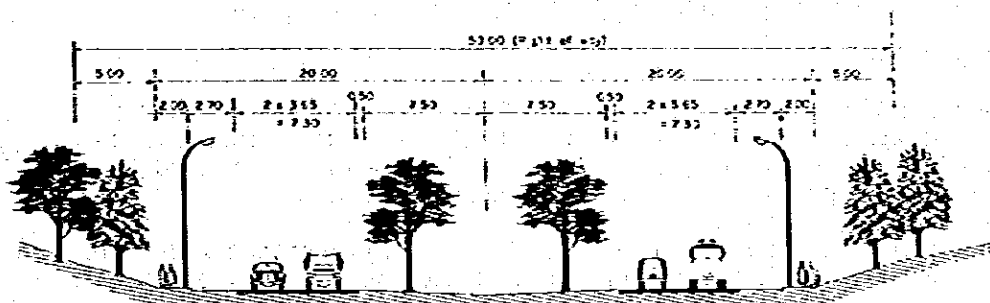
### 5) Construction Cost and Evaluation

Construction cost is estimated at 17.3 million balboas, of which 50.6% will be in foreign currencies and 10.4% land cost. While the evaluation of all new roads, excluding Via San Miguelito Oeste, results in even a higher IRR of 39.0%, the same is true with the Los Andes section of Corredor Norte. The two, then, would be mutually substitutable.

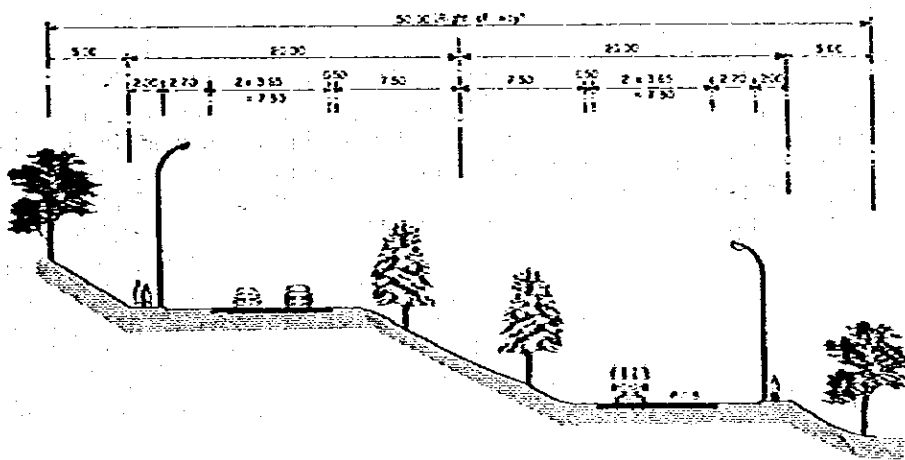




**SECTIONS OF VIA SAN MIGUELITO OESTE BY MAIN INTERSECTIONS**



**TYPICAL CROSS SECTION OF VIA SAN MIGUELITO OESTE  
(SECTION AT SAME LEVEL OF CARRIAGEWAY)**



**TYPICAL CROSS SECTION OF VIA SAN MIGUELITO OESTE  
(SECTION AT GRADE SEPARATION)**

**FINANCIAL COST OF VIA SAN MIGUELITO OESTE**

| DESCRIPTION  | Unit: 1,000 Balboas in 1983 price |               |              | Total         |
|--------------|-----------------------------------|---------------|--------------|---------------|
|              | Foreign Portion                   | Local Portion | Land Cost    |               |
| Road         | 5,324                             | 4,140         | 1,787        | 11,251        |
| Bridges      | 1,316                             | 1,236         | -            | 2,552         |
| Engineering  | 961                               | 481           | -            | 1,442         |
| Contingency  | 1,140                             | 878           | -            | 2,018         |
| <b>TOTAL</b> | <b>8,741</b>                      | <b>6,735</b>  | <b>1,787</b> | <b>17,263</b> |

## 9. Via Espana

### 1) Land use and Intersection Allocation

The subject road section occurs in the new central business district of Panama, consisting of foreign banks and other offices, hotels, and high-class speciality stores, where heavier density of land utilization is expected in the future. As such, this road section should desirably be developed as a model street of Panama city, equipped with adequate sidewalks and pedestrian crossings, and other essential facilities of the street. Efforts to develop this section should include the rearrangement of the existing 20 intersections into 12 with signalized, located at intervals of 200 to 250 meters, the improvement of the road in commensuration with this intersection improvement, and the installation of roadside trees and parking spaces, bus stops, and other ancillary facilities.

### 2) Future Traffic

The volume of traffic entering intersections is expected to be from 80,000 to 114,000 vehicles per day in the year 2000 at Federico Boyd and Via Poiras Intersections, where such volume is already nearly as high, and about 150,000 vehicles per day at Via Brazil intersection after the opening of Corredor Norte, where such volume is presently about one-half the level. Buses are expected to continue to represent about 16% of traffic on Via Espana.

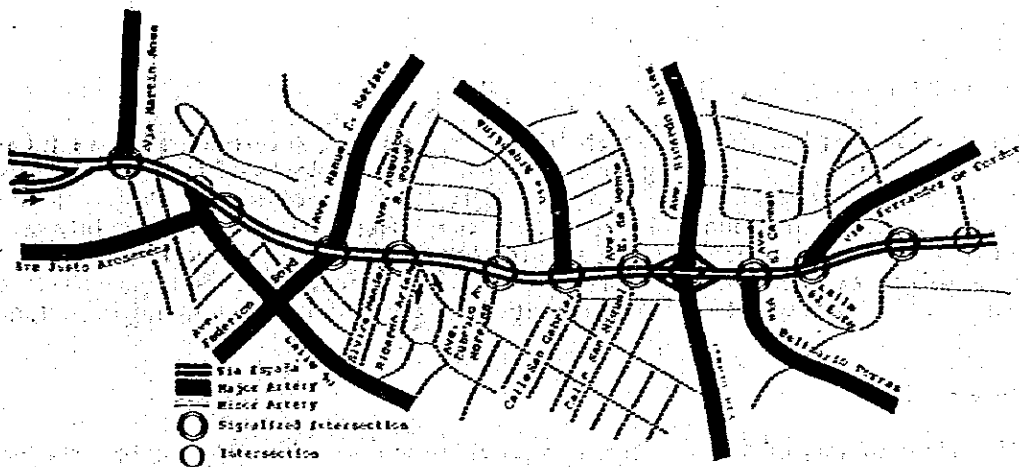
### 3. Preliminary Design

In consideration of the present right-of-way of 40 meters, Via Espana shall be improved to be a wide six lane street. The section between Via Martin Sosa Intersection (the starting point of the Study) and Via Federico Boyd Intersection, however, shall be widened toward only one side because the other side of the road is an incline and cannot be utilized easily.

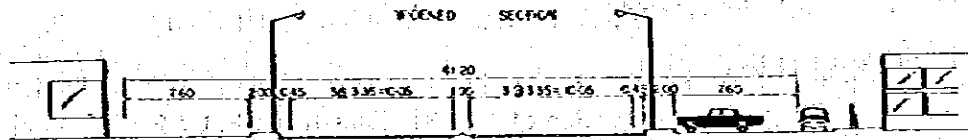
With improvement by the addition of an exclusive left-turn lane, all the intersections but Via Brazil Intersection are calculated to have an adequate capacity to accommodate the volume of traffic up to the year 2000. The grade-separation of Via Brazil Intersection is suggested in meeting the heavy traffic demand at this intersection. An underpass is planned for Via Espana in view of the traffic flow, as well as of the building and other land use condition and the scenery of the adjacent area.

### 4) Construction Cost and Evaluation

The construction cost needed for the above improvement work for a total extension of 3.1 kilometers is estimated at 14.1 million balboas, of which 47.9% will be in foreign currencies and 11.7% land cost. The cost of Via Brazil Intersection grade separation represents 19.7% of said total. A high economic return of 33.6% is expected from this single project. When the construction of Corredor Norte and other new roads is taken into consideration, however, the evaluation becomes lower.



ROAD NETWORK ALONG VIA ESPANA



WIDENED CROSS SECTION OF VIA ESPANA

GEOMETRIC ITEMS OF VIA ESPANA

|                     |      |
|---------------------|------|
| Road Length (km)    | 3.1  |
| Design Speed (km/h) | 50   |
| Number of Lane      | 6    |
| Lane Width (m)      | 3.35 |
| Shoulder Width (m)  | 0.45 |
| Median (m)          | 1.0  |
| Pedestrian (m)      | 2.0  |
| Right of Way (m)    | 40.0 |

FINANCIAL COST OF VIA ESPANA

| DESCRIPTION  | Unit: 1,000 Balboas in 1983 price |               |              |               |
|--------------|-----------------------------------|---------------|--------------|---------------|
|              | Foreign Portion                   | Local Portion | Land Cost    | Total         |
| Road         | 3,688                             | 3,212         | 1,655        | 8,555         |
| Bridges      | 1,407                             | 1,367         | -            | 2,774         |
| Engineering  | 774                               | 687           | -            | 1,461         |
| Contingency  | 880                               | 745           | -            | 1,625         |
| <b>TOTAL</b> | <b>6,749</b>                      | <b>5,710</b>  | <b>1,655</b> | <b>14,114</b> |

## 10. Via Bolivar and San Miguelito Intersection

### 10.1. Via Bolivar

#### 1) Land Use and Intersection Allocation

The subject section of Via Bolivar, which is an arterial street traversing Panama urban area in east-west direction, is trimmed with large 400 to 500-meter long blocks of land occupied by schools, hospitals, and government agencies. Via Ricardo J. Alfaro, which crosses Via Bolivar in the subject section, is a trunk road which functions to bypass the latter. At Martin Sosa Intersection, the starting point of the subject section, a trumpet interchange is under construction by MOP, but since Via Martin Sosa will be extended in the future to Corredor Norte, it will become necessary to modify its shape. The section ends at El Paical Intersection, which will increase in its importance in the future.

#### 2) Preliminary Design

The existing right-of-way of 60.96 meters can provide the space for widening to a six lane street. The space unused for road shall be utilized as parking space, frontage road, and slope land.

The rotary intersection under the presently grade-separated intersection with Via Ricardo J. Alfaro shall be provided with signals. The grade-separation of Via El Paical Intersection is recommended in view of an estimated quadrupling of traffic flowing into that intersection upon the opening of Corredor Norte for service.

#### 3) Construction Cost and Evaluation

Construction cost for the total extension of 2.25 Km is estimated at 7.0 million balboas, of which 54.8% will be by foreign currency and 1.2% will be land cost. The cost of intersection grade-separation will be 41.6% of the total. Evaluation together with Via El Paical resulted in an IRR of 6.8%, or, even with the exclusion of the expensive intersection grade-separation, 10.9%.

