1.4. Preliminary Design and Construction Cost

1.4.1. Design Conditions

1) Urban Development in the Vicinity of Bus Centers

The establishment of a bus center with the accompanying unification of previously scattered bus stops will result in the convergence of bus passengers to one location. This will be nothing but the "gathering of customers", essential to the locating of commercial activities. Thus, commercial potentials will rise in the vicinity upon the opening of a bus center. Specifically, development in the vicinity of each of the four planned bus centers will be predicted below.

(1) Cinco de Mayo Bus Center

Despite its central location, a sizable unexploited public land remains in Maranon Renewal Area, where the establishment of a bus center is planned, while adjacent to the site of this bus center are all sorts of facilities for use by the citizenry, to include the commercial and amusement center of Ave. Central, and, close to the public market, the National Congress (Palacio Legislativo), MIVI facilities, museums (Museo del Hombre Panameno, Museo Afro-Antillano de Panama), a municipal swimming pool, and other cultural and recreational facilities, as well as an inter-urban bus center (see Fig. IV-1-11).

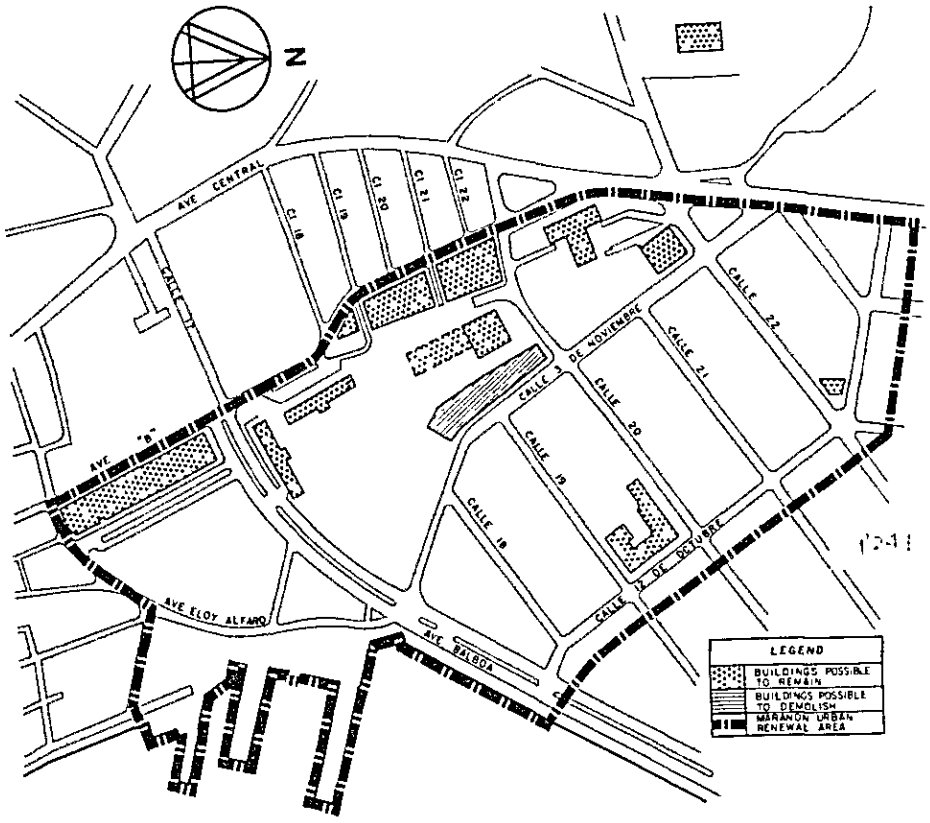


Fig. IV-1-11 EXISTING STEADY STRUCTURES IN MARANON RENEWAL AREA

Maranon Renewal Area is the area stretching over Santa Ana Corregimiento and Calidonia Corregimiento, designated as an urban renewal area (14.9 hectares) by the Government decree of July 1975. When designated as such, all acts of development, public or private, are subject to prior approval of MIVI. A number of alternative development concepts have been proposed for this area, but none has been put into execution. This Study will formulate a guideline for the renewal of Maranon area centering around the Bus Center Facilities.

