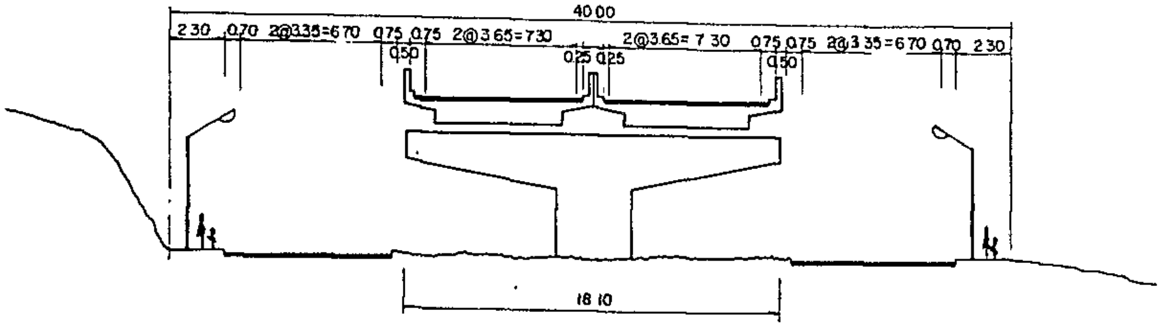
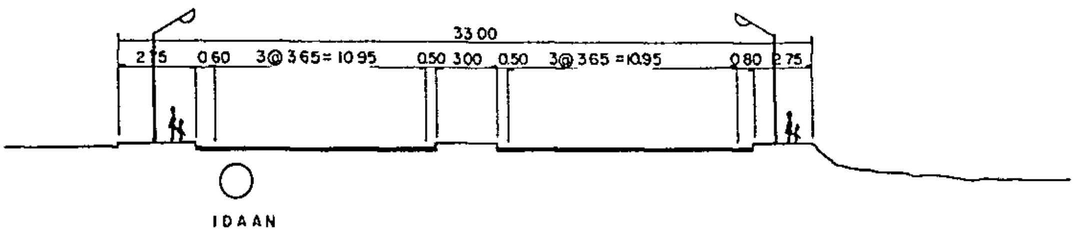


(a) FLYOVER ON VIA RICARDO J. ALFARO



(b) WIDENING OF TRANSISTMICA

Fig. III-3-44 IMPROVED CROSS SECTIONS AT SAN MIGUELITO INTERSECTION

3) Road Alignment

The straight horizontal alignment of Transistmica and a circular curve of 700m radius included in that of Via Ricardo J. Alfaro near the intersection pose no particular problem. As for vertical alignment, both Transistmica and Via Ricardo J. Alfaro slope down, the former with a gradient of 0.65% to 1.4% and the latter, 0.3% to 3.6%, but both are flat at the crossing part and pose no problem. If Transistmica is made an overpass, the lenght of grade separation will be 408m, and if Via Ricardo J. Alfaro is made an overpass, 419m.

4) Intersection Remodelling

The intersection saturation rates calculated for the case of grade separating Transistmica - Via Bolivar and the case of grade separating Via Ricardo J. Alfaro - Via Domingo Diaz (see Fig. III-3-45) indicate that the intersection capacity will be adequate in both cases until the year 2000. Because the turning traffic is heavy in both cases, the saturation rates are about the same. The exclusive lane with a radius of curvature of about 50m now existing at the intersection will be utilized as an exclusive right-turn lane. Signal phases for the grade-separated intersection in the two cases are shown in Fig. III-3-46.

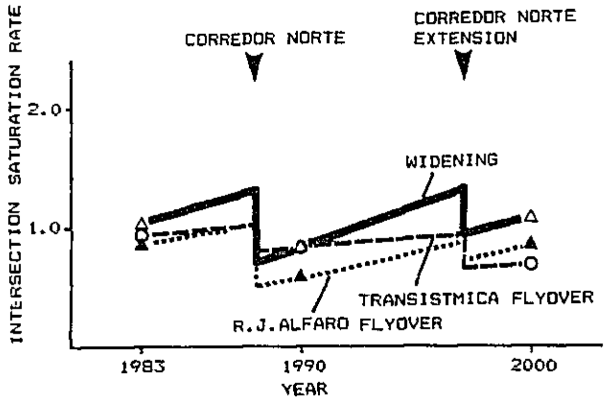


Fig. III-3-45 SATURATION RATE OF GRADED INTERSECTION

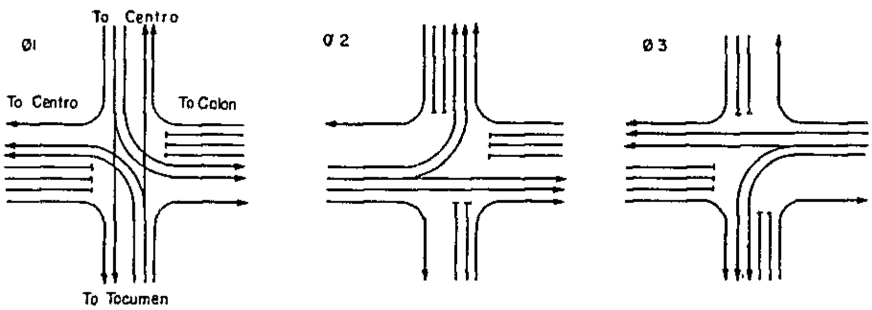


Fig. III-3-46 SIGNAL PHASING OF GRADED INTERSECTION

3.5.2 Structures

San Miguelito Intersection has a descent of a 3.0% gradient from Via Ricardo J. Alfaro toward Via Domingo Diaz and a declivity of a 2.5% gradient from Transistmica toward Via Bolivar. A tributary to Rio Abajo crosses Via Bolivar and Via Domingo Diaz at about 90m from the intersection. A water main pipe of 54-inch diameter is buried about 1.5m below the shoulder of Transistmica. As for soil, on Via Ricardo J. Alfaro side, a bearing layer of silty clay with qu = 200 tons/m2 is reached at the depth of about 1.0m, while on Via Domingo Diaz side, the surface soil of silt with an N-value of 10 to 30 down to about 4.5m is underlaid by a bearing layer of silty clay with qu = 200 - 300 tons/m2.

Grade separation of the intersection can only be made by an overpass in view of the presence of a bearing layer close to the ground surface and of the cost of relocating the water main pipe. In view of the traffic movement in the intersection, a bridge along Via Ricardo J. Alfaro (Alternativa A) with a maximum span of 40m can keep the clearance limit under the cantilever beam of the piers. However, the necessary under-the-girder clearance cannot be achieved under the bus center bridge, planned at 85m from the intersection on Via Ricardo J. Alfaro side. Therefore, the clearance limit under the girders of the superstructure must be secured by lowering the vertical alignment, applying continuous box girder as the superstructure, and the maximum span results 53m. A bridge along Transistmica (Alternative B) will have a maxium span of 35m, for which the suitable type will be PC simple composite girder.

A comparison of these two alternatives in Table III-3-11 indicates that difference in construction cost will be small (about US $3M). Alternative B, which will require little on-site work, will be better in facility of construction than Alternative A, which will have to be mostly done on site and will require timbering. Alternative A with varying girder heights will have a better appearance. Also, Alternativa A excels in the aspect of bus operation, as discussed in Chapter IV.1.2.4. All in all, Alternative A is believed more sensible than B. Work under Alternative A will be staged as illustrated in Fig. III-3-47.

TABLE III-3-11 COMPARATIVE EVALUATION OF FLYOVERS AT SAN MIGUELITO INTERSECTION

Item	Flyover on Transistmica	Flyover on Via R. J. Alfaro
1. Description	Flyover on Transistmica. 1 lane widening for R. J. Alfaro.	Flyover on R. J. Alfaro 1 lane widening for Transistmica.
2. Intersection Saturation Rate		
3. Land Requirement	within R.O.W.	within R.O.W.
4. Compensation	None	None
5. Bridge	P.C. Simple Composite Girder 5@36.65=178.30	P.C. Continuos Box Girder 30.0+53.0+30.0=113.0
6. Approach Gradient	7%	7%
7. Staging at Site	No need	Necessary
8. Detour During Construction	Easy	Fair
9. Appearance of Bridge	Fair	Excellent
10. Bus Operation	Exclusive signal phase for bus operation may be needed	Weaving on ramps only
11. Pedestrian	1-Deck on R.J.Alfaro 1-Deck with Bus Ramp 1-Deck on Transistmica	2-Decks on Transistmica 1-Crossing on Surface
12. Public Services	No conflict with IDAAN watermain	No conflict with IDAAN watermain
13. Cost	3 MB	3 MB

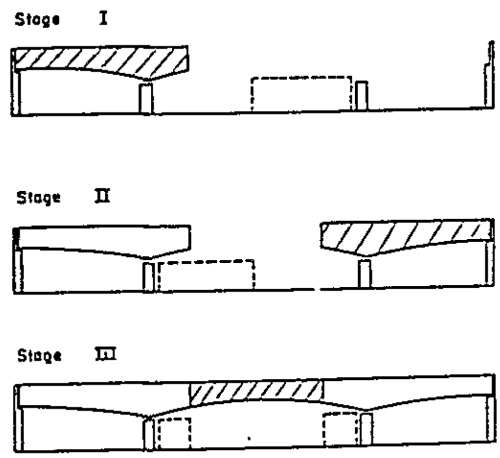


Fig. III-3-47 CONSTRUCTION STAGE AND DETOUR PLAN DURING CONSTRUCTION

4. Cost Estimation

4.1 Construction Cost

1) Preconditions to Estimation

(1) Contract Method

MOP has been executed construction projects by either force account, closed tender or open tender system. Closed tender is applied to projects costing less than 150,000 balboas, and to projects in excess of 150,000 balboas, the open tender is applied, according to the guideline. It has been generally small scale projects that MOP has executed directly, although no guideline existed to that effect.

Some subject projects--particularly the improvement of existing roads (but not intersection grade-separation)—may be separated into small pieces for direct execution by MOP. However, in view of the fact that a rather short time is available for work with the target completion year of 1990 and also because the subject projects are larger in scale than any that MOP has directly executed, it is assumed for the purpose of present cost estimation that all the subject projects be awarded as a single contract through international bids.

(2) Construction Method

Although the present MOP practice is that of using nearly manual work in local road improvement, heavy equipment method is applied generally in large construction work such as Autopista. Therefore, under said assumption of international tendering, cost estimation assumes a construction method utilizing the most efficient assortment of modern heavy equipment, except for dominantly manual work inevitable in road improvement work to be carried out in urban areas, where mechanized operation will meet various difficulties.

2) Estimation Method

(1) Estimation Process

Following the generally used estimation concept, each construction cost item (e.g. soil cutting, foundation work, pavement, etc.), consisting of materials, machinery, and labor costs components, is calculated as the product of unit price and quantity. These cost items are added up to total direct construction cost. Then, added to the direct cost is indirect cost, consisting of temporary facilities cost, field office maintenance cost, and overhead—each prorated to the individual direct cost items. The total of direct and indirect costs, thus obtained, gives unit contract price of each cost item. Now, added to the direct and indirect cost total are such compensation costs as for land, houses, and public facilities, allowance for contingencies, and engineering service cost in arriving at the total project cost (see Fig. III-4-1 for the flow of estimation steps).

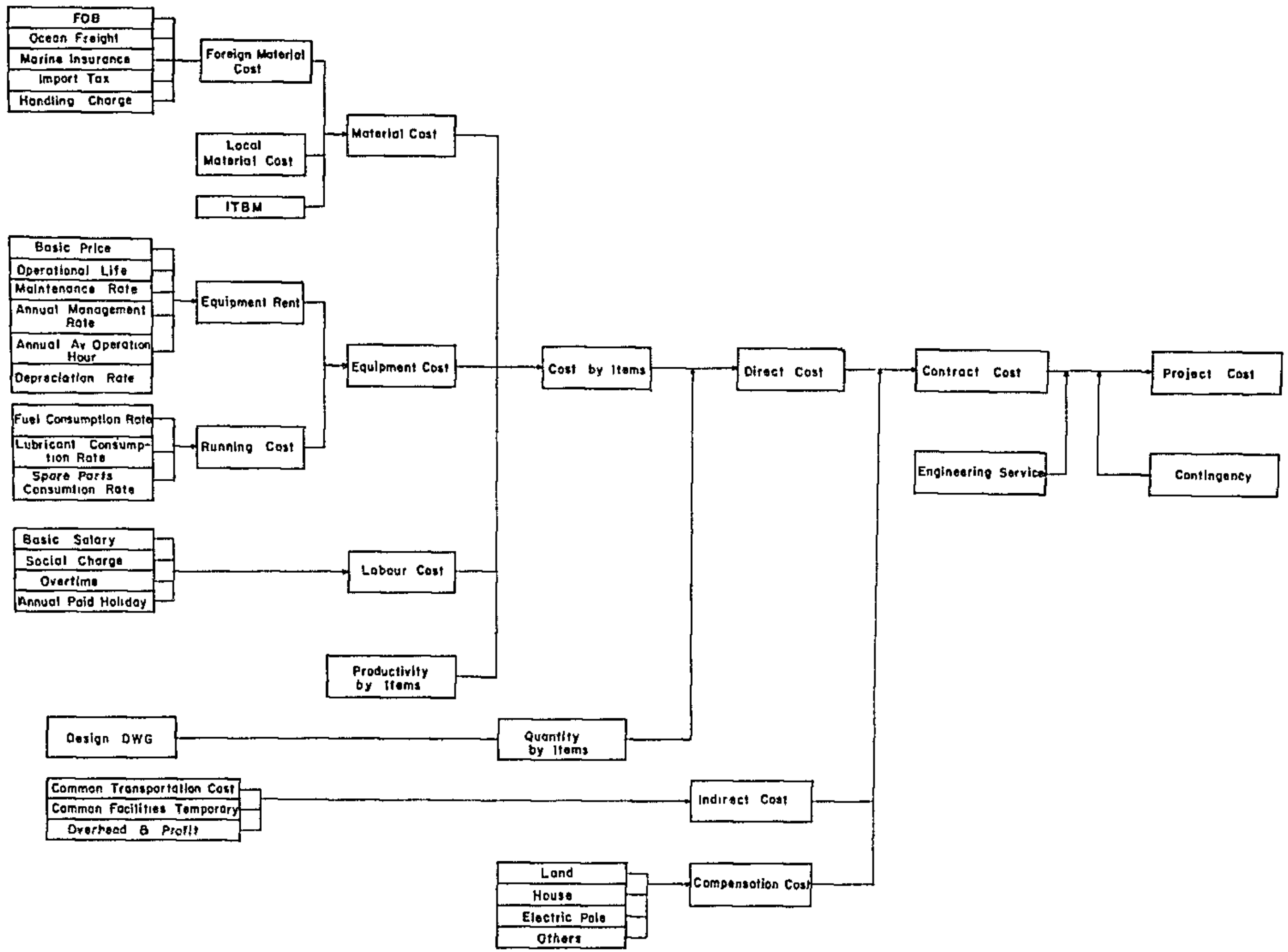


Fig. III-4-1 COST ESTIMATE PROCESS

(2) Labor Cost

Amounts paid to the government or to individuals as social charge account for as much as about 55% of the base wages paid to construction workers (see Table III-4-1). In the present estimation of labor cost, the 52% rate added for overtime, vacation, social insurance, and so forth, according to the "Maintenance Project (W.B.), 1980" is used. Average unit wages are estimated separately for specialized laborers (carpenters, scaffolding men, masons, reinforcement bar assemblers, etc.) as skilled labour and for unspecialized laborers as unskilled labour, using the date of the Construction Material Price List (Lista de Materiales de Construccion; CAPAC, October 1983) as a reference. Those who drive normal and dump trucks are classified as Drivers, and those who drives special equipment and plants, as Operators. The unit cost of construction labour including social charge is shown by classification in Table III-4-2.

TABLE III-4-1 SOCIAL CHARGE AND OVERHEAD

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

NOTE: 1/ Expressed as Thirteenth Month.
SOURCE: CAPAC

TABLE III-4-2 LABOUR COST

No.	Classification	Unit	Foreign (US $)	Local (B./)
1	Driver	Hr.	0.00	3.05
2	Foreman	Hr.	0.00	4.57
3	Operater	Hr.	0.00	4.27
4	Skilled Labour	Hr.	0.00	3.98
5	Unskilled Labour	Hr.	0.00	2.33

SOURCE: CAPAC AND ESTAMPA Estimate.

(3) Machinery Cost

Machinery cost is broken down into rentals and operation costs. For estimation of machinery rentals, a Base Price is used rather than FOB or CIF value. Equipment rental is calculated as follows:

Base Price x ((Depreciation Rate + Annual Maintenance Rate) / Operational Life + Annual Management Rate)/Standard Annual Operational Hour

This estimation method allows the use of same equipment for more than one project, and the rental is paid only for the hours the equipment is operated. Therefore, equipment may be brought into Panama without import tax, provided that the equipment is brought out upon work completion (or the tax is paid only when the equipment is sold in Panama). Cost for transporting the equipment may not be attributed to any particular unit price item for unit price contracting, and, therefore, is included in common temporary work cost as a part of indirect cost.

As the base price, prices in Japan, which are believed more reasonably applicable to international contractor's heavy equipment, are used, rather than prices in Panama which Panamanian dealers indicated as being 1.5 to two times higher than Japanese prices, due partly because of the distribution system chiefly catering to small domestic demand.

Various previous studies in Panama have indicated that generally longer operational lives are applied for construction equipment in Panama, under no MOP stipulation. For the present estimation, the operational lives provided for in the Construction Equipment Rental Calculation Table (the Japan Construction Mechanization Association) are used, because the estimation of machinery expenses using these lives have resulted in values comparable to the construction equipment lease rates prevailing in Panama (October 1983). The operational life, base price, annual maintenance rate, and standard annual operational hour are shown in Table III-4-3.

The cost of operation particularly of heavy construction equipment represents a fairly substantial portion of each cost item. While machinery operation cost is estimated by its work efficiency, which may vary from one country to another, such efficiency is believed to depend more importantly on the combined work capacity of the equipment. Therefore, ratio assuming the work capacity of the most representative combination of equipment is used in estimating machinery operation cost for each cost item.

(4) Materials Cost

The cost of imported materials is estimated by adding to FOB value the freight of US $4.40 per 100-lb container from Miami, U.S.A., to Panama and the insurance at the rate of 0.5% of FOB value to arrive at CIF value, then by applying to the FOB value the import tax rate per "Arancel de Importacion, January 1982", to arrive at the local price, and further applying sales tax (Impuesto de Transferencia de Bienes y Muebles: ITBM) except for fuels, which are exempt from sales tax, at the rate of 5% of the local price to finally arrive at the material cost.

Most domestically manufactured products are processed from imported raw materials (for instance, gasoline and diesel oil are refined from imported crude oil and reinforcement bars are fabricated from imported ingot), and few are made right from domestic raw materials. The prices of materials whose raw materials are available in Panama such as sand, aggregate, and cement represent no raw material cost but mostly the cost of operation of equipment or plant for their processing. Therefore, a certain part of these domestically available construction material prices is assumed to include foreign currency portion at the rates shown in Table III-4-4. Also, Construction Material Price List (CAPAC, October 1983) was referred to in determining their unit prices.

TABLE III-4-3 EQUIPMENT OPERATIONAL LIFE

NO	MACHINE NAME	BASIC PRICE (Balboas)	OPERATIONAL LIFE (Year)	MAINTENANCE RATE (%)	ANNUAL MANAGE RATE (%)	ANNUAL OPERATION HOUR (Hrs.)
1	Aggregate Spreader 2.3m3	28,000	6	50	7	700
2	Apron Feeder 30t	15,000	6	75	7	1,000
3	Asphalt Finisher 3m	74,000	6	80	7	750
4	Asphalt Plant 60t	410,000	6	85	7	1,000
5	Batching Plant 32m3	145,000	7	70	7	1,000
6	Belt Conveyer 0.35*10m	1,040	2	85	5	1,500
7	Belt conveyer 0.6*15m	7,000	2	85	5	1,500
8	Bulldozer 11t	59,000	5	105	7	1,300
9	Bulldozer 19t	134,000	6	105	7	1,100
10	Compressor 4.6m3	11,400	6	90	5	980
11	Compressor 9.6m3	19,000	6	90	5	980
12	Concrete Breaker 25kg	1,900	2	35	5	1,050
13	Concrete Bucket	300	5	30	5	1,050
14	Concrete Finisher 5.5m	109,000	6	55	7	600
15	Concrete Spreader 2.3m	68,000	6	55	7	600
16	Concrete Cutter 0.3m	1,500	3	45	5	700
17	Diesel Hammer 1.25t	24,500	6	85	7	1,200
18	Diesel Hammer 2.5t	36,800	6	85	7	1,200
19	Distributer 4Kl	15,000	6	60	7	600
20	Dump Truck 2t	62,000	4	70	10	1,150
21	Dump Truck 6t	19,000	4	80	10	1,500
22	Dump Truck 11t	34,000	4	80	10	1,700
23	Earth Oager 0.45m	23,600	6	85	7	1,200
24	Engine Pump 4in.	1,600	5	140	5	1,100
25	Grout Mixer	2,090	5	60	7	1,000
26	Grout Pump	1,400	5	140	5	1,000
27	Hand Hammer 1.1m3	670	2	35	5	1,050
28	Hydrouric Shovel 0.6m3	64,000	5	75	7	1,300
29	Line Marker 90kg	3,200	5	60	7	1,150
30	Macadam Roller 12t	32,000	7	80	7	900
31	Motor Grader 3.7m	61,000	6	80	7	1,000
32	PC Jack	10,500	5	60	5	980
33	Road Sweeper 1.8m	53,000	5	55	7	1,000
34	Soil Compacter 0.5t	1,200	5	100	5	800
35	Soil Compacter 1.6t	1,300	5	100	5	800
36	Soil Mixing Plant 100t	38,000	7	70	7	1,000
37	Spray Gun	1,200	5	60	7	900
38	Sprayer 0.3 kl	1,200	5	40	5	700
39	Surface Vibrater 1.5*0.3	1,200	3	65	5	840
40	Tandem Roller 10t	30,000	7	80	7	800
41	Tire Roller 15t	32,000	7	80	7	900
42	Truck 5t	15,000	4	80	7	1,500
43	Truck 8t	23,000	4	80	7	1,500
44	Truck Crane 5t	42,000	4	85	7	1,100
45	Truck Crane 7t	43,000	4	105	7	1,100
46	Truck Crane 11t	63,600	6	85	7	1,100
47	Truck Crane 16t	102,300	6	85	7	1,100
48	Truck Crane 70t	470,000	6	65	7	1,100
49	Truck Crane 90t	630,000	6	65	7	1,100
50	Truck Mixer 3m3	30,000	4	85	5	900
51	Vibration Hammer 30 kw	31,000	5	100	7	800
52	Vibration Roller 3.5t	15,500	6	75	7	900
53	Vibrater	680	3	35	5	840
54	Watering Cart 5.5 kl	26,000	5	75	7	1,200
55	Wheel Loader 1.4m3	54,000	6	105	7	1,100

TABLE III-4-4 FOREIGN CURRENCY PORTION IN RAW MATERIAL

DESCRIPTION	FOREIGN CURRENCY PORTION (%)	LOCAL CURRENCY PORTION (%)
Cement	60.0	40.0
Sand	60.0	40.0
Crushend Stone	60.0	40.0
Filler	60.0	40.0
Reinforcement	70.0	30.0
Wood	40.0	60.0
Concrete Products	60.0	40.0
Gasoline	51.6	48.4 1/
Diesel Oil	64.7	35.3 1/
Heavy Oil	64.2	35.8 1/
Electricity	----	100.0

1/ Including import tax. ITBM excempt.
SOURCE: TEAM ESTIMATE

(5) Compensation Costs

Information for estimating unit costs for land acquisition and compensation for demolished houses and relocated public facilities is available from two major sources: the tax assessment data of Ministerio de Hacienda, which is revised occasionally, and the market prices reported in a non-periodically published printing named Servicios Comerciales (SERCOM). The tax assessment is generally lower than the market price. For the present cost estimation, the market price is used.

Under the application of valorizacion system, private land acquired in many MOP-executed projects was uncompensated for. The estimation assumes that this system will not be applied, even though there is a possibility it will be applied to the subject projects.

TABLE III-4-5 COMPENSATION COST (UNIT: 1,000 Balboas)

	DESCRIPTION	UNIT	Foreign Portion	Local Portion
House	1. 1F House	SQM	0.0	100.0
	2. 2F House	SQM	0.0	700.0
Land	3. Bella Vista	SQM	0.0	162.0
	4. Alameda	SQM	0.0	90.0
	5. 5 de Mayo	SQM	0.0	2000.0
	6. Los Andes #2	SQM	0.0	30.0
	7. Chivo-Chivo	SQM	0.0	15.0
	8. Los Angeles	SQM	0.0	180.0
	9. Forest	SQM	0.0	5.0
	10. Martin Sosa	SQM	0.0	90.0
Others	11. High Tension Pole	PCS	30000.0	20000.0
	12. Electric Pole	PCS	600.0	400.0
	13. Transmission Line	PCS	90000.0	60000.0

SOURCE: SERCOM AND OTHERS

As for the Corredor Norte Project, no land cost is estimated for the Reverted Area, which is owned by the government. As for Via Cerro Ancon Project, its cost includes the acquisition of land still remaining under private ownership in Maranon Renewal Area, where MIVI has been buying land. See Table III-4-5 for the unit land costs by area.

Building compensation costs are estimated by the market price of SERCOM. Information obtained from IRHE and the past experiences of MOP are taken into consideration in estimating compensation for the removal and relocation of such public facilities as electric poles, high voltage power transmission towers, etc.

(6) Indirect Costs

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

Unlike direct construction cost, these indirect costs can vary substantially from one contractor to another, and a number of assumptions must be made for their estimation. Therefore, for the simplicity of the estimation, the ratio of indirect cost to direct cost in previously implemented projects is used. The foreign currency portion and the local currency portion of indirect costs are estimated at 18% and 14% of the direct costs, respectively, or 32% combined (see Table III-4-6).

TABLE III-4-6 INDIRECT COST COMPONENT

DESCRIPTION	FOREIGN Portion	LOCAL Portion	TOTAL
1. Common Temporary Facilities			
1-1 Transportation	1.06	0.12	1.18
1-2 Mobilization and Demobilization	0.38	1.07	1.45
1-3 Temporary Facilities	0.40	0.60	1.00
1-4 Enviroment Control	0.20	0.30	0.50
1-5 Safety Facilities	0.12	1.08	1.20
1-6 Public Services Charge	---	1.00	1.00
1-7 Quality Control	0.44	0.44	0.88
1-8 Field Office Maintenance	0.72	0.89	1.61
Subtotal	3.32	5.50	8.82
2. Field Management	3.40	9.22	12.62
3. General Management	11.40	--	11.40
TOTAL	18.12	14.72	32.84

Note: Unit; Percent to the direct cost
SOURCE: TEAM ESTIMATE.

(7) Engineering Service Cost

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

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

(8) Contingency

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

In view of the fact that the subject projects are to be implemented in urban areas where unexpected difficulties are highly possible, in reference to past project experiences, 15% of the total construction and engineering service costs is assumed.

The factor of price increase, as well as price contingency in excess thereof, are considered only for the projects subject to financial analysis and, therefore, not considered for road projects, as a rule, where the cost is estimated in October 1983 prices and disbursed each year.

3) Unit Sections

Projects under the Study consist of the construction of five new routes, improvement of four existing routes, and the improvement of an intersection. None needs to be implemented as one project in itself. Therefore, each of them is divided into a number of unit sections in the manner described below, for cost estimation purposes. They must not be confused with unit sections for actual construction work execution to be determined with due consideration to project priority, work volume, and other factors.

(1) Each unit section will be connected with other roads in such a way that it can be opened for service and produce benefit without waiting for the completion of other sections.

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

(3) Each bridge, whose construction cost represents so large a portion of total project cost, is treated as one independent unit section element by itself.

For new road construction, when no substitute road will be available, each unit section must be connected with an existing road link in order to produce benefit and, therefore, will necessarily become rather long. For the upgrading of existing road, when a substitute road will always be available, on the other hand, the project can be divided into unit sections more freely depending on the section characteristics and the roadside area peculiarities. For instance, the grade-separation of an intersection is usually made a unit section element by itself. The road projects, unit sections, and section elements are shown in Table III-4-7.

4) Cost Items

Cost items and item units for estimation purposes shall conform with those used by current MOP contract. However, some of those items are expressed in terms of quantity of materials used (e.g. liters of asphalt, cubic meters of aggregate), rather than in terms of finished work quantity. Because to do so can be inappropriate to the present stage of cost estimation, which suffices to assign investment priority order without determining detailed work conditions and specifications, cost items are grouped into those each of which can be expressed by a common unit price (in the case of pavement, for instance, by unit price per square meter).

For actual cost estimation, each cost item is conceived of in three stages: plant products, site products, and work items. The work items conform with cost items for unit price contracting. Plant products and site products are the items of the breakdown of each work item. Specifically, plant products are materials produced and delivered by a field plant, such as asphalt mixture. Asphalt mixture is placed, compacted and finished into a surface course, which is a site product. Work item is for example a pavement consisting of site products: an aggregate subbase course, a stabilized bituminous base course, and an asphalt surface course. The unit price of each work item, such as per square meter in the case of pavement, is multiplied by the quantity calculated through designing, in estimating each cost item. For existing road upgrading projects, which are to be accomplished in urban areas where the use of heavy construction equipment will possibly be restricted, the type of pavement chiefly accomplished by hand is added as a cost item.

Plant product items, site product items, and work items are listed in Table III-4-8. The estimation process in the example of asphalt pavement is illustrated in Table III-4-9.

5) Cost Estimation Result

(1) Total Cost

The cost, disregarding price escalation and price contingency of each route and each unit section, estimated in October 1983 prices, is shown in Table III-4-10. The total project cost comes to approximately 116 million balboas--66 million for new road construction and 50 million balboas for existing road upgrading.

The land cost of 13.6 million balboas represents a relatively large portion, or 18.3%, of total cost of road upgrading projects, while land cost is only 4.6 million balboas or 6.9% of new road projects and 13.6 million balboas or 11.7% of all projects.

(2) Cost per Kilometer

The upgrading of existing roads, excluding cost for San Miguelito Intersection improvement, is estimated at an average cost of 5.2 million balboas per kilometer of road extension. This is 1.6 times more expensive than the construction of new roads, estimated at an average cost of 3.26 million balboas per kilometer. The reason why road upgrading work is relatively expensive is because they involve intersection grade-separation work, even though the length of the road to be upgraded is relatively short. More importantly, however, it is because the required land acquisition and compensation costs are greater than in new road projects. For instance, in the case of Via El Paical Project, whose unit cost is the highest of all projects at 10.7 million balboas per kilometer, the cost of road widening itself is 2.13 million balboas per kilometer or only 19.9% of the total project cost, while the cost of grade-separation of the intersection with Via Ricardo J. Alfaro represents 24.0% of the total, land cost represents 11.9%, and compensation cost, as much as 44.2%. Also, in the case of Via Cerro Ancon Project, which runs through the choicest district of Panama Metropolitan Area, the land and compensation costs based on market prices come to an overwhelming 74.4% of total estimated project cost.