### 10.2. San Miguelito Intersection

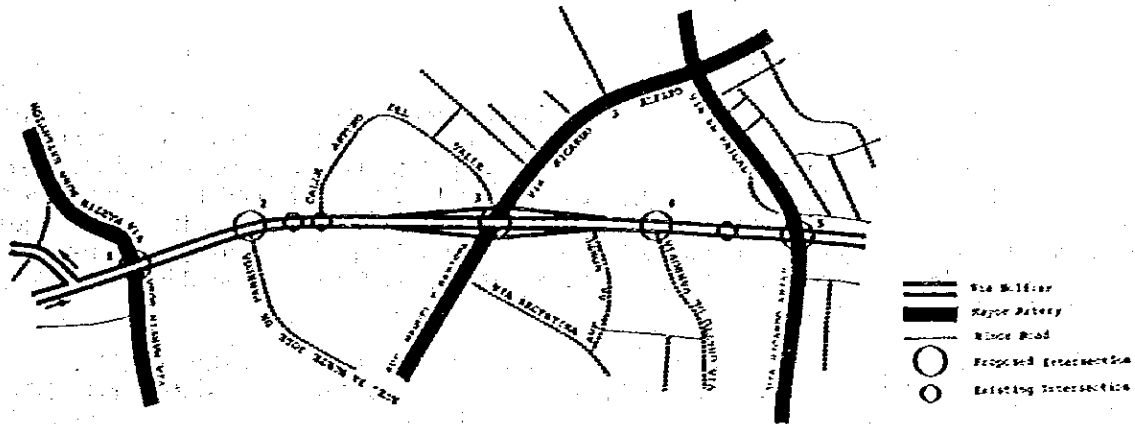
At San Miguelito Intersection, Transistmica, as the only road connecting northern Panama with the central area, intersects with Via Domingo Diaz, an arterial which, on the other hand, connects western Panama with the central area. Presently no bypass is available for traffic from Transistmica, and the rate of concentration is high at the intersection during peak hours. Both the peak hour factor and the volume of traffic will be much affected upon the completion of Corredor Norte. However, directional traffic pattern when Transistmica will be bypassed by Corredor Norte completed within the Reverted Area and such pattern when Via Domingo Diaz will be bypassed by Corredor Norte further extended will be quite dissimilar.

#### 2) Preliminary Design

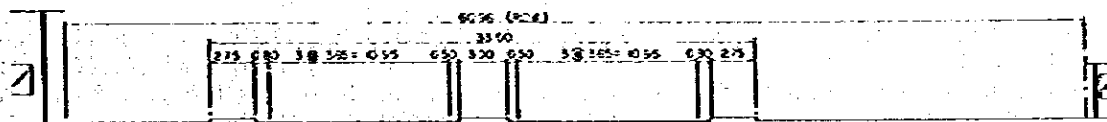
Whichever the case may be, the capacity of this intersection may not be adequately expanded to meet the traffic demand up through the year 2000, although both intersecting roads have sufficient right-of-way, and, therefore, grade separation of this intersection is recommended. Via Domingo Diaz shall be grade separated in consideration of traffic flow at the bus center to be established adjacent to the intersection.

#### 3) Construction Cost and Evaluation

The construction cost is estimated at 4.7 million balboas, of which 54.7% will be in foreign currencies. The cost of the viaduct and the pedestrian bridge represents 69% of the total. This project is proven excellent with the IRR of 24.5% as a result of evaluation based on a more detailed intersection analysis than, and separately from, the same evaluation method as of roads.



**ROAD NETWORK ALONG VIA BOLIVAR**



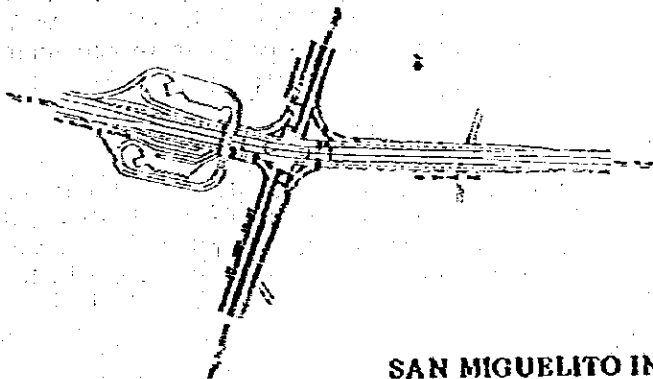
**WIDENED CROSS SECTION OF VIA BOLIVAR**

**GEOMETRIC ITEMS OF VIA BOLIVAR**

|                     |       |
|---------------------|-------|
| Road Length (km)    | 2.25  |
| Design Speed (km/h) | 50    |
| Number of Lane      | 6     |
| Lane Width (m)      | 3.65  |
| Shoulder Width (m)  | 0.80  |
| Median (m)          | 4.0   |
| Pedestrian (m)      | 2.75  |
| Right of Way (m)    | 60.96 |

**FINANCIAL COST OF VIA BOLIVAR**

| DESCRIPTION  | Unit: 1,000 Balboas in 1983 price |               |           |              |
|--------------|-----------------------------------|---------------|-----------|--------------|
|              | Foreign Portion                   | Local Portion | Land Cost | Total        |
| Road         | 1,434                             | 1,034         | 81        | 2,549        |
| Bridges      | 1,492                             | 1,441         | -         | 2,933        |
| Engineering  | 432                               | 216           | -         | 648          |
| Contingency  | 504                               | 404           | -         | 908          |
| <b>TOTAL</b> | <b>3,862</b>                      | <b>3,095</b>  | <b>81</b> | <b>7,038</b> |



**SAN MIGUELITO INTERSECTION PLAN**

**FINANCIAL COST OF SAN MIGUELITO INTERSECTION**

| DESCRIPTION       | Unit: 1,000 Balboas in 1983 price |               |           |              |
|-------------------|-----------------------------------|---------------|-----------|--------------|
|                   | Foreign Portion                   | Local Portion | Land Cost | Total        |
| Road              | 663                               | 474           | -         | 1,137        |
| Bridges           | 1,237                             | 1,180         | -         | 2,417        |
| Pedestrian Bridge | 47                                | 57            | -         | 104          |
| Engineering       | 293                               | 146           | -         | 439          |
| Contingency       | 336                               | 279           | -         | 615          |
| <b>TOTAL</b>      | <b>2,577</b>                      | <b>2,136</b>  | <b>-</b>  | <b>4,713</b> |

## 11. Via Cerro Ancon

### 1) Land Use and Intersection Allocation

The section from Ave. Balboa to Cinco de Mayo, from where Via Cerro Ancon originates, will traverse about the middle of the Marañon Urban Renewal Area under the MIVI Project and, therefore, is to be planned under said project concept. The section from Cinco de Mayo to Ave. Frangipani is where Via Bolivar, which leads toward northeastern part of Panama, and Pan American Highway, which leads toward the western part of Panama, are connected, and, as such, it is to be widened and upgraded. The right-of-way is confined in the section from Ave. Frangipani to Gaillard Road, which is lined on one side with canal facilities, DNTTF office, and so forth, and on the other side, with the premises of Panama Railway.

In Marañon Area, three intersections shall be developed: Ave. Balboa, Cinco de Mayo bus center entrance, and Ave. Central. Further north, four intersections with the existing arterials shall be developed.

### 2) Future Traffic

Via Cerro Ancon offers connection between the terminal point of Corredor Norte and Ave. Balboa, which will be a part of Corredor Sur in future, and a daily traffic of 30,000 to 40,000 vehicles is predicted in the section from Gaillard Road to Ave. Central in the year 2000. A daily traffic of 103,000 vehicles, or twice the present level, is predicted at the intersection with Ave. de Los Martires (Pan American Highway).

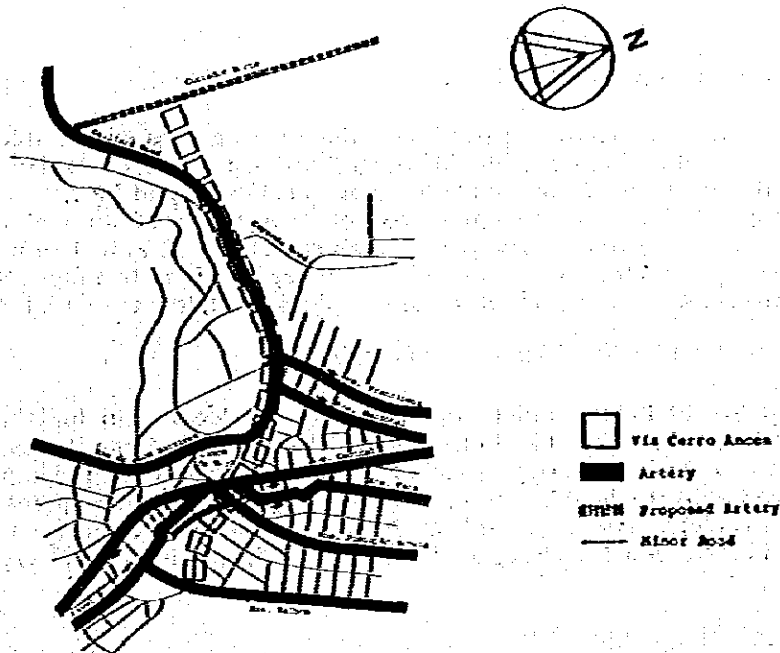
### 3) Preliminary Design

The standard cross section, conforming with the recommendation of the ESTAMPA Masterplan, is designated with six lanes. In the section where the route will run parallel to the Panama Railway track, the widening of this road may be facilitated by the removal of the track up to Balboa Heights Station, depending on the level of utilization of the railway.

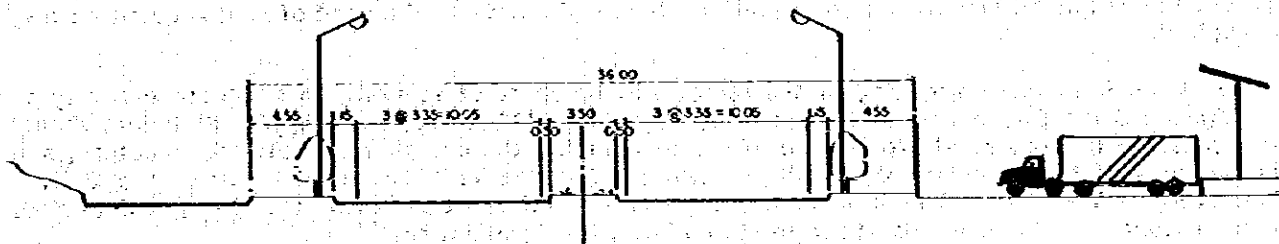
The pairs of one-way streets which presently converge onto Ave. Central Intersection, causing traffic congestion, shall be improved so that the intersection will be singled out. Ave. Frangipani and Ave. Nacional also constitute a pair of one-way roads and shall be rearranged into one intersection, which, incidentally, shall take into consideration the path of flow of buses in and out of the suburban bus terminal which will be established near the intersection. The major flow of traffic at intersection with Ave. de Los Martires, which is presently on said road, will shift onto Via Cerro Ancon upon its extension in the future, and this intersection shall be designed to accommodate the major flow on Via Cerro Ancon.