In view of the existing facilities and the facilities which will be established in the area under government concept, future development of the area is conceived of in terms of the following zoning (Fig. IV-1-12).

a. Cultural Zone	Consolidation of the existing museums, a swimming pool, and parks.
b. Government Agencies Zone	Consolidation of the National Congress and government facilities.
c. Traffic Facility Zone	Cinco de Mayo Bus Center
d. Commercial Zone	Formation of commercial linkage between Ave. Central and the Public Market
e. Tourist Zone	Consolidation of pier area into tourist spot
f. Housing Zone	Redevelopment of the existing housing areas

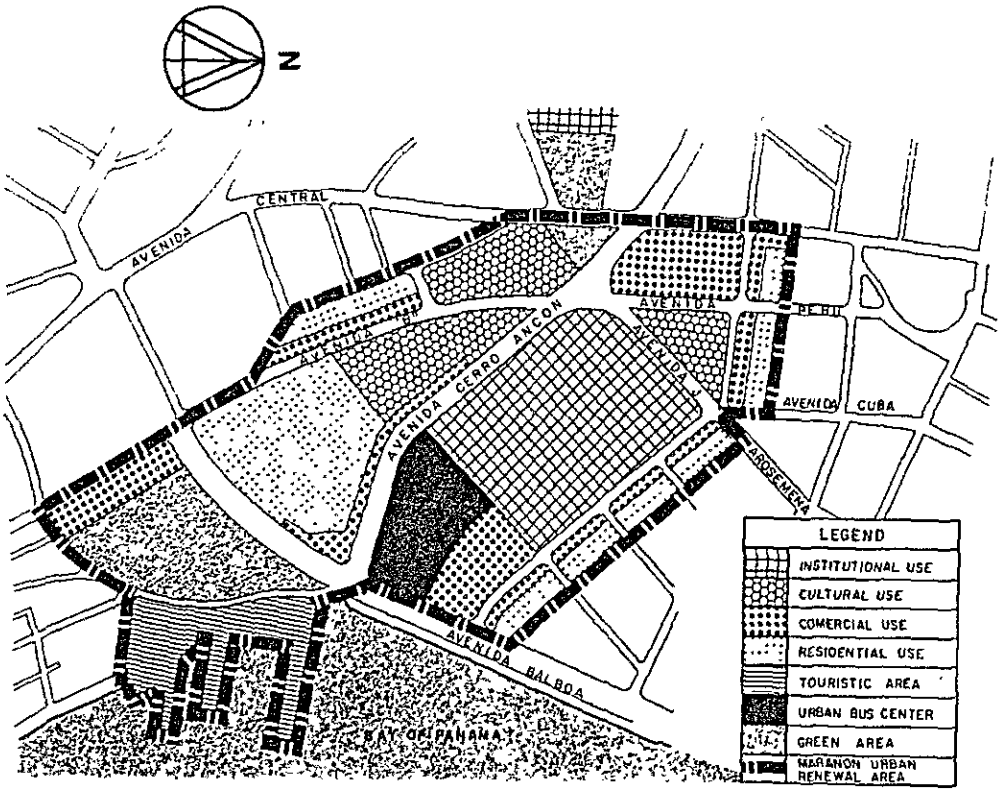


Fig. IV-1-12 FUTURE LAND USE PROPOSED IN MARANON RENEWAL AREA

The concept is to create an attractive and prosperous area for bus passengers and other pedestrians, as well as citizenry at large, through the renewal development of the various complex functions mentioned above. Future task shall be the assessment of various pedestrian facilities (such as pedestrian deck, promenade, shopping mall) with due consideration to the flow of people (Fig. IV-1-13).