Of the new road construction projects, Via San Miguelito Oeste Project shows the highest unit cost of 4.31 million balboas per kilometer.

TABLE III-4-7 ROAD PROJECTS AND SECTIONS

Road and Section	Component	From	To
NEW ROAD PROJECT			
1. CORREDOR NORTE WEST			
1.1 Corredor Norte-1	Corredor Norte-1	Gaillard Road	Martin Sosa
1.2 Corredor Norte-2	a.Corredor Norte-2 b.Ascanio Villalaz Br.	Martin Sosa	Ascanio Villalaz
1.3 Corredor Norte-3	a.Corredor Norte-3 b.El Paical IS Br.	Ascanio Villalaz	El Paical Ext.
2. CORREDOR NORTE EAST			
2.1 Corredor Norte-4	a.Corredor Norte-4 b.Autopista Access Br. c.Rio Abajo Br.	El Paical Ext.	Autopista Access
2.2 Corredot Norte-5	Corredor Norte-5	Autopista Access	San Miguelito Oeste
3. CORREDOR NORTE LOS ANDES			
3.1 Corredor Norte-6	Corredor Norte-6	San Miguelito Oeste	Los Andes
3.2 Corredor Norte-7	Corredor Norte-7	Los Andes	Transistimica
4. SAN MIGUELITO OESTE			
4.1 San Miguelito Oeste-1	a.San Miguelito Oeste-1 b.San Miguelito Oeste IS Br.	Corredor Norte	Autopista
4.2 San Miguelito Oeste-2	a.San Miguelito Oeste-2 b.Quebrada Tesorera Br.	Autopista	Transistmica
5. EL PAICAL EXTENSION			
5.1 El Paical Ext.	El Paical Ext.	Juan Pablo II	Corredor Norte
6. MARTIN SOSA EXTENSION			
6.1 Martin Sosa Ext.	Martin Sosa Ext.	Via Bolivar	Corredor Norte
7. CERRO ANCON EXTENSION			
7.1 Cerro Ancon Ext.	Cerro Ancon Ext.	Gaillard Road	Corredor Norte
ROAD IMPROVEMENT			
8. VIA ESPANA			
8.1 Via Espana-1	Via Espana-1	Martin Sosa	Federico Boyd
8.2 Via Espana-2	Via Espana-2	Federico Boyd	E. de Pons
8.3 Via Espana-3	a.Via Espana-3 b.Via Brasil Br.	E. de Ponds	Via Porras
8.4 Via Espana-4	Via Espana-4	Via Porras	J. Zarak
9. VIA BOLIVAR			
9.1 Via Bolivar-1	Via Bolivar-1	Martin Sosa	Ent. of Paso Elevado
9.2 Via Bolivar-2	a.Via Bolivar-2	Ent. of Paso Elevado	Exit. of Paso Elevado
	b.Via Bolivar-3	Exit of Paso Elevado	El Paical
	c.Via Bolivar Br.		
10.VIA EL PAICAL			
10.1 El Paical-1	El Paical-1	Via Bolivar	R.J.Alfaro
10.2 El Paical-2	a.El Paical-2 b.El Paical Br.	R.J.Alfaro	La Alameda
	c.El Paical-3	La Alameda	Juan Pablo II
11.VIA CERRO ANCON			
11.1 Cerro Ancon-1	Cerro Ancon-1	Av. Balboa	Av. Frangipani
11.2 Corro Ancon-2	Cerro Ancon-2	Av. Frangipani	Gaillard Road
12.SAN MIGUELITO INTERSECTION			
12.1 San Miguelito Intersection	a.San Miguelito Intersection b.San Miguelito Intersection Br. c.Pedestrian Br.		

Of the unit section elements, Via San Miguelito Oeste-1 (from San Miguelito Interchange to Autopista Interchange) is the highest at 6.47 million balboas per kilometer, including the cost of San Miguelito Oeste Interchange, followed by Corredor Norte-7 (in Los Andes Area) at 5.71 million balboas per kilometer, including compensation for houses in Los Andes Area in the amount of 3.4 million balboas, or 66.2% of the total cost of 5.14 million balboas, and Corredor Norte-6 (from San Miguelito Oeste Interchange to Los Andes) at 4.85 million balboas per kilometer, including the cost of the greatest volume of soil cutting of all unit section, needed in the hilly area where the route will go through, as 38.8% of the total cost.

TABLE III-4-8 COST ESTIMATE ITEMS (Unit: Balboas)

(1) PLANT PRODUCT

NO	DESCRIPTION	UNIT	FOREIGN PORTION	LOCAL PORTION
P 1	Screened Aggregate	CUM	8.68	6.17
P 2	BT Aggregate	CUM	48.94	13.02
P 3	Asphalt Concrete	CUM	58.24	14.44
P 4	Concrete	CUM	33.63	22.45
P 5	Grounting	LM	0.36	1.27
P 6	PC Concrete	CUM	44.73	40.53
P 7	Street Lighting	SET	762.10	471.43

(2) SITE PRODUCT

NO	DESCRIPTION	UNIT	FOREIGN PORTION	LOCAL PORTION
S 1	Hand Excavation	CUM	1.67	5.21
S 2	Structure Evaluation	CUM	3.98	4.08
S 3	Hand Backfill	CUM	0.08	3.51
S 4	Equip. Backfill	CUM	0.88	0.92
S 5	Pave. Exp. Joint	SQM	0.28	0.05
S 6	Pave. Trans. Joint	SQM	1.05	0.21
S 7	Pave. Vert. Joint	SQM	0.26	0.11
S 8	Pave. Curing	SQM	0.99	0.48
S 9	Lean Concrete	CUM	28.29	59.01
S 10	Foundation Concrete	CUM	33.30	27.05
S 11	Concrete Pavement	CUM	60.65	31.27
S 12	Concretre Joint	LM	6.95	0.62
S 13	Wood Forming	SQM	4.67	29.34
S 14	Steel Forming	SQM	7.01	21.04
S 15	Agg. Subbase course	CUM	11.73	7.85
S 16	Reinforcing	TON	515.37	422.05
S 17	Staging	CUM	3.20	6.91
S 18	Support	CUM	16.45	4.04
S 19	Hand Agg. Subbase	CUM	10.45	15.54
S 20	Structure Concrete	CUM	41.91	37.69
S 21	Struting	TON	100.69	51.57
S 22	Piling	LM	45.10	30.52
S 23	Sheet Piling	TON	380.01	198.00
S 24	Erection 16t	TON	26.79	8.56
S 25	Erection 70t	TON	87.68	5.07
S 26	Erection 90t	TON	97.85	4.18
S 27	Prestressing	TON	3201.30	2980.78
S 28	Bridge Slab	CUM	167.46	302.53
S 29	Hand Railing	LM	56.78	80.57
S 30	Steps	SQM	83.24	75.91
S 31	Hands Asphalt Surf.	CUM	61.90	27.54
S 32	Hands BT Base Course	CUM	52.14	26.18
S 33	Seal Coating	SQM	0.37	0.10
S 34	Tack Coating	SQM	0.06	0.01
S 35	Prime Coating	SQM	0.22	0.04
S 36	Asphalt Surface	CUM	63.67	17.71
S 37	BT Base Course	CUM	53.65	15.55

(3) WORK ITEM

NO	DESCRIPTION	UNIT	FOREIGN PORTION	LOCAL PORTION
W 1	Clearing and Grubbing	SQM	0.68	0.19
W 2	Cutting (Common)	CUM	2.52	0.79
W 3	Cutting (Unsound Rock)	CUM	3.38	1.11
W 4	Cutting (Sound Rock)	CUM	8.19	5.66
W 5	Sodding	SQM	0.06	2.58
W 6	Seeding	SQM	0.40	0.80
W 7	Concrete Pavement 20cm	SQM	13.89	7.43
W 8	Concrete Pavement 25cm	SQM	17.51	9.39
W 9	Asphalt Pavement A-1	SQM	17.04	5.72
W 10	Asphalt Pavement A-2	SQM	17.39	10.65
W 11	Sidewalk Pavement	SQM	4.84	2.58
W 12	Concrete Curb	LM	2.32	7.13
W 13	Retaining Wall 3m	LM	191.90	212.86
W 14	Retaining Wall 5m	LM	317.91	347.30
W 15	Retaining Wall 7m	LM	504.09	537.11
W 16	Box Culvert 7m*4m	LM	2850.02	2977.62
W 17	Box Culvert 2m*2m	LM	621.78	638.51
W 18	Box Culvert (2+2)*2m	LM	1232.33	1264.06
W 19	Box Culvert (2.5+2.5)*2.5m	LM	1580.89	1657.59
W 20	Box Culvert (4.5+4.5)*3.5m	LM	3677.33	3523.89
W 21	Box Culvert (5+5)*3.5m	LM	4301.62	4044.31
W 22	Box Culvert (8+8)*5.5m	LM	5955.03	5431.15
W 23	Marking	KM	1748.83	888.39
W 24	Traffic Sign	KM	3388.72	3488.32
W 25	Traffic Signal	SET	7029.32	350.26
W 26	Lighting (30m Spacing)	KM	25885.40	16012.60
W 27	Lighting (35m Spacing)	KM	22231.90	13752.50
W 28	Guard Railing	LM	39.73	10.36
W 29	Overley	SQM	3.34	0.93
W 30	Pipe Culvert D1500mm	LM	232.40	184.64
W 31	Pipe Culvert D1350mm	LM	204.20	163.09
W 32	Pipe Culvert D1050mm	LM	123.39	99.94
W 33	Pipe Culvert D900mm	LM	94.26	76.76
W 34	Pipe Culvert D750mm	LM	75.75	61.98
W 35	Pipe Culvert D600mm	LM	54.29	45.59
W 36	Shoulder Pavemnt	SQM	10.18	4.56
W 37	Pipe Culvert 600mm C-Type	LM	39.01	34.13
W 39	U-Ditch 0.3m*0.3m	LM	10.66	45.42
W 40	V-Ditch 2m*1m	LM	8.76	13.38
W 41	Planting	PCS	0.14	3.09

TABLE III-4-9 EXAMPLE OF BITUMINOUS PAVEMENT COST ESTIMATE

(1) Asphalt Concrete PER 181 Cum (Unit: Balboas)

DESCRIPTION	UNIT	QUANTITY	UNIT PRICE		TOTAL	
			FOREIGN	LOCAL	FOREIGN	LOCAL
EQUIPMENT						
Asphalt Plant 60t	HR	7.00	218.28	55.66	1527.98	398.62
Bulldozer 11t	HR	8.40	23.32	3.28	195.89	27.51
Wheel Loader 1.4m3	HR	8.40	22.27	3.50	187.03	29.40
Miscellaneous	%	2.40			38.22	8.93
MATERIAL						
Screened Crusher	CUM	226.00	5.22	3.91	1178.75	884.06
Sand	CUM	52.00	4.51	3.38	234.51	175.88
Filler	CUM	12.00	5.02	3.76	60.24	45.18
Asphalt 60-100	Ton	27.80	250.00	25.63	6950.00	712.38
Miscellaneous	%	2.00			168.47	36.35
LABOUR						
Operater	HR	33.60	0.00	4.27	0.00	143.42
Unskilled Labour	HR	63.00	0.00	2.33	0.00	146.94
Miscellaneous	%	5.00			0.00	14.52
TOTAL					10541.10	2614.18
PER 1 CUM					58.24	14.44

(2) Bituminous Surface Course PER 181 CUM (Unit: Balboas)

DESCRIPTION	UNIT	QUANTITY	UNIT PRICE		TOTAL	
			FOREIGN	LOCAL	FOREIGN	LOCAL
EQUIPMENT						
As. Finisher 3m	HR	7.00	36.68	4.95	256.79	34.65
Mac. Roller 12t	HR	7.00	12.61	2.78	88.30	19.44
Tire Roller 15t	HR	7.00	12.59	2.76	88.11	19.34
Tandem Roller 10t	HR	7.00	13.33	4.84	93.33	33.85
Soil Compacter 1.6t	HR	7.00	1.31	0.58	9.17	4.06
Watering Cart 5.5kl	HR	12.30	10.10	0.75	124.28	9.23
Dump Truck 6t	HR	12.10	8.03	0.72	97.16	8.71
Miscellaneous	%	2.00			15.14	2.59
MATERIAL						
Asphalt Concrete	CUM	181.00	58.24	14.44	10541.10	2614.18
Miscellaneous	%	2.00			210.82	52.28
LABOUR						
Operater	HR	28.00	0.00	4.27	0.00	119.52
Driver	HR	24.40	0.00	3.05	0.00	74.39
Unskilled Labour	HR	65.10	0.00	2.33	0.00	151.84
Foreman	HR	11.80	0.00	4.57	0.00	53.97
Miscellaneous	%	2.00			0.00	7.99
TOTAL					11524.20	3206.05
PER 1 CUM					63.67	17.71

(3) Asphalt Pavement PER 1 SQM (Unit: Balboas)

DESCRIPTION	UNIT	QUANTITY	UNIT PRICE		TOTAL	
			FOREIGN	LOCAL	FOREIGN	LOCAL
EQUIPMENT						
Miscellaneous	%	0.00			0.00	0.00
MATERIAL						
Agg. Subbase course	CUM	0.20	11.73	7.85	2.35	1.57
BT Base Course	CUM	0.15	53.65	15.55	8.05	2.33
Asphalt Surface	CUM	0.10	63.67	17.71	6.37	1.77
Tack Coating	SQM	1.00	0.06	0.01	0.06	0.01
Prime Coating	SQM	1.00	0.22	0.04	0.22	0.04
Miscellaneous	%	0.00			0.00	0.00
LABOUR						
Miscellaneous	%	0.00			0.00	0.00
TOTAL					17.04	5.72
PER 1 SQM					17.04	5.72

TABLE III-4-10 SUMMARY OF FINANCIAL COST OF ROAD PROJECTS
(Unit: 1,000 Balboas)

ROAD	LENGTH (KM)	CONSTRUCTION FOREIGN	CONSTRUCTION LOCAL	LAND	TOTAL	PER KM	FOREIGN (%)	LOCAL (%)
I. NEW ROAD PROJECT								
1. CORREDOR NORTE WEST								
1.1 Corredor Norte-1	1.645	601	455	0	1056	642	56.9	43.1
1.2 Corredor Norte-2	1.625	3075	2141	0	5216	3210	59.0	41.0
1.3 Corredor Norte-3	1.195	1415	878	0	2293	1919	61.7	38.3
Subtotal	4.465	5091	3474	0	8565	1918	59.4	40.6
2. CORREDOR NORTE EAST								
2.1 Corredor Norte-4	4.065	8479	5671	0	14150	3481	59.9	40.1
2.2 Corredor Norte-5	0.935	2058	1314	23	3395	3631	60.6	39.4
Subtotal	5.000	10537	6985	23	17545	3509	60.1	39.9
3. CORREDOR NORTE LOS ANDES								
3.1 Corredor Norte-6	1.835	4923	3495	480	8898	4849	55.3	44.7
3.2 Corredor Norte-7	0.900	1142	2033	1964	5139	5710	22.2	77.8
Subtotal	2.735	6065	5528	2444	14037	5132	43.2	56.8
TOTAL	12.200	21693	15987	2467	40147	3291	54.0	46.0
4 SAN MIGUELITO OESTE								
4.1 San Miguelito Oeste-1	1.010	3417	2677	440	6534	6469	52.3	47.7
4.2 San Miguelito Oeste-2	2.991	5324	4058	1347	10729	3587	49.6	50.7
TOTAL	4.001	8741	6735	1787	17263	4315	50.6	49.4
5. EL PAICAL EXTENSION	1.650	1436	892	0	2328	1411	61.7	38.3
6. MARTIN SOSA EXTENSION	2.100	3306	2378	319	6003	2859	55.1	44.9
7. CERRO ANCON EXTENSION	0.359	319	182	0	501	1396	63.7	36.3
TOTAL OF NEW ROAD	20.310	35495	26174	4573	66242	3262	53.6	46.4
II ROAD IMPROVEMENT								
8. VIA ESPANA								
8.1 Via Espana-1	0.866	1470	1681	1655	4806	5550	30.6	69.4
8.2 Via Espana-2	0.910	1084	733	0	1817	1997	59.7	40.3
8.3 Via Espana-3	0.453	2868	2333	0	5201	11481	55.1	44.9
8.4 Via Espana-4	0.830	1327	963	0	2290	2759	57.9	42.1
TOTAL	3.059	6749	5710	1655	14114	4614	47.8	52.2
9. VIA BOLIVAR								
9.1 Via Bolivar-1	1.250	381	298	0	679	543	56.1	43.9
9.2 Via Bolivar-2	0.996	3481	2797	81	6359	6385	54.7	45.3
TOTAL	2.246	3862	3095	81	7038	3134	54.9	45.1
10. VIA EL PAICAL								
10.1 Via El Paical-1	0.640	1029	1396	788	3213	5020	32.0	68.0
10.2 Via El Paical-2	0.668	2884	6981	868	10733	16067	26.9	73.1
TOTAL	1.308	3913	8377	1656	13946	10662	28.1	71.9
11. VIA CERRO ANCON								
11.1 Via Cerro Ancon-1	1.080	1470	991	5660	8121	7519	18.1	81.9
11.2 Via Cerro Ancon-2	0.921	1027	565	0	1592	1729	64.5	35.5
TOTAL	2.001	2497	1556	5660	9713	4854	25.7	74.3
12. San Miguelito IS		2577	2136	0	4713		54.7	45.3
TOTAL OF IMPROVEMENT	8.614	19598	20874	9052	49524	5202	39.6	60.4
GRAND TOTAL	28.924	55093	47048	13625	115766	3839	47.6	52.4

On the other hand, the lowest unit cost of 0.64 million balboas per kilometer is estimated for Corredor Norte-1 (from its western end to Ave. Ascanio Villalaz), which will go through the previous Albrook Airfield, where overlay is the only work expected.

(3) Currency Portioning

The ratio of foreign currency portion to total project cost is estimated at 47.6% for all projects, 53.6% for new road projects, and 39.6% for improvement projects. The low foreign currency portion of improvement projects is explained by the nature of work which will require much hand work with only limited use of large equipment. The ratio of foreign currency portion to total construction cost excluding land cost is 53.9% for all projects, 57.6% for new road projects, and 48.4% for improvement projects.

(4) Cost of Frontage Roads

Although plans for future use of land along Corredor Norte and Via San Miguelito Oeste have not yet been finalized, if frontage roads are constructed in conformity with the policy given in III-2.1.4, the lengths and costs of such roads in each unit section will be as shown in Table III-4-11. The total extension will be about 16 kilometers and will cover about half of the unit sections of Corredor Norte and Via San Miguilito Oeste. The frontage road will run through nearly all the unit section containing the old Albrook Airfield runway (Corredor Norte-1) and in 80% (excludes sloping land) of the unit section which runs from the Via El Paical Interchange to Autopista Access (Corredor Norte-4).

The cost of constructing the frontage roads is estimated at about 300,000 balboas per kilometer on average — or a total of 4.88 million balboas, which is about 8.5% of the cost of Corredor Norte and Via San Miguelito Oeste construction and equivalent to 7.4% of the total cost of new road construction. For Corredor Norte alone, frontage roads will cause construction cost to increase by about 10%.

TABLE III-4-11 COST OF FRONTAGE ROAD

Roads and Sections	Length (Km)	Financial Cost (1,000B./) Foreign	Local	Total	% to Total Const. Cost
(1) CORREDUR NORTE					
1.1 Corredor Norte East					
Corredor Norte-1	3.02 (91.8)	510	374	884	83.7
-2	0.78 (24.0)	136	99	235	4.5
-3	0.51 (21.3)	91	67	158	6.9
Subtotal	4.31 (48.3)	737	540	1277	14.9
1.2 Corredor Norte West					
Corredor Norte-4	6.25 (76.9)	1093	801	1894	13.4
-5	0.60 (32.1)	107	78	185	5.4
Subtotal	6.85 (68.5)	1200	879	2079	11.8
1.3 Corredor Norte Los Andes					
Corredor Norte-6	2.44 (66.5)	441	323	764	8.6
-7	- (-)	-	-	-	-
Subtotal	2.44 (44.6)	441	323	764	5.4
Total	13.60 (55.7)	2378	1741	4119	10.3
(2) VIA SAN MIGUELITO OESTE					
Via San Miguelito-1	1.72 (85.1)	289	212	501	7.7
-2	0.90 (15.0)	152	111	263	2.5
Total	2.62 (32.7)	441	323	764	4.4
GRAND TOTAL	16.22 (50.1)	2819	2064	4883	8.5
% to All the New Roads	(39.9)				(7.4)

Note: ( ) shows the percent section length with frontage road to the total length

4.2 Maintenance Cost

1) Definition

Maintenance work is classified into routine maintenance work and periodic maintenance work. Routine maintenance work is required irrespective of traffic volume or road surface condition and includes such works as grass cutting and the cleaning of road side ditches and culverts. Periodic maintenance work is required depending on traffic volume and road surface condition and includes such works as overlay, patching, sealing, and other road surface repair, as well as the repair of bridge slabs.

For the present estimation, the following are not included in road maintenance cost:

a. Road patrol and inspection personnel wages and overhead. These costs shall be included in current expenses of the responsible agencies. Therefore, the maintenance cost shall be expressed in direct cost.

b. Minor existing road improvement such as the addition of shoulders and side ditches, which are usually included in road maintenance cost in Panama, but shall be treated as a part of the initial cost in this study.

c. Electric power charge for road lighting which shall be paid by municipal and other local governments.

2) Present Road Maintenance Condition

As of 1983, Panama Metropolitan Area roads are maintained by MOP. Namely, the maintenance of road markings, traffic countings, axle weight surveys, and the rehabilitation of roads and bridges are consucted by the Maintenance Division (Direccion de Mantenimiento Vial), and the repair and maintenance of road draining facilities, overlay, and small scale improvement work are conducted by the Metropolitan Road and Drainage Division (Direccion Metropolitana de Calles y Drenajes Pluviales). The Metropolitan Road and Drainage Division spent 1.9 million balboas on about 640 kilometers, for work including small scale improvement, during 1980. Large scale rehabilitation work, such as the widening of Via Porras, were under the jurisdiction of the Maintenance Division.

3) Maintenance Cost Estimation

The projects subject to this Feasibility Study will, when implemented and completed, affect the amount of government fund required for road maintenance from year to year.

The maintenance cost of the subject projects is estimated excluding the cost of minor improvement work although presently included by the government and assuming a higher maintenance level, such as more frequent renewal of road markings, than now actually executed. As defined in the above, the cost is estimated in terms of direct construction cost of each work item; routine maintenance cost, which is not affected by road standard and traffic volume, is given as a fixed amount, and periodic maintenance, which inherently varies depending on traffic volume and lane width, is proportional to the number of lanes. Work items, frequency and estimated cost are given in Table III-4-12.

TABLE III-4-12 MAINTENANCE COST ESTIMATE

DESCRIPTION	FREQUENCY	COST/YEAR	
		FOREIGN	LOCAL
1. Routine Maintenance			
1.1 Grass Cutting	1 time/year	15.0	4,088.0
1.2 Ditch and Drain Cleaning	1 tiem/year	-	48.9
1.3 Lamp Change	1 tiem/1000 days	537.3	157.3
1.4 Traffic sign Repair	1 time/10 years	313.1	371.4
Total		865.4	4,665.6
2. Periodic Maintenance			
2.1 Resurfacing	1 time/10 years	637.0	278.0
2.2 Pavement Marking	1 time/5 years	117.1	54.3
2.3 Expansion Joint Change	1 time/20 years	-	215.3
Total		754.1	547.6

Unit for Routine Maintenance ; Balboas per Km
Periodic Maintenance ; Balboas per Km per Lane

4.3 Implementation Plan

4.3.1 Planning Conditions

Of the roads comprising the transportation network to be completed by the mid-term target year of 1990 under ESTAMPA Masterplan, those principal arterial roads to be opened for service by 1990 are subject to this present Feasibility Study. If these important projects are to be desirably finished within a period of three to four years (by 1900), the total construction cost of an estimated 116 million balboas translates to an investment fund requirement of 20 to 85 million balboas each year. Introduction of some foreign funds will be inevitable.

Of the subject projects for a number of new road construction and a number of existing road improvement undertakings, a priority emphasis must be placed on the construction of the Albrook section of Corredor Norte, as a new road, in view of the fact that numerous other development projects are decided for early implementation in the previous Albrook Airfield, where a large expanse of immediately usable flat vacant land is available in a neighborhood of the urban area.

4.3.2. Process and Duration

In view of the estimated construction period of three to four years, the preparatory period available after the completion of this Feasibility Study will be approximately two years. The following must be completed within this preparatory period.

a. Formulation of a budget for the domestic currency portion of the investment fund and obtainment of the cabinet sanction on the budget

b. Procurement of foreign funds as necessary, and formulation of a program for repayment thereof with interest

c. Acquisition of privately owned land as necessary

d. Detailed designing and compilation of work specification

e. Tender processing and contract making on designing and construction work

4.3.3 Implementation Program

Against the target year of 1990, the net period actually available for the work of projects will be about three years after allowing time needed for fund generation, detailed designing, and other preparations. If the projects are divided into unit sections by principle arterial roads, the opening of the project roads for service will have to be 1998 or after.

1) New Road Construction

(1) Work Volume

Corredor Norte and Via San Miguelito Oeste, which will be constructed in hilly or mountainous areas, will involve a relatively large volume of earthwork. Particularly the area near the ending point of Corredor Norte will require crushing and removing a substantial quantity of andestic rock and basalt outcrops. Other routes are to be laid in flat land, requiring chiefly only pavement work. The work quantities required in individual unit sections are listed in Table III-4-13.

TABLE III-4-13 WORK QUANTITIES OF ROAD PROJECTS

NEW ROAD

Item	Unit	Corredor Norte West	Corredor Norte East	Corredor Norte Los Andes	San Miguelito Oeste	El Paical Extension	Martin Sosa Ext.	Cerro Ancon Ext.	Total
Road									
Cutting	CUM	199,352	483,601	244,908	244,893	74,476	101,439	9,100	1,357,769
Concrete Pavement (20cm)	SQM	—	—	—	—	21,038	21,440	—	42,478
Concrete Pavement (25cm)	SQM	40,977	85,323	40,369	69,926	—	—	—	236,595
Asphalt Pavement A-1	SQM	1,100	—	—	—	—	—	4,690	5,790
Asphalt Pavement A-2	SQM	—	—	—	—	—	—	—	—
Sidewalk Pavement	SQM	7,810	15,645	7,500	12,000	9,891	10,080	1,890	64,816
Shoulder Pavement	SQM	18,503	38,181	11,520	27,648	3,768	3,840	720	104,180
Retaining Wall	LM	128	130	—	70	—	—	—	328
Box Culvert	LM	—	233	52	351	13	116	—	726
Pipe Culvert	LM	221	1,100	235	621	155	34	—	2,366
Drainage	LM	11,770	13,073	9,930	9,334	1,570	4,030	1,050	50,757
Bridge									
Structure Concrete	CUM	726	3,351	—	2,407	—	602	—	7,086
Prestressed Concrete	CUM	324	162	—	1,151	—	358	—	1,995
Forming	SQM	2,822	9,884	—	11,748	—	2,242	—	26,696
Reinforcing Bar	TON	85	447	—	417	—	98	—	1,047
Prestressing Steel	TON	27	13	—	56	—	22	—	118
Excavation	CUM	2,923	3,391	—	3,606	—	581	—	590,920
Pile	LM	560	672	—	—	—	1,507	—	2,739

ROAD IMPROVEMENT

Item	Unit	Via Espana	Via Bolivar	Via Cerro Ancon	Via El Paical	San Miguelito Intersection	Total
Road							
Cutting	CUM	44,430	40,710	17,269	81,480	4,405	118,294
Concrete Pavement (20cm)	SQM	—	11,460	—	18,099	—	29,559
Concrete Pavement (25cm)	SQM	—	—	—	—	—	—
Asphalt Pavement A-1	SQM	—	—	46,800	—	—	46,800
Asphalt Pavement A-2	SQM	56,870	—	—	—	8,655	65,525
Sidewalk Pavement	SQM	—	10,109	14,360	7,951	3,352	35,772
Shoulder Pavement	SQM	14,748	—	—	—	—	14,748
Retaining Wall	LM	1,053	—	—	—	—	1,053
Box Culvert	LM	30	—	—	—	112	142
Pipe Culvert	LM	8,048	2,865	2,016	3,942	1,270	18,141
Drainage	LM		—	—	—	—	—
Bridge							
Structure Concrete	CUM	5,676	4,905	—	5,701	2,758	19,040
Prestressed Concrete	CUM	390	866	—	372	1,440	3,068
Forming	SQM	11,602	24,734	—	10,995	11,017	58,348
Reinforcing Bar	TON	380	420	—	395	312	1,507
Prestressing Steel	TON	25	65	—	23	72	185
Excavation	CUM	28,364	4,278	—	30,942	4,144	67,728
Pile	LM	—	—	—	—	—	—

(2) Work Program

In Panama, dry season is usually from January to April, and rainy season is from May to December, when it rains for about an hour almost everyday with hourly precipitation reaching 30 millimeters. Bridge foundation work and earthwork shall be programmed for accomplishment during the dry season, but in view of the total work volume and duration, at least two dry seasons (that is, two years) will be needed for the entire project accomplishment. For the period requiring land acquisition and the relocation of buildings, power transmission facilities, and so forth, time needed for the preparation for, and the accomplishment of, such work shall be included in the work program.

(3) Work Sequence

All the projects can be divided into four or five sections in consideration of the connection of a new road to an existing, the urgency of development of land where the road project is to be implemented, and traffic congestion on existing roads (see Fig. III-4-2). The road development must be accomplished quickly in the old Albrook Airfield, where the implementation of various other development projects are expected. Early opening of the section from Transistmica to Autopista is desirable for accommodating the traffic, but the completion must not be sooner than 1990 because of the quantity of work required. Then, as a realistic sequence of project implementation, the completion of Via Cerro Ancon Extension and Corredor Norte within the old Albrook Area by 1987 and the completion of other projects by the opening of the entire extension of Corredor Norte in 1990 have been scheduled.