### 4) Construction Cost and Evaluation

Construction cost for the total extension of 2.0 kilometers is estimated at 9.7 million balboas, 25.7% of which will be by foreign currency and 58.3% will be land cost or the cost of acquisition of privately owned land within Marañon Renewal Area. This project will have a remarkable significance (IRR = 34.1%) if Corredor Norte is constructed, but if not, only a small economic effect (IRR = 6.2%).



ROAD NETWORK ALONG VIA CERRO ANCON



WIDENED CROSS SECTION OF VIA CERRO ANCON

GEOMETRIC ITEMS OF VIA CERRO ANCON

|                     |      |
|---------------------|------|
| Road Length (km)    | 2.00 |
| Design Speed (km/h) | 50   |
| Number of Lane      | 6    |
| Lane Width (m)      | 3.35 |
| Shoulder Width (m)  | 1.15 |
| Median (m)          | 4.5  |
| Pedestrian (m)      | 4.55 |
| Right of Way (m)    | 36.0 |

FINANCIAL COST OF VIA CERRO ANCON

| DESCRIPTION  | Unit: 1,000 Balboas in 1983 price |               |              | Total        |
|--------------|-----------------------------------|---------------|--------------|--------------|
|              | Foreign Portion                   | Local Portion | Land Cost    |              |
| Road         | 1,919                             | 1,227         | 5,660        | 8,806        |
| Engineering  | 252                               | 126           | -            | 378          |
| Contingency  | 326                               | 203           | -            | 529          |
| <b>TOTAL</b> | <b>2,497</b>                      | <b>1,556</b>  | <b>5,660</b> | <b>9,713</b> |

## 12. Via El Paical

### 1) Land Use and Intersection Allocation

Via El Paical presently is of undivided two lanes, lined with houses on one side and with the MIVI development land on the other from Transistmica Intersection to Ricardo J. Alfaro Intersection and, in the north of it, with new housing areas on both sides. Particularly in La Alameda Area, houses are built beyond the designated construction lines to retain a width of 30 meters, approaching the right-of-way of 15 meters. The feasibility of improvement of Via El Paical to a divided 4-lane road will depend on its value of service to the roadside dwellers, how it is to intersect with Transistmica and Via Ricardo J. Alfaro, which are presently trunk roads, and adjustment with houses on both sides.

### 2) Future Traffic

The north half of Via El Paical, which was originally the local road for the new housing area developed from Via Ricardo J. Alfaro to Rio Curundu, has since 1983, when it was connected with Via Juan Pablo II, started to function as a bypass road for traffic flowing from the canal area. When it is connected with Corredor Norte in the future, its importance will further increase and the traffic, which is now 7,400 vehicles per day, will quadruple to 28,000 vehicles per day. Traffic on Transistmica and on Via Ricardo J. Alfaro, which is already presently quite heavy, will remain little changed in the future.

### 3) Preliminary Design

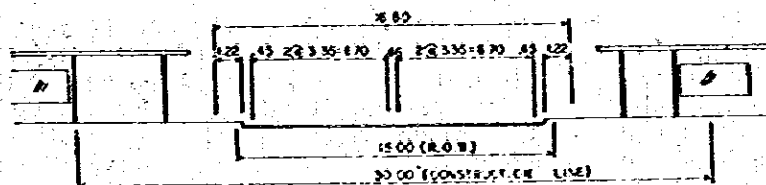
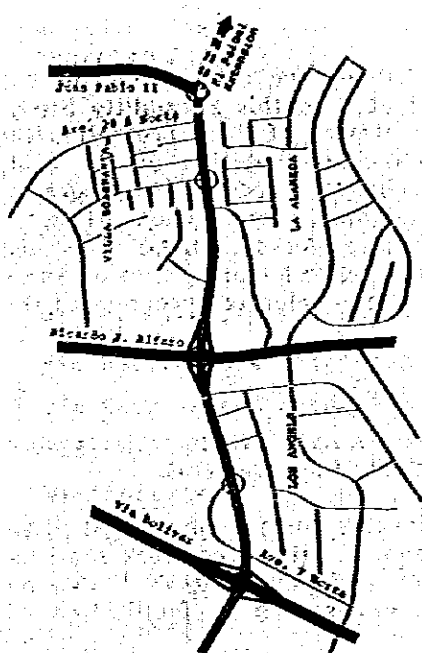
Since Via El Paical is required to disperse a large volume of traffic as the north-south arterial in Panama urban area in the future, its cross section is designated with high-grade specifications. Should the acquisition of additional right-of-way be difficult in view of the houses abutting the present Via El Paical, however, a cross section which will eliminate the need of land acquisition may be applied.

In as much as more widening of the street will be short of securing an adequate capacity to accommodate the future volume of traffic at Ricardo J. Alfaro Intersection, Via El Paical should underpass Via Ricardo J. Alfaro in view of the topography, the overall road network structure, and the handling of traffic during the grade separation work. At Via Bolivar Intersection, Via Bolivar shall overpass Via El Paical as it was explained already. Intersections with other local streets shall be redistributed at the intervals of 200 to 250 meters with signalization.

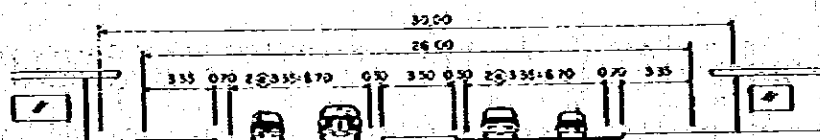
### 4) Construction Cost and Evaluation

Construction cost for the total extension of 1.3 kilometer is estimated at 13.9 million balboas, 20% of which will be foreign currency portion and 11.8%, land cost. The cost of underpassing Via El Paical at intersection with Via Ricardo J. Alfaro will represent 24% of this total. The urgency of this project is relatively low, because the effects of new roads will not be impaired so much by not improving this road. While the necessary land cost will be large in this section, the improvement will not result in a substantial expansion of the road capacity.





SHORT TERM CROSS SECTION OF VIA EL PAICAL



LONG TERM CROSS SECTION OF VIA EL PAICAL

ROAD NETWORK ALONG VIA EL PAICAL

GEOMETRIC ITEMS OF VIA EL PAICAL

|                     |      |
|---------------------|------|
| Road Length (km)    | 1.30 |
| Design Speed (km/h) | 50   |
| Number of Lane      | 4    |
| Lane Width (m)      | 3.35 |
| Shoulder Width (m)  | 0.70 |
| Median (m)          | 4.5  |
| Pedestrian (m)      | 3.35 |
| Right of Way (m)    | 26.0 |

FINANCIAL COST OF VIA EL PAICAL

| DESCRIPTION  | Unit: 1,000 Balboas in 1983 price |               |              |               |
|--------------|-----------------------------------|---------------|--------------|---------------|
|              | Foreign Portion                   | Local Portion | Land Cost    | Total         |
| Road         | 1,327                             | 5,613         | 1,656        | 8,596         |
| Bridges      | 1,312                             | 1,290         | -            | 2,602         |
| Engineering  | 763                               | 382           | -            | 1,145         |
| Contingency  | 510                               | 1,093         | -            | 1,603         |
| <b>TOTAL</b> | <b>3,912</b>                      | <b>8,378</b>  | <b>1,656</b> | <b>13,946</b> |

### 13. Road Project Implementation Plan

#### 1) Plan Condition

In accordance with the ESTAMPA Masterplan, the year 1990 shall be the target year for the opening of roads constructed and upgraded under the projects subjected to this Feasibility Study. Prior to the construction, the necessary preparation for the implementation of these projects after the feasibility study includes budget allocation for the domestic currency portion of the cost, obtaining loans for the foreign currency portion, formulation of foreign loan redemption programs, acquisition of privately owned land as necessary, detailed designing, formulation of work specification, and awarding of contract through bid. Because all these works shall be scheduled between 1985-1990, the section where no such difficulty as land acquisition or lot of amount of works is foreseeable shall be scheduled in the early stage, so as to achieve the accelerated progress of the work.

#### 2) Work Period

The work period of the projects is estimated as about three years and a half. Whole projects were classified to two projects packages (the new road construction and the road improvement).

The period of work of new road construction projects, which will involve much earthwork, shall be determined in consideration of weather conditions in and around Panama City. The work shall be started in dry season, and work plan assumes that rock excavation and pavement work can be achieved in all seasons. Structural work shall also be started in dry season in facilitation of excavation work.

Work plan assumes that the improvement of existing roads, which will be mainly pavement work without involving as much earthwork and, therefore, be little affected by weather, can be accomplished in any season, and that projects involving an underpass, which will require greater earthwork than projects involving an overpass, will require a longer period of work than the latter.