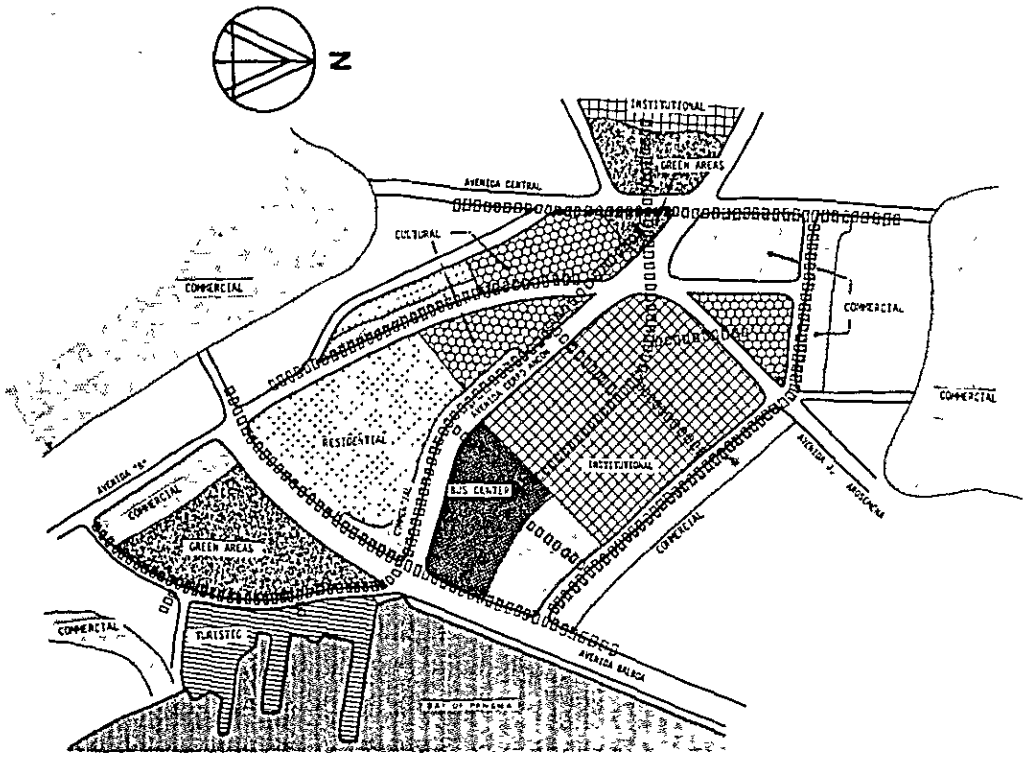


Fig. IV-1-13 PEDESTRIAN MOVEMENT IN MARANON RENEWAL AREA

(2) Universidad Bus Center

Around the site of this bus center are the University of Panama and government agencies occupying large blocks, and they will continue to exist in the future. It will be desirable that squatter area between Rio Curundu and Via Bolivar be cleared for locating university and other public facilities. Also desirable will be the opening of a kiosk in the Bus Center building for the convenience of bus passengers.

(3) San Miguelito Bus Center

In the vicinity of the bus center site are untapped hills (elevation difference of about 15 meters) in the northwestern corner of San Miguelito Intersection and factory sites in the southwestern corner. On the east of the Intersection are housing areas. Restaurants and markets are located around the Intersection, where two arterials cross each other.

Future population increases in San Miguelito District (by about two times from the 157,000 in 1980 to 302,000 in the year 2000) will contribute to the concentration of people around the Intersection as attracted by the bus center, when it is opened. Commercial

development around the core of Intersection/Bus Center can result in the formation of a commercial nuclei in San Miguelito District.

(4) Chanis Bus Center

Existing along Via Espana are sporadic markets, restaurants, service stations, and so forth to cater to the needs of the local inhabitants, but their utilization by bus passengers will become conspicuous when the Bus Center is opened. More commercial facilities will be located along the road in the future, but it will be desirable that the general area of the Bus Center and Chanis Intersection be developed as one unified area of commercial accumulation

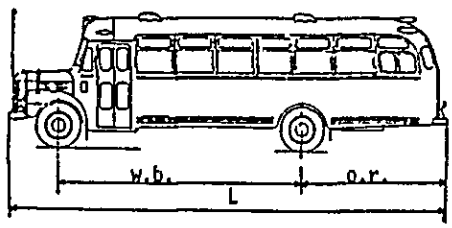
2) Design Standards

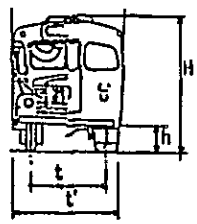
(1) Buses

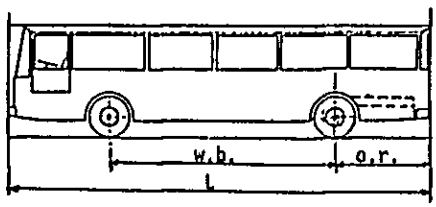
Diverse types and sizes of buses are operated in Panama City. The dimensions of that which is representative of nearly 30 different models are presented in Table IV-1-13. The largest in terms of size of all buses is Pegaso 6000, a cab-over (one-box) type bus, and this bus will be used to determine various bus size parameters for the purpose of the bus center design. To do so is appropriate and necessary in view of the fact that increasingly large buses will be introduced into Panama urban bus service in the future. The dimensions of the design standard bus is determined as: total length, 12m; Width, 2.5m; height, 3.2m; and wheel base, 5.8m.