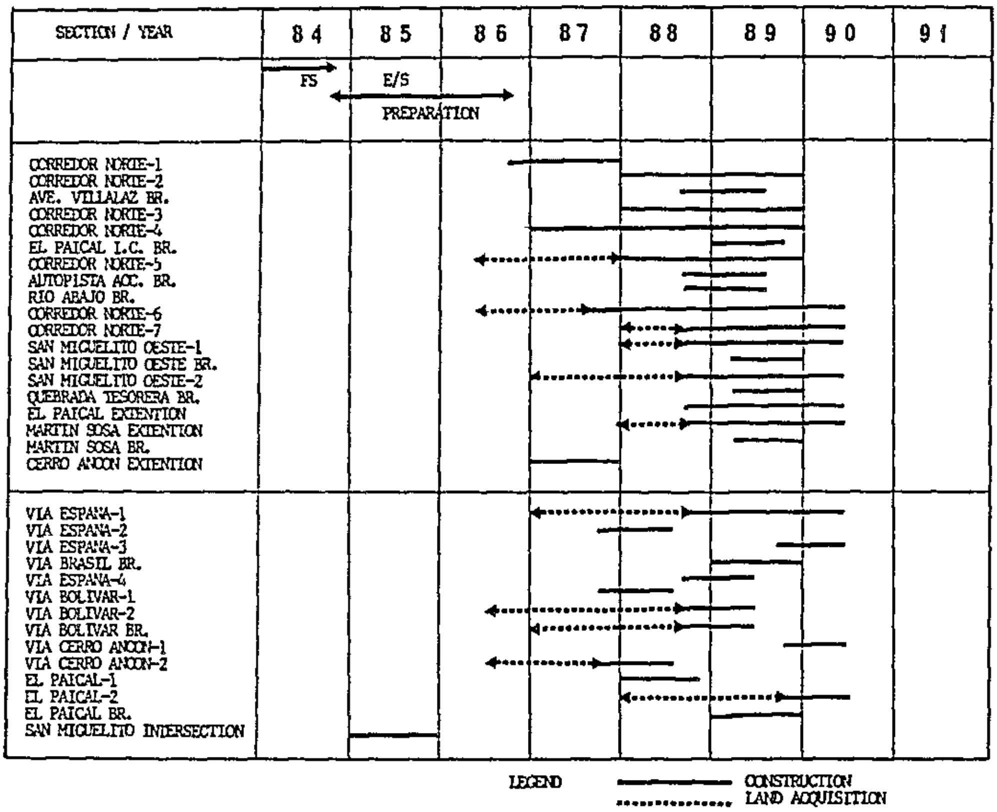


Fig. III-4-2 ROAD PROJECTS IMPLEMENTATION SCHEDULE

4) Work Section

If each road is treated as a single project, the amount of soil cutting would not balance with the amount of banking. For instance, most of the earthwork required for Via Martin Sosa Extension will be banking, while that for the San Miguelito Oeste - Transitmica section of Corredor Norte will be mostly cutting. With additional consideration of the importance of effective work program management in view of the limited time available, it is believed appropriate to treat all the projects as one or two projects (Via Cerro Ancon Extension and Corredor Norte as one project, and all others as another project).

2) Road Improvement

(1) Work Quantity

Work quantities are shown in Table III-4-13. Excepting bridge construction, the major work is paving, followed by miscellaneous work such as demolition accompanying road widening and curbstone laying. Upgrading of existing roads will have to be done without stopping the existing traffic, and, therefore, will necessarily have to be done by hand in a large portion.

(2) Work Program

In the case of improvement of existing roads, work program will vary from one project to another depending on the work condition. In view, however, of the fact that certain improvement work was once achieved in Panama with complete blocking of traffic, the work conditions appear relatively lenient in comparison with conditions in Japan. The construction of flyovers shall be planned assuming the possibility of substantially restricting traffic flow on the minor traffic road.

(3) Work Section and Sequence

Individual routes can be worked on separately, and each route, therefore, is deemed a project. Work sequence shall be determined in consideration of the amount of work in each section as separated by princiapal arterial roads, the degree of traffic congestion, land acquisition, and relationship to the road with which the section is to be linked.

Presently heavily travelled Via Bolivar is being widened to one side by the Panama Government, and shall be implemented at an early opportunity as a continuation of said government undertaking.

The solution of traffic congestion at San Miguelito Intersection is an urgent need of the government, and the completion of this project shall be scheduled for 1985.

Land acquisition will be needed for the entire extension of Via El Paical, a part of Via Espana, and Via Cerro Ancon. These projects shall be implemented in the latter half, allowing time for necessary preparations. The implementation of all other sections shall be scheduled for after the preparatory period and in consideration of total construction cost and the balance of work quantities.

4.3.4 Implementation Agency

In Panama, the construction of new roads and the improvement of existing roads are accomplished under the authority of the Ministry of Public Works (MOP). In the past, MOP established ad hoc project teams for the planning and implementation of such large scale projects as Autopista Project and Pan American Highway Project. Such ad hoc project teams should be formed for the implementation of the subject projects also, which are believed too large for the strength of any of the existing ordinary routine work sections of MOP.

TABLE III-4-14 ROAD PROJECS INVESTMENT PLAN
(FINANCIAL COST IN 1983 PRICES) Unit: 1,000 Balboas

(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

5 Road Project Evaluation

5.1 General Approach

5.1.1. Social Benefit of Road Project

Inasmuch as all the roads subject to this Study are ordinary urban arterial roads and not toll roads, the project evaluation in this Chapter shall center around the so-called economic assessment wherein the social cost of, and the benefits resulting from, the construction of new roads or the improvement of the existing roads will be compared. When a conclusion is arrived at through an economic evaluation in the narrow sense of the word, additional consideration shall be given to impacts upon environment, energy conservation effects, effects on urban development, and other results which can be expected from the implementation of the projects.

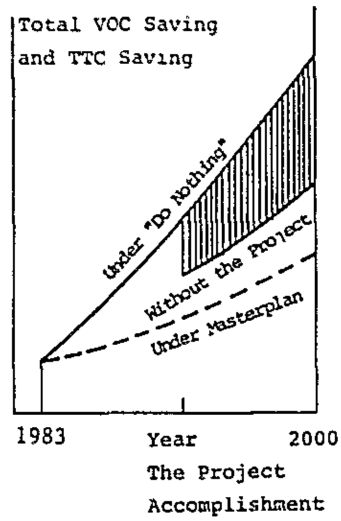
Prior to the economic evaluation, the project cost (financial cost) discussed in the preceding Sub-Chapter shall be converted into economic cost by eliminating the transfer cost, introducing the shadow wage rate, and modifying land cost in consideration of its opportunity cost.

Of the numerous social and economic benefits that can be expected to result from the completion of road projects, contrasted against said economic cost shall be vehicle operating cost saving and travel time saving, which are the most direct benefits. These benefits shall be quantified using the unit values calculated on economic cost basis.

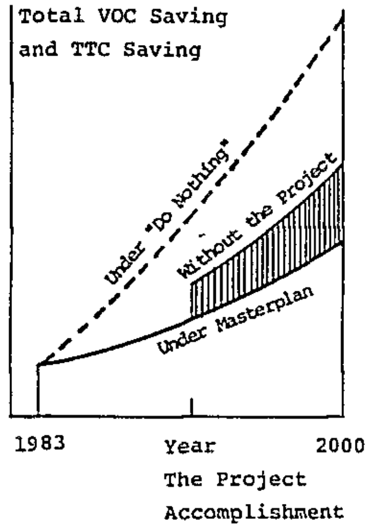
5.1.2 Evaluation Method

These benefits shall be conceived of as the differences arrived at by deducting the total vehicle operating cost and the total travel time cost if the subject projects are all implemented (with-project case) from the total vehicle operating cost and total travel time cost should none of the projects be implemented (without-project case) during the period of analysis, 1985 through the year 2000. This is the usual method of feasibility studies. However, ESTAMPA Masterplan used a different method: while benefit from all the projects as a whole was calculated in the same way as stated here, the benefits expected from individual projects were conceived of as the difference arrived at by deducting the total vehicle operating cost and the total travel time cost in "with-project" case from the total vehicle operating cost and the total travel time cost should a given project not be implemented (see Fig. III-5-1). Thus, it should be noted that the evaluation result here by will not be directly comparable with that of the Masterplan.

Project benefit varies depending on road network. The existing road network shall be the base of comparison here, but it is assumed, as an exception, that Autopista (Arraijan - Panama) will be completed by the middle of the 1990s even in "without-project" case in view of its vital significance on traffic assignment. At the time of the Masterplan Study (1981-1982), the Autopista Project was believed to be implemented without fail. Subsequently, however, the project was called off due to changes in economic situations of Panama and Venezuela, the country which was to offer a loan thereof.



(1) Feasibility Study



(2) Masterplan

Fig. III-5-1 DEFINITION OF ROAD PROJECT BENEFIT

The time the cost is incurred and the time the benefit is accrued do not coincide, and therefore, they must be converted into present values by the use of appropriate discount rates before they may be compared. Internal rate of return shall be used as the evaluation index, with additional consideration for net present value and cost/benefit ratio.

While the stream of benefits shall be cut off at the year 2000 for the purpose of discounted cash flow analysis, the residual value as of the year 2000 of the road, which will continue to exist as assets beyond the year 2000 shall be accounted for as a negative cost in the year 2000. In other words, of the total investment, depreciation only up to year 2000 shall be accounted for in the cost stream.

5.1.3 Vehicle Operating Cost

In the study of inter-urban road projects, vehicle operating cost is usually expressed as the function of road surface condition, road alignment, gradient, and vehicle speed. However, in the case of intra-urban roads, which are almost all paved and whose road surface conditions are generally comparable, vehicle operating cost is affected more importantly by such factors as traffic volume, intersection density, and traffic controls, rather than by the physical conditions of the road. It follows that the unit value of vehicle operating cost on urban roads must be expressed not only per unit of trip length but also per unit of travel time.

In the same method as used by the Masterplan, vehicle operating cost is estimated, using data for Panama City in 1983 prices, as the total of running cost (the cost proportionate to travel distance such as fuel, lubricants, tires, parts, repairing, and depreciation) and running time cost (the cost proportionate to travael time such as the opportunity cost of capital, crew wages, insurance, a part of depreciation and overhead costs).

For this analysis, vehicles are classified into passenger cars, light trucks, trucks, and buses. For the estimation of vehicle cost, fuel cost, and so forth, the following models, whose number of registration is relatively large in Panama City, have been selected to represent said four classification of vehicles:

Passenger Cars	......Toyota Corolla
Light trucks	......Toyota Dyna
Trucks	......Isuzu(10-ton)
Bus	......Ford B-700

The market value (financial cost) of each cost item is first obtained per each kilometer or per each hour, whichever the case may be, and converted to economic cost by deducting the tax (import tax and sales tax or ITBM) which is included in the market price and by applying the shadow wage.

1) General Characteristics of Vehicles

The kind of fuels used by various vehicle types, their actual and estimated costs, annual operating time, annual operating distance, and operation lives are listed in Table III-5-1. All but passenger cars use diesel oil (some light trucks and buses which use gasoline are disregarded). Large American cars, which account for an estimated 10 or 15% of all cars in Panama City, costing 1.5 to 1.8 times higher than the above representative model, and using much gasoline are also disregarded. These simplification will result in understatement of vehicle operating cost and, therefore, in conservative economic evaluation.

TABLE III-5-1 VEHICLE CHARACTERISTICS AND COST IN PANAMA, 1983

Vehicles Characteristics	Car	Light Truck	Truck	Bus
1. Make/Model	Toyota Corolla	Toyota Dyna	Isuzu	Ford B-700
2. Fuel Type	Gasoline	Diesel	Diesel	Diesel
3. Financial Cost (B/.)	6,050	7,455	36,000	54,000
4. Economic Cost (B/.)	4,930	6,210	32,500	54,000
5. Annual Operating Hour (hrs)	1,200	1,500	1,500	2,250
6. Annual Operating Distance (km)	15,000	30,000	30,000	40,500
7. Average Vehicle Life (year)	10	12	12	15

SOURCE: ESTAMPA

In view of its public nature, bus industry is protected in Panama through the exemption of import tax on buses and the supply of fuel at a lower price than for other types of vehicles.

2) Fuel and Lubricant Cost

At the end of 1983, the price of gasoline in Panama was 2.28 balboas per gallon, and that of diesel oil, 1.33 balboas per gallon. Crude oil is imported and processed at a refinery in Colon for domestic consumption. In the absence of definite data on tax levy, the tax is estimated at about 26% of the market price of gasoline and about 8% of such price of diesel oil, judging from the crude oil import tax rate and information from distributors. The market price of lubricant is 2.50 balboas per gallon, or 1.40 balboas per gallon in economic cost after deducting tax.

The fuel consumption rate of vehicles for use in city is estimated at values lower than the standard values (Table III-5-2), based on the information from vehicle users. Lubrication is assumed at every 5,000 kilometers for all vehicle types.

TABLE III-5-2 FUEL AND LUBRICANT COST

(a) Price B/. per Gallon)

	Financial	Economic
Gasoline	2.28	1.68
Diesel	1.33	1.23
Lubricant	2.50	1.40

(b) Consumption Rate

	Car	Light Truck	Truck	Bus
Gasoline (km/gallon)	35.0	----	----	----
Diesel (km/gallon)	----	27.70	12.88	11.87
Lubricant (gallon/5000km)	0.75	1.5	6.5	9.0

SOURCE: ESTAMPA

3) Tire Cost

Passenger cars have four wheels, while all others types of vehicles have six wheels. The market price of tires includes 20% import tax and 5% distribution tax. The useful life of tires are 15,000 Kms for passenger cars, 16,000 Kms for light trucks, and 17,000 Kms for trucks and buses (see Table III-5-3).

TABLE III-5-3 TIRE COST

	Car	Light Truck	Truck	Bus
Number of Tire	4	6	6	6
Financial Cost/Tire (B/.)	30.40	52.50	181.65	181.65
Economic Cost/Tire (B/.)	24.32	42.00	145.32	145.32
Tire Life (1000 km)	15	16	17	17

SOURCE: ESTAMPA

4) Parts and Mechanics Costs

The cost of parts other than tires is estimated by applying the price of new vehicle by a fixed rate, as determined taking into consideration the data in Manila, Philippines, and data surveyed by the World Bank in Panama. Automobile mechanics cost is calculated by multiplying the mechanics wages by the annual net maintenance time of each vehicle type. In view that vehicle repair work is carried out partly by unskilled laborers, the economic cost is estimated at 95% of such financial cost (Table III-5-4).

TABLE III-5-4 SPARE PARTS AND MAINTENANCE LABOUR COST

DESCRIPTION	Car	Light Truck	Truck	Bus
Spare parts requirement*	0.091	0.088	0.122	0.318
Maintenance Labour required per annum (hr)	30	50	250	320
Unit Labour Cost				
Financial (B/./hour)	2.00	2.00	3.00	2.50
Economic (B/./hour)	1.90	1.90	2.85	2.37

SOURCE: ESTAMPA

Note. * ; % of new vehicle cost minus tire cost.

5) Depreciation Expense

To be depreciated is the cost of the vehicle excluding tires. The residual values are estimated at 5% for passenger cars and light trucks and 10% for trucks. In the case of buses, whose engines are often replaced, the operation life of the engine is considered six years (without residual value) and that of the chassis, 10 years (with 10% residual value) (see Table III-5-5).

TABLE III-5-5 DEPRICIATION EXPENSE

DESCRIPTION	Car	Light Truck	Truck	Bus
Vehicle life (years)	10	12	12	6 for Engine 10 for Body & Chassis
Residual Value Ratio (%)	5	5	10	10
Distance to Time Proportion	50:50	70:30	70:30	85:15

Depreciation expense is divided into running cost and running time cost. This division is usually done based on the result of analysis of used car market value decision mechanism, but because such adequate data cannot be obtained in Panama City, data from Manila City is used. As a result, ratio between running cost share and the running time cost share of depreciation expense is considered fifty-fifty for passenger cars, seventy-thirty for light trucks and trucks, and eighty five-fifteen for buses. The running time cost share is considered to be large in the case of passenger cars, whose value depreciates by time much more than by operating distance.

6) Opportunity Cost of Capital

This cost is considered to be 10% of the assessed value of the vehicle as arrived at by deducting the cumulative total of depreciation expenses from the new vehicle price or generally, one-half of the new vehicle price.

7) Crew Cost, Insurance, and Miscellaneous

Crew cost is wages paid drivers, conductors, and truck assistants. No crew cost is considered for passenger cars. Because light trucks are used not only for cargo transport but also for commuting and shopping, 60% of driver wage is considered as crew cost. For each truck, 0.5 assistants are considered. Buses in Panama have no conductor, and no conductor wage is considered(see Table III-5-6).

TABLE III-5-6 CREW, OVERHEAD AND INSURANCE COSTS

DESCRIPTION	Car	Light Truck	Truck	Bus
Crew Cost (cent/hr)				
Financial	--	150.00	375.00	250.00
Economic	--	142.50	356.25	237.50
Overhead Cost (cent/hr)				
Financial	--	----	57.26	----
Economic	--	----	53.61	----
Insurance (cent/hr)				
Financial	14.37	2.21	25.38	19.63
Economic	13.65	2.10	24.11	18.65

SOURCE: ESTAMPA

While a fair portion of passenger cars are insured, the insurance coverage rate of other types of vehicles, particulary those for business use, is low. Insurance cost as an item of running time cost is obtained by applying the assumed insurance coverage rate to the average amount of insurance premium paid on each vehicle type, as estimated based on a number of sample surveys.

Miscellaneous cost is the overhead expense of transport company as prorated based on crew wages. No miscellaneous cost is considered for buses, most of which are owned by one-bus owners rather than by a company. Many trucks are also owned by one-truck owners and, therefore, miscellaneous cost for trucks is estimated at 10% of other running time cost, rather than the usual 80 to 110% of direct personnel wages.

8) Running Cost and Running Time Cost

The above discussed cost items can be summarized as presented in Table III-5-7. In the case of passenger cars, running cost in market price is 10.17 cents per hour per car. At the speed of 30 kilometers per hour, a distance of two kilometers can be travelled in two minutes. Then, running cost is:

$$10.17 + 63.04 \times 2/60 = 12.27 \text{ cents}$$

The running cost of light truck is likewise calculated at 15.41 cents, that of truck, at 50.94 cents, and that of bus, 59.38 cents. The variance between the running cost in economic value and running cost in market value is greatest in the case of passenger cars, the former being 78% of the latter. Such gap is very small for light trucks and trucks (said ratio being 90%), as well as for buses (97%). The breakdown of running cost at the speed of 30 kilometers per hour is shown in Fig. III-5-2.

For the evaluation of road projects, total running cost is obtained by applying the unit cost of each vehicle type to the total vehicle-kilometers of operation and the total running time in the entire Panama Metropolitan Area (the Study Area) as obtained as a result of traffic assignment.

5.1.4 Travel Time Cost

Travel time saving resulting from smoother flow of traffic as brought about by a road project implementation is considered an item of benefit in that such time saving would be utilized for some other economic production. The value of time thus saved varies by the productivity of the person making the trip and the purpose of the trip.

TABLE III-5-7 SUMMARY OF VEHICLE OPERATING COST IN PANAMA, 1983

(1) Running Cost (Distance Related Cost (Cents/Vehicle/Km)

	Car	Light Truck	Truck	Bus
Financial Cost				
1. Fuel	6.51	4.80	10.33	11.20
2. Lubricant Oil	0.04	0.07	0.33	0.45
3. Tire	0.81	1.97	6.41	6.41
4. Spare Parts	0.53	0.63	4.26	16.82
5. Maintenance Labour	0.40	0.33	2.50	1.98
6. Depreciation (Distance-related)	1.88	1.34	6.11	9.03
7. Total	10.17	9.14	29.94	45.89
Economic Cost				
1. Fuel	4.80	4.44	9.55	10.36
2. Lubricant Oil	0.02	0.04	0.18	0.25
3. Tire	0.64	1.58	5.13	5.13
4. Spare Parts	0.44	0.52	3.86	16.82
5. Maintenance Labour	0.38	0.32	2.38	1.83
6. Depreciation (Distance-related)	1.53	1.10	5.53	9.03
7. Total	7.81	8.00	26.63	43.92

(2) Fixed Cost (Time Related Cost) (Cents/Vehicle/Km)

	Car	Light Truck	Truck	Bus
Financial Cost				
1. Depreciation (Time Related)	23.47	10.96	52.37	28.69
2. Capital Opportunity Cost	25.20	24.85	120.00	120.00
3. Crew Cost	----	150.00	375.00	237.50
4. Insurance Cost	14.37	2.21	25.38	19.63
5. Overhead Cost	----	----	57.26	----
6. Total	63.04	188.02	630.01	405.82
Economic cost				
1. Depreciation (Time Related)	19.13	9.43	47.44	28.69
2. Capital Opportunity Cost	20.54	20.54	108.33	120.00
3. Crew Cost	----	142.50	356.25	237.50
4. Insurance Cost	13.65	2.10	24.11	18.65
5. Overhead Cost	----	----	53.61	----
6. Total	53.32	174.54	589.74	404.84

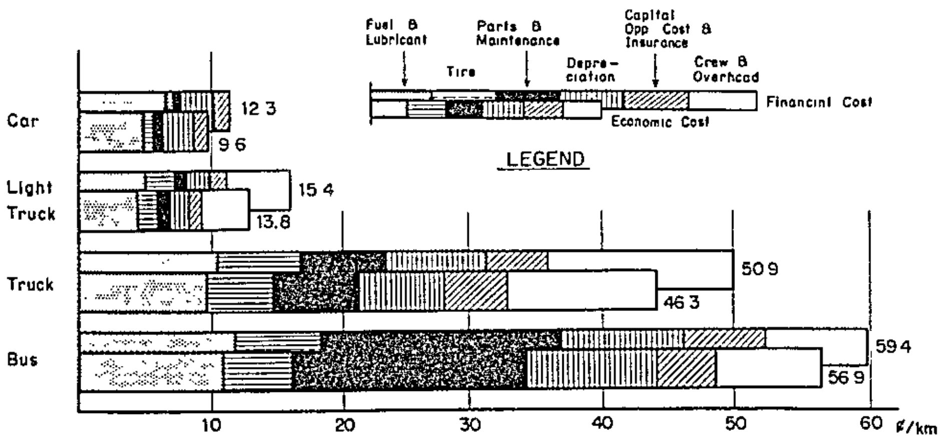


Fig. III-5-2 VEHICLE OPERATING COST IN PANAMA, 1983

1) Time Value

Relationship between the income distribution of Panama citizens and their car ownership was established in the Masterplan Study. In 1980, the average monthly income of all households was 461 balboas, but there was a substantial difference between such income of car owning households of 850 balboas and that of non-car owning households of 322 balboas. Therefore, one fixed unit value of time saving cannot be applied to all modes of transport. Rather, different time values are considered for car trips and bus trips.

Assuming that said 1980 incomes have increased by an annual rate of 5% each and that the number of work hours is 160 per month (8 hours per day x 20 days), the 1983 value of time for working members of the car owning family is 6.14 balboas per hour, and that for working members of the non-car owning family, 2.33 balboas per hour. Although families may have more than one worker per family, this is believed reasonable in view of the fact that 13% of car owning families own more than one car and because any car must be rarely used for productive activities by more than one family member at the same time.

TABLE III-5-8 FUTURE TRIP PURPOSE COMPOSITION BY MODE

(1) 1990 (percent)

	Work	School	Home	Business	Shopping	Private	Total
1. Walk, Two Wheelers	8.24	27.93	47.32	0.87	5.87	9.77	100.00
2. Private Car	22.00	6.92	37.94	4.42	5.77	22.96	100.00
3. Truck	20.71	0.02	32.88	40.23	2.03	4.14	100.00
4. Taxi	13.76	6.77	46.67	2.74	3.66	26.40	100.00
5. Route Bus	21.10	14.24	45.91	1.33	4.01	13.40	100.00
6. Private Bus	7.43	39.40	48.12	2.30	0.76	1.99	100.00
Total	17.92	14.84	43.27	4.59	4.60	14.78	100.00

(2) 2000

	Work	School	Home	Business	Shopping	Private	Total
1. Walk, Two Wheelers	8.07	27.48	48.86	7.62	5.71	9.12	100.00
2. Private Car	22.35	6.84	36.86	4.68	5.82	23.44	100.00
3. Truck	20.32	0.03	33.17	39.90	2.13	4.45	100.00
4. Taxi	13.53	6.76	45.56	2.98	2.83	27.35	100.00
5. Route Bus	21.28	13.58	45.44	1.34	4.06	14.31	100.00
6. Private Bus	8.03	39.51	47.75	2.21	0.74	1.76	100.00
Total	18.07	14.40	42.94	4.76	4.63	15.20	100.00

2) Trip Purpose

Benefit from travel time saving is considered only for three trip purposes: business, going to work and coming home from work. No such benefit is considered for other purposes, namely, going to school, shopping, private purpose, and coming home from either of these trips, because, in these cases, there is no guarantee that travel time saving is used for some productive activity.

One-half of saving in travel time for going to work and coming home from work is considered to be used for a productive undertaking and the remaining half, for domestic or other non-productive activities. The result of prediction of purpose distribution by mode is shown for 1990 and 2000 in Table III-5-8.

3) Travel Time Value per Vehicle

In arriving at travel time value per vehicle applied to the time value of riders are (1) the average occupancy rate of the particular type of vehicle and (2) the composition ratio of the particular trip purpose. Passenger car and taxi occupancy rates average to 1.5 persons per vehicle. As for passenger car, the time value of car owning family members is applied to the driver, while the average of such values of car owning and non-car owning families is applied to passengers (co-riders). As for taxi cabs, the crew cost is applied to the driver, and said average value is applied to 0.5 passengers. Although trip composition will change from 1990 to the year 2000, as seen in Table III-5-8, the average of these two years shall be used as the future share. The travel time value of passenger cars and taxi cabs as thus calculated and weighted by traffic volumes, comes to an average of 1.10 balboas per vehicle per hour.

Travel time value is not considered for trucks, whose crew cost is already accounted for in the vehicle operation cost. The present average seat occupancy rate of route buses of 27 is predicted to increase to 30 in the future as a result of the introduction of large buses and the rationalization of bus routes and of bus allocation to routes. The time values of non-car owning families, as well as the total of shares of business trips and commuting trips (assuming that commuting trips are equal to trips coming home from work), are applied to said future occupancy rate of 30, and travel time value per route bus comes to 7.26 balboas per hour. Such value is likewise estimated at 3.70 balboas per hour for each private (school, company) bus.

These unit time values for the types of vehicles are used in estimating the time saving benefit of road projects.

5.1.5 Economic Cost of Road Projects

For the assessment of the burden of road project implementation upon the national or regional economy, the project cost expressed in terms of market price discussed in the previous sub-chapter is now converted to economic cost. This conversion is chiefly through the elimination of transfer costs and adjustment for the correction of market price not determined through a sound market mechanism and, therefore, not expressing the true value.

1) Taxes

Customs duties and transfer and other taxes, which are merely transfer costs of, and do not constitute the input of any value to, the project, are excluded in the calculation of economic cost. The rates of customs duties vary by the commodity, but their deduction resulted in 20 to 30% reduction in the costs of imported goods. Also, the 5% sales tax (ITBM) imposed upon almost all construction materials, tools, and equipment is also excluded.

Some domestic products are taxed upon the importation of their raw materials, but such raw material taxation is disregarded as a rule, inasmuch as a complete survey over the importation and production conditions of all products to be used in the projects will be practically impossible. The only exception is petroleum fuels, for which the economic price stated under 5.1.3. (Vehicle Operating Cost) is used.

2) Shadow Wage Rate

Road construction usually heavily utilizes unskilled laborers. Unskilled laborers represent about 30% of the wages, which is nearly 30% of the financial project cost. The unemployment rate of 8.4% in Panama in 1982, as released by the government, is believed to have risen subsquently. Then, the opportunity cost of unskilled laborers must be less than the statutory (the labor law) minimum wage of 120 balboas per month. The construction cost must be corrected by using a shadow wage rate.

A review of various studies done in Panama has resulted in the finding that diverse shadow wage rates have been used. For instance, the 1979 Colon Bus Terminal Project of MIG/MIPPE1/ estimated that shadow wage rate was theoretically zero under the unemployment rate of 25% but used market wage rates. The 1980 Hydraulic Power Plant Study of MOP2/ assessed shadow wage at 70% of market wage rates, while the 1976 Sewer Treatment Facility Project of IDAAN/MIPPE3/ assessed unskilled labor wages at zero and semi-skilled labor wages at 50%.

This Study shall use the shadow wage rate of 60% of market wage rates, which is the same as that used in the 1981 Autopista Project Study4/ and which corresponds to the rate in a society with the unemployment rate of 13% by the formula of Haveman 5/.

3) Opportunity Cost of Land

The important feature of the subject projects is that the project cost, discussed in the previous sub-section, includes no cost for government owned land. Most of the new road projects will pass through the government-owned Reverted Area, and Via Cerro Ancon will also partially use government owned land in El Maranon Area.

That no cost will be incurred for land does not mean that the land is without value. Therefore, for economic evaluation of the projects, the opportunity cost of the land must be considered. The opportunity cost is estimated at the present land price, without taking into consideration the land price appreciation to be expected upon the opening of the project road and the development of roadside areas. Thus, the amount of opportunity cost is estimated at 10 balboas per square meter for Albrook Airfield and 30 balboas per square

Note.

(1) "Estudio de Factibilidad, Terminal de Transporte Publico de Pasajeros de la Ciudad de Colon" MIG/MIPPE, Sept.1979.

(2) "Estudio de Factibilidad Tecnico Economico y Diseno Final del Proyecto Punta Pena-Casa de Maquina (Proyecto Hidroelectrico Changuinola I)" MOP, August 1983.

(3) "Systema de Tratamiento de Aguas Negras y Rehabilitacion de los sistemas de Acueducto y Alcantarillado del Casco Viejo, Ciudad de Panama" IDAAN/MIPPE, Diciembre 1976.

(4) "Autopista Arraijan-Panama, Estudio para seleccion de la Alternativa Optima de Empalme con la Ciudad de Panama" MOP, July 1981

(5) $So = Sn \times (1.25 - D/0.20)$

where; S0 : Shadow wage rate
Sn : Nominal wage in market price
D : Unemployment rate

meter for Los Andes Area, both for Corredor Norte Project; at 15 balboas per square meter for area along Chivo-Chivo road; at 2000 balboas per square meter for El Maranon Area (in view of actual transaction price of neaby commercial land); and at two to five balboas per sqare meter for other areas.

Land is not a depreciable asset. As such, the land cost included in investment amounts is accounted for in cash flow analysis. Thus, the true effect of land cost inclusion in investment is smaller that what it appears to be, the net addition being the equivalent of interest on land cost.

4) Inflation

Discount cash flow analysis uses 1983 prices. The price contingency, which assumes an annual price inflation of 3%, must therefore be eliminated from economic cost.

The result of conversion of financial costs to economic costs through the above explained procedure is shown in Table III-5-9. The total amount changed little from the financial cost of 115.77 million balboas to the economic cost of 116.07 million balboas, because 5.5 million balboas of land cost added to economic cost was about offset by a comparable reduction in construction cost.