#### 3) Implementation Schedule and Investment Plan

The construction schedule is planned with due consideration of the above, and the sections in the previous Albrook Airfield are planned to be commenced in the late 1986. The other sections except for the improvement of San Miguelito Intersection are scheduled between late 1987 and early 1990. Assuming a single contract for all the projects, detailed designing is allocated to mid 1985 - mid 1986. Total construction cost of these projects will be 116 million balboas, and the yearly investment amount will be from 4 to 52 million balboas, which will be more than twice the past experiences and, therefore, introduction of the foreign loans will be inevitable. The yearly investment of the local portion will be from 2.6 million balboas to 18.7 million balboas.

| SECTION / YEAR            | 84 | 85          | 86 | 87    | 88    | 89    | 90    |
|---------------------------|----|-------------|----|-------|-------|-------|-------|
|                           | FS | E/S         |    |       |       |       |       |
|                           |    | Preparation |    |       |       |       |       |
| Corredor Norte            |    |             |    | ----- | ----- | ----- | ----- |
| Via San Miguelito Oeste   |    |             |    | ----- | ----- | ----- | ----- |
| Via El Paical Extension   |    |             |    |       | ----- | ----- | ----- |
| Via Martin Sosa Extension |    |             |    |       | ----- | ----- | ----- |
| Via Cerro Ancon Extension |    |             |    | ----- | ----- | ----- | ----- |
| Via Espana                |    |             |    |       | ----- | ----- | ----- |
| Via Bolivar               |    |             |    | ----- | ----- | ----- | ----- |
| Via Cerro Ancon           |    |             |    | ----- | ----- | ----- | ----- |
| Via El Paical             |    |             |    |       | ----- | ----- | ----- |
| San Miguelito IS          |    |             |    |       | ----- | ----- | ----- |

Legend      ——— Construction  
 ----- Land Acquisition

### IMPLEMENTATION SCHEDULE OF ROAD PROJECTS

#### INVESTMENT PLAN (FINANCIAL COST)

##### (1) New Road Construction Projects

| ROAD                      | 1985 | 1986  | 1987  | 1988   | 1989   | 1990  | TOTAL  | FOREIGN | LOCAL  |
|---------------------------|------|-------|-------|--------|--------|-------|--------|---------|--------|
| Corredor Norte            | 351  | 1,177 | 6,057 | 14,969 | 15,500 | 2,092 | 40,146 | 21,693  | 18,543 |
| Via El Paical Extension   | 22   | 65    | 0     | 125    | 1,495  | 623   | 2,329  | 1,436   | 893    |
| Via Martin Sosa Extension | 53   | 159   | 0     | 563    | 4,002  | 1,224 | 6,002  | 3,306   | 2,696  |
| Via Cerro Ancon Extension | 5    | 14    | 482   | 0      | 0      | 0     | 500    | 319     | 181    |
| Via San Miguelito Oeste   | 144  | 595   | 2,158 | 6,820  | 7,545  | 0     | 17,263 | 8,741   | 8,522  |
| Sub-Total                 | 575  | 2,010 | 8,697 | 22,477 | 28,542 | 3,939 | 66,240 | 35,495  | 30,745 |
| Price Contingency         | 35   | 186   | 1,092 | 3,580  | 5,539  | 905   | 11,337 | 6,075   | 5,262  |
| Total                     | 610  | 2,196 | 9,789 | 26,057 | 34,081 | 4,844 | 77,577 | 41,570  | 36,007 |

##### (2) Road Improvement Projects

| ROAD              | 1985  | 1986  | 1987   | 1988   | 1989   | 1990   | TOTAL   | FOREIGN | LOCAL  |
|-------------------|-------|-------|--------|--------|--------|--------|---------|---------|--------|
| Via Espana        | 0     | 464   | 567    | 5,093  | 5,840  | 2,150  | 14,114  | 6,749   | 7,365  |
| Via Bolivar       | 0     | 274   | 145    | 4,614  | 2,006  | 0      | 7,039   | 3,863   | 3,176  |
| Via Cerro Ancon   | 0     | 151   | 2,965  | 3,090  | 2,230  | 1,276  | 9,713   | 2,497   | 7,216  |
| Via El Paical     | 0     | 721   | 915    | 2,401  | 4,685  | 5,226  | 13,947  | 3,914   | 10,033 |
| San Miguelito IS  | 4,713 | 0     | 0      | 0      | 0      | 0      | 4,713   | 2,577   | 2,136  |
| Sub-Total         | 4,713 | 1,610 | 4,592  | 15,198 | 14,761 | 8,652  | 49,526  | 19,600  | 29,926 |
| Price Contingency | 287   | 150   | 576    | 2,421  | 2,864  | 1,989  | 8,287   | 3,280   | 5,007  |
| Total             | 5,000 | 1,760 | 5,168  | 17,619 | 17,625 | 10,641 | 57,813  | 22,880  | 34,933 |
| Grand Total       | 5,610 | 3,965 | 14,957 | 43,676 | 51,706 | 15,485 | 135,390 | 64,450  | 70,940 |

## 14. Bus Center - Objectives and Functions

### 1) Objectives

Bus transportation in Panama City has reached the stage of requiring the rerouting of buses and the optimum allocation of buses to each route. As one of strategic means of achieving these goals, the construction of bus centers has been planned. Bus centers will achieve the following practical goals:

- a. The safety, convenience, and amenity of waiting and transferring bus passengers
- b. The control of bus operation in order that buses be operated to suit the demand
- c. The realization of bus rerouting through the opening of new routes and the modification of existing routes at the opportunity of opening bus centers
- d. The ultimate modernization of bus business, the improvement of bus service quality, and the increase of bus passengers through the introduction of new types of bus service and bus operation control

### 2) Future Bus Demand

The number of those who utilize buses in Panama Metropolitan Area is predicted to increase from the 509,000 per day in 1980 to 847,000 per day in 1990 and, further, to 1,160,000 per day by the year 2000, or twice the present level. The number of buses, on the other hand, need not increase at the same rate as passengers. That is, demand in the year 2000 can be met with about 1,100 buses, or only 20% more than the present fleet of 910 buses, through (1) the introduction of large buses and (2) the improvement of bus operation ratio through the rationalization of routes and the enhancement of vehicle maintenance program.

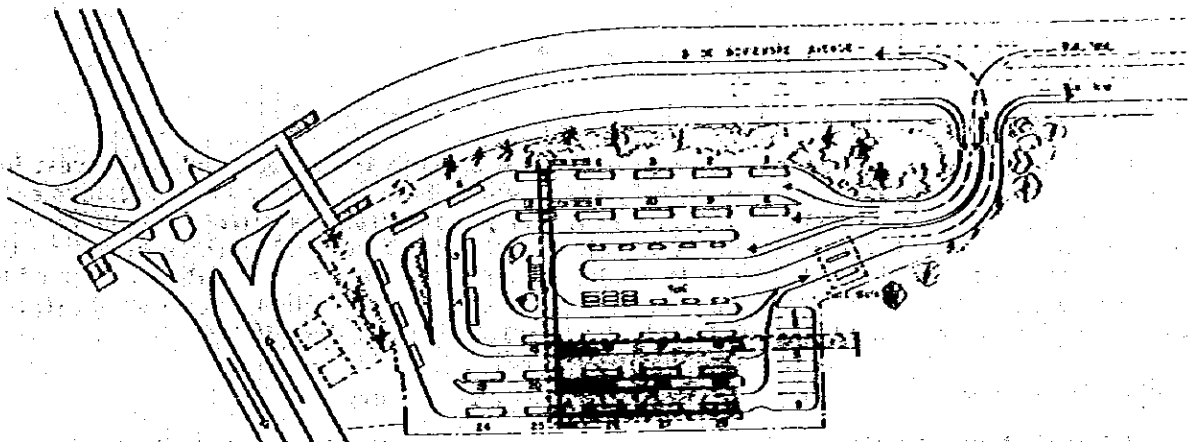
### 3) Bus Rerouting

Bus rerouting shall be accomplished in accordance with the following basic policies:

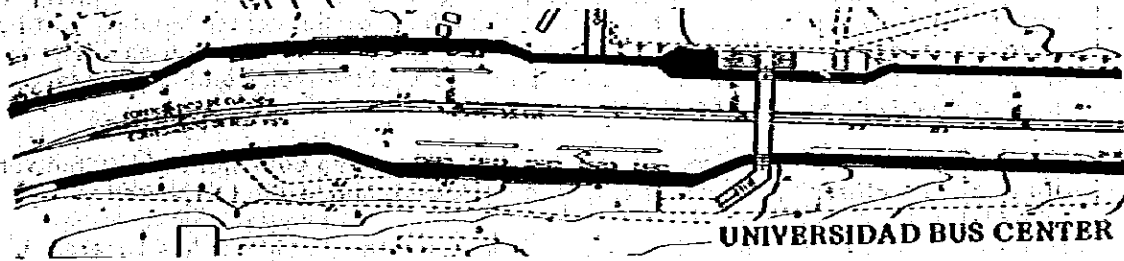
- a. Introduction of express bus from suburbs to Centro (on two routes: (1) Via Corredor Norte, and (2) Ave. Balboa)
- b. The termination of all existing bus routes at Cinco de Mayo Bus Center and the introduction of mini-buses on circular route in the old built-up area.
- c. The shortening of the long bus routes from Tocumen and Las Cumbres to the downtown.
- d. Establishment of a bus center circular bus route
- e. Establishment of new bus routes or the enhancement of existing routes in areas where bus service is sub-standard.
- f. Rerouting of SACA buses and rerouting of buses from cities west of the canal.

### 4) Bus Center Location and Facilities

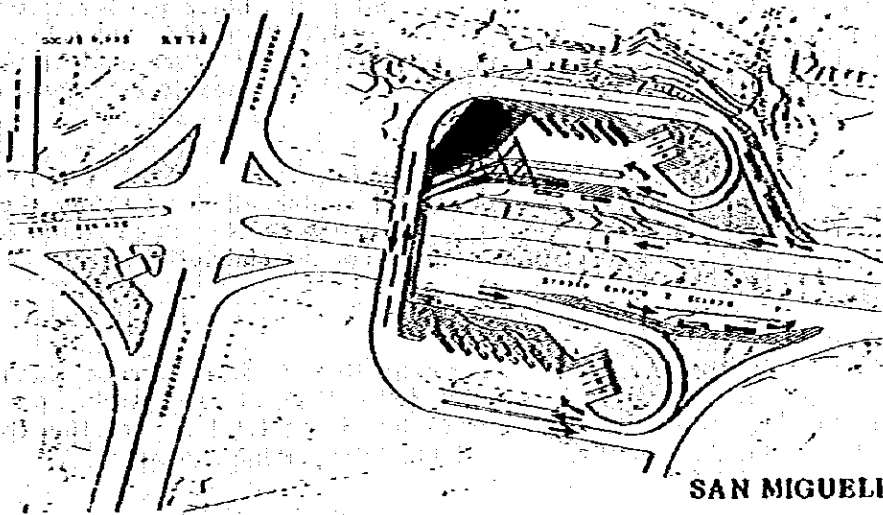
The site behind the MIVI building and along Via Cerro Ancon has been selected for Cinco de Mayo Bus Center, the site along Via Simon Bolivar has been selected for Universidad Center, and the site along Via Espana, about 250 meters from the Paseo Cinquentenario Intersection toward Centro, has been selected for Chanis Center. The west side of San Miguelito Intersection has been selected for San Miguelito Bus center. The required number of bus berths are 30 berths for Cinco de Mayo Center, 10 berths for Universidad Center, 17 berths for San Miguelito Center, and 15 berths for Chanis Center. Cinco de Mayo Bus Center will be the largest in terms of the number of passengers, and, as such, facilities for the administration of all the four centers will be located here. Universidad Center will be equipped as a large bus stop. The remaining two centers will be equipped with all the fundamental facilities of bus center.