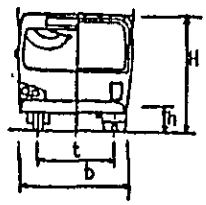
TABLE IV-1-13 DIMENSIONS OF BUS

Type	Model	Seat Capacity	Overall Length (l)	(wb)	(or)	(b)	(t)	(H)	(h)	Turning Radius (Mini)
Bonnot	Mitsubishi B-370	71	10.5	5.6	3.5	2.49	1.85	3.5	0.25	10.5
Bonnet	Thomas B. 325n	72	11.25					2.97		
Cab-Over	Isuzu BC151P	81	10.4	5.34	2.94	2.49	2.02	3.02	0.26	9.3
Cab-Over	Pegaso 6000	73	11.3	5.6	3.35	2.5	2.02	3.02		
Desing Criteria			12.0	5.8	3.6	2.5	2.02	3.2	0.26	10.8









(2) Turning Radius

Vehicles turn around the center point, which is on the extension of rear axle (point O in Fig. IV-1-14). The traces of all parts of the vehicles are concentric circles around that point O. Turning radii of the various parts of a vehicle calculated based on said dimensions, are as follows. The minimum turning radius (minimum distance from point O to outer front wheel) is about 10.8m, front outmost radius (distance from point O to the tip of the most protruding part of the vehicle in its front portion) is 12.2m, rear outmost radius is 9.7m, and innermost radius is 5.8m. Relationships among the pre-turning vehicle-side clearance (C) when an obstacle (wall, fense) exists inside the turn, the pathway width (N), and distance from the starting point of the turn to the corner (M) are given in Fig. IV-1-14.

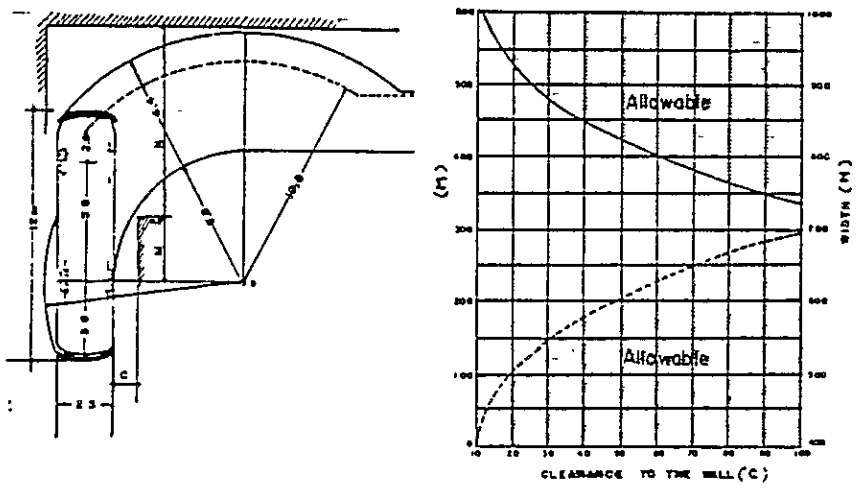
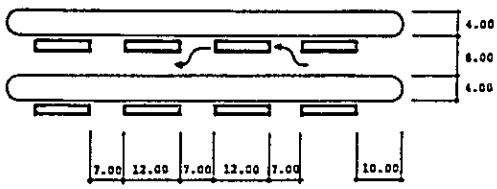
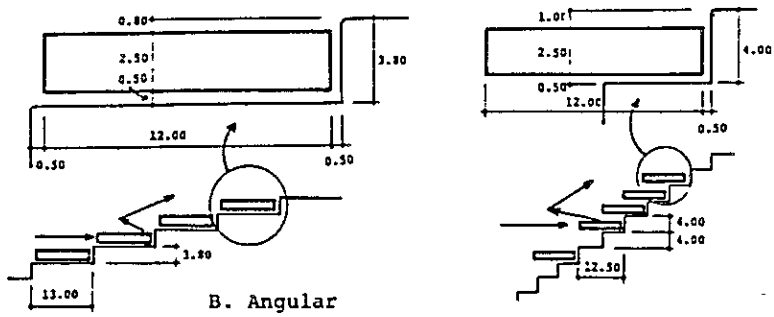


Fig. IV-1-14 TURNING RADIUS OF BUS



A. Parallel (Front-in out)



B. Angular

(Front-in, rear-out)

Fig. IV-1-15 STANDARD DESIGN OF PLATFORM

(3) Loading/Unloading Berths

Loading/unloading bus berths can be arrayed either parallel or perpendicular to the platform. The former array does not offer the best economy of platform space, but allows for easier and quicker maneuver of the bus, while the latter saves platform space but makes departure maneuvering difficult and dangerous, particularly when a passenger crosses behind the bus without considering the way the bus is moving. Necessary dimensions of both arrangements are shown in the Fig. IV-1-15.