TABLE III-5-9 ECONOMIC COST OF ROAD PROJECTS

(Unit: B/.1000 in 1983 price)

Project	Total Cost		Schedule in Economic Cost					
	Financial	Economic	1985	1986	1987	1988	1989	1990
New Road Construction								
1. Corredor Norte (West)	8,564	10,537	75	2,373	1,129	3,307	3,289	-
2. Corredor Norte (East)	17,545	18,531	156	2,113	4,124	5,989	6,149	-
3. Corredor Norte (Los Andes)	14,036	13,622	104	356	676	5,086	5,378	2,022
4. San Miguelito Oeste	17,263	16,445	137	572	2,131	6,473	7,132	-
5. El Paical Ext.	2,329	2,213	20	62	-	118	1,421	592
6. Martin Sosa Ext.	6,002	6,860	50	150	-	1,720	3,784	1,156
7. Cerro Ancon Ext.	500	521	17	51	453	-	-	-
Sub-total	66,240	68,729	559	6,041	8,513	22,693	27,153	3,770
Road Improvement								
1. Via Espana	14,115	13,261	-	433	547	4,835	5,451	1,995
2. Via Simon Bolivar	7,039	6,670	-	260	140	4,352	1,918	-
3. Via Cerro Ancon	9,713	9,449	-	143	2,965	3,072	2,124	1,195
4. Via El Paical	13,947	13,554	-	706	902	2,338	4,443	5,165
5. San Miguelito Intersection	4,713	4,360	4,360	-	-	-	-	-
Sub-total	49,527	47,344	4,360	1,542	4,554	14,597	13,936	8,355
Total	115,767	116,074	4,919	7,583	13,067	37,290	41,089	12,125

5.2. Evaluation Result and Recommendations

5.2.1. Package Evaluation

1) Conclusion

When evaluated as a package of projects by the method explained in the preceding sub-chapter, the road improvement projects as a whole show excellent results. Against the total cost of 116.0 million balboas, they will produce an accumulated economic benefit of about 400 million balboas until the year 2000 and their internal rate of return is estimated at a high 26.4%. If 12% discount rate is used, net present value is 72.5 million balboas, and benefit/cost ratio is 2.2 (see Fig. III-5-3).

Of the benefits, about 40% comes from vehicle operating cost (VOC) saving and 60% from travel time saving. Therefore, VOC saving alone amounts to 1.5 times the investment, and IRR, even if travel time saving benefit is disregarded, 16.2%. This project package is very feasible.

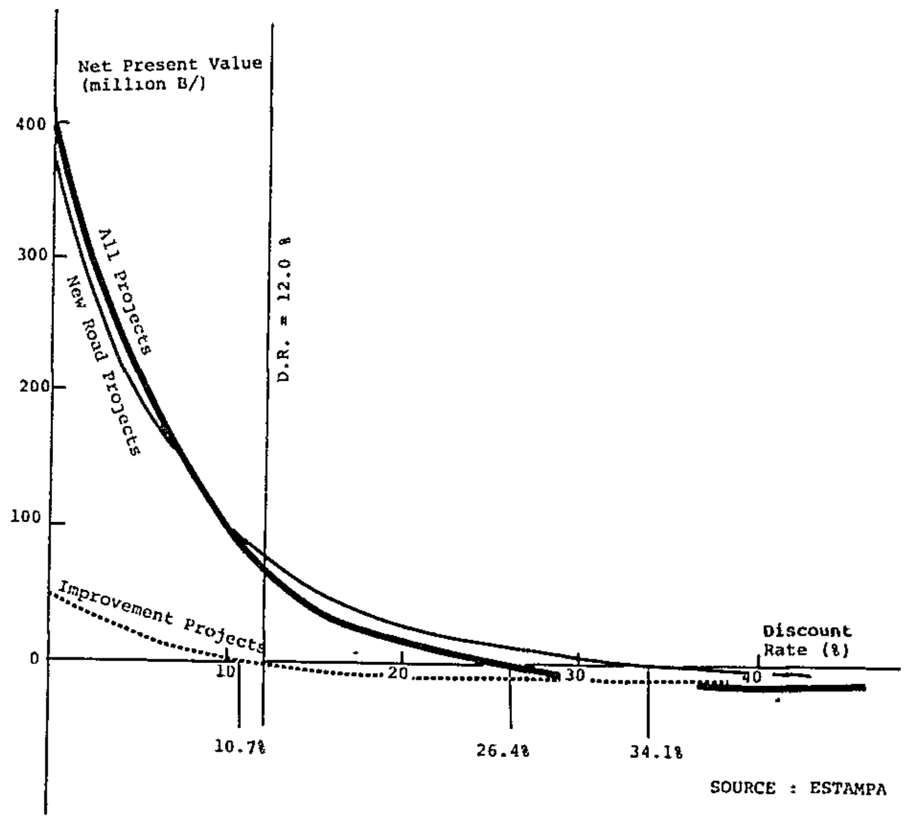


Fig. III-5-3 NET PRESENT VALUE AND INTERNAL RATE OF RETURN OF ROAD PROJECTS

2) Sensitivity Analysis

The sensitivity of traffic demand and of construction cost has been analyzed.

If traffic demand is 10% less than forecast (that is, if all O-D traffic volumes are 10% less than estimatd), IRR will slightly decrease to 21.2%. This means that IRR's sensitivity to traffic demand is 2.0 (because 10% demand decline results in 20% IRR decline). Judging from this value, this project package will remain feasible (and IRR will remain over 12%), as long as traffic demand does not fall 27% or more short of the forecast.

Likewise, a 10% overage in the estimated construction cost will result in 24.3% IRR. Thus, IRR sensitivity to construction cost, 0.8, is weaker than to traffic demand. This project package will never become unfeasible for the reason of construction cost (unless it unrealistically increases to 2.2 times the estimate).

It can be concluded from the above that changes in traffic demand from what is forecast or construction cost inflation beyond estimation will hardly threaten the economy of the package of road projects as a whole.

If the assumption of this Feasibility Study that Autopista (Arraijan-Panama) will be completed by the middle of the 1990s turns out to have been wrong, what impact will it have upon the subject projects is the next subject of analysis.

In conclusion, the overall IRR of all the road projects combined will drop by 0.4 point to 26.0%, while that of all new road projects will conversely rise by 1.2 point to 35.3%, and that of all improvement projects will drop by 1.4 point to 10.7%. In other words, without Autopista, new roads will produce greater effects, and upgraded roads, smaller effects. In any way, the feasibility of either the new road projects or the road improvement projects would not be affected much by the Autopista Project.

5.2.2 New Road Projects and Improvement Projects

On the other hand, projects for the construction of new road, altogether show a high IRR of 34.1%, while projects for the improvement of existing roads, as a whole, show a low IRR of only 10.7%. If the IRR of 12% is considered critical, the improvement projects cannot be said to be feasible.

This contrast shows that the improvement of existing roads alone will be short of meeting the predicted doubling of traffic demand (or 2.2. times increase in terms of vehicle-kilometers) by the year 2000. As previously pointed out, Corredor Norte will accommodate a heavy traffic of 30,000 to 70,000 vehicles per day, mitigating that much burden on the existing roads. Therefore, the road capacity expansion that can be expected from the widening and improving of Via Espana, Via Simon Bolivar, and Via El Paical will still be far short of meeting the heavy traffic demand, should Corredor Norte not be constructed, and serious traffic congestion will become chronic on those roads.

Another explanation of the low IRR of improvement projects is the high project cost in relation to the road capacity increase. These projects will necessitate the acquisition of expensive land, much compensation for relocated houses and public facilities, and expensive intersection grade-separation construction. Should improvement project cost possibly be reduced by 10%, the IRR improves to 12.1.%. Therefore, efforts must be used to save the project cost in designing and work accomplishment.

5.2.3 Project Component Evaluation

Discussions therefore have revealed that, although the road projects as a whole will be feasible, there will be a difference in the level of feasibility between the new road projects as a whole and existing road improvement projects as a whole. It is, then, to be expected that individual new road projects, as well as individual improvement projects, will show varying levels of economic effects. As another project package sensitivity analysis, the effect of presence or absence of a given individual project to the economic benefit is analyzed in order to reveal the relative importance of the projects.

A number of different project combinations are considered for this analysis, including certain projects and excluding other projects, as shown in Table III-5-10 and the results are summerized in Table III-5-11. In these Tables, Case 100 assumes the implementation of all the subject projects. Case 200 assumes the implementation of all new road construction projects. Case 300 assumes the implementation of all existing road improvement projects. (The result of the analysis of these three cases has previously been explained).

TABLE III-5-10 PROJECT COMPONENTS FOR EVALUATION

CASE NUMBER	100	200	201	WITHOUT IMPROVEMENT				
				202	203	204	205	206
NEW ROAD								
1. Corredor Norte West	○	○	▲	○	○	○	○	○
2. Corredor Norte East	○	○	○	▲	○	○	○	○
3. Corredor Norte Los Andes	○	○	○	▲	○	▲	○	○
4. San Miguelito Oeste	○	○	○	▲	▲	○	○	○
5. El Paical Extention	○	○	○	▲	○	○	▲	○
6. Martin Sosa Extention	○	○	▲	○	○	○	○	▲
7. Cerro Ancon Extention	○	○	▲	○	○	○	○	○
IMPROVEMENT								
8. Via Espana	○	▲	▲	▲	▲	▲	▲	▲
9. Via Bolivar	○	▲	▲	▲	▲	▲	▲	▲
10. Via El Paical	○	▲	▲	▲	▲	▲	▲	▲
11. Via Cerro Ancon	○	▲	▲	▲	▲	▲	▲	▲

CASE NUMBER	211	WITH IMPROVEMENT				
		212	213	214	215	216
NEW ROAD						
1. Corredor Norte West	▲	○	○	○	○	○
2. Corredor Norte East	○	▲	○	○	○	○
3. Corredor Norte Los Andes	○	▲	○	▲	○	○
4. San Miguelito Oeste	○	▲	▲	○	○	○
5. El Paical Extention	○	▲	○	○	▲	○
6. Martin Sosa Extention	▲	○	○	○	○	▲
7. Cerro Ancon Extention	▲	○	○	○	○	○
IMPROVEMENT						
8. Via Espana	○	○	○	○	○	○
9. Via Bolivar	○	○	○	○	○	○
10. Via El Paical	○	○	○	○	○	○
11. Via Cerro Ancon	○	○	○	○	○	○

CASE NUMBER	300	301	302	WITHOUT NEW ROAD				
				303	304	305	306	307
NEW ROAD								
1. Corredor Norte West	▲	▲	▲	▲	▲	▲	▲	▲
2. Corredor Norte East	▲	▲	▲	▲	▲	▲	▲	▲
3. Corredor Norte Los Andes	▲	▲	▲	▲	▲	▲	▲	▲
4. San Miguelito Oeste	▲	▲	▲	▲	▲	▲	▲	▲
5. El Paical Extention	▲	▲	▲	▲	▲	▲	▲	▲
6. Martin Sosa Extention	▲	▲	▲	▲	▲	▲	▲	▲
7. Cerro Ancon Extention	▲	▲	▲	▲	▲	▲	▲	▲
IMPROVEMENT								
8. Via Espana	○	○	▲	▲	○	○	▲	○
9. Via Bolivar	○	▲	○	▲	○	▲	○	○
10 Via El Paical	○	▲	○	▲	○	▲	○	▲
11. Via Cerro Ancon	○	▲	○	○	▲	○	▲	○

CASE NUMBER	311	312	WITH NEW ROAD				
			313	314	315	316	317
NEW ROAD							
1. Corredor Norte West	○	○	○	○	○	○	○
2. Corredor Norte East	○	○	○	○	○	○	○
3. Corredor Norte Los Andes	○	○	○	○	○	○	○
4. San Miguelito Oeste	○	○	○	○	○	○	○
5. El Paical Extention	○	○	○	○	○	○	○
6. Matin Sosa Extention	○	○	○	○	○	○	○
7. Cerro Ancon Extention	○	○	○	○	○	○	○
IMPROVEMENT							
8. Via Espana	○	▲	▲	○	○	▲	○
9. Via Bolivar	▲	○	▲	○	▲	○	○
10. Via El Paical	▲	○	▲	○	▲	○	▲
11. Via Cerro Ancon	▲	○	○	▲	○	▲	○

Note: ○ With Project
▲ Without Project

TABLE III-5-11 SUMMARY TABLE OF ROAD PROJECT EVALUATION

Case No.	Description	Cost(Million B./) Financial	Economic	Average Congestion Ratio	IRR(%)	Evaluation NPV (Million B/.)	B/C
100	All Projects	111.1	111.7	0.944	26.4	72.5	2.2
101	Demand -10%	111.1	111.7	0.845	21.2	47.2	1.8
102	Cost +10%	122.2	122.9	0.944	24.3	74.7	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

1) Corredor Norte , East Section vs, West Section (Cases 201, 202, 211, and 212)

Divided at the intersection with Via El Paical Extension, the East Section of Corredor Norte shows a better economy than the West Section under the assumption that the sections will be connected to all new roads in plan, as shown in Fig. III-5-4. The East Section will be connected with Transistmica Highway, thereby serving the new urban area in the reverted land while bypassing the existing urban area. Whereas, the West Section will serve only the new urban areas in the previous Albrook Airfield and in the vicinity of Camino de la Amistad. Thus, the above judgement is substantiated.

2) Corredor Norte, Los Andes Section vs. Via San Miguelito Oeste (Cases 203, 204, 213, and 214)

In these cases, the section to be evaluated is excluded from all new road projects, and, therefore, the lower the resulting IRR, the higher the economic value of the excluded section.

It is noteworthy in the first place that both Cases 203 and 204 show a higher IRR does Case 200 (all new road project). This means that the construction of either one of Los Andes Section and San Miguelito Oeste will result in a higher return than the construction of both. Which of the two should be given priority depends on whether or not the existing road is upgraded. If it is upgraded, Los Andes Section will have an advantage over San Miguelito Oeste, and vice versa. Nevertheless, difference in IRR between the two is small enough that the priority should be decided more in view of other factors such as development of future road network, roadside area development potentials and the ease of land acquisition.

3) Via El Paical Extension vs. Via Martin Sosa Extension (Cases 205, 206, 215, and 216)

As the arterial road to connect Panama downtown with Corredor Norte when its entire route is opened for service, a slight advantage of El Paical Extension is evidenced by a lower IRR in its absence than in the absence of Via Martin Sosa Extension.

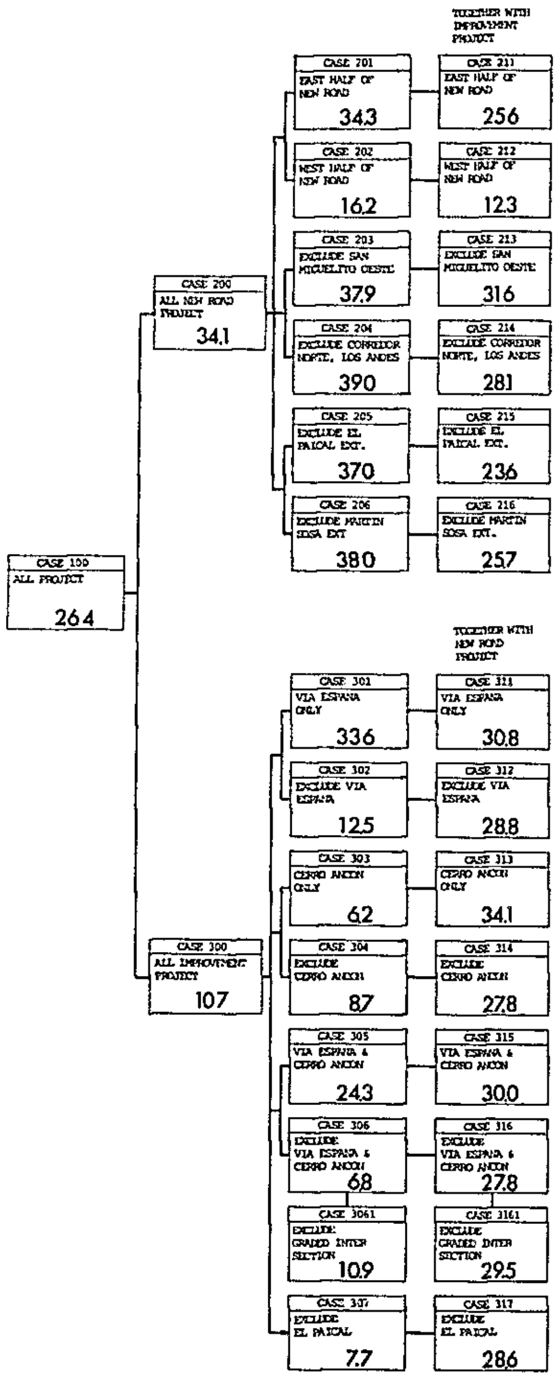


Fig. III-5-4 INTERNAL RATE OF RETURN UNDER VARIOUS ROAD NETWORK

4) Via Espana (Cases 301, 311, 302. and 312)

Of the generally low economy of existing road improvement projects, project for the widening and improving of Via Espana shows an unusually high IRR of 33.6%, with the net present value of 8.9 million balboas and the benefit/cost ratio of 2.3.

The above evalution assumes the improvement of Via Espana alone, without any new road construction. Should it be upgraded together with the construction of all the new roads, the overall IRR comes to 30.8%, which is 3.1 point reduction from said 34.1% IRR from only all new road projects. In fact, evaluated against the base case of "the present road network plus all the planned new roads," the IRR of the improvement of Via Espana alone declines to 13.5%.

In conclusion, the improvement of Via Espana will bring about a substantial economic return when the new roads are not constructed, but, if they are constructed, the economic benefit of the improvement of Via Espana alone will be very small.

5) Via Cerro Ancon (Cases 303,313,304, and 314)

In reverse to the improvement of Via Espana, the improvement of Via Cerro Ancon without the construction of the new roads will result in a nearly impossible IRR of only 6.2%, but, with new road construction, it will result in as high an IRR as 34.1%, which happens to be the same IRR from all new road projects as a whole.

6) Via Bolivar vs. Via El Paical (Cases 305 through 317)

The economy of these two projects is low with the IRR of only 6.8% if no other projects are implemented. Conversely, however, the IRR of improvement projects other than these two (that is, the improvement of Via Espana and Via Cerro Ancon) is 24.3%.

The major reasons why the return of these projects is low is, in the first place, because the widening of Via El Paical will entail land acquisition and compensation for houses and, secondly, grade-separation of the intersection of the two roads will require as much as 2.6 million balboas. If the same benefit can be expected without the intersection grade-separation, the IRR of these two projects will be improved to 10.9%.

The cost of the 2.25-kilometer Via Bolivar widening, for which the existing right-of-way is wide enough, is relatively low (if the intersection grade-separation is excluded, only 1.4 million balboas), but little economic benefict can be expected therefrom.

5.2.4 San Miguelito Intersection Improvement Project

The link travel condition applied to the calculation of benefit arising from road improvement takes into consideration the roadside conditions, in addition to the traffic capacity of the link. In this sense, intersection intervals, intersection traffic capacity, and other intersection conditions are incorporated into it. However, its defining method is an approach to the link as a whole from a macroscopic viewpoint, rather than pertaining to individual intersections. Of the subject road projects, the improvement of San Miguelito Intersection is recommended as improvement into an independent intersection and not the improvement of the link connected to that intersection. Therefore, the improvement benefit of San Miguelito Intersection shall not be calculated by the change of the link travel conditions connected to the intersection, but by the procedure below.

1). Analysis Method

Benefit resulting from an intersection improvement is considered in terms of a decrement of delay time for waiting at the intersection—either delay due to congestion in an oversaturation situation or waiting for traffic signal change. These delay times are conceptually illustrated in Fig. III-5-5. San Miguelito Intersection, the subject of present discussion, is presently nearly saturated in peak hours, and its grade-separation is recommended for the avoidance of oversaturation in the future. Then, its benefit will be the elimination of delay time which would otherwise be unavoidable under oversaturation condition in peak hours, should the intersection be left unimproved. On the other hand, the grade-separation of Via Ricardo J. Alfaro to Via Domingo Diaz will result in the elimination of signal waiting delay for traffic in this direction. The reduction of these two kinds of delay time shall be considered the benefit for the present analysis. The benefit is calculated through the process presented in Fig. III-5-6.

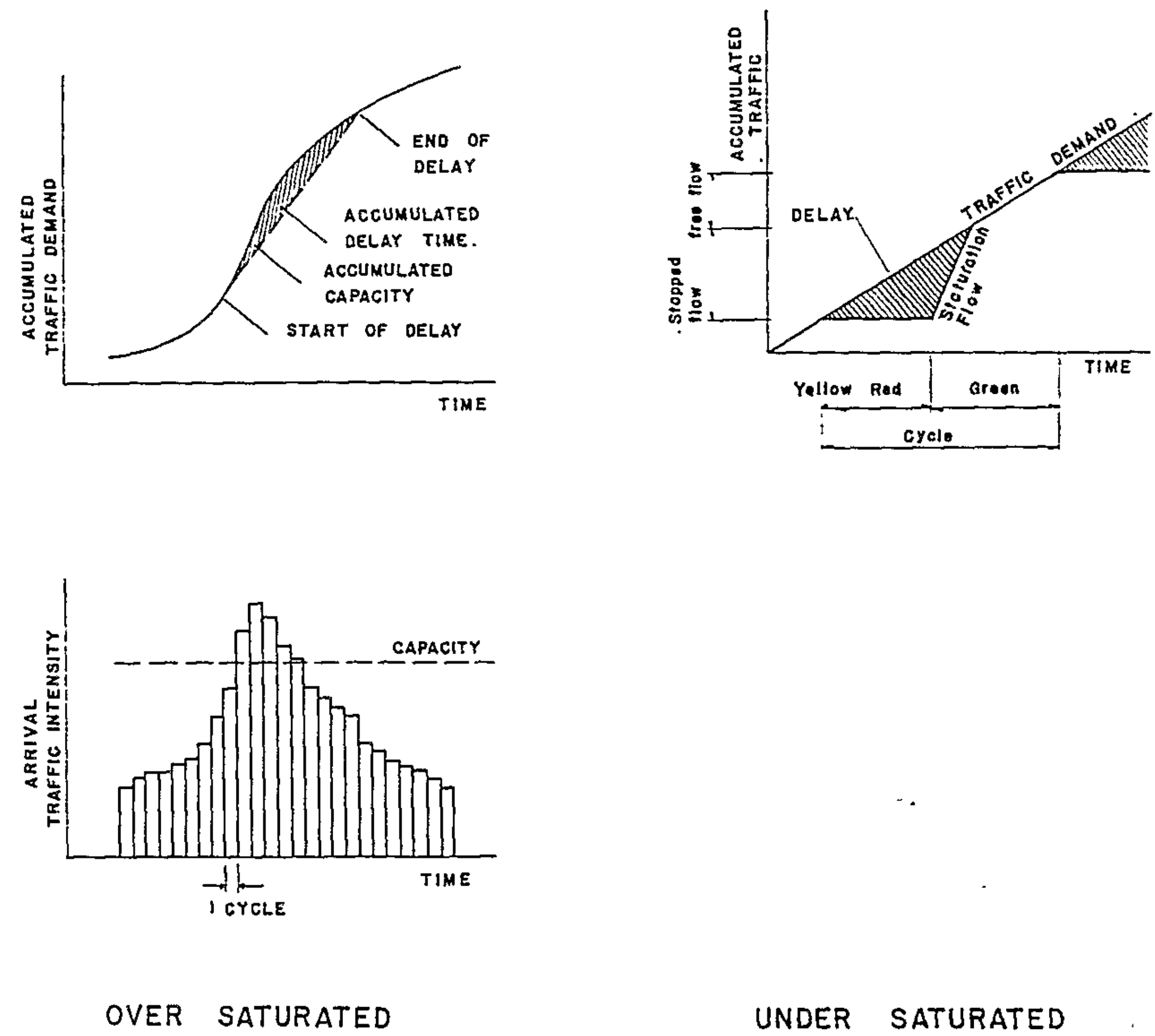


Fig. III-5-5 CONCEPT OF DELAY AT INTERSECTION

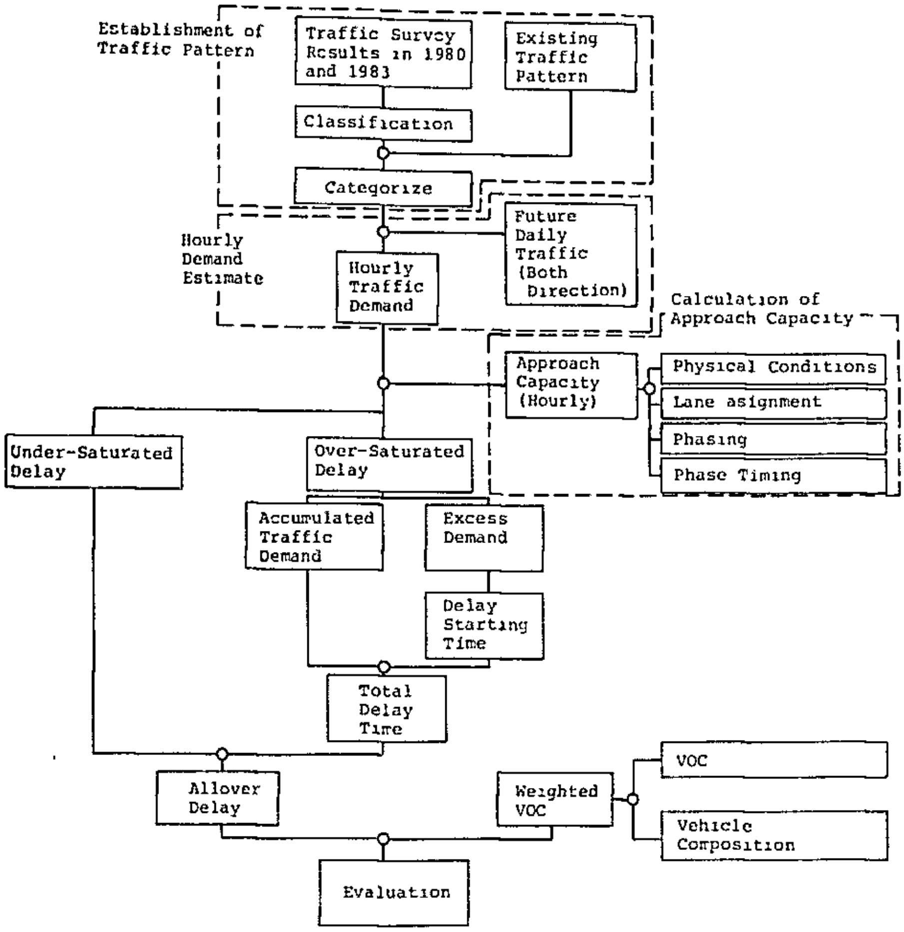


Fig. III-5-6 FLOW CHART OF INDEPENDENT INTERSECTION EVALUATION

2). Arrival Distribution

Arrival distribution in the approach of an intersection will vary in the future, when traffic network, roadside conditions, and other factors will change. Also, hourly traffic distribution at an intersection pertains to the volume of traffic passing through the intersection and, as such, presents a different pattern from that of arrival distribution. Therefore, the number of typical patterns selected from the result of roadside traffic counting in Panama Metropolitan Area shall be used as arrival distributions for the present analysis.

The results of the 24-hour and the 12-hour roadside traffic counting surveys conducted in the ESTAMPA Materplan Study and this Feasibility Study have been classified into six patterns: (a) morning peak type, (b) early morning peak type, (c) evening type, (d) dual peak type, (e) triple peak type, and (f) combination type. Traffic toward urban area presents the morning peak type pattern and that toward suburbs, the evening peak type, on arterial roads. The dual peak type is observed in urban area, while the early morning peak type, which is presently seen on arterial roads in suburbs, will gradually shift to morning peak type as urbanization progresses. On non-arterials roads, those who go to work in the morning, come home for lunch and back home for the evening are responsible for the triple peak type. Combination type presents no particular characteristic(see Fig. III-5-7).

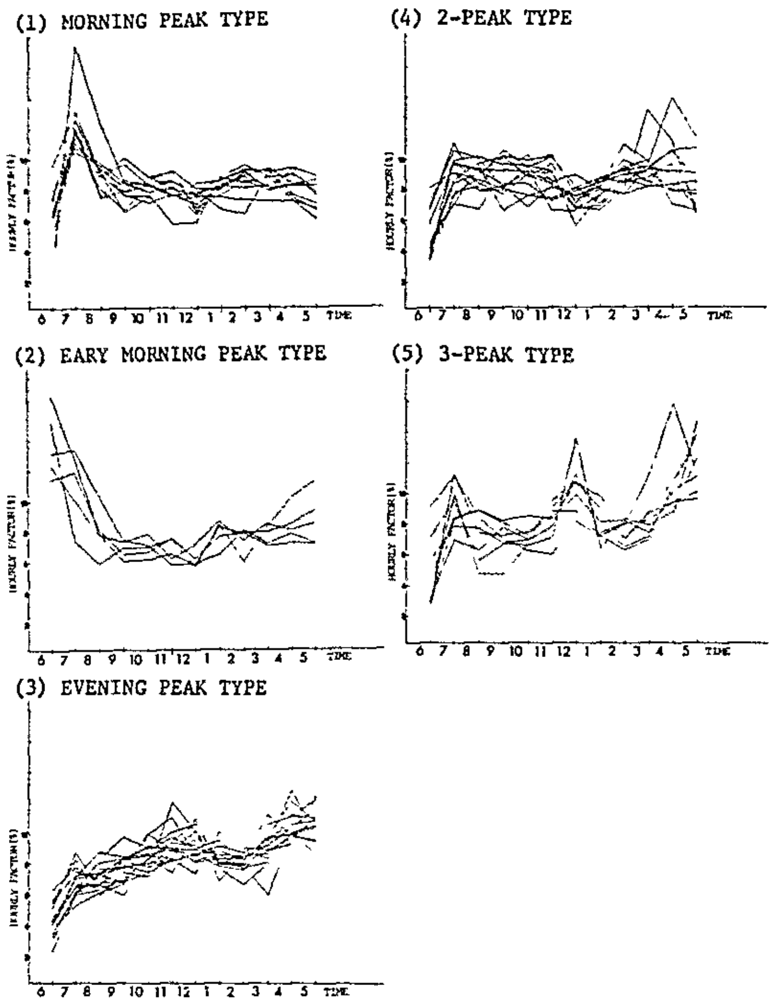


Fig. III-5-7 TRAFFIC PATTERN IN PANAMA

After the comparison of these hourly distribution patterns and the present hourly distribution pattern of traffic passing through San Miguelito Intersection, traffic arrival pattern in each of the approach has been assumed as presented in Table III-5-11. The representative arrival patterns are shown in Fig. III-5-8.