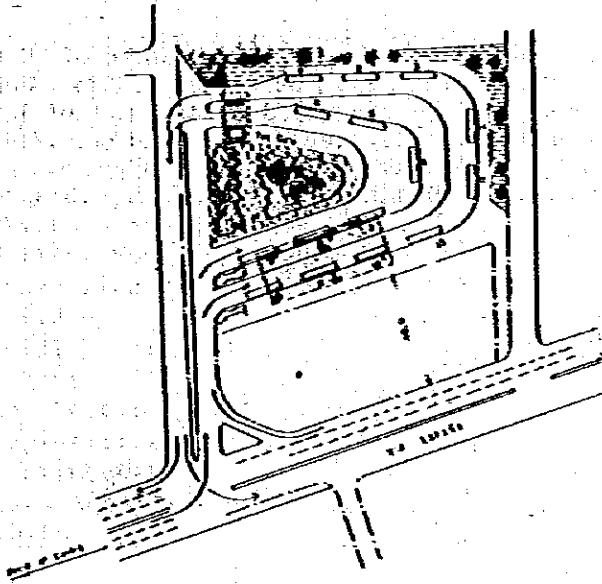
**CINCO DE MAYO BUS CENTER**



**UNIVERSIDAD BUS CENTER**



**SAN MIGUELITO BUS CENTER**



**CHANIS BUS CENTER**

## 15. Bus Center - Preliminary Design and Investment Schedule

### 1) Organization and Operation

The Bus Center business will realize some revenue, but, because the government will invest in it and because of the highly public nature of the business, it should be managed by an autonomous entity of management committee consisting of government and private representatives both in terms of management and finance. The same committee shall also direct the bus maintenance center so that the functions of the two will form an organic whole. Under a director and a deputy director of bus centers, with offices in Cinco de Mayo Center, shall be an operations division and an administration division, and under the operations division shall be four individual bus center offices.

### 2) Preliminary Design

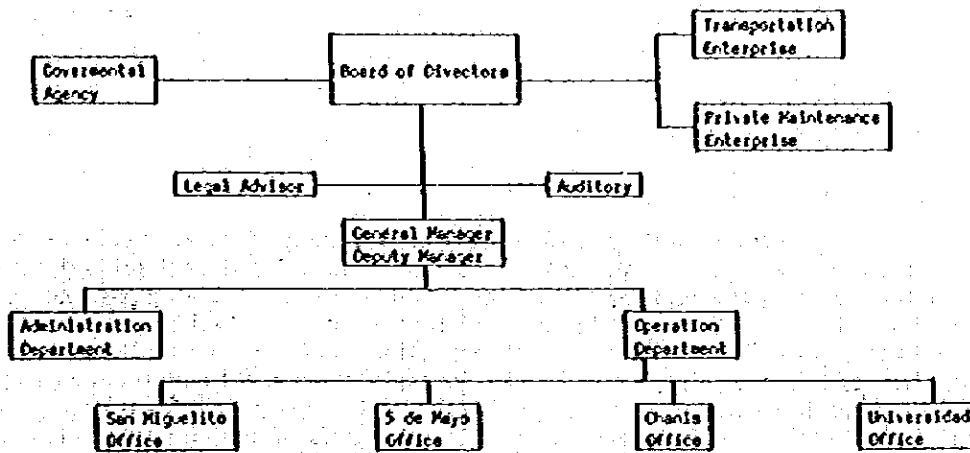
- a. Cinco de Mayo Bus Center shall have one gate on Via Cerro Ancon. The center should be designed in unity with and as a part of the entire Marañon Renewal Project. A pedestrian deck will accommodate most passengers walking to and from the bus center, thereby separating them from vehicle traffic. The ground floor of the center building will be made an atrium, with the center office and various service facilities gathered on the mezzanine. On the eastern part of the center premises will be a commercial building operated by the center for its major source of revenue.
- b. Universidad Bus Center shall consist of two large bus stops on both sides of Via Bolívar, each with five bus berths, as well as shelters, benches, kiosks, and public telephones.
- c. San Miguelito Bus Center shall consist of 13 bus berths on one side of Via Ricardo J. Alfaro and another 13 on the other side in order to serve all public buses passing through the intersection. The two parts shall be connected by a pedestrian bridge and a bus bridge, because the center is to support the turn-back operation of buses and transferring passengers. The center office shall be on the left side of Via Ricardo J. Alfaro, coming from the intersection.
- d. Chanis Bus Center shall have only one gate and a rather long approach to the gate, utilizing an existing road, so that buses entering and leaving the center will least hinder the heavy through traffic on Via Espana, so that the land needed for the center will be minimized, and so that the land space facing Via Espana will be used for commercial activities.

### 3) Construction Cost

The total investment amount for the four bus centers is estimated at 16.1 million balboas in 1983 prices, of which 50% is land cost. If the cost of government owned land, which constitutes a majority of both Cinco de Mayo and San Miguelito Center sites, is excluded, the total construction cost will come to 12.8 million balboas, of which 36.2% will be foreign currency portion.

### 4) Implementation Schedule

Cinco de Mayo Bus Center, whose establishment is the most urgently demanded of all the four, shall be tentatively established with minimal investment and shall be opened in 1985. Universidad Center, which will require a small investment, shall be completed by the end of 1985. The construction of other three centers shall start in October 1985, preceded by about one year for land acquisition and detailed designing. The construction work of each center will require a time of about 14 months, but the opening of San Miguelito Center, which will involve earthwork, will be three or four months later than the other two.



### ORGANIZATION OF BUS CENTER

| Bus Center           | 84 | 85     | 86    | 87    | 88 |
|----------------------|----|--------|-------|-------|----|
| <b>Cinco de Mayo</b> |    |        |       |       |    |
| Engineering Service  |    | -----* |       |       |    |
| Land Aquisition      |    |        | ===== |       |    |
| Construction         |    |        |       | ===== | 6  |
| <b>Universidad</b>   |    |        |       |       |    |
| Engineering Service  |    | =====  |       |       |    |
| Land Aquisition      |    | =====  |       |       |    |
| Construction         |    | 7      | 3     |       |    |
| <b>San Miguelito</b> |    |        |       |       |    |
| Engineering Service  |    |        | 10    | 9     |    |
| Land Aquisition      |    |        | 10    | 9     |    |
| Construction         |    |        |       | 10    | 6  |
| <b>Chanis</b>        |    |        |       |       |    |
| Engineering Service  |    |        | 10    | 9     |    |
| Land Aquisition      |    |        | 10    | 9     |    |
| Construction         |    |        |       | 10    |    |

\* ----- Provisional

### IMPLEMENTATION SCHEDULE OF BUS CENTER PROJECTS

#### CONSTRUCTION COST FOR BUS CENTERS

Unit: 1,000 Balboas in 1983 price

| Facilities               | Cinco de Mayo | Univer-sidad | San Miguelito | Chanis       | TOTAL         |
|--------------------------|---------------|--------------|---------------|--------------|---------------|
| 1. Road and Parking      | 308           | 292          | 189           | 159          | 948           |
| 2. Platform and Sidewalk | 63            | 39           | 41            | 43           | 186           |
| 3. Utility Work          | 185           | 4            | 123           | 77           | 389           |
| 4. Pedestrian Bridge     | 206           | -            | 9             | -            | 215           |
| 5. Building              | 821           | 54           | 1,016         | 485          | 2,376         |
| 6. Buiding Services      | 249           | 7            | 308           | 115          | 679           |
| 7. Others                | 341           | 22           | 166           | 173          | 702           |
| 8. Bus Center Bridge     | -             | -            | 769           | -            | 769           |
| 9. Engineering           | 261           | 50           | 315           | 126          | 752           |
| 10 Contingency           | 365           | 69           | 440           | 176          | 1,050         |
| 11 Land Acquisition      | 462           | -            | 2,408         | 1,872        | 4,742         |
| <b>TOTAL</b>             | <b>3,261</b>  | <b>537</b>   | <b>5,784</b>  | <b>3,226</b> | <b>12,807</b> |

## 16. Bus Maintenance Center - Basic Concept

### 1) Objectives and Function

The bus fleet existing in Panama City suffers from superannuation of 8.5 years in average, great diversity of 30 different models, and frequent breakdowns and a high accident ratio due to inadequate mechanical maintenance and the lack of bus owners recognition on the importance of periodical inspection and preventive maintenance. The bus maintenance center shall be established to perform the functions and the objectives of (a) mechanical inspection to change the maintenance system from the present practice of breakdown repair to preventive maintenance, (b) maintenance to provide high quality maintenance service with modern equipment, (c) parts supply, and (d) training and education to mechanics and inculcation on drivers and bus business operators of the standardization of buses and the rationalization of bus business.

### 2) Demand for Bus Maintenance

Presently, city buses are repaired twice a month on the average, spending an average total of 3.4 days in the shop per month. The demand for repair of city buses alone is estimated at 140 buses per day, based on the figures of 910 buses in a fleet and 22 work days in a month. On the other hand, in Panama City are about 50 repair shops each with three stalls on the average for a total capacity of 150 buses. Thus, the demand is currently satisfied, and a large scale maintenance center may oppress those small shops to cause a social friction. Therefore, the bus maintenance center shall have the capacity to serve only about 10% of total city buses estimated to exist in 1990, as a pilot business or the first step toward the modernization of bus industry.

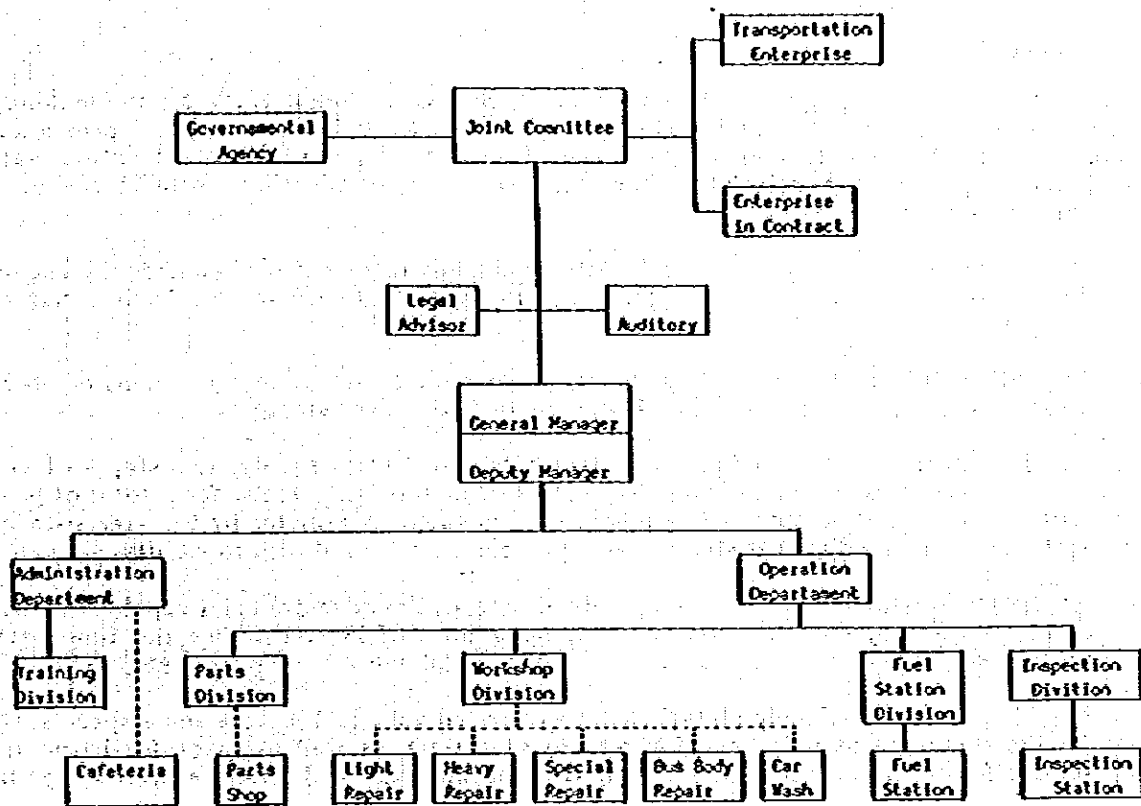
### 3) Organization and Operation

The bus maintenance center shall have five sections, four corresponding to said four functions, and a fuel supply section. Of the five, Inspection Section, Parts Section, Maintenance Section, and Fuel Supply Section shall be under Operation Division, and Training Section shall be under Administration Division. Both divisions shall be under the Center Director. A contract for leasing the facility will be appropriate with regard to the Parts Center and Repair Center, while a contract for entrusting the operation will be appropriate with regard to the Inspection Center and Fuel Supply Station. The establishment of a management committee consisting of government and private representatives will facilitate the collaboration of the two Divisions on bus maintenance center operation.

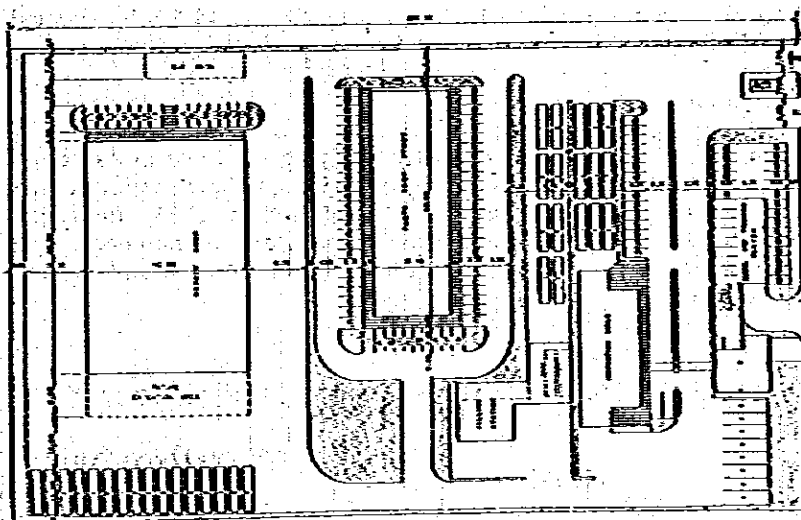
### 4) Location and Layout

The previous Albrook Airfield has been selected as the site of the bus maintenance center in view of the land use condition, accessibility, infrastructural development level, and its proximity to DNTT, the authorities having jurisdiction over bus business. The center has been designed assuming a rectangular land site of 200 meters by 125 meters. The administration building shall be placed in front, facing a road, and be backed by, from front to rear, the Inspection Center, Parts Center, and Repair Center in the descending order of the frequency of visitors. Traffic shall enter the center premises through only one gate and circulate on the premises in one-direction. The Training Center shall be located within the administration building. The vehicle washing stand for buses brought in for maintenance shall be located by the Repair Center. The design is subject to modification depending on the shape and access condition of the land actually acquired.





**ORGANIZATION OF BUS MAINTENANCE CENTER**



**BUS MAINTENANCE CENTER LAYOUT PLAN**

## 17. Bus Maintenance Center - Preliminary Design and Investment Schedule

### 1) Preliminary Design

Because of the flat topography of the land site, the only earthwork shall be for the building itself and for heavy equipment foundations and underground fuel tank. Buildings shall, as a principle, be of reinforced concrete in order to maximize the use of domestically available construction materials. The adopted compact design principle emphasizes economy, eliminating wasteful space. Major facilities of each sub-center shall be;

- a. **Administration Building:** Director's office, administration office, conference rooms, and lecture rooms where courses and lectures will be given to trainee mechanics, drivers, and owners.
- b. **Inspection Center:** One line of up-to-date large vehicle inspection equipment, number plate issuance office, vehicle inspection shop, reception room, and storages.
- c. **Parts Center:** Six stores of bus manufacturers' parts sales agents, two stores of common parts such as tires and batteries, and one store of maintenance tools, for a total of 10 stores, with an average floor space of 10 square meters each. A 5-meter by 5-meter span module system shall be used so that store partitioning can be achieved with flexibility.
- d. **Repair Center:** A minor repair shop with six stalls, heavy and special repair shop with six stalls, and a body shop with three stalls, for a total of 15 stalls. For the time being, no vehicle washing machine shall be installed at the adjoining vehicle wash stand.
- e. **Miscellaneous:** Fuel Supply Station shall be equipped with fuel meters and a space sufficient for the simultaneous refueling of two buses at a time, as well as space for lubrication oil service for one bus. Each center shall have a parking space and personnel welfare facilities.

### 2) Construction Cost

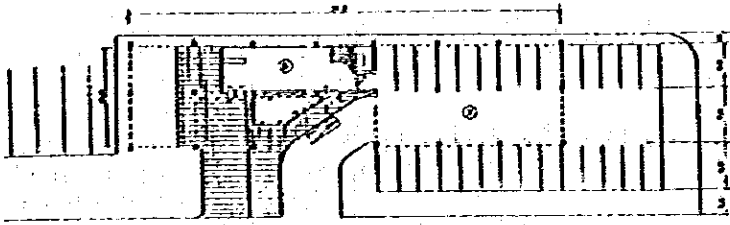
Total construction cost of the center is estimated at 5.25 million balboas in 1983 prices, including 3.20 million balboas as the cost of buildings and 2.06 million balboas as the cost of machines and equipment. Of said total, 57.5% will be by foreign currency and 42.5% by domestic. No land cost is included, because a publicly owned land will be used.

### 3) Implementation Schedule

Because the Government of Panama is currently studying land use in Albrook Area, it is essential that land site be acquired immediately after the completion of the Feasibility Study. Detailed design shall be completed and machines and equipment identified in 1985, fund generation and public relations activities started in 1986, and the construction work commenced upon the end of rainy season of that year. Construction period is estimated to be 18 months, and the target opening date of the center is to be early 1988.

#### INVESTMENT SCHEDULE OF BUS MAINTENANCE CENTER PROJECT

|                   | Unit; 1,000 Balboas in 1983 price |              |              |              |               |              |              |              |
|-------------------|-----------------------------------|--------------|--------------|--------------|---------------|--------------|--------------|--------------|
|                   | FINANCIAL COST                    |              |              |              | ECONOMIC COST |              |              |              |
|                   | 1985                              | 1986         | 1987         | TOTAL        | 1985          | 1986         | 1987         | TOTAL        |
| Civil Works       | 35                                | 735          | 163          | 933          | 32            | 684          | 153          | 869          |
| Building Works    | 117                               | 1,722        | 1,288        | 3,127        | 103           | 1,529        | 1,133        | 2,765        |
| Building Services | 15                                | 226          | 172          | 413          | 14            | 208          | 158          | 380          |
| Land Acquisition  | 0                                 | 0            | 0            | 0            | 248           | 0            | 0            | 248          |
| Equipment         | 0                                 | 0            | 2,112        | 2,112        | 0             | 0            | 2,112        | 2,112        |
| <b>Total</b>      | <b>167</b>                        | <b>2,683</b> | <b>3,735</b> | <b>6,585</b> | <b>397</b>    | <b>2,421</b> | <b>3,556</b> | <b>6,374</b> |



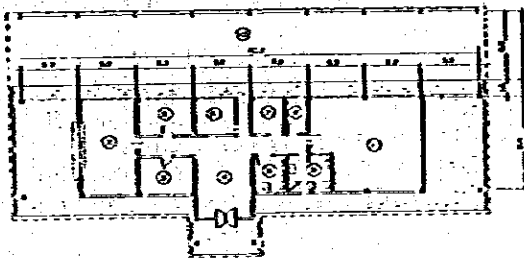
**ADMINISTRATION BUILDING**

GROUND FLOOR



- 1. Messing room
- 2. Reception office
- 3. Working room
- 4. Instruction room
- 5. Lecture room
- 6. Water closets
- 7. Parking
- 8. Plot

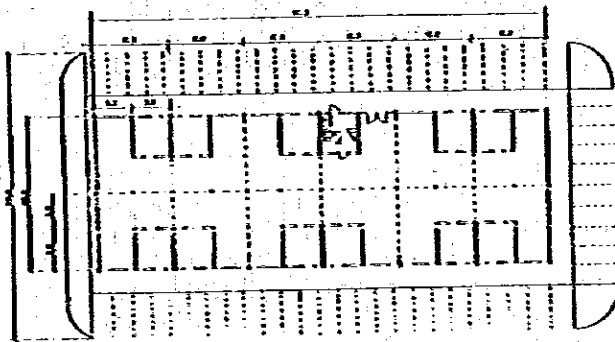
SECOND FLOOR



- 1. Injection room
- 2. Work's storage office
- 3. Messing room
- 4. Entrance hall
- 5. Bed room
- 6. Control room
- 7. Storage
- 8. Entrance
- 9. Water closets
- 10. Inspection line

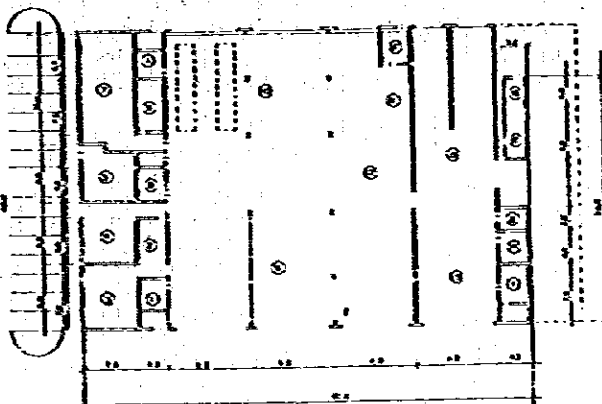
GROUND FLOOR

**INSPECTION CENTER**



GROUND FLOOR

**PARTS SHOP**



GROUND FLOOR

- 1. Reception and office
- 2. Shower room
- 3. Locker room
- 4. Injection pump repair shop
- 5. Electric parts repair shop
- 6. Light repair shop
- 7. Engine parts repair shop
- 8. Laundry
- 9. Tools and parts room
- 10. Heavy repair shop
- 11. Engine parts room
- 12. Parts washing area
- 13. Body repair shop
- 14. Tools and material storage
- 15. Air compressor room
- 16. Oil storage
- 17. Engine test room

**WORKSHOP**

### 13. Road Project Evaluation

#### 1) Vehicle Operating Cost and Travel Time Cost

Economic analysis of the road projects has been done by cost-benefit analysis wherein saving in vehicle operating cost and reduction in travel time, both resulting from the construction of new roads or the improvement of existing roads, are deemed beneficial. The Masterplan measured benefits to result from individual projects in the process of implementing all the projects by schedule, but this Feasibility Study has measured decrement or difference in travel cost between the case wherein the present road network is left alone until the year 2000 ("Do nothing" case) and the case wherein all the subject projects are implemented—as usually done in feasibility studies. As an exception, however, it is assumed that Autopista will be completed in 1995.