TABLE III-5-12 APPLIED HOURLY TRAFFIC PATTERN

APPROACH AND DIRECTION		APPLIED PATTERN
1. Transistmica	Straight	Morning Type
	Left Turn	Evening Type
	right Turn	Mornign Type
2. Via Bolivar	Straight	Evening Type
	Left Turn	Dual Peak Type
	Right Turn	Evening type
3. Via Domingo Diaz	Straight and Left Turn	Dual Peak Type
	Right Turn	Evening Type
4. Via R.J.Alfaro	Straight and Left Turn	Evening Type
		Evening Type

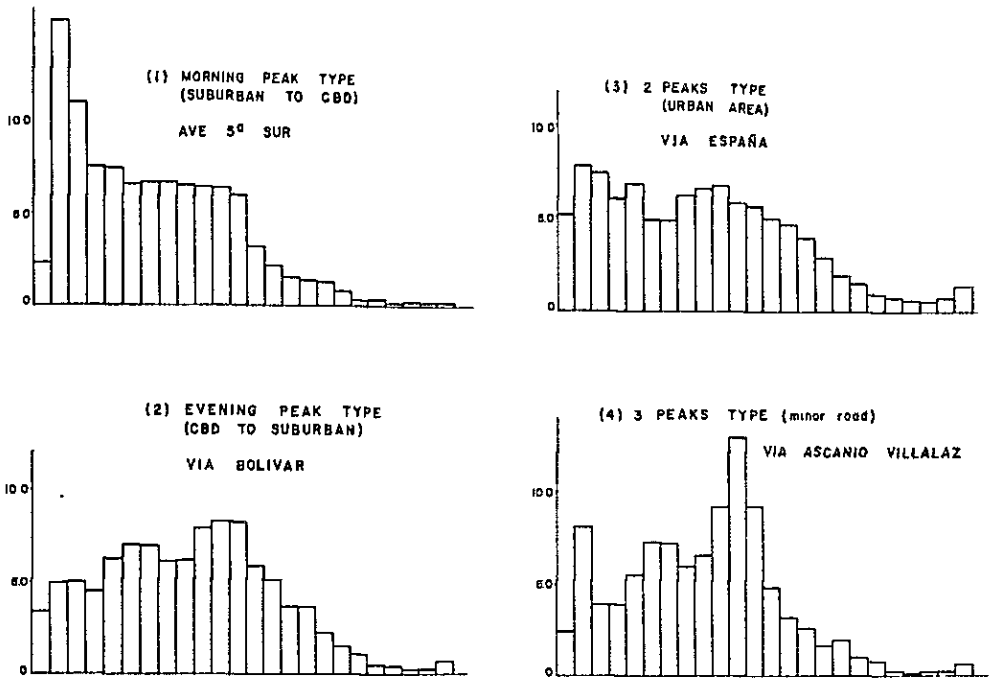


Fig. III-5-8 TYPICAL HOURLY FLUCTUATIONS IN PANAMA

3). Traffic Volume

The volume of traffic entering into San Miguelito Intersection will change substantially upon the completion of Corredor Norte and the completion of Corredor Norte Extension. For the present discussion, completion of Corredor Norte in 1990 and the completion of Corredor Norte Extension after the year 2000 is used as the base case, while also considering the case wherein the completion of the Los Andes section of Corredor Norte will be delayed beyond 1990, and the case wherein Corredor Norte Extension will be completed in the year 2000.

4). Intersection Capacity

Intersection capacity shall conform with that defined by HCM. The capacity is calculated for each approach of the intersection. The value of the capacity depends on the number of lanes, lane width, and other physical conditions, as well as on how the lane is used and signal phases and splits. Signal phase time varies by hour in Panama, where traffic signals are operated by traffic policemen in morning and evening peak hours. Since the purpose of the present analysis is chiefly to see effects on delay by changes in physical conditions, uniform phase and split are assumed for all intersection approaches. The direction control of lanes can be changed after the improvement of an intersection, and it is assumed that the control which will allow a maximum capacity in peak hours will be applied to each approach.

5). Delay Time

Delay due to oversaturation occurs when the arriving traffic exceeds the volume that a cycle of traffic signal phases can handle. The traffic volume revealed through this Study is expressed by hour, but, in order to understand the actual delay time situation, the traffic volume data must be broken down into signal cycles or seconds. As shown in Fig. III-5-9, this calculation is achieved assuming that delay begins at the beginning of an hour in which arriving traffic exceeds hourly traffic capacity.

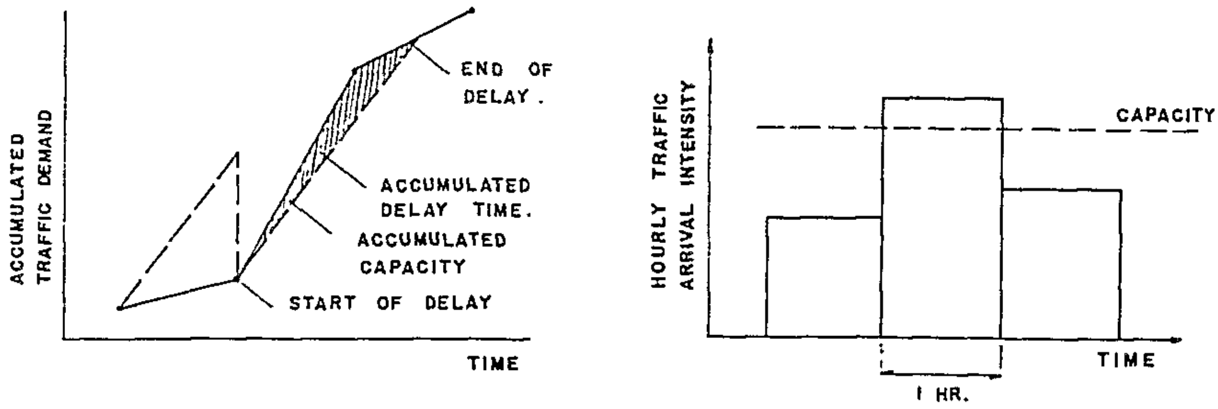


Fig. III-5-9 IDEAL SITUATION OF DELAY AT INTERSECTION

Oversaturation, which presently occurs during and around the peak hours, is expected to spread out to the level of average daily traffic as the volume of traffic increases, when delay time will be technically accumulated to an average of two hours or to a maximum of four hours. Of course, the traffic will detour the intersection in avoidance of such an unrealistic delay time, and, therefore, a maximum delay time of 30 minutes is used for the purpose of calculating total delay time. Table III-5-13 presents delay time and the traffic capacity of each intersection approach when Corredor Norte will be completed in 1990. Straight traffic through Via Domingo Diaz and Via Ricardo J. Alfaro will enjoy reduction in undersaturation delay time reduction as a result of the grade-separation of the intersection.

6). Travel Time Cost

The travel time cost is calculated as the average of time values for various vehicle types as weighted at the composition rates of vehicle types on links which converge on to San Miguelito Intersection. Said vehicle type composition and the weighted average value are shown in Table III-5-14.

TABLE III-5-13 CALCULATED DELAY AT THE INTERSECTION
(Unit; Min.)

1. WITHOUT IMPROVEMENT

APPROACH		CAPACITY (VHE/HR)	1983 TOTAL	1983 AV.	1990 TOTAL	1990 AV.	2000 TOTAL	2000 AV.
TRANSISTMICA	ST.	1,046	32,174	11.5	-	-	104,775	19.4
	L	451	-	-	29,745	13.4	180,855	25.8
	R	1,181	-	-	-	-	-	-
VIA BOLIVAR	ST.	685	12,714	4.9	-	-	184,122	24.0
	L	327	-	-	-	-	-	-
	R	1,031	-	-	-	-	-	-
DOMINGO DIAZ	ST.							
	L	1,228	9,262	3.1	50,209	8.9	552,571	26.4
	R	1,206	-	-	-	-	-	-
R.J.ALFARO	ST.							
	L	1,193	16,030	3.7	-	-	106,816	24.8
	R	1,027	-	-	-	-	-	-
SUB TOTAL			70,179		79,953		1,099,139	

2. WITH IMPROVEMENT

APROACH		CAPACITY (VHE/HR)	1983 TOTAL	1983 AV.	1990 TOTAL	1990 AV.	2000 TOTAL	2000 AV.
TRANSISTMICA	ST.	1,243	5,621	3.1	-	-	92,289	18.9
	L	451	-	-	29,745	13.4	180,855	25.8
	R	1,973	-	-	-	-	-	-
VIA BOLIVAR	ST.	1,086	-	-	-	-	-	-
	L	374	-	-	-	-	-	-
	R	1,259	-	-	-	-	-	-
DOMINGO DIAZ (0.2)	ST.		(840)	(0.1)	(1,910)	(0.2)	(2,517)	
	L	962	-	-	-	-	-	-
	R	1,206	-	-	-	-	-	-
R.J.ALFARO (0.2)	ST.		(912)	(0.1)	(2,652)	(0.2)	(2,618)	
	L	818	-	-	-	-	-	-
	R	1,636	-	-	-	-	-	-
SUBTOTAL			5,622		29,745		273,144	
DIFERENCE(OVER SATURATED)			64,558		50,209		825,994	
UNDER SATURATED DELAY			1,752		4,562		5,135	
TOTAL DELAY DIFERENCE			66,310		54,771		831,129	

NOTE: () SHOWS REDUCED DELAY BY GRADE SEPARATION

TABLE III-5-14 VEHICLE COMPOSITION AT SAN MIGUELITO INTERSECTION

APPROACH	PASS.CAR	TRUCK	BUS PRIVATE	BUS ROUTE	TOTAL
Via R.J.Alfaro	22,242	2,952	298	1,268	26,760
Via Bolivar	15,945	2,780	535	2,220	21,580
Via Domingo Diaz	38,722	5,144	970	3,730	48,566
Transistmica	19,019	2,671	576	2,934	25,140
TOTAL	95,928	13,547	2,319	10,252	122,046
PERCENT	78.6	11.1	1.9	8.4	100.0
VOC	108.32	278.34	589.87	767.87	
Weighted VOC	85.14	30.90	11.21	64.50	191.75

SOURCE:ESTAMPA

7). Result

The following cases have been considered for present analysis:

Case 1: The completion and opening for service of Corredor Norte (but not Corredor Norte Extension) in 1990.

Case 2: A 10% increase in the construction cost of Case 1

Case 3: A 20% increase in the construction cost of Case 1

Case 4: In addition to the opening of Corredor Norte in 1990, the opening of Corredor Norte Extension in the year 2000.

Case 5: A 10% reduction in traffic volume from Case 1

Case 6: Non-construction of the Los Andes Section of Corredor Norte, but the opening of San Miguelito Oeste in 1990.

The internal rates of return (IRR) calculated for these six cases are shown in Table III-5-15. In Case 1, IRR is 24.5%, indicating a high significance of the grade-separation of San Miguelito Intersection. The effect of construction cost fluctuations is small on the value of IRR, as 10% change in the former resulted in only 1% reduction in the latter. The completion of Corredor Norte Extension is feared to be delayed until the year 2000 or later due to the difficulty of necessary land acquisition, and its effect on this intersection is believed to be small. A 10% reduction in traffic in Case 5, however, will result in a narrower time zone in which delay will occur, substantiallly affecting IRR to the extent that the significance of the interserction grade-separation can be suspected. Nevertheless, traffic reduction will hardly occur in reality in view of the fact that, from the reason of capacity limitation, the traffic which do not go through San Miguelito Intersection will come back again. In Case 6, when the construction of Corredor Norte will be delayed, IRR will be even higher to suggest a greater significance of the improvement of San Miguelito Intersection.

TABLE III-5-15 EVALUATION RESULTS

CASE	DESCRIPTION	ANNUAL BENEFIT(1,000 B/.)			IRR(%)
		1983	1990	2000	
Case 1	With Corredor Norte	635	874/525	7698	24.5
Case 2	Cost +10%	635	874/525	7698	22.9
Case 3	Cost +20%	635	874/525	7698	22.9
Case 4	With Corredor Norte Extension	635	874/525	7698/4747	24.1
Case 5	Without Corredor Norte	635	874	7859	27.3
Case 6	Traffic Demand -10%	127	89/71	·3035	7.9

5.3 Social Impact of Road Projects

Road construction, new or improvement, will certainly bring about many different effects - direct or indirect, and positive or negatives. Of such effects, only savings in vehicle operating cost and travel time were considered as benefit in the project evaluation of the preceding sub-chapter. Here, aspects of other social impact will be reviewed.

5.3.1 Job creation

Panama is suffering from economic stagnation and accompanying serious unemployment, which is said to exceed 10% in urban areas. The population of Panama Metropolitan Area is 730,000 and population at work is 220,000. If unemployment corresponds to 10% of this, the number of the unemployment must exceed 2,000 in the Metropolitan Area.

In this situation, jobs to be created through the implementation of Corredor Norte and other road projects will be a hardly ignorable blessing. Because about 30% of the total investment will be in wages, and about one third of the wages will be paid to unskilled laborers, these projects will require, conservatively estimated, a total of 860,000 man-days of unskilled laborers (340,000 for new roads and 520,000 for improvement). Assuming a 3 years construction period, 700 to 800 unskilled laborers will have a job.

Taking into consideration additional employment opportunities to be indirectly created as a result of these projects, unemployment will be drastically reduced to less than the present level by the simultaneous implementation of all the subject road projects. This will be very helpful to the solution of social unrest.

5.3.2 Mitigation of Traffic Congestion

The values of major traffic indices as a result of traffic assignment under three cases are presented in Table III-5-16: that all road projects be implemented (Case 100), that only new road construction projects be implemented (Case 200), and that only existing road improvement projects be implemented (Case 300). Because the O-D traffic volumes remain the same, little difference in total operating distance (vehicle-kilometers) is seen between these cases.

TABLE III-5-16 TRAFFIC INDICATOR WITH/WITHOUT PROJECTS

Indicatiors	Case	Base Case		100		200		300	
	Year	1990	2000	1990	2000	1990	2000	1990	2000
1. Total Length of Network (km)		307.1	307.1	307.1	307.1	307.1	307.1	307.6	300.0
2. Traffic Load (1,000 veh./hr.)		5735.0	9134.0	5699.0	8847.0	5680.0	8852.0	5759.0	8972.0
3. Total Travel Time (1,000 veh./hr.)		653.0	1340.0	486.0	1102.0	515.0	1109.0	623.0	1318.0
4. Average Congestion Rate (Whole Area)		1.075	1.631	0.911	1.368	0.926	1.394	1.065	1.594
5. Average Congestion Rate (Central)		0.928	1.215	0.815	0.944	0.893	1.040	0.882	1.031
Length of Congestion Section (km)									
6. 1.0 and more		154.6	230.3	122.6	212.8	124.7	219.4	154.4	226.7
7. 1.5 and more		63.8	146.1	48.2	97.1	49.9	99.5	64.2	131.6
Traffic Volume Congestion Section									
8. 1.0 and more		3769.0	7505.0	2704.0	6759.0	2785.0	7014.0	3637.0	7257.0
9. 1.5 and more		2859.0	6349.0	1937.0	5008.0	2116.0	5045.0	2717.0	6254.0

Against the base case (do-nothing case, which assumes the implementation of none of these projects), Case 300 shows a slightly greater total operation distance in 1990, while Case 100 shows 25% less in 1990 but only 3% less in the year 2000. This indicates that the implementation of those projects subject to the Feasibility Study (Case 100) alone will be short of meeting the traffic demand estimated for the year 2000, as it can also be seen from the average congestion rates in far excess of 1.0 on all the project roads in that year. It is apparent that such other projects as Corredor Sur which were recommended in the Masterplan must also be implemented.

5.3.3 Transport Energy Conservation

The quality of traffic planning in Panama Metropolitan Area will have a significant impact upon the national energy situation. Of the total national energy consumption, the transport sector is responsible for 27% of all energy and for about one half of petroleum energy, according to the 1981 survey of the National Energy Commision (CONADE), while of the total 130,000 motor vehicles in Panama, 52% is concentrated in the Metropolitan Area. Then, it turns out that about one fourth of the total national petroleum energy consumption is used for motor vehicles in the Metropolitan Area.

Assuming that all the new and improvement road projects will be implemented, the forecast furture assigned traffic volume will come to a daily average of 8,850,000 vehicle-kilometers in the year 2000, which will be an about 3% saving from "do-nothing" case. The average rate of fuel consumption for each type of vehicle is applied to such operating distance value, and energy saving is estimated at 800,000 balboas in 1990 and at 6.5 million balboas in the year 2000. Using this accelerating trend of saving, the cumulative total savings from 1990 to 2000 is estimated at 40.1 million balboas. Allowing for the tax, which amounts to an average 25% of market prices of petroleum products, the national economy of Panama will enjoy an estimated 30.1 million balboas of petroleum fuel conservation as a consequence of the implementation of these projects.

Total investment in these projects will be 116.1 million balboas in terms of economic cost, and cumulative total depreciation of the facilities up to the year 2000 will be 42.6 million balboas. Then, as much as 70% of the investment will be recovered by said energy savings alone. It should be pointed out that the above is an underestimation of energy saving, because the estimation assumes a constant rate of fuel consumption per unit of operating distance and disregards the declining fuel economy to result from drop in vehicle operation speed.

5.3.4 Financial Aspect

Since the turn of the decade, the Ministry of Public Works (MOP) has invested from 50 to 70 million balboas for development purposes each year, but only seven or eight million balboas in roads in Panama Metropolitan Area (see Table III-5-17).

Now, if the local currency portion (60.7 million balboas) of the total project cost (115.8 million balboas) is to be invested over a period of six years from 1985 to 1990, this project package implementation will entail a yearly burden on the state coffers of nearly 20 million balboas on the average (all in 1983 prices). This means that such burden will suddenly swell to three times the past record.

TABLE III-5-17 RECENT INVESTMENT TO ROAD PROJECTS IN PANAMA METROPOLITAN AREA

YEARS	PROJECTS	AMOUNT (B/.1000)
1979	1. Construction of Pedestrian bridges	175
	2. Widening of Transistmica-Las Cumbres	300
1980	1 Widening of Transistmica (San Miguelito-Alcalde Diaz)	2,500
	2. Rehabilitation of street in Panama City	4,200
	3. Construction of Pedestrian Bridges Villa Lorena	40
1981	1. Widening of Via Porras	1,000
	2. Widening of Transistmica (San Miguelito-Alcalde Diaz)	1,500
	3. Rehabilitation of Transistmica	400
	4. Rehanilitation of Via Espana	250
	5. Maintenance of Street in Panama City	885
1982	1. Widening of Via Porras (street 87-Via Espana)	1,950
	2. Maintenance of street in Panama City	3,819
	3. Connection between El Paical-Test Block (Juan Pablo II)	120
	4. Street of San Miguelito	700
	5. Street of Francisco A. Paredes	234

If the foreign currency portion can be borrowed from international financial institutions and foreign governments, it will be imperative that said need of local currency portion be met domestically. In devising drastic measures to enable this, possibilities recommended for consideration include, but not limited to, the active utilization of the Panamanian wisdom called valorization, the Masterplan-recommended introduction of a new gasoline tax and appropriation to the road projects of at least a portion of proceeds from the sale of the Reverted Area to private parties.

5.3.5 Environmental Impact

The primary impact will be traffic noise. Of all the project roads, a heavy traffic of 30,000 to 70,000 vehicles per day is expected to flow at a fairly high speed on Corredor Norte, which will be a high standard street conforming to the specification of semi-high speed roads with a partially semi-access control. Assuming an hourly traffic of 3,500 vehicles with 15% large vehicles, estimation using a traffic noise model resulted in 66 to 68 db (A) at 30 meters from the edge of this road and in 65 to 66 db(A) at 50 meters. Compared with the traffic noise of 62 to 64 db(A) calculated 30 meters from Via Ricardo J. Alfaro in the vicinity of Villa Caceres (hourly traffic of 1,800 vehicles with 7% large vehicles), the level of noise from Corredor Norte will be higher by only about 4 db(A) and will not be a particular problem. In the sections of Corredor Norte lined with houses, it will be desirable that a 30 to 40 meter buffer zone be established.

Any impact upon natural environment will be only from Via El Paical Extension to be constructed across the area designated for the natural park. Once inhabited by Panama Canal construction workers and later vacated, this area has spontaneouly returned to a natural forest. Although without any rare species, the vegetation makes the are a valuable land of abundanat green in a proximity to the built-up area. Therefore, the road designing should strive to keep tree felling to an essential minimum so that the road will have the least detrimental effect upon the natural beauty of the park, while the road will be a pleasant thoroughfare running in the shade of trees. Delicately distributed mounds will much conceal the road from the eyes of park visitors.

The intended route of El Paical Extension will also pass through an area where Camino de la Cruz, a stone paved road from the 16th Century, is possibly burried. This possibility was not thought of and the historical asset was not found when Camino de la Amistad was constructed through this same area. This time, however, the earthwork should be carried out carefully along with archeological investigations and, should the old stone road be found, the route of Via El Paical Extension should be reexamined for the preservation of this cultural asset.

5.4 An Overall Evaluation and Recommendations

Despite the diverse levels of economy of the individual projects, the high overall economy of the projects as a whole, indicated by the high internal rate of return of 26.4%, makes the implementation of these projects as one package recommendable.

However, the simultaneous implementation of all of these projects accompanies an apprehension in the aspect of fund generation, inasmuch as the required investments will be incomparably greater than the previous size of Metropolitan Area road development investment funds, as pointed out in the previous sub-chapter. Also, the contract processing and surveillance capacities of the government can be a bottleneck. It is, therefore, quite possible that the implementation of some of the projects will be held back until the 1990s.

Just in case such deferral becomes inevitable, the relative priority orders should be assigned to the projects from an overall perspective. The priorities shall be assessed against the following four criteria:

a. Economic Eifficiency (the internal rate of return shall be the index of this efficiency)

b. Financial Impact (or burden on government finance, measured by the index of the amount of investment)

c. Social Impact (measured chiefly in terms of the ease of land acquisition, while considering the effects of changes in land use).

d. Development Effect (Urban development potentiality or related effect to the development of other projects).

On the strength of the result of this assessment (see the result in Table III-5-18), the following recommendations are hereby made.

TABLE III-5-18 PRIORITY SETTING OF ROAD PROJECTS

Section / Criteria	(1)Economic Efficiency	(2)Financial Impact	(3)Social Impact	(4)development effect	(5)Comprehensive priority
New Road Construction					
1. Corredor Norte West	△	△	○	○	2
2. Corredor Norte East	○	▲	○	○	1
3. Corredor Norte Los Andes	○	▲	▲	○	1/3 *
4. San Miguelito West	○	▲	△	△	1/3 *
5. El Paical Extention	○	○	△	△	1
6. Martin Sosa Extention	▲	△	△	○	3
7. Cerro Ancon Extention	▲	○	△	△	3
Road Improvement					
8. Via Espana	○	▲	▲	△	4
9. Via Bolivar	▲	○	○	△	4
10. Via El Paical	▲	△	▲	△	5
11. Via Cerro Ancon	▲	△	▲	○	2/4 **
12. San Miguelito Int.	○	○	○	○	1

Note: ○: Good △: Fair ▲: Bad
* Project 3 and 4 are competitive. If one has priority 1, the other has 3.
** If new roads are developed, project 11 has priority 2, otherwise, 4.

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 three 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 area 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. The next highest priority should be placed on the western half of Corredor Norte, followed by Via San Miguelito Oeste, Via Martin Sosa Extension, and Via Cerro Ancon Extension, in that order.

An administration project unit teams 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 exisitng 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.

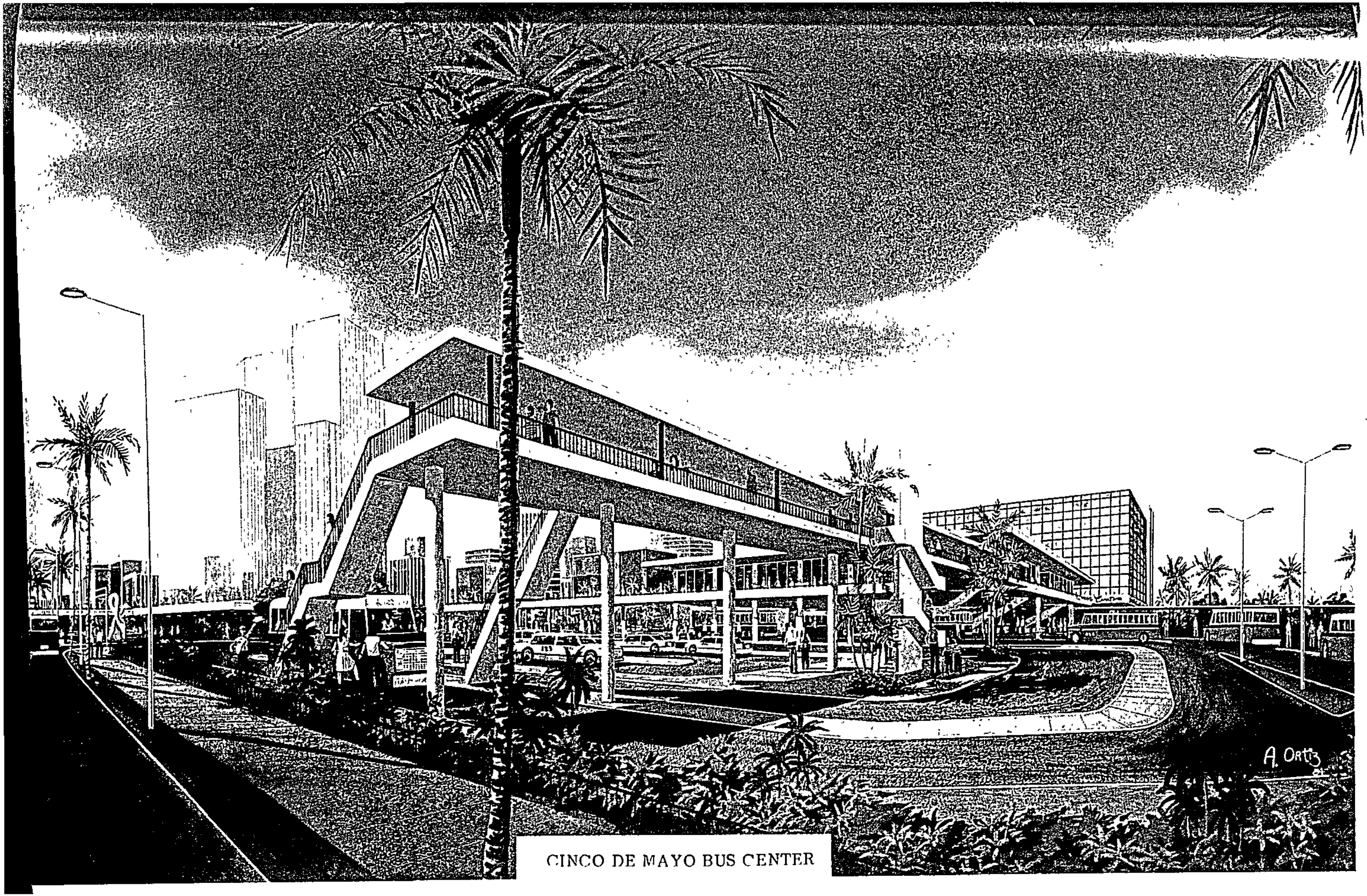
If Corredor Norte is opened in the near future, the widening and improvement of Via Espana is of no urgent need. If Corredor Norte is constructed in the distant future (such as the end of the century) or if it is not constructed at all, this project will bring about a very substantial benefit (IRR =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

Contrary to Via Espana, the construction of Via Cerro Ancon will be a very important project if the new road is 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%.

Ⅳ. PUBLIC TRANSPORTATION FACILITY PROJECTS

1. BUS CENTER PROJECTS

2. BUS MAINTENANCE CENTER PROJECT



CINCO DE MAYO BUS CENTER

IV PUBLIC TRANSPORTATION FACILITY PROJECTS

1. Bus Center Project

1.1 Present Bus Service Condition

1.1.1 Demand and Supply Structures

1) Bus Demand Structure

The 1981 ESTAMPA I person-trip survey found a total of about 440,000 urban bus passengers per day in Panama city bus service area, which amounted to 43.5% of all trips excluding walking trips. The same study found that about 80% of the urban inhabitants accepted the bus as their major mode of transport. Demand for bus transport is generated mostly by no-car owning class with a monthly income of 500 balboas or less. About 80% of those with the monthly income of 300 or less and about 70% of those with an income between 300 and 500 balboas use the bus as their chief mode of transport.

The origin destination(O-D) structure of bus passengers are typically characterized as follows as observed in Table IV-1-1:

TABLE IV-I-1 BUS PASSENGER OD, BY 1981 PT SURVEY

(1,000 Trips)

ORIGIN		DESTINATION								
		I	II	III	IV	V	VI	VII	E	Total
I	Centro	28	13	34	12	2	22	4	16	130
II	Bella Vista	14	2	13	6	1	10	2	4	50
III	Area Residencial	34	13	34	10	2	19	3	6	122
IV	Juan Diaz/Pedregal	12	6	9	10	2	3	1	2	45
V	Tocumen	2	1	2	2	2	1	-	-	10
VI	San Miguelito	21	10	19	3	1	17	2	3	79
VII	Ancon Este	4	2	3	1	-	2	4	2	18
E	External Area	15	4	6	2	-	19	2	25	55
	Total	128	50	121	47	11	78	18	57	510

SOURCE: ESTAMPA I

a) Centro area has a strong attractive power as the center of Panama City, as evidenced by the fact that the number of urban bus trips originating or terminating in Centro area totalled 230,000, about half of the total 440,000 trips. For travel within Centor area, a total of 28,000 bus trips were made.

b) Centro area is followed by an intermediate area between the downtown and a suburb, that is, from Punta Paitilla to Rio Abajo (the area called "Area Residencial" in the Masterplan), where originating and terminating bus passengers numbered 120,000 each, of which 68,000 passengers were going to or from Centro area.

c) Sandwiched between the above two areas, Bella Vista is growing as a new urban center, but, because many of the residents use their own cars, the number of bus passengers is relatively small, at trip generation and attraction of 50,000 each.

d) These three areas (Centro, Area Residencial and Bella Vista) together generated and attracted about 70% of total bus trip demand and, therefore should be carefully reviewed in future bus planning.

e) Bus transport demand generating in the eastern area (Juan Diaz, Pedregal and Tocumen) is 54,000 passengers, of which 21,000 proceed to Centro-Bella Vista. On the other hand, the demand generating in the northern part of the city (San Miguelito, Las Cumbres and Chilibre) is 83,000 passengers, of which 33,000 go to Centro-Bella Vista.

Demand for bus transport presents three daily peaks (see Fig. IV-1-1): a morning peak from 6:00 to 8:00, a noon peak from 11:00 to 13:00, and an evening peak from 16:00 to 18:00, for a total of six hours into which 60% of total daily demand is concentrated. However, the hourly variation of bus traffic at Teatro Edison Bus Stop in Centro, where a large number of bus routes converge, fails to present as distinct peak hours. Buses run rather frequently even during the hours of few passengers, and this is chiefly because bus operation is left up to the driver's discretion rather than to a controlled schedule.

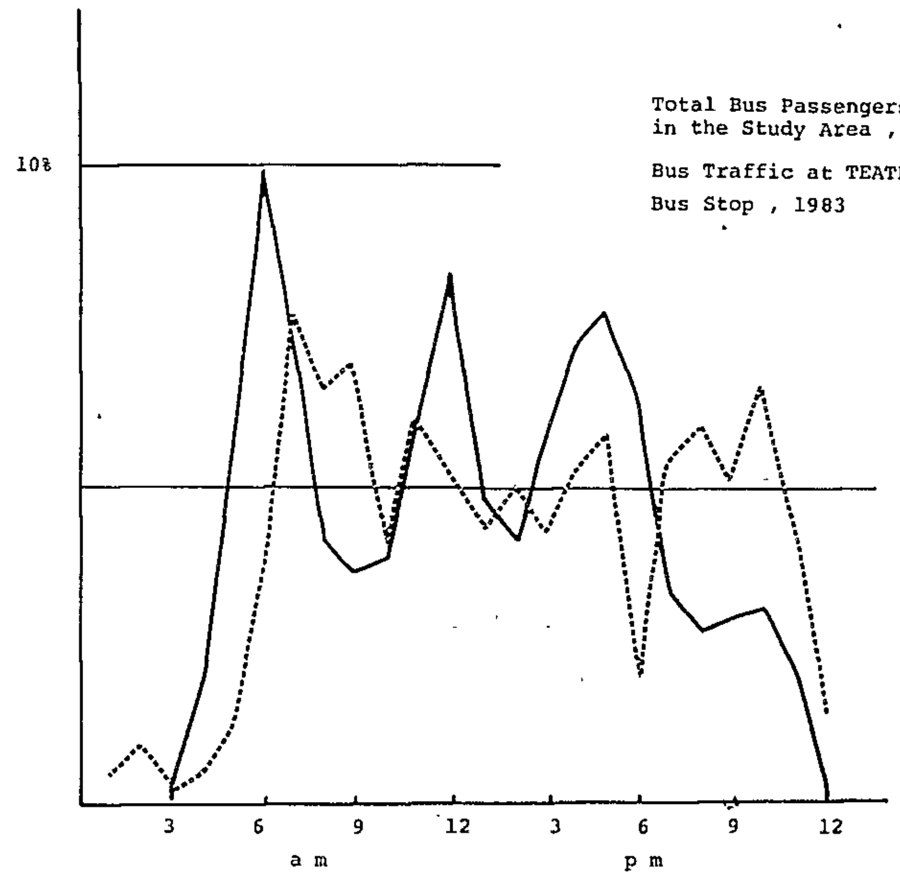


Fig. IV-1-1 HOURLY FLUCTUATION OF BUS PASSENGERS AND BUS SERVICE

2) Bus Service Supply-Demand Balance

Total number of urban buses registered decreased from the 1,455 in 1981 to 1,127 in 1983, while the number of operational buses droped from 1,088 to 910. During this period, the traffic police (DNTTT) revoked "ghost" registrations and caused the scrapping of superannuated unserviceable buses. As a result, average seat capacity per bus increased from 47 to 53.

According to the 1983 ESTAMPA II survey findings, the total travel distance of buses is 101,046 Km/day, and average travel distance is 111 Km/bus/day. Therefore, the maximum transport capacity can be calculated as;

53 passengers x 910 buses x 111 Km/day = 5,353,530 persons/Km/day

On the other hand, the number of bus passengers is estimated at 509,100 and the average trip length at 7.4 Km in 1983, for the total transport demand of 3,767,340 persons/Km/day, which amounts to 70% of said total transport capacity. Because the seat occupancy ratio of the bus was 58% in 1981, it may be claimed that the transport efficiency of the bus has been improved, while it means to the passengers that bus service frequency dropped and the buses have become more crowded.

Presently a total of 56 city bus routes are in service as a result of three deletions (route numbers 3, 14 and 52 from Panama Viejo, Villa Rica, and Santa Marta) and the following five additions in 1983 to the 54 routes which existed in 1981:

Victoriano Lorenzo - Via Espana - Centro
Los Andes - Via Espana - Centro
Bello Horizonte - Via Espana - Centro
Ciudad Bolivar - Ricardo J. Alfaro - Centro
Veranillo - Via Espana - Centro

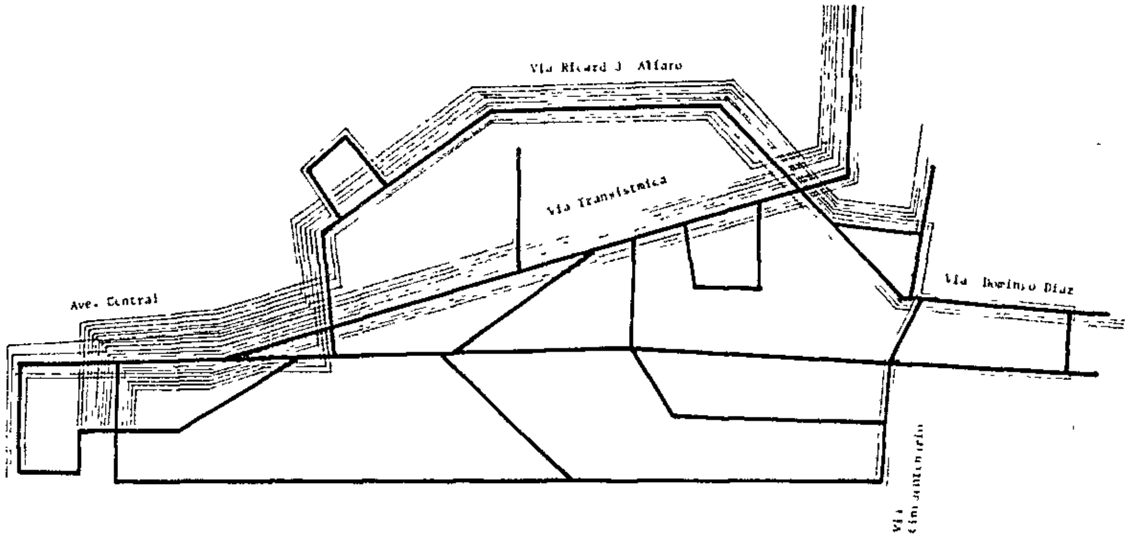
A route map is presented in Fig. IV-1-2. Almost all routes originate in Tocumen, San Miguelito, or other suburban area and go to Centro. They turn back at Calle 12 in San Felipe and Chorillo and return to the original piquera through the same routes with the exception of some one-way street sections.

Peak hour bus demand is estimated for each bus route and compared with the actual service frequency (see Table IV-1-2).

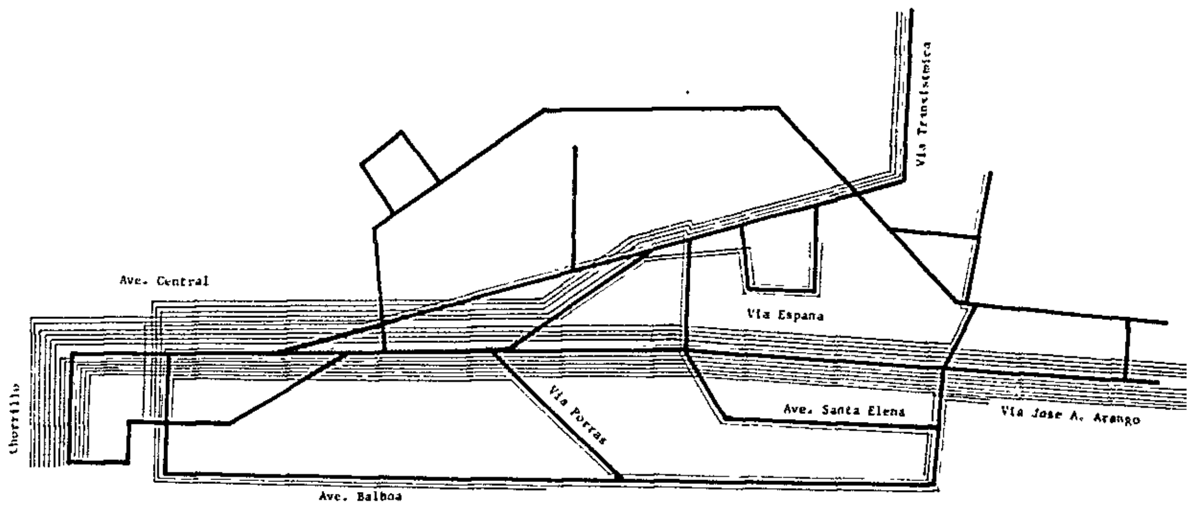
As a result, buses were found very crowded in the following routes, where the demand far exceeds the supply.

Villa Rica - (Via Fernandez de Cordoba) - Centro
Veranillo - (Via Espana) - Centro
San Pedro - (Via Espana) - Centro
Juan Diaz - (Via Espana) - Centro
Pedregal - (Via Espana) - Centro
Tocumen - (Via Espana) - Centro

The fact that, while adequate number of buses are in operation to satisfy the demand on the average, over-and short-supply of service is conspicuous on certain routes indicates less than efficient allocation of buses to individual routes.



(1) BUS ROUTE IN NORTHERN PART



(2) BUS ROUTE IN SOUTHERN PART

Fig. IV-1-2 BUS ROUTE NETWORK, 1983

TABLE IV-1-2 NUMBER OF BUSES REQUIRED IN PEAK HOUR, 1981

Code	Route	Through Max. Passengers	Average Capacity of Bus	Buses Required per hour	Travel Time for one per Round Trip (Hour)	Total Buses Required	Buses Actually Operated per hour
1	Panama Viejo - Via Porras - Calle 12	583	47	6.2	2.5	16	8.5
2	Panama Viejo - Ave. Balboa - Calle 12	1,339	51	13.1	2.0	27	7.5
3	Panama Viejo - Via 11 de Octubre - Calle 12	387	54	3.6	2.0	8	1.5
4	El Cruce - Ave. Balboa - Corozal	374	46	4.1	1.0	5	8.0
5	Panama Viejo - Santa Clara - Calle 12	276	52	2.7	3.0	8	2.0
6	Panama Viejo - San Miguelito - Calle 12	346	54	3.2	2.5	8	3.0
7	Parque Legislativo - Ave. Balboa	580	16	18.1	1.0	19	15.5
8	El Cruce - Curundu	46	53	0.4	1.0	1	1.0
9	Boca La Caja - Calle J - El Chorrillo	950	27	17.6	1.5	27	20.0
10	El Cruce Clayton	215	47	2.3	1.5	4	2.7
11	Betania - Via Transistmica - El Chorrillo	891	47	9.5	2.0	19	9.5
12	Villa Rica - Puente - El Chorrillo	625	39	8.0	2.0	16	5.0
13	Villa Rica - Calle 9a. - El Chorrillo	995	43	11.6	2.0	24	8.5
14	Villa Rica - Puente - Mercado	124	34	1.8	2.0	4	2.0
15	Veranillo - Via Espana El Chorrillo	1,848	51	18.1	2.5	46	7.0
16	El Cruce - Albrook - Diablo	52	57	0.5	1.0	1	1.0
17	Veranillo - Via Transistmica - El Chorrillo	1,909	61	15.6	2.5	39	16.0
18	Automotor - Via R. J. Alfaro - Calle 12	636	46	6.9	2.0	14	6.5
19	Samaria - Via R. J. Alfaro - Calle 12	329	51	3.2	2.0	7	7.0
20	El Cruce - Paraiso	206	48	2.1	1.5	4	2.5
21	Veranillo - Via R. J. Alfaro - Calle 12	247	70	1.8	2.0	4	0.5
22	El Cruce - Rodman - Cocoli	52	46	0.6	1.0	1	0.5
23	Villa Lorena - Via Espana - Calle 12	73	45	0.8	2.0	2	0.5
24	El Cruce - Amador	118	48	1.2	1.0	2	3.0
25	Villa Lorena - Via Espana - El Chorrillo	104	42	1.2	2.5	3	1.5
26	Villa Lorena - Calle J. - El Chorrillo	516	32	8.1	2.0	17	6.0
27	San Pedro - Via Espana - Calle 12	1,022	44	11.6	2.5	29	12.5
28	San Pedro - Via Espana - El Chorrillo	1,319	40	16.5	2.5	42	6.5
29	San Pedro - Calle J. - El Chorrillo	713	40	8.9	2.0	18	9.0
30	Juan Diaz - Via Espana - El Chorrillo	1,060	48	11.0	2.5	28	7.0
31	Pedregal - Via Transistmica - El Chorrillo	2,848	49	24.1	2.5	61	18.0
32	Pedregal - Via Espana - El Chorrillo	1,874	46	20.4	3.0	62	20.5
33	Pedregal - Via R. J. Alfaro - Calle 12	359	58	3.1	2.5	8	2.5
34	La Mananitas - Via R. J. Alfaro - Calle 12	711	52	6.8	3.0	21	6.0
35	El Cruce - Gamboa	65	43	0.8	2.0	2	1.3
37	Tocumen - Via Espana - El Chorrillo	1,903	47	20.2	3.5	71	9.5
39	Santa Librada - Via R. J. Alfaro - Calle 12	417	52	4.0	3.0	12	3.0
40	Cerro Batea - Via R. J. Alfaro - Calle 12	711	51	7.0	2.5	18	5.0
41	El Valle - Via Espana - Calle 12	556	48	5.8	2.0	12	5.0
42	El Valle - Via Transistmica - Calle 12	898	51	8.8	1.5	14	4.5
43	Los Andes - Via R. J. Alfaro - Calle 12	590	46	6.4	2.0	13	4.5
44	Alcalde Diaz - Via Transistmica - Calle 12	1,500	55	13.6	2.5	34	13.0
45	Santa Librada - Via Espana - Calle 12	915	50	9.2	2.5	23	3.0
46	Santa Librada - Via Transistmica - Calle 12	973	52	9.4	2.0	19	8.5
47	Cerro Batea - Via Transistmica - Calle 12	1,024	52	9.8	2.5	25	9.0
48	Cerro Batea - Via Espana - Calle 12	421	49	4.3	2.5	11	4.5
49	Bello Horizonte- Via Transistmica- El Chorrillo	898	58	7.7	2.5	20	8.5
50	Bello Horizonte - Via Espana - El Chorrillo	739	49	7.5	3.0	23	6.0
51	El Cruce - Howard - Kobee	256	50	2.6	1.0	3	2.5
52	Santa Marta - Monte Oscuro - Calle 12	352	57	3.1	3.0	10	2.5
53	Chilibre - Area del Canal - Panama	476	41	5.8	1.5	9	6.0
54	Panama - Area del Canal - Chilibre	482	41	5.9	1.5	9	6.5
55	Chilibre - Via Transistmica - Panama	174	38	2.3	2.0	5	3.0
56	Panama - Via Transistmica - Chilibre	190	41	2.3	1.5	4	2.0
TOTAL		37,267		401.2		932	

SOURCE: ESTAMPA I

1.1.2 Bus Service Quality

1) Running Speed

The average running speed of buses is about 20 km/hr, but in sections of Via Espana and Ave. Central it drops to less than 10 km/hr. Also in parts of Via Ricardo J. Alfaro and Ave. Justo Arosemena, the speed drops below 15 km/hr depending on the hour of the day.

Presently, there are a total of 56 urban bus routes, with an average length of 17.8 km. Many suburban routes are long, and 12 of them are 20 km or longer. With a relatively high operation speed, a round trip service takes 3.0 to 3.5 hrs. on seven routes. Generally, the longer the route, the greater the variance of demand by section zone and the lower the passenger density and profitability. This is true also in Panama itself and is another reason why bus rerouting is wanted.

2) Operation Hour and Service Frequency

Bus operation generally starts from about 5:00 A.M. in the morning and is continued until about 23:00 P.M. at night. However, SICOTRAC buses are not operated by any schedule but at the discretion of each driver and, therefore, on arterial roads, two or three buses are being operated even during night hours. SACA buses and buses operated on Ave. Balboa stop operation at 21:00 P.M. at night, and the last bus for Las Cumbres way leaves at 21:30 P.M.

Bus service frequency is low (30 or less per day) on Gaillard Road, Ave. Santa Elena, and Via 11 de Octubre. On roads which traverse the built-up area, such as Via Espana, Via Transistmica, and Via Ricardo J. Alfaro, bus service frequency exceeds 300 per day, except on Ave. Balboa (Fig. IV-1-3).

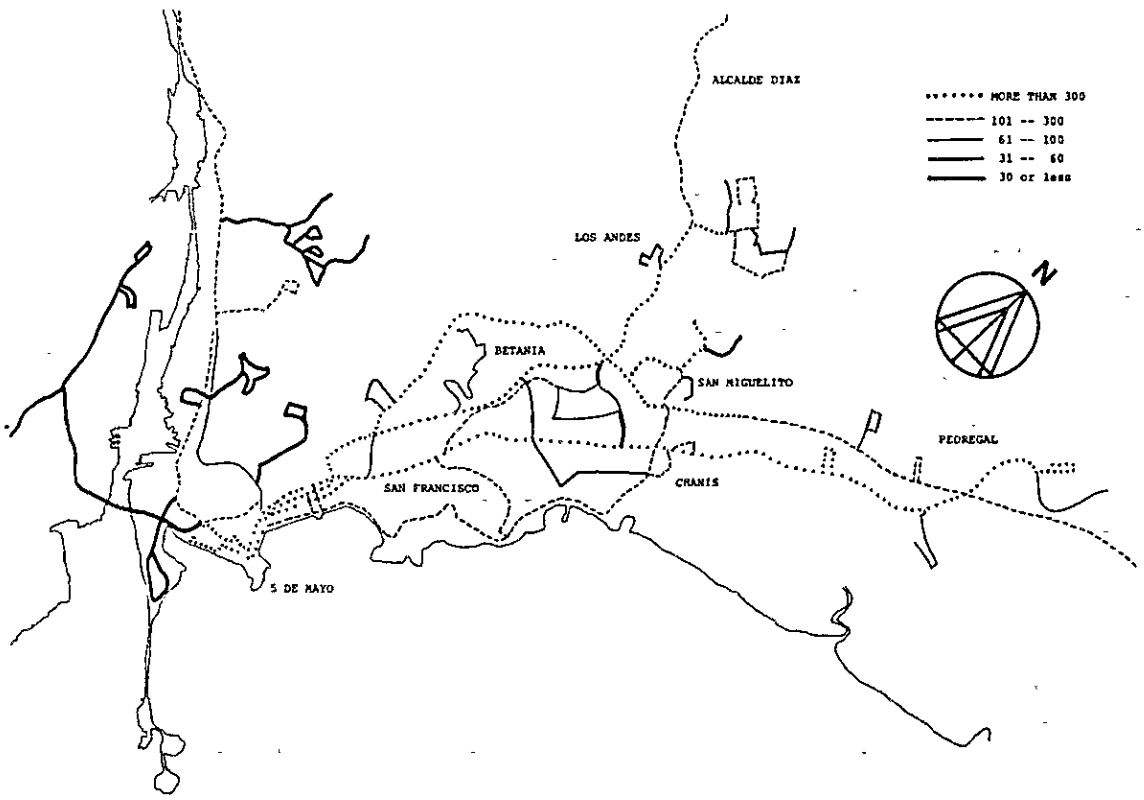


Fig. IV-1-3 BUS SERVICE FREQUENCY (SERVICE DAY)

3) Bus Fares

Two tariff systems are in effect: the zone fare system used in major urban areas, and the fixed route fare system used chiefly in the Canal Area.

By the zone system, San Miguelito and a part of Juan Diaz are within one zone from Centro and the basic fare is 15 cents, beyond which, 5 cents is added for every extra zone. From Centro to Alcalde Diaz is three zones and the fare is 25 cents, while up to Tocumen is four zones and 30 cents. Fares are all paid in cash with no ticket and no season ticket is sold. Children (free up to five years of age) and students (5-cent discount for up to senior high school children only when wearing the uniform) are subject to discount system (Fig. IV-1-4).

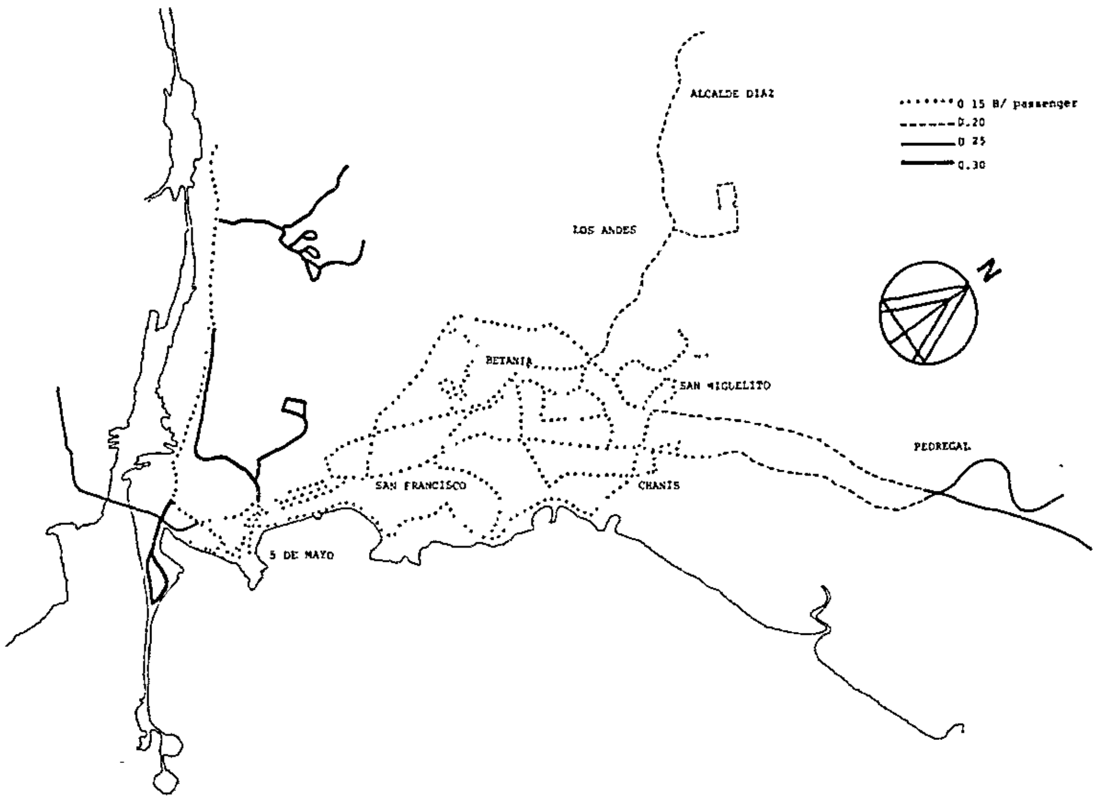


Fig. IV-1-4 ZONE SYSTEM OF BUS TRAFFIC TO/FROM CENTRO

SACA bus fares are fixed by route, 20 cents up to Corosal, 30 cents up to Curundu, Diablo, or Amador, 35 cents up to Fort Clayton or Paraiso, 40 cents up to Cocoli or Kobbe, and 65 cents up to Gamboa.

4) Bus Stops and Terminals

Average distance between bus stops is 220 m on Ave. Central, 330 m on Via Espana, 450 m on Ave. Balboa, and 500 m on Via Ricardo J. Alfaro—the lower the residential house density the longer the distance. Those with shelter account for 80% of all bus stops on Via Simon Bolivar and Via Espana, but only 50% on all other roads. On Via Domingo Diaz, Via Simon Bolivar, and Via Espana, 60 to 70% of bus stops have a bus bay, while on other roads, less than 40%.

No urban bus terminal is located in the urban center. Inter-city bus terminals with crude facilities are located on Ave. B and other locations. At the origin of bus routes in the suburbs, there are small terminals with poor facilities called piqueras. Fig. IV-1-5 shows the location of piqueras.

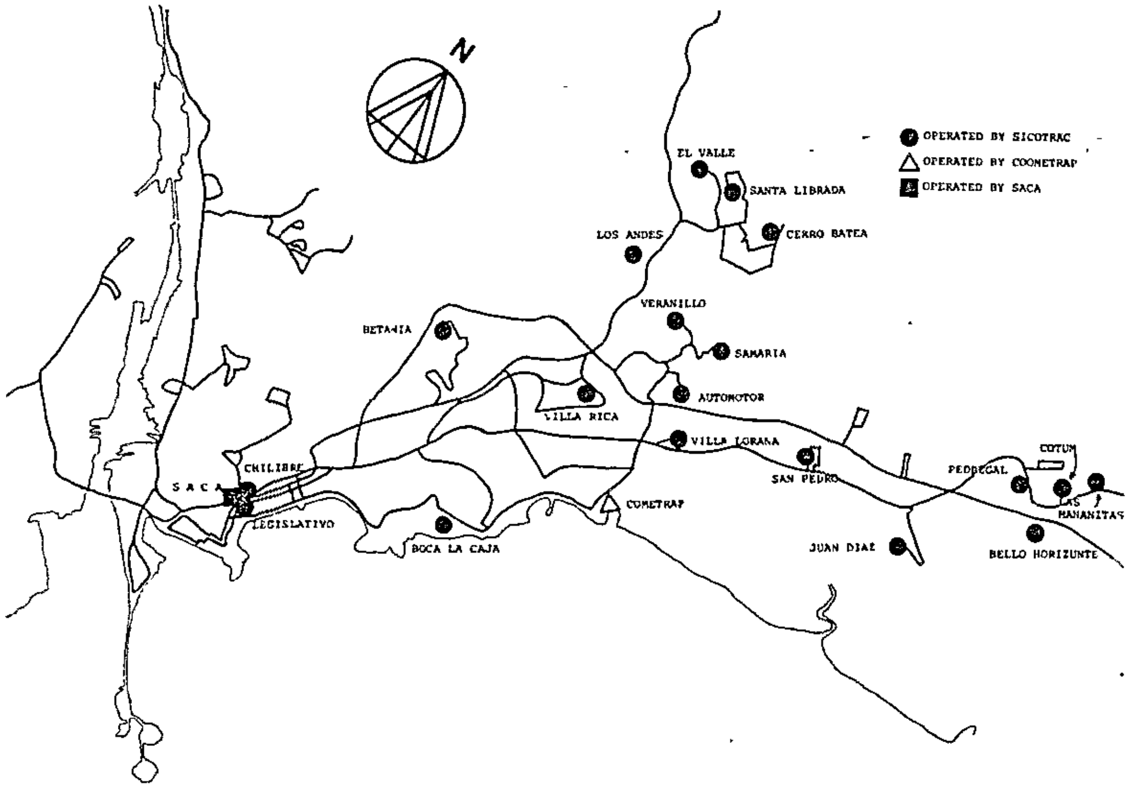


Fig. IV-1-5 LOCATIONS OF PIQUELAS

5) Traffic Accidents

In 1980, traffic accidents involving a bus numbered 1376, or 17% of total traffic accidents. This was at the rate of 81.5 accidents per 100 buses — a rate very high in relation to other types of vehicles. Accident statistics for Panama City for the years of 1978 and 1980 are presented in Table IV-1-3.

TABLE IV-1-3 TRAFFIC ACCIDENTS IN PANAMA CITY

Vehicles Type/Accidents		No. of Accident		Accidents/100 Vehicles	
		1978	1980	1978	1980
Private Vehicles	Passenger Car	3853	4223	9.5	7.8
	Bus	12	18	3.8	5.1
	Truck	140	178	14.2	7.6
	Others	---	1	---	3.4
Commercial Vehicles	Passengers Car	883	964	25.0	25.7
	Bus	1258	1376	88.3	81.5
	Truck	1098	1233	18.5	14.0
	Others	11	8	19.0	13.8
Other Vehicles	Motorcycle	60	85	6.3	8.4
	Bicycle	55	64	1.3	2.1

SOURCE: CONTRALORIA GENERAL/ESTAMPA

1.1.3 Bus Business Operators

Of the total of three bus business operating entities existing in Panama as of the end of 1983, the largest is SICOTRAC, which owns 93% of all buses and carries 96% of all passengers. SICOTRAC is a syndicate organized by bus owners and drivers and is not a bus company in the ordinary sense of the word. As an organization to protect the member interests, it negotiates with the government on route changes and fare revisions, is engaged in fuel supply service (tax-free fuel is available for buses), and controls the order of bus departure from each piquera. Within SICOTRAC, diverse relationships exist between the bus owner and the driver, but the most common arrangement is that the driver rents a bus from the owner for a fixed price and defrays the cost of operation except for repairing and insurance. SICOTRAC prohibits the ownership of more than two buses by any of its members (Table IV-1-4).

TABLE IV-1-4 BUS OPERATORS IN PANAMA CITY, 1983

Operator		No. of Buses Registered	No. of Buses Operated	Operation Ratio(%)	Agerage Age of Buses
SICOTRAC	Sindicate	1,098	885	80.6	8.6
COOMETRAP	Cooperative	29	25	86.2	7.0
SACA	Cooperative	42	42	100.0	N.A.
Total		1,169	952	89.9	

SOURCE: ESTAMPA

SACA covers the Canal Area for service, has its own tariff system, practices an advanced vehicle maintenance system with periodical inspections and parts inventory control, and is faring well. The fleet of COOMETRAP, once a large organization having over 200 buses, has been shrinking rapidly in the recent years.

The bus business profitability analysis in ESTAMPA Masterplan Study found that, despite the high seat occupancy ratio of 60 to 70%, the low fare rates and the low bus operation ratio depressed the profitability so low that it was difficult for a new entrant into the industry with a new bus to realize any profit. In reality, bus business operators continue their business contented with an apparent profit resulting from their disregard of the opportunity cost of capital and depreciation expenses; in fact, many of their buses are fully depreciated old buses. Should the opportunity cost of capital and depreciation expense be ignored, break-even point can be exceeded with passenger occupancy of 50% of the capacity (Table IV-1-5).

TABLE IV-1-5 FINANCIAL CHARACTERISTIC OF BUS OPERATORS, 1981

	Total Operation Kilometrage(Km)	Total Sales/day (Balboa)	Passenger per Route Length (pax/Km)	Passenger per Operating Km (pax/Km)	Sales per Operating Km (cents/Km)	Sales per Passenger Kilometers (cents/pax.Km)
SICOTRAC	107,064	66,634	348	3.9	62.2	2.20
COOMETRAP	8,438	5,328	240	4.4	63.1	2.55
SACA	5,196	2,819	38	1.7	54.3	4.30
COTUM	4,382	1,960	175	2.6	44.7	2.18
NOV.20 NOV.	1,274	866	133	4.0	68.0	2.20
Co. Y. INDEP.	5,278	2,091	38	1.2	29.6	1.53
AVERAGE	131,632	79,698	261	3.7	60.5	2.22

SOURCE: ESTAMPA I

Many relatively short routes, such as those originating from San Miguelito or San Isidro, show good profitability, while many long routes originating from Chilibre or Tocumen, where little population concentration exists near the piquera, show poor profitability.

Bus business operators fail to realize the importance of vehicle maintenance, as it will be further discussed later, and buses are being repaired only upon breakdown, rather than subjected to a preventive maintenance program. Thus, the maintenance expense of buses tends to be rather high.

1.1.4 Public Transport Administration

Bus business is generally under the jurisdiction of the Ministry of Internal Justice (MIGJ). Under MIGJ is the National Police (Fuerzas de Defensa), a function of which is the Traffic Police (DNTTT). DNTTT issues drivers licenses, inspects and registers buses, approves bus operation, and attempts to eliminate all that impede bus operation. The Land Transportation Agency (DINTRAT), which is also under MIGJ, issues bus route franchises, approves bus terminal plans and construction, and advises the Price Adjustment Agency on the determination and revision of bus fares. All buses must be inspected by DNTTT once a year and receive a renewed number plate from the municipal office.

Central Panamena Trabajadores del Transporte (CPTT) is a private umbrella organization of bus, truck, and taxi industries. CPTT coordinates and adjusts between and among land transportation businesss organizations as necessary and attempts to solve any land transportation problems in cooperation with said two government authorities. Taxi drivers are organized into an association called FENACOTA.

1.2 Future Bus Demand and Bus Rerouting Plan

1.2.1 Future Bus Demand

The total number of daily bus trips in the Study Area is predicted to increase to about 600,000 in 1990, or about 1.6 times the present, and to 800,000 in 2000.