Vehicle operating cost can be classified into running cost, which is proportionate to the time length of travel. Unit values of these costs have been calculated based on available data for Panama. As a total of the running cost and fixed cost, vehicle operating cost per kilometer at the running speed of 30 kilometers per hour have been estimated at 12.3 cents for passenger cars, 15.4 cents for light trucks, 50.9 cents for trucks, and 59.4 cents for buses. Taxes included in cost elements have been deducted from these unit costs to arrive at the economic cost to be used for economic evaluation. Economic cost is 10 to 20% lower than financial cost.

Time cost saving has been used only for the following trip purposes: business, going to work, and going home from work. Estimated based on the average household income of car owning families of 983 balboas per month and that of non-car owning families of 372 balboas per month, both in 1983, unit time cost is 1.34 balboas per hour for passenger cars and 6.90 balboas per hour for buses. One-half of time value for business trips is used for trip purposes of going to work and going home.

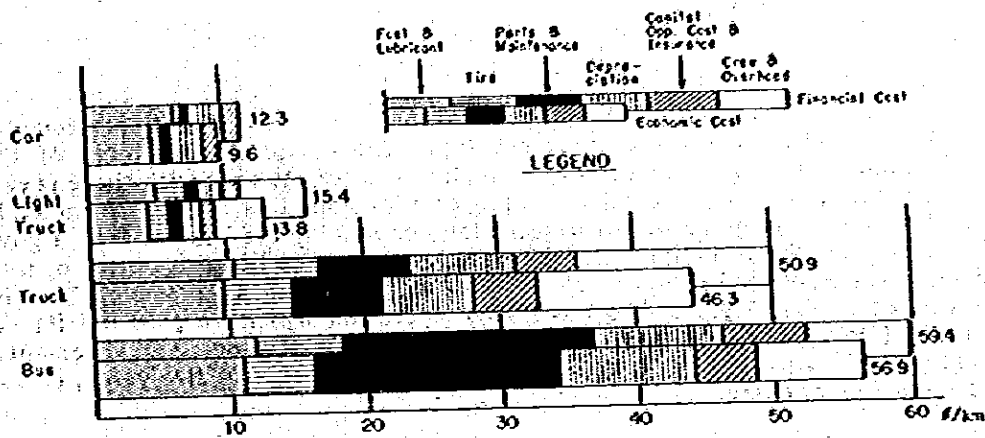
#### 2) Economic Cost of Road Project

For use in economic evaluation, the construction cost of road project has been converted from financial cost basis to economic cost basis by deducting taxes (import tariffs and transaction taxes) and 40% of the cost of unskilled laborers from the road construction cost, and adding thereto the opportunity cost of publicly owned land, which involves no land acquisition cost in the financial sense. The economic cost of all the road projects combined is 119.7 million balboas, which is slightly higher than the financial cost.

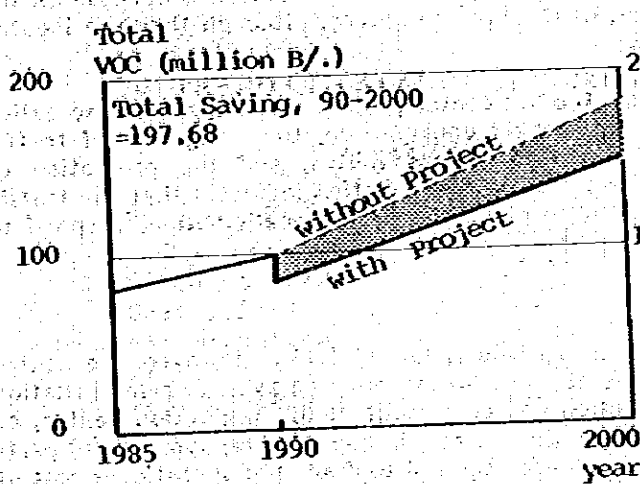
#### 3) Evaluation Results

The evaluation of all road projects subject to this Feasibility Study as one large project package resulted in the finding that its implementation is highly significant from an economic standpoint with very high internal rate of return (IRR) of 26.4% and net present value (NPV) of 72.5 million balboas. When this "package" is opened and separated into new road construction projects and existing road improvement projects, however, the former shows an IRR of 31.4% and the latter, only 10.7%, indicating the low economy of improvement projects. The message is that future traffic demand cannot be satisfied merely by the widening of Via Espana and Via Simon Bolivar.

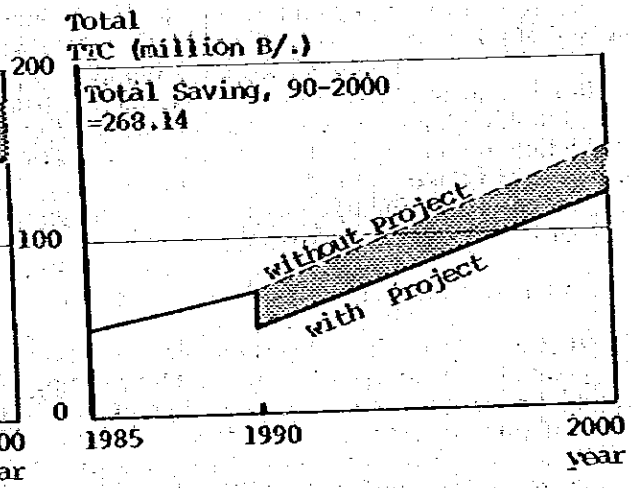
Of the possible negative impacts of road construction and improvement upon the ecology and environment, none is believed to be serious. Rather, very large positive effects are expected in the aspects of transport energy conservation, the creation of employment opportunities during the construction work, and, particularly, the stimulation of development in areas along newly constructed roads.



VEHICLE OPERATION COST IN PANAMA, 1983



SAVING OF VOC BY PROJECTS



SAVING OF TTC BY PROJECTS

SUMMARY TABLE OF ROAD PROJECT EVALUATION

| Case No. | Description                        | Cost (Million B./) |          | Average Congestion Ratio | IRR(%) | Evaluation        |     |
|----------|------------------------------------|--------------------|----------|--------------------------|--------|-------------------|-----|
|          |                                    | Financial          | Economic |                          |        | NPV (Million B./) | B/C |
| 100      | All Projects                       | 111.1              | 111.7    | 0.944                    | 26.4   | 72.5              | 2.2 |
| 101      | Demand -101                        | 111.1              | 111.7    | 0.845                    | 21.2   | 47.2              | 1.8 |
| 102      | Cost +102                          | 122.2              | 122.9    | 0.944                    | 24.3   | 75.7              | 2.0 |
| 200      | All New Road Projects              | 66.2               | 68.7     | 1.040                    | 34.1   | 87.3              | 3.2 |
| 300      | All Improvement Projects           | 44.8               | 43.0     | 1.031                    | 10.7   | -2.1              | 0.9 |
| 201      | East Half of New Roads             | 51.2               | 50.8     | 1.195                    | 34.3   | 61.3              | 3.3 |
| 202      | West Half of New roads             | 15.1               | 20.1     | 1.103                    | 16.2   | 5.0               | 1.5 |
| 203      | Exclude San Miguelito Oeste        | 60.2               | 52.3     | 1.058                    | 37.9   | 70.7              | 3.5 |
| 204      | Exclude Corredor Norte Los Andes   | 52.2               | 55.1     | 1.054                    | 39.0   | 83.4              | 3.8 |
| 205      | Exclude El Paical Ext.             | 63.9               | 66.5     | 1.043                    | 37.0   | 104.3             | 3.8 |
| 206      | Exclude Martin Sosa                | 60.2               | 61.9     | 1.111                    | 38.6   | 117.1             | 4.2 |
| 301      | Via Espana Only                    | 14.1               | 13.3     | 1.166                    | 33.6   | 8.9               | 2.3 |
| 302      | Exclude Via Espana                 | 30.7               | 29.7     | 1.050                    | 12.5   | 0.7               | 1.0 |
| 303      | Cerro Ancon Only                   | 9.7                | 9.5      | 1.107                    | 6.2    | -2.6              | 0.5 |
| 304      | Exclude Cerro Ancon                | 35.1               | 33.5     | 1.071                    | 8.7    | -4.1              | 0.8 |
| 305      | Via Espana and Cerro Ancon         | 23.8               | 22.8     | 1.097                    | 24.3   | 14.1              | 2.2 |
| 306      | Exclude Via Espana and Cerro Ancon | 21.0               | 20.2     | 1.078                    | 6.8    | -4.4              | 0.6 |
| 307      | Exclude El Paical                  | 30.9               | 29.4     | 1.036                    | 7.7    | -6.5              | 0.7 |

## 19. Bus Facility Project Evaluation

### 1) Bus Center Project

The sources of bus center revenues will be (a) bus center use charge (30 cents per round trip), (b) commercial facilities rentals, and (c) advertisement fees. The complete repayment of the initial investment including land cost and commercial loans including interests only with those revenues will be possible but not easy. The entity operating the bus centers should be relieved from at least the burden of land cost, either by free use of government land or making the cost of land a government investment. If this is done, the financial internal rate of return (FIRR) of bus center operation will be 10.6%, and the generation of fund to pay a 10% per annum interest will be possible. That is, should the loan redemption period be 15 years, the bus center operation will have paid off its debts and realize a profit in the 16th year of operation. If more favorable softer financing arrangement, such as loan at an interest rate of 6% per annum, is possible, debts can be paid off in five years, or bus center may be opened for use free of charge.