Bus trips are most concentrated in Centro (I), followed by Area Residencial (III), and, Bella Vista (II). In view of the large land size of Area Residencial, the concentration density is heavy in Centro and Bella Vista, the former attracting about 2.4 times greater trips than the latter at the present, and a reduced 1.7 times in 1990. Although Bella Vista will grow as an urban center faster than will Centro, Centro will still attract 15% greater number of bus trips than will Bella Vista in 1990.

Bus trips O-D (Integrated Zones) table for 1980 is shown in Table IV-1-6, and those for future, in Table IV-1-7 and IV-1-8. In 1980, six O-D pairs had a heavy bus traffic of 15,000 or more person-trips (excluding inter-zonal trips): Centro to and from Area Residencial, Centro to and from San Miguelito, and Area Residencial to and from San Miguelito. Those with 10,000 or more person-trips per day were: in addition to the above six, Juan Diaz-Pedregal to and from Centro, from Area Residencial to Juan Diaz-Pedregal, Bella Vista to and from Centro, and Bella Vista to and from Area Residencial. Similarly in 1990, a bus traffic of 15,000 person-trips per day or more will be seen in all combinations of Centro, Bella Vista, Area Residencial, and Juan Diaz-Pedregal with the exception of three pairs: Juan Diaz-Pedregal to and from San Miguelito and from Bella Vista to Juan Diaz-Pedregal. However, pairs with 24,000 person trips per day (which is 1.6 times the 15,000 person trips, in view of the fact that overall bus trip is estimated to increase 1.6 times) will still be the same six pairs made up by the combination of Centro, Area Resiencial and San Miguelito.

The existing bus routes can be conceived of as those providing shuttle service between suburban residential areas and Casco Viejo via Plaza 5 de Mayo. The number of bus routes becomes greater in the urban area than in the northern and easthern suburban areas, and most of the routes converge onto either Via Transistmica or Via Espana in the vicinity of Bella Vista. After that, all routes lead to Casco Viejo, where they are divided into two: one group of routes turn around at Calle 12 and the other at El Chorrillo and both return to their origins. Therefore, the number of bus routes reaches maximum in the vicinity of Plaza 5 de Mayo, which is an entrance to Casco Viejo.

The number of passengers also increases as the bus moves from suburban areas to Panama Urban Area and reaches maximum between Area Residencial and Bella Vista, after which, it decreases slightly, towards Centro. In Centro, the concentration of bus passengers is large in Calidonia and Santa Ana, but only a small number of passengers reach deep into Casco Viejo (that is, El Chorrillo and San Felipe). This pattern will remain unchanged in 1990.

From the above observation of bus routes and passengers, the followings can be pointed out:

a) The demand reaches maximum at the middle of bus routes, but bus service enlarges towards the end of routes (urban center), throwing demand and supply out of balance.

TABLE IV-I-6 BUS PASSENGER OD, BY 1981 PT SURVEY

(1,000 TRIPS)

	Origin	Destination								
		1	2	3	4	5	6	7	8	Total
1	Centro	27.7	13.4	33.7	12.5	1.9	21.8	4.3	15.7	131.2
2	Bella Vista	14.0	1.9	12.8	5.6	0.7	9.7	1.6	3.7	50.0
3	Area Residencial	34.1	13.0	34.3	10.2	1.8	19.0	3.3	5.9	122.1
4	Juan Diaz/Pedregal	11.6	5.9	9.4	9.9	1.8	3.3	0.4	2.0	45.3
5	Tocumen	1.8	0.7	1.6	2.5	1.9	1.3	0.2	0.4	10.4
6	San Miguelito	21.0	9.9	19.4	3.3	1.4	16.9	2.1	2.7	78.0
7	Ancon Este	3.9	1.8	3.4	0.3	0.3	2.0	4.4	1.6	17.7
8	External Area	14.1	3.7	5.8	1.8	0.4	2.6	1.4	25.1	54.9
	Total	128.4	50.3	120.9	46.7	10.7	77.8	17.7	57.1	509.6

SOURCE: ESTAMPA I

TABLE IV-1-7 BUS PASSENGER OD, 1990

(1,000 Trips)

	Origin	Destination								
		1	2	3	4	5	6	7	8	Total
1	Centro	24.5	16.4	36.4	17.5	4.8	26.0	8.1	28.9	162.6
2	Bella Vista	16.0	5.4	19.0	11.5	2.6	15.7	6.0	13.7	89.9
3	Area Residencial	40.0	21.8	47.9	17.0	5.4	25.1	8.6	17.5	183.3
4	Juan Diaz/Pedregal	16.0	11.0	17.5	16.2	7.3	6.9	1.2	7.0	83.1
5	Tocumen	4.1	2.5	5.3	6.4	4.1	3.2	0.7	2.9	29.2
6	San Miguelito	27.3	16.3	27.6	7.1	2.5	23.5	5.0	7.9	117.2
7	Ancon Este	6.4	4.5	8.9	1.2	0.7	5.9	8.0	6.1	41.7
8	External Area	23.5	13.9	17.4	6.5	2.7	7.3	4.7	64.0	140.0
	Total	157.8	91.8	180.0	83.4	30.1	113.6	42.3	148.0	847.0

SOURCE: ESTAMPA I

TABLE IV-1-8 BUS PASSENGER OD, 2000

(1,000 Trips)

	Origin	Destination								
		1	2	3	4	5	6	7	8	Total
1	Centro	19.2	15.2	32.7	20.4	5.9	30.6	7.8	32.7	164.5
2	Bella Vista	14.4	5.9	21.2	16.3	3.7	22.3	7.5	19.5	110.8
3	Area Residencial	34.5	24.1	50.3	21.6	7.3	34.5	9.5	24.1	205.9
4	Juan Diaz/Pedregal	17.4	14.8	21.5	25.3	15.1	15.5	2.3	13.3	125.2
5	Tocumen	4.9	4.2	8.8	11.8	6.2	7.7	1.4	6.5	51.5
6	San Miguelito	32.4	23.2	39.0	16.3	6.4	49.6	10.1	18.7	195.7
7	Ancon Este	6.4	5.6	10.6	2.2	1.1	10.9	10.7	9.8	57.3
8	External Area	30.9	22.9	27.7	13.4	6.1	19.0	8.1	121.8	249.9
	Total	160.1	115.9	211.8	127.3	51.8	190.1	57.4	246.4	1160.8

SOURCE: ESTAMPA I

b) For the same reason, the average congestion ratio of buses should be low from Bella Vista to Plaza 5 de Mayo and even lower in Casco Viejo, but traffic congestion caused by heavy bus traffic in Centro is one of the most serious traffic problems in Panama City.

c) In 1990, the number of passengers will increase from Area Residencial and from San Miguelito towards Bella Vista. None of the existing routes turns back in Bella Vista.

As the boundary of Panama City has expanded, the bus routes which have all been established for shuttle service between suburban residential areas and Centro have now come to suffer from the following problems:

d) Bus operation cost has increased due to longer route lengths.

e) One-round operation time has increased also due to the longer route lengths, which, in turn, resulted in lower turnover ratio, less operational flexibility in peak hours, and longer travel time particularly in the case of long distance passengers.

f) Both the quantity and quality of bus service in north-south direction are inferior compared with east-west direction.

g) Because it is intended that passengers will reach their destinations without transferring buses, the development of passenger transfer facilities has lagged

1.2.2. Bus Rerouting Plan

Based on estimated bus demand in 1990, the following policies were considered by ESTAMPA Masterplan for bus rerouting:

a. Introduction of express bus routes from suburbs to Centro via Corredor Norte or Ave. Balboa.

b. Discontinuation of all urban bus routes to Cinco de Mayo (that is, prohibition of bus entry into the old built-up areas such as Casco Viejo) and introduction of loop mini-bus routes into the old built-up area.

c. Shortening of routes from Tocumen and Chilibre to Panama urban center, and turn-back operation of buses at Universidad, San Miguelito and Chanis bus centers.

d. Introduction of a loop route covering the four bus centers (Ave. Peru - Via Martin Sosa - Transistmica - Via Domingo Diaz -Via Cincuentenario - Via Espana - Ave. J. Arosemena).

e. Introduction of new routes to or enhancement of existing routes in areas where bus service is presently substandard (Curundu Area, Punta Paitilla area, and areas along Calle 50 and Via Cincuentenario).

As a result of analysis under these policies, a bus route network of a total of 21 routes was recommended for 1990. Based on the future demand for bus service are estimated the number of bus fleet needed in 1990 and 2000, shown in Table IV-1-9. The establishment of bus centers will give impetus to bus rerouting but will not by itself guarantee that the new route network will become effective.

TABLE IV-1-9 RECOMMENDED REROUTING AND FLEET ALOCATION PLAN

Bus Base	Route Code	Routes	Bus Fleet 1990	Bus Fleet 2000
1	1	Ciudad Bolivar-Transistmica-San Miguelito Bus Center	57	118
2	2	Cerro Batea-Corredor Norte-Universidad Bus Center	91	187
	3	Cerro Batea-Corredor Norte-5 de Mayo Bus Center	22	33
	4	Cerro Batea-Transistmica-Universidad Bus Center	62	64
	5	Cerro Batea-Domingo Diaz-Universidad Bus Center	54	95
	6	Cerro Batea-Ricardo J. Alfaro-Chanis Bus Center	16	17
3	7	Villa Guadalupe-Ave. Balboa-5 de Mayo Bus Center	102	105
	8	Villa Guadalupe-Via Porras-5 de Mayo Bus Center	95	98
4	9	Ave. Jose Torrijos-Ave. Balboa-5 de Mayo Bus Center	71	78
	10	Via Domingo Diaz-Via Jose Arango-Chanis Bus Center	22	23
	11	Ave. Jose Torrijos-Via Espana-Universidad Bus Center	48	59
	12	Ave. Jose Torrijos-Ave. Justo Arosemena-5 de Mayo Bus Center	60	62
5	13	Via Espana-Via Cincuentenario-Chanis Bus Center	25	52
	14	Via R. J. Alfaro-Via Manuel E. Batista-Chanis Bus Center	11	11
	15	Ave. Balboa-Via Manuel E. Batista-5 de Mayo Bus Center	12	12
	16	Ave. "A"-Ave. Eloy Alfaro-5 de Mayo Bus Center	145	149
	17	Ave. "A"-Ave. de los Martires-5 de Mayo Bus Center	3	3
6	18	Via Cincuentenatio-Ave. Balboa-5 de Mayo Bus Center	3	4
	19	Ave. Sta. Elena-Via 11 de Oct.-5 de Mayo Bus Center	2	2
	20	Via Domingo Diaz-Via Argentina-Universidad Bus Center	32	33
	21	Via Cincuentenario-Calle 50-5 de Mayo Bus Center	32	33
TOTAL			965	1,223

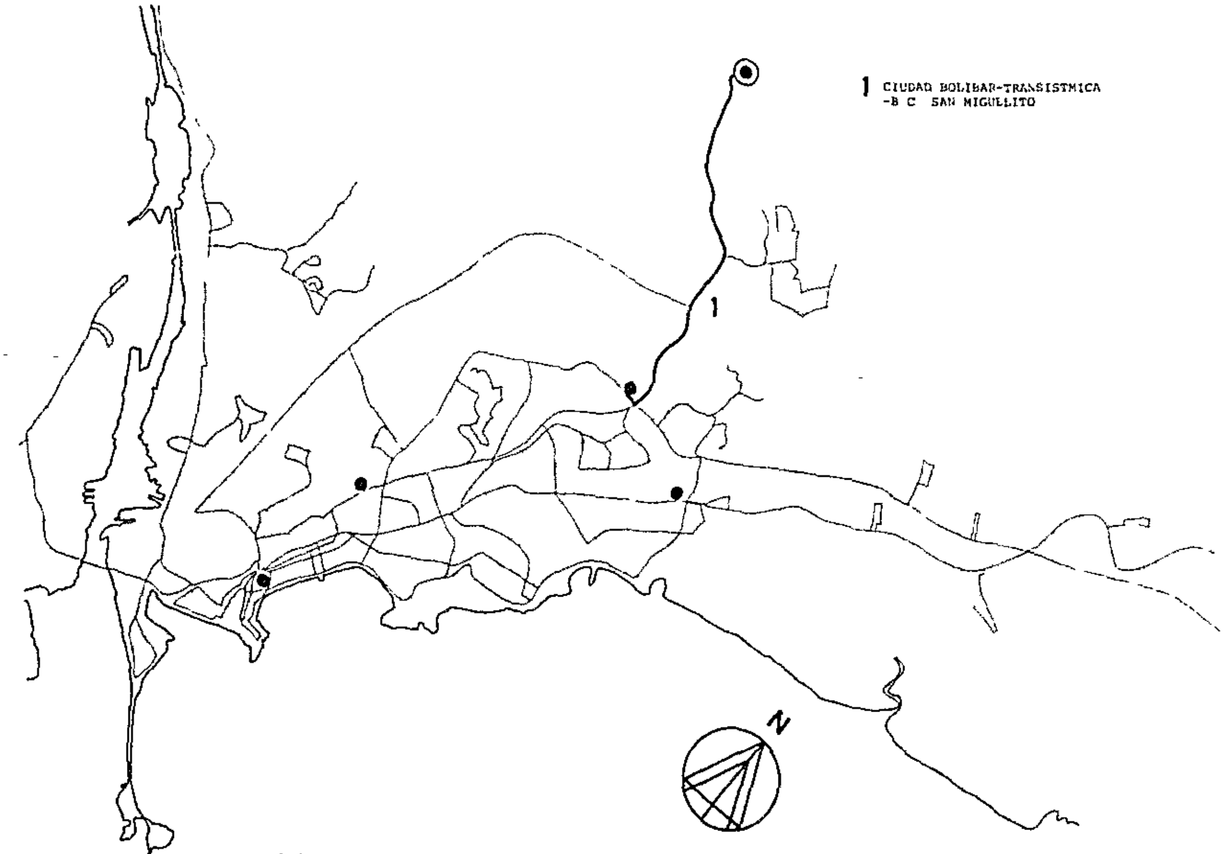
The method of achieving bus re-routing should be carefully examined. A too hasty change will not only cause confusion among bus users but will also cause such social frictions as the violation of the established rights of bus operators. It is, therefore, important to gradually realise re-routing in accordance with a planned programme while a social concensus is formed. The following suggests how re-routing could possibly be achieved.

In Panama, the bus service system operated by individual bus owners has a long history. From the viewpoints of freedom of operation and the pursuit of profits, etc. this system has certain advantages. However, in terms of the public character of the bus service, i.e. convenience for users, it is at a disadvantage. The possibility of transforming individual private operations, therefore, to an organisational business is examined here. The basic trends of thought are as follows:

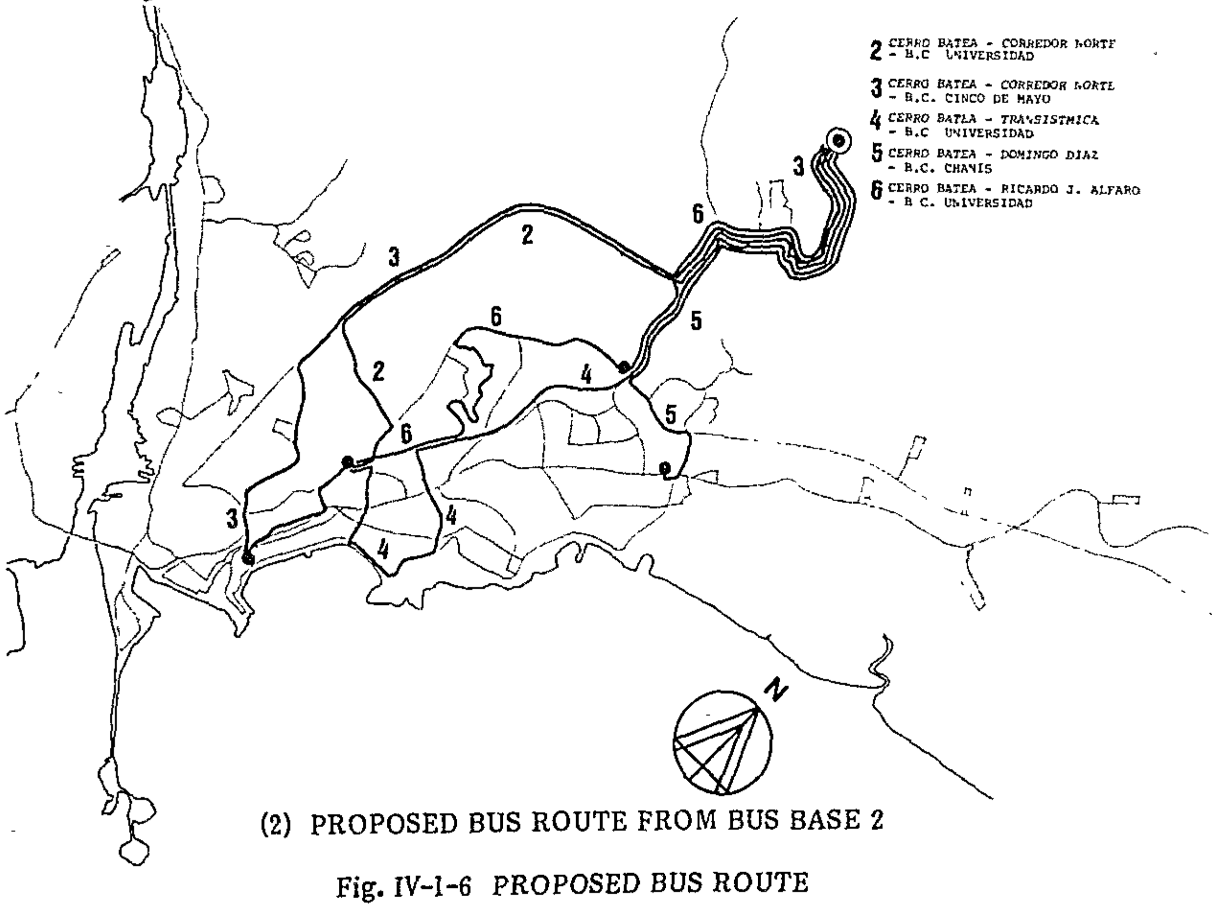
(a) The suggested 21 routes (excluding the territory of the present SACA bus) may be classified into 6 groups by their respective directions from the Cinco de Mayo Bus Centre, as shown in Figure IV-1-6, (1) through (6). For the convenience of the present argument, each group is assumed to be operated by a single organization (enterprise).

(b) Each enterprise will set up a bus yard (to be called a Bus Base) at the starting point of each bus route. In some cases, the existing piqueras will be used and in other cases new Bus Bases will be set up to cover several piqueras.

(c) The Bus Base will carry out such functions as the management of vehicle and driver operation, vehicle check before work, provide a place of rest for drivers and parking for unoperated buses, etc. Possibly, the headquarters of the enterprise might also be located here.

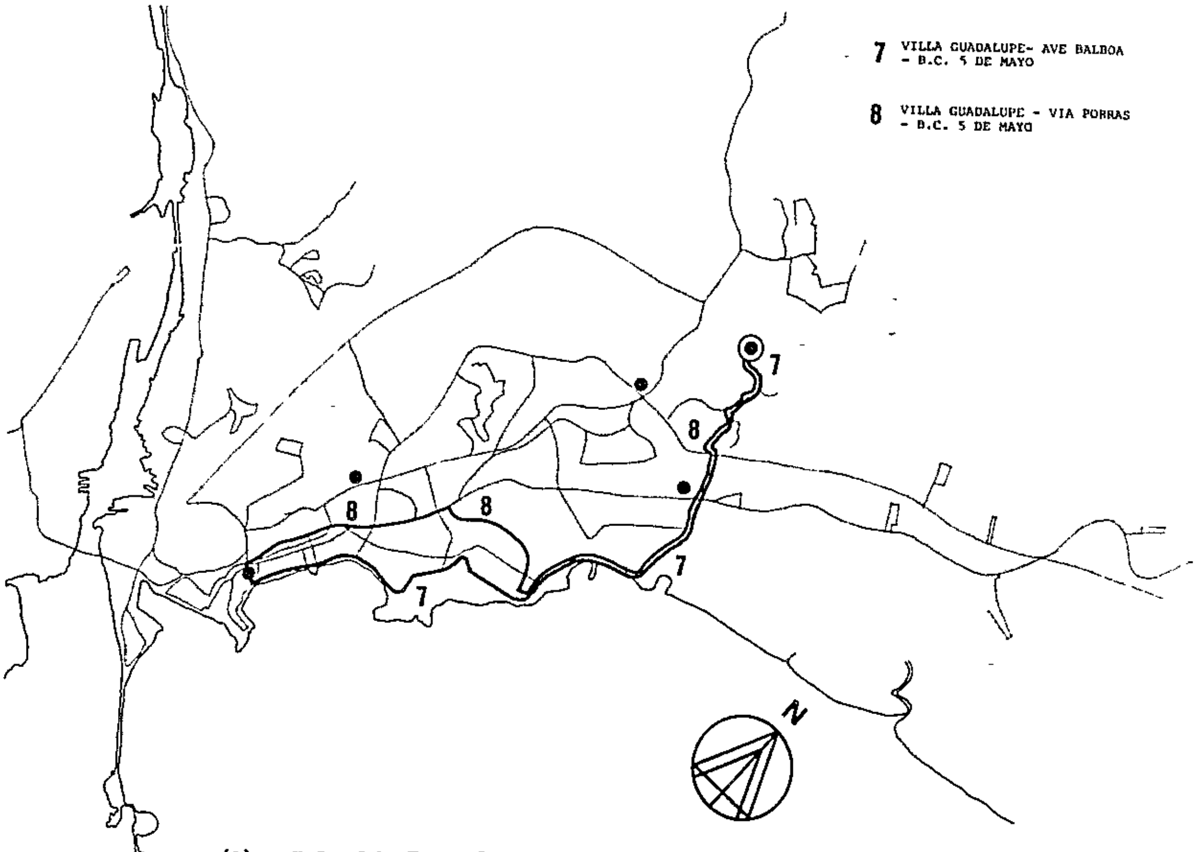


(1) PROPOSED BUS ROUTE FROM BUS BASE 1

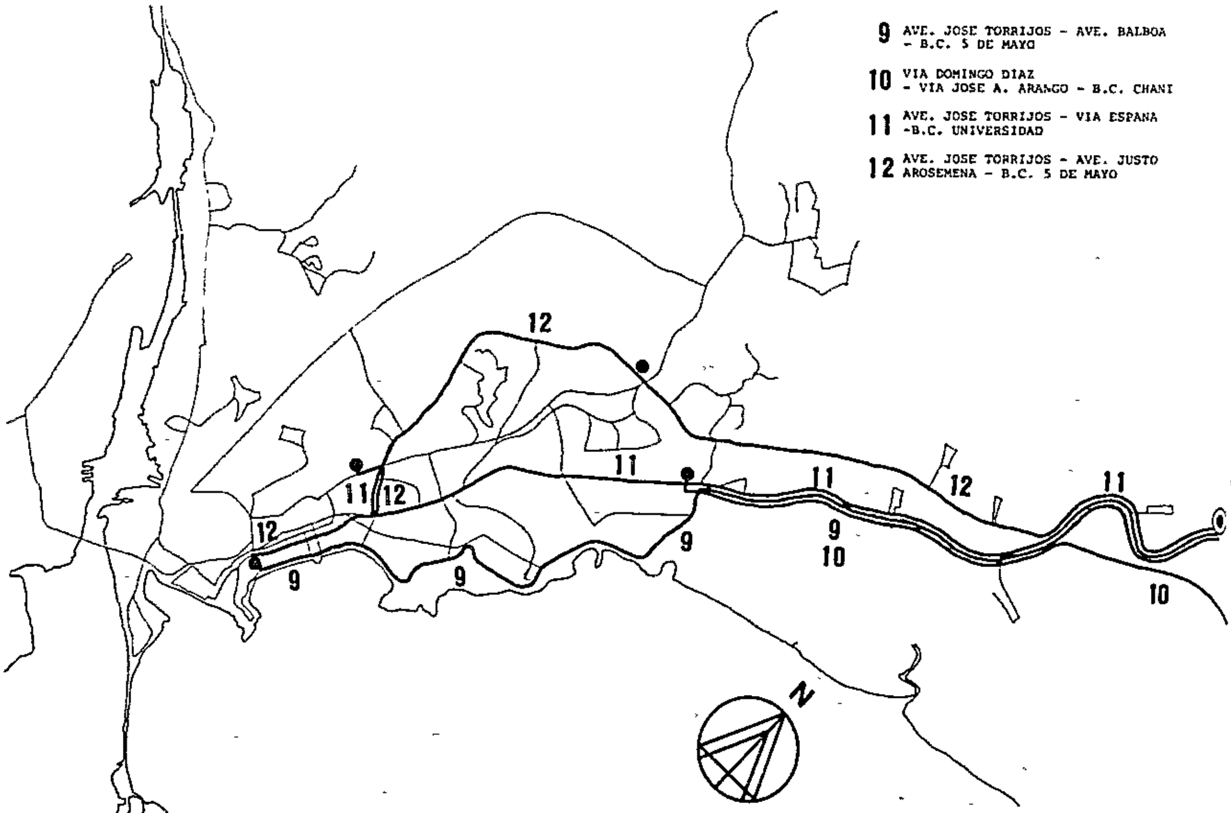


(2) PROPOSED BUS ROUTE FROM BUS BASE 2

Fig. IV-1-6 PROPOSED BUS ROUTE

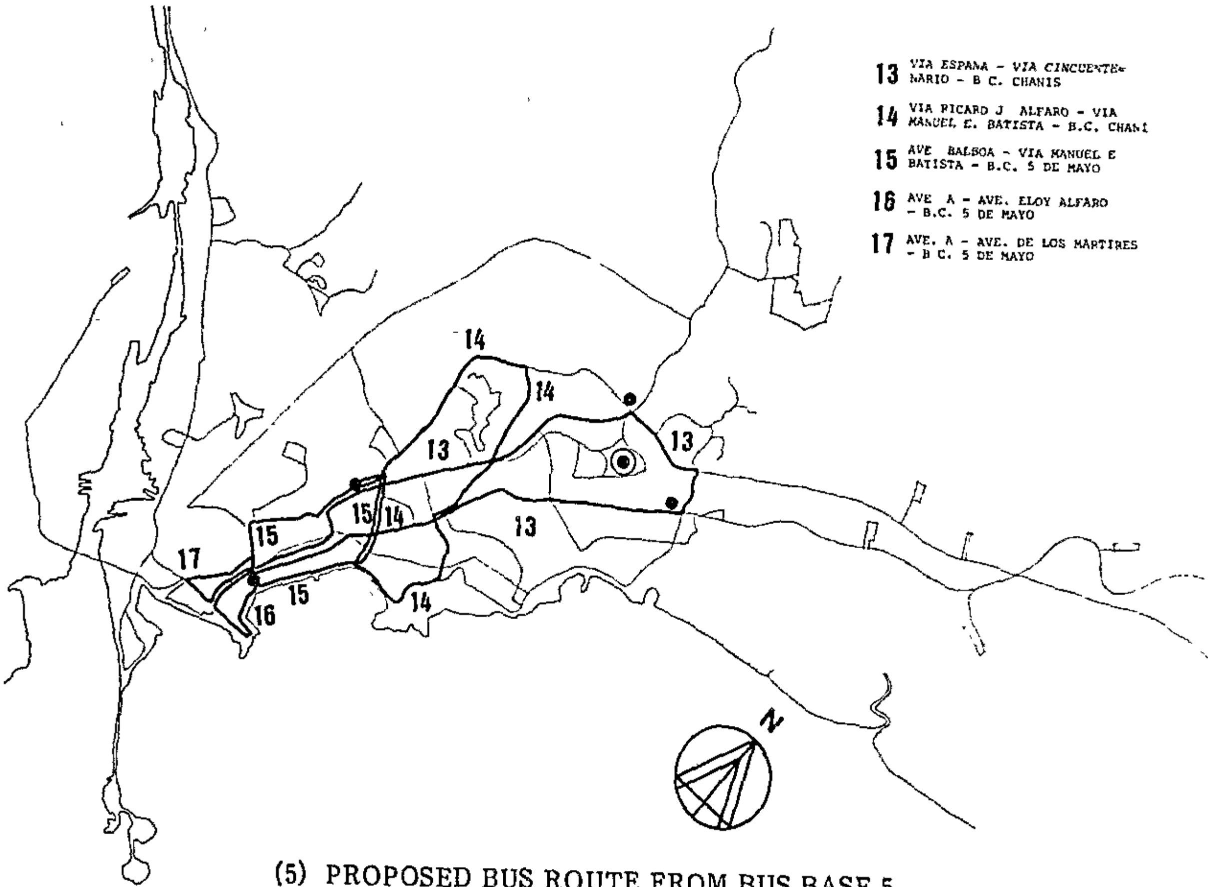


(3) PROPOSED BUS ROUTE FROM BUS BASE 3

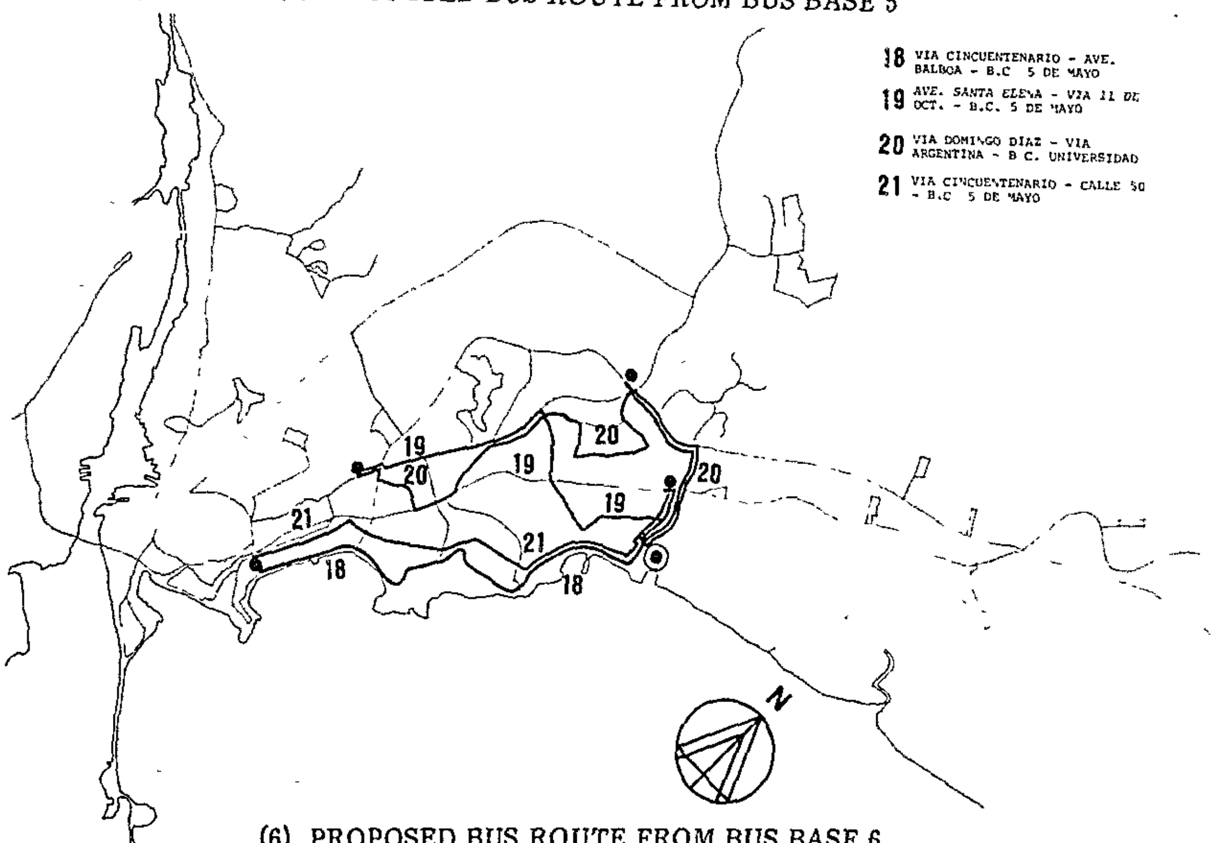


(4) PROPOSED BUS ROUTE FROM BUS BASE 4

Fig. IV-1-6 PROPOSED BUS ROUTE



(5) PROPOSED BUS ROUTE FROM BUS BASE 5



(6) PROPOSED BUS ROUTE FROM BUS BASE 6

Fig. IV-1-6 PROPOSED BUS ROUTE

(d) In principle, the business licenses for the current routes should be revised but not abolished. The current holders of the bus route licenses will join with an enterprise which has similar routes to theirs. In concrete terms, they will become either employees or shareholders of the enterprise. The enterprise will either purchase the buses owned by these current bus operators on the basis of a fair assessment of the vehicle values or will issue shares equivalent to the vehicle values.