In the same way as stated regarding the economic evaluation of road projects, the financial statements of the bus center company are converted onto accounting price basis, and economic internal rate of return (EIRR) is calculated at 9.6%. This rather low rate of return is because all the bus centers are planning on low use charges in view of their public nature, although they are located on land of a high commercial value.

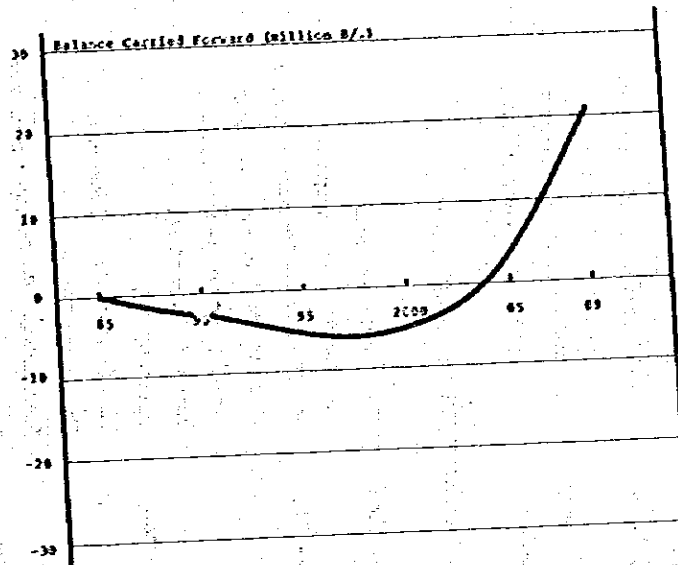
In addition to profits to the bus center company, the bus center project will bring about so-called spillover effects, such as the improvement of bus passenger convenience, the mitigation of traffic congestion on roads in the vicinity, the rationalization of bus routes, and the promotion of commercial activities in and around the center. For instance, a calculation indicates that the traffic congestion mitigation effect of Cinco de Mayo Bus Center on the nearby roads will correspond to 8.3% of its construction cost.

### 2) Bus Maintenance Center Project

FIRR calculated for the bus maintenance center as a whole is low at 4.4%. However, the center will switch to a profit position in the 11th year of operation (1998) assuming an average price inflation rate of 3% per year and if (a) the cost of construction and equipment of bus inspection center, or 12.6% of total investment, is made a public investment with no requirement for repayment, (b) parts center, bus repair center, and fuel supply center tenants are required to share the operational cost of the center administration, in addition to their payment of such center facility rentals (the amounts to be determined based on 15-year installment redemption with 7% interest per annum) and (c) a long term loan is obtained at the interest rate of 7% per annum.

The revenue will come to an EIRR of 6.8% as calculated under the same conditions as financial evaluation. The low EIRR is because the rentals and charges are not determined on profit seeking basis—the same reason as for bus centers.

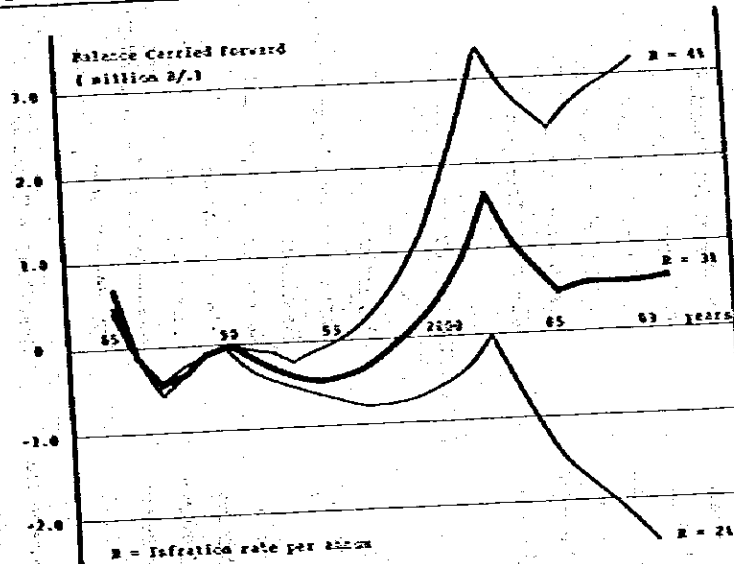
The social benefits expected from the bus maintenance center project are: (a) the elongation life of buses and a resultant bus purchase cost saving, (b) the improvement of bus operation rate and the reduction of number of buses needed, and (c) the reduction of on-the-road breakdown of buses and consequentially fewer traffic accidents and higher quality bus service.



TREND OF BALANCE CARRIED FORWARD OF BUS CENTERS

EVALUATION OF BUS CENTER

| Bus Center    | Financial |      |       | Economic |      |       |
|---------------|-----------|------|-------|----------|------|-------|
|               | IRR(%)    | B/C  | NPV   | IRR(%)   | B/C  | NPV   |
| Cinco De Mayo | 16.38     | 1.38 | 0.88  | 9.57     | 0.81 | -0.91 |
| Universidad   | 20.93     | 2.00 | 0.55  | 25.53    | 2.63 | 0.76  |
| San Miguelito | 6.04      | 0.54 | -2.12 | 6.78     | 0.59 | -1.97 |
| Chánis        | 8.47      | 0.70 | -0.81 | 10.04    | 0.83 | -0.44 |
| Four Centers  | 10.58     | 0.88 | -1.29 | 9.57     | 0.80 | -2.56 |



TREND OF BALANCE CARRIED FORWARD OF BUS MAINTENANCE CENTER

EVALUATION OF BUS MAINTENANCE CENTER

|           | IRR(%) | B/C  | NPV(Million B/.) |
|-----------|--------|------|------------------|
| Financial | 4.39   | 0.57 | -2.36            |
| Economic  | 6.87   | 0.64 | -1.98            |

## 19. Bus Facility Project Evaluation

### 1) Bus Center Project

The sources of bus center revenues will be (a) bus center use charge (30 cents per round trip), (b) commercial facilities rentals, and (c) advertisement fees. The complete repayment of the initial investment including land cost and commercial loans including interests only with those revenues will be possible but not easy. The entity operating the bus centers should be relieved from at least the burden of land cost, either by free use of government land or making the cost of land a government investment. If this is done, the financial internal rate of return (FIRR) of bus center operation will be 10.6%, and the generation of fund to pay a 10% per annum interest will be possible. That is, should the loan redemption period be 15 years, the bus center operation will have paid off its debts and realize a profit in the 16th year of operation. If more favorable softer financing arrangement, such as loan at an interest rate of 6% per annum, is possible, debts can be paid off in five years, or bus center may be opened for use free of charge.

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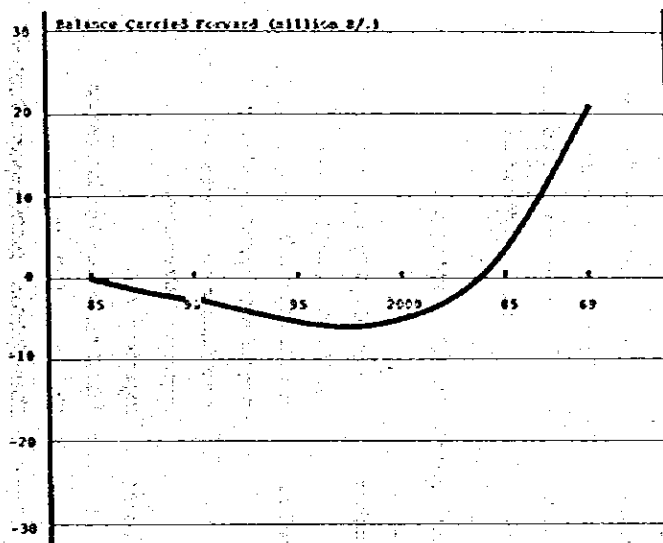
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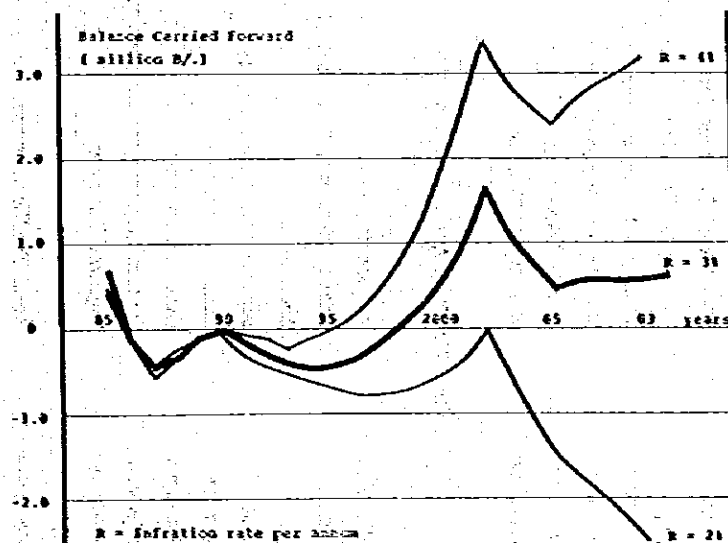




**TREND OF BALANCE CARRIED FORWARD OF BUS CENTERS**

**EVALUATION OF BUS CENTER**

| Bus Center    | Financial |      |       | Economic |      |       |
|---------------|-----------|------|-------|----------|------|-------|
|               | IRR(%)    | B/C  | NPV   | IRR(%)   | B/C  | NPV   |
| Cincó De Mayo | 16.38     | 1.38 | 0.88  | 9.57     | 0.81 | -0.91 |
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| Four Centers  | 10.58     | 0.88 | -1.29 | 9.57     | 0.80 | -2.56 |



**TREND OF BALANCE CARRIED FORWARD OF BUS MAINTENANCE CENTER**

**EVALUATION OF BUS MAINTENANCE CENTER**

|           | IRR(%) | B/C  | NPV(Million B/.) |
|-----------|--------|------|------------------|
| Financial | 4.39   | 0.57 | -2.36            |
| Economic  | 6.87   | 0.64 | -1.98            |

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 Planificador de Transporte Publico  
 Ingeniero de Transito y Vialidad  
 Planificador de Transporte Publico  
 Ingeniero Estructural  
 Ingeniero Vial  
 Planificadora de Facilidades de  
 Transporte Publico  
 Planificadora de Transporte Publico  
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