(e) After reorganization has been completed, the Government will no longer issue licenses to private individuals but only to enterprises. In doing so, it should regulate the licensing of new routes so that notable differences in earnings will not occur among these enterprises.

(f) The Government will always monitor the payability of the bus service operation and the quality of the services by means of analysing reports to be submitted by the enterprises and various data on the bus centers. A policy where the tax revenues from enterprises with high earnings could be used to subsidise unprofitable routes may be worthy of consideration.

1.3. Bus Center Plan

1.3.1. Basic Ideas for Bus Centers

Buses are the important means of transportation, which nearly half of all passengers in Panama City use for making trips. Yet, there is almost no urban facilities for the buses other than a number of large bus stops. As the urban area has been expanding toward Tocumen and Las Cumbres, and as the central business district has been expanding from Centro toward Bella Vista, the structure of transport demand has has been changing but no effective response has been made in terms of bus routes except for merely moving the terminal points of bus routes away into suburban areas, thereby prolonging the routes. As a result, bus service demand and supply imbalance has been brought about, and bus business profitability and service quality have deteriorated.

Bus transport in Panama City is now faced with the need of rerouting in order to achieve the optimum distribution of buses to various routes, and the construction of bus centers has been planned as a strategic tool to achieve such goal. Practically, bus centers are for the following purposes:

a. To provide a safe and pleasant facility for passengers waiting for or changing the bus.

b. To control bus operation so as to meet the demand.

c. To provide impetus for bus rerouting through the introduction of new routes and the changing of existing routes, and

d. To ultimately achieve the modernization of bus operating entities, the improvement of bus service, and the increase of bus passengers through the introduction of new bus services and bus operation control.

Bus centers will attract a large number of passengers, bringing about new flows of people. As this happens, potentials of commercial and housing development will rise in the surrounding areas, and land price will rise to stimulate active private investments. In this sense, the establishment of bus centers can trigger the formation of a new urban nucleus, and therfore, bus center facility plans should not stay only with the matters of center premises but should also include the study of ways and means to properly orient private development investment in consideration of their impacts upon the surrounding areas. Bus centers are particularly public in nature, but their profitability is usually low. If those who will utilize the centers (that is, bus operators) cannot be expected to bear much cost of the center and if goverment subsidy cannot be expected, worth considering will be to incorporate commercial facilities in the center and to offset net losses from the center operation of, or rentals from, such facilities.

ESTAMPA Masterplan recommended the establishment of bus centers at four locations in Panama Metropolitan Area: Cinco de Mayo (El Maranon), Universidad, San Miguelito, and Chanis. These centers will be characterized differently and will have dissimilar functions, described below.

1) Cinco de Mayo Bus Center

As the route-end for buses operating east of the Canal, this center will be most strongly characterized as a bus terminal, while it will also function as a nodal point for long distance buses operating in suburban areas west of the Canal. Important for this center will be its relationship with the urban functions around it and the planning of the paths of peoples flow. It should be planned as a part of the Maranon Renewal Project.

2) Universidad Bus Center

This will be the large bus stop located in front of the University of Panama and will be planned as a part of the Via Bolivar Widening Project. Peak hour concentration rate will be high with a large number of University faculty, staff, and students coming and going, and care should be used in designing space for passengers waiting for the bus.

3) San Miguelito Bus Center

Situated at a location where transferring bus passengers concentrate, this center will provide for the convenience of such passengers. The grade separation of San Miguelito Intersection will make it unable to establish a combined bus stop near the intersection, while the establisment of separate bus stops will make it very inconvenient for the transferring passengers. Therefore, all bus routes passing through this intersection will be led into the center for convenient bus transferring. Also, shuttle routes will be introduced for rerouting purpose. Because the nearby intersection is where two major arterials cross each other and large number of people live in the nearby San Miguelito District, it will be important that land use in the vicinity of center be carefully studied and planned.

4) Chanis Bus Center

This center will resemble San Miguelito Bus Center in that the number of transferring passengers will be large, that routes ending at this center will be introduced, and that development potentials are high in the vicinity areas. As for bus rerouting, the enhancement of bus service on Via Cincuentenario is in plan.

1.3.2. Site Plan

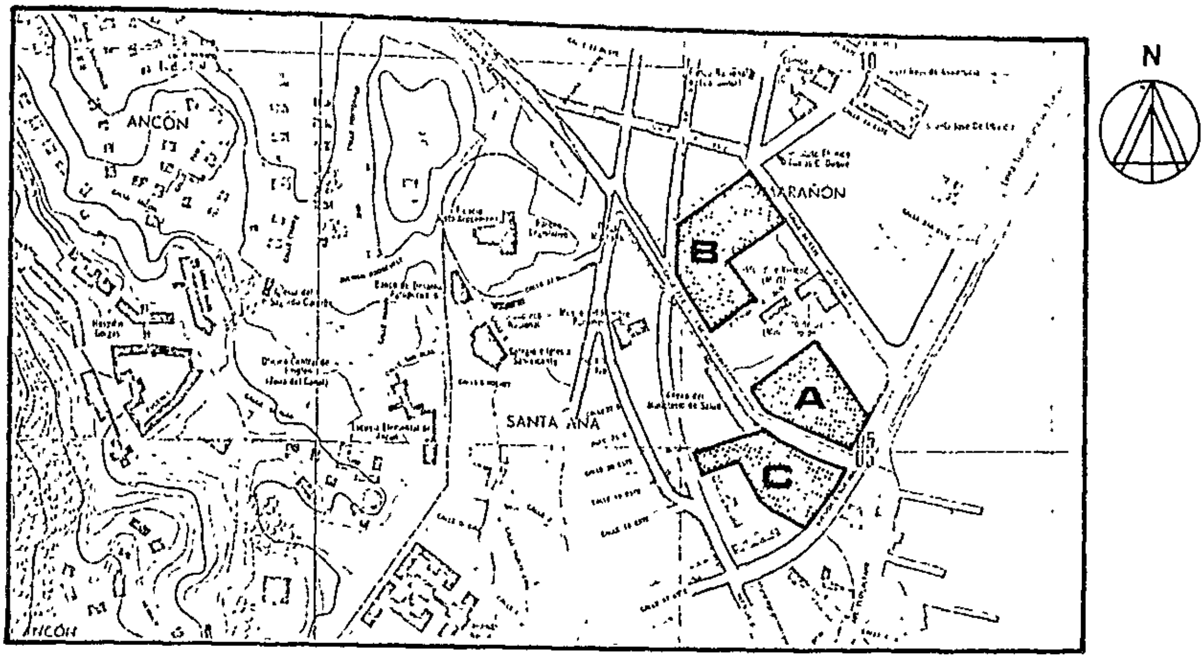
A sizable vacant lot or a lot currently with a low density utilization was sought for with preference to a government owned land in each of the general locations of bus centers, as determined by ESTAMPA Masterplan. As a result, candidate sites have been indentified as shown in Fig. IV-1-7 (1) through (4). In view of the comparison of their topography, ease of land acquisition, and traffic conditions, as presented in Table IV-1-10, each site is discussed below.

1) Cinco de Mayo Bus Center

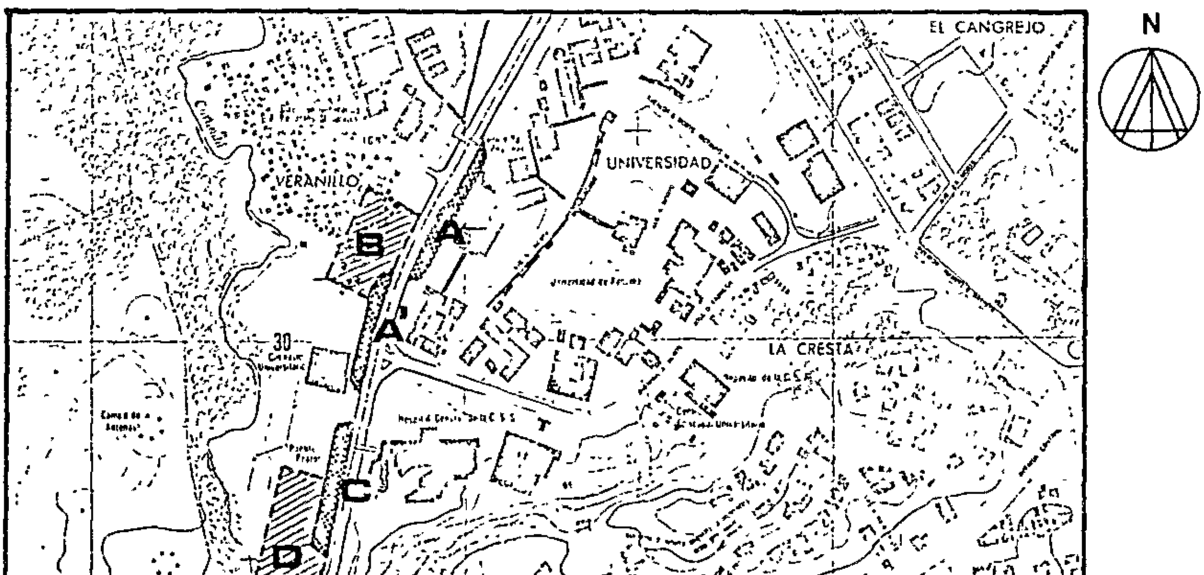
Site C is already used as a long distance bus center, which will not be competely relocated to Albrook Bus Terminal but will be retained even after the completion of said Terminal under DINTRAT project. Then, choice is between Site A and B. With all other conditions comparable, Site A is preferred over Site B in terms of impact upon nearby roads, because it will be very difficult to have buses enter and leave Site B due to the presence of nearby Ave. Central/Ave. Peru and Via Cerro Ancon intersections. Moreover, urban functions of a higher order than a bus center should be located on Site B in view of its higher urban development potentials due to the presence of National Congress building, Museums, and hotels. Therefore, Site A is selected.

2) Universidad Bus Center

large bus bays shall be constructed at the same location as the existing bus bay (Site A) on the Panama University side of Via Bolivar and between the existing bus bay and University gymnasium (Site A') on the other side of the road.

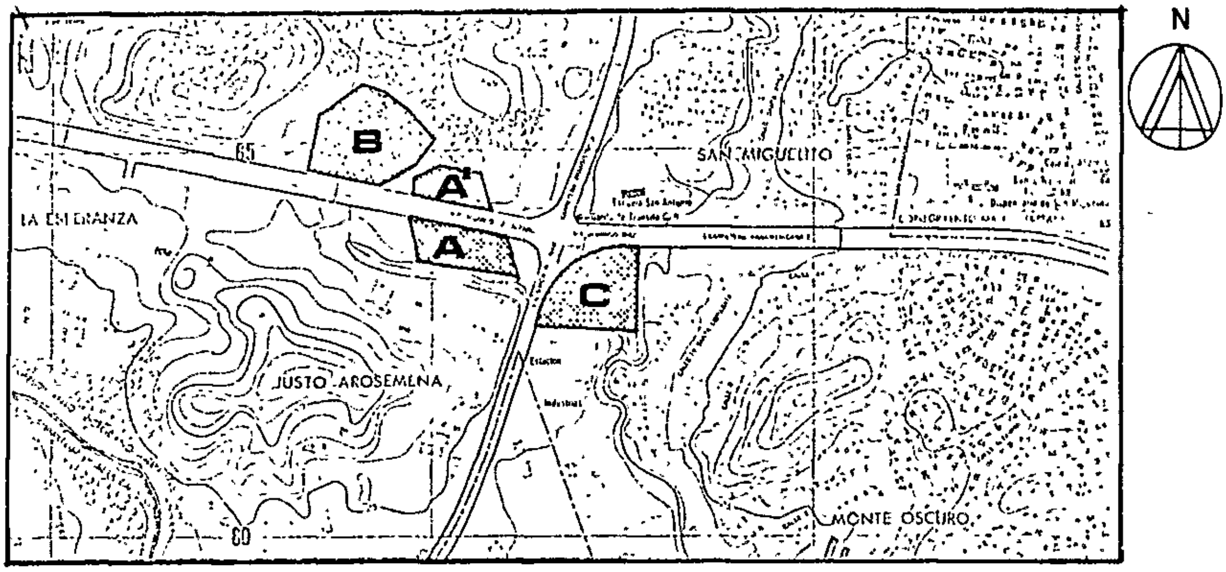


(1) CINCO DE MAYO

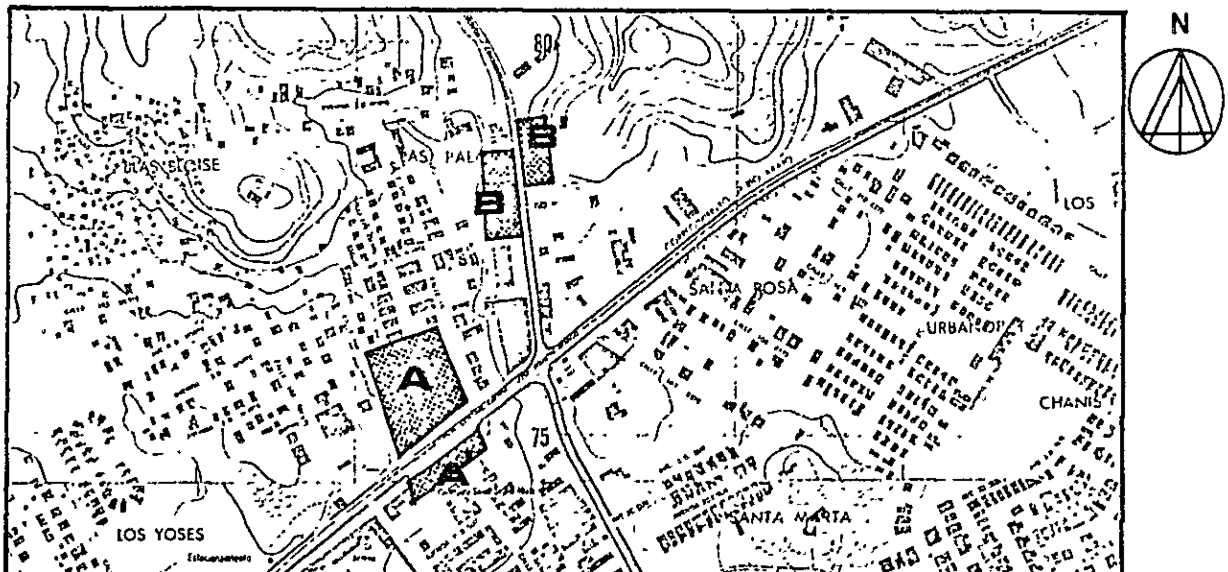


(2) UNIVERSIDAD

Fig. IV-1-7 ALTERNATIVE SITES OF BUS CENTERS



(3) SAN MIGUELITO



(4) CHANIS

Fig. IV-1-7 ALTERNATIVE SITES OF BUS CENTERS

TABLE IV-1-10 EVALUATION OF ALTERNATIVE SITES FOR BUS CENTERS

Criteria \ Alternative	A	B	C
1. Topography	○	○	○
2. Land Acquisition	○	○	▲
3. Bus Circulation	○	○	○
4. Traffic Flow	○	△	○
5. Passenger's accessibility	△	○	△

2. Universidad

Criteria \ Alternative	A	A'	B	C	D
1. Topography	○	○	○	△	△
2. Land Acqisition	○	○	▲	○	△
3. Bus Circulation	○	○	○	○	○
4. Traffic Flow	△	△	△	▲	△
5. Passenger's Accessibility	○	○	○	○	△

3. San Miguelito

Criteria \ Alternative	A	A'	B	C
1. Topography	○	▲	△	○
2. Land Acquisition	△	○	△	▲
3. Bus Ciruculation	△	△	○	▲
4. Traffic Flow	△	△	○	▲
5. Passenger's Accessibility	△	△	▲	○

4. Chanis

Criteria \ Alternative	A	A'	B	B'
1. Topography	○	○	△	▲
2. Land Acqisition	▲	▲	△	△
3. Bus Circulation	○	○	△	△
4. Traffic Flow	△	△	○	○
5. Passenger's Accessibility	○	○	△	△

○ Good
△ Fair
▲ Bad

3) San Miguelito Bus Center

Site A is selected as the lot closest to the intersection without having any detrimental effect upon intersection traffic. Also considered shall be the use of Site A', across from Site A as necessary.

4) Chanis Bus Center

Presently bus traffic is very light on Via Cincuentenario, while bus traffic on Via Espana is the heaviest of all roads in Panama City. Therefore, it will not be wise to have buses come into a bus center located along Via Cincuentenario. Besides, Site B/B' is not wide enough for a bus center. Site A shall be used, with the possibility of using Site A' also as necessary.

1.3.3. Demand for Bus Centers

Future demand (the number of passengers to utilize bus center) is estimated by applying future increase rate in the particular zone (person-trip survey zone) to which each bus center belongs, to the number of potential center users in 1981 as calculated based on the number of passengers loading and unloading at bus stops in 1981 and a conversion rate curve (see Fig. IV-1-8 for the flow chart). The conversion rate curve shown in Fig. IV-1-9 is not based on any survey data but is estimated as follows based on the behavioral pattern of Panamanians. That is, because no bus stop will be established within 300 meters of a bus center as a rule, those who presently utilize bus stops within 150 meters will all come to use the center. Likewise, 50% of those who presently use bus stops within 300 meters, and 20% of those who presently use bus stops within 400 meters, will come to use the center, while those who presently use a bus stop 500 meters or more away from the center will not use the center.

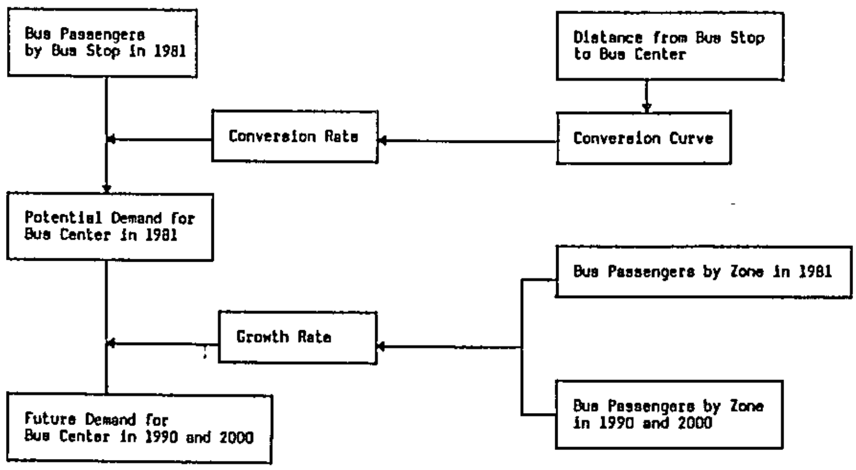


Fig. IV-1-8 FORECASTING PROCEDURE OF BUS CENTER DEMAND

The result of this estimation is shown in Table IV-1-11. Cinco de Mayo Bus Center will have the largest number of passengers, over 100,000 in 1990, but subsequent increase rate will be low and will have only a little more passengers in the year 2000. The number of passengers to use other three centers will similarly be about 20,000 each.

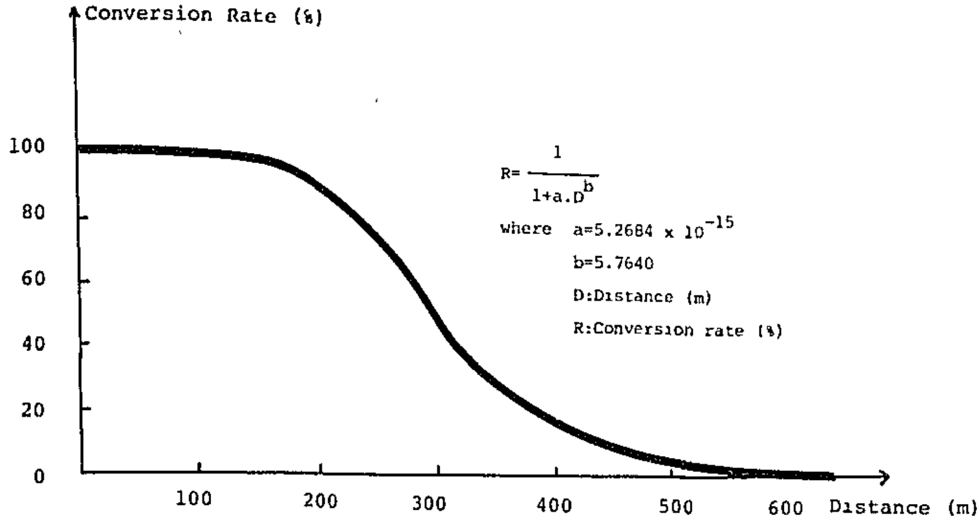


Fig. IV-1-9 BUS PASSENGER CONVERSION CURVE

TABLE IV-1-11 DEMAND FORECAST AND PLANNING CAPACITIES OF BUS CENTERS

Items		Bus Center: Cinco de Mayo	Universidad	San Miguelito	Chanis
Passengers	1980	83,933	15,943	17,072	12850
	1990	103,903	18,229	20,223	16620
	2000	106,000	20,337	23,936	19672
No. of Buses*		2,899	2,480	2,710	1805
Affection by Rerouting (Tentative)		-20%	-10%	-10%	-10%
After Rerouting	1981	2,320	2,230	2,440	1990
	1990	2,970	2,550	2,890	2570
Planning Capacity					
Daily Traffic		3,500	3,000	3,400	3000
Peack Hour Traffic		350	300	340	300
Average Turn Over (min/bus)		5	1.5	3	3
Required Space per Bus (m2)		500	360	500	500
Berth required		30	8	17	15
Total Floor Area (ha)		1.50	0.28	0.85	0.75

Note: * No. of Buses: which may use the bus center based on 1981 network.

The number of buses that will utilize each bus center will be 2,000 to 3,000 per day in 1990 (the total of imbound and outbound buses at three bus centers other than Cinco de Mayo). With a margin of about 20%, the planning capacity is set at 3,500 buses per day for Cinco de Mayo Bus Center, 3,000 for Universidad, 3,400 for San Miguelito, and 3,000 for Chanis. The bus turnover rates are assumed to be five minutes per bus per each stop at Cinco de Mayo Bus Center (which is longer than at other centers due to the characteristic of this center as a terminal), 1.5 minutes at Universidad, and three minutes at the remaining two centers and the peak rate of 10% was applied for the estimation of bus berth numbers. As the results, Cinco de Mayo Bus Center will need 30 berths and will have to be a fairly large center, while Universidad Bus Center will need four berths each for imbound and outbound buses, and the remaining two centers will each need about half the number of Cinco de Mayo Center.

1.3.4. Bus Center Facility Plan and Bus Circulation Plan

Various facilities usually needed at a bus center (terminal) are classified into A, B, and C according to their general importance, and the facilities needed at each of the four bus centers are identified in view of their characteristics and the situation prevailing in Panama (see Table IV-1-12).

All the basic bus center facilities are identified for Cinco de Mayo Bus Center, because it will be a large center with a large number of passengers utilizing it. Commercial facilities, a telephone center, and a small park will be installed not as bus center facilities but as a part of the Maranon Renewal Project, and they are assigned with a lower prioriy than what would otherwise be assigned. Also, ticketing booth shall not be installed, because urban buses will most likely not use a ticket system in the near future. Facilities of this kind will easily be installed, when needed.

Planned for Universidad Bus Center will be a shelter, benches, a kiosk, and telephones, in addition to the facilities needed for arriving and departing buses and loading and unloading passengers. The installation of a public toilet will be desirable if space is available. The remaining two bus centers will follow the example of Cinco de Mayo Bus Center but will have somewhat fewer administrative facilities.

1.3.5 Bus Center Administration

In view of the Bus Center's non-profit nature and its function of controlling bus service operation under statutory obligation, its management by a government agency is appropriate. On the other hand, taking into consideration the facts that the Center is to operate on its own revenues, that it must provide good service, and that it will own certain commercial facilities, the Center is also suited to management by a private concern. In theis way, the administration of the Bus Center has both a public and private aspect.

In order to control the operation of bus services efficiently, it is necessary to have the four Bus Centers be managed by a single body. This arrangement is also important for maintaining a centralized control over information, for allowing the operation of those bus centers which will not be viable if operated alone, and for ensuring a streamlined organization.

For the above reasons, we propose that a single administrative body of semi-public/semi-private nature be organized to manage the four Bus Centers (see Fig. IV-1-10). In other words, we propose that a Joint Board of Directors be organized as the policy-and decision-making body of the Bus Centers.

The Joint Board of Directors will be comprised of representative(s) of public transportation authorities and representatives of private bus operators, bus drivers, Bus Maintenance Enterprises, etc. (as well as representatives of each bus operating enterprise after bus re-routing has been completed). The Board, which will meet twice a month, will have the responsibility of supervising Center activities, solving any problems that may arise, and auditing the Centers' accounts.

TABLE IV-1-12 BUS CENTER FACILITIES

Facility Group	Facility	General Importance	Cinco de Mayo	Universidad	San Miguelito	Chanis
FACILITIES FOR PASSENGERS	1. Platform	A	●	●	●	●
	2 Concours	A	●	●	●	●
	3 Information Counter	A	●	▲	●	●
	4 Lavatory	A	●	▲	●	●
	5 Cafeteria	A	●		●	●
	6 Kiosk	A	●	●	●	●
	7 Telephone Booth	A	●		●	●
	8 Waiting Hall	B	●		▲	▲
	9 First Aid Station	B	●		▲	▲
	10 Restaurant	B	▲		▲	▲
	11 Locker Room	B	●		▲	▲
	12 Shopping Arcade	B	▲			
	13 Telecom Office	C				
	14 Luggage Claim Office	C	●			
	15 Game Corner	C	▲			
OTHER FACILITIES	1 Traffic Sign	A	●	●	●	●
	2 Sun/Rain Shade	A	●	●	●	●
	3 Street Light	A	●	●	●	●
	4 Green-belt	B	▲		▲	▲
	5 Flower Bed	B	▲	▲	▲	▲
	6 Park	C				
	7 Fountain	C				
FACILITIES FOR ADMINISTRATION	1. Administration Office	A	●		●	●
	2 Operation Room	A	●		▲	▲
	3 Drivers Room	A	●		▲	▲
	4 Rest Room	A	●		▲	▲
	5 Ticket Office	A				
	6 Refectory	B	▲		▲	▲
	7 Guardmans Room	B	●		▲	▲
	8 Meeting Room	B	▲			
	9 Announce Room	B	●			
	10 Saloon	C	▲			
	11 Sathroom	C	▲			
FACILITIES FOR VEHICLES	1 Entrance/Exit Road	A	●		●	●
	2 Circulation Road	A	●		●	●
	3 Loading/Unloading space for	A				
	3-1 Bus	A	●	●	●	●
	3-2 Taxi	A	●		▲	▲
	3-3 Private Car	A	▲		▲	▲
	4 Parking/Queuing Space for dus	A	●		●	●
	5 Toll Gate	A	●		●	●
	6 Fuel Stand	B	●		▲	▲
	7. Parking/Halting Space for car	B	▲		▲	▲
	8 Bus Wash Stand	B	▲			

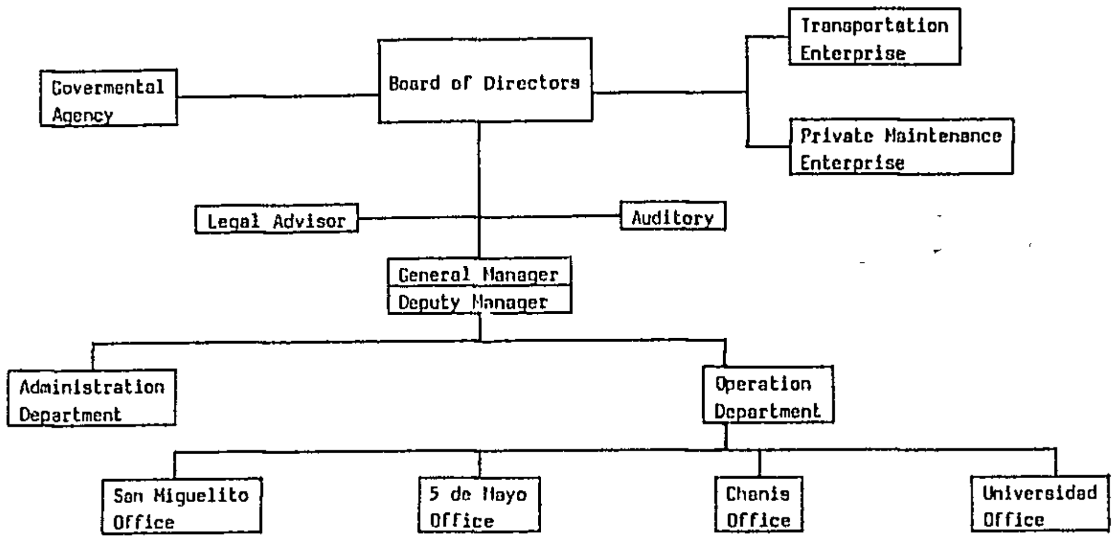


Fig. IV-1-10 BUS CENTER ADMINISTRATION ORGANIZATION

A general manager and deputy manager will be appointed by the Board of Directors and will have the responsibility of ensuring smooth execution of work. Positioned below the general manager and deputy manager will be the general affairs department and the operations department, and below the operations department will be the four Bus Center offices. The four Centers' daily work will be super-personnel placement, wages and general affairs will be handled by the general affairs department. Heads of the two department will be appointed by the general manager, and the department heads will attend the Board of Directors meetings.

Each Center will be headed by an administrator, and each Center will have a person in charge of accounting, a secretary, ticket collector and seller, maintenance man, supervisor, inspector, dispatcher, information service, first-aid and guard, among others.