(4) Pedestrian Deck

A standard design of pedestrian deck is shown in Fig. IV-1-16. Under the girder clearance is 4.0m because girder height ranges from 0.50m to 1.50m depending on the style, the floor slab height is 4.50m, and a gradient of 1/2, and have a halfpace of 2.0m.

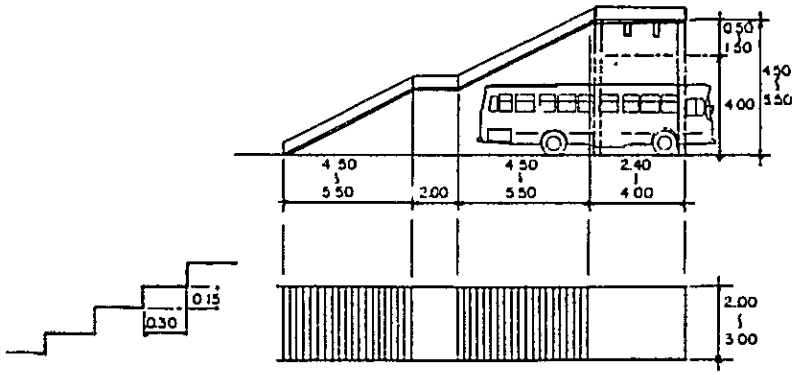


Fig. IV-1-16 STANDARD DESIGN OF PEDESTRIAN BRIDGE

1.4.2. Preliminary Design

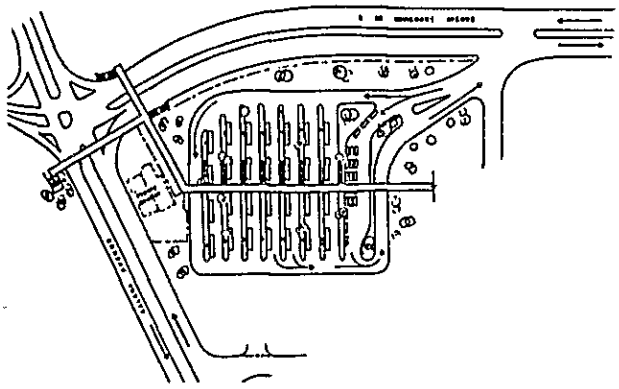
1) Cinco de Mayo Bus Center

(1) Alternatives Evaluated

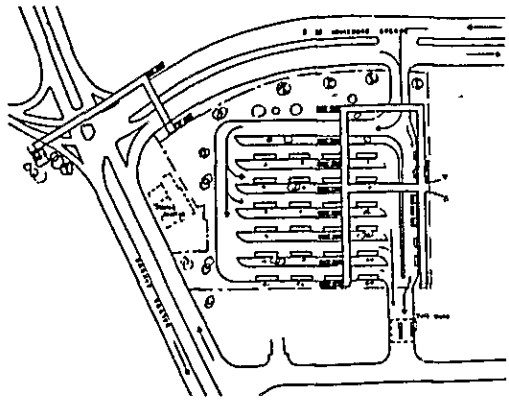
Because almost all buses come from Ave. Central/Ave. Peru and a few buses come from Ave. Balboa, the entrance/exit is to be placed on the Via Cerro Ancon side. Pedestrian decks will be installed to connect the center with the commercial facilities whose construction is planned in the vicinity area. Five alternative ways of bus circulation are considered (Fig. IV-1-17).

Alternative 1:

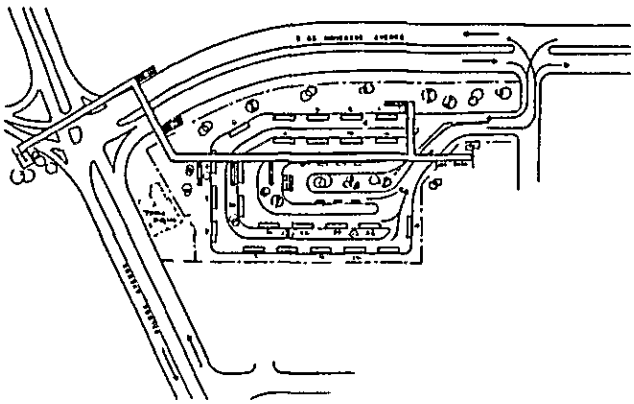
Buses are to be parked aside platforms which are arrayed parallel to each other. The lines of flow of buses and passengers are clear and easy to understand, but transfer will not be so convenient because passenger movement from one platform to another will have to be by pedestrian decks. Many stairs will be needed, requiring additional construction cost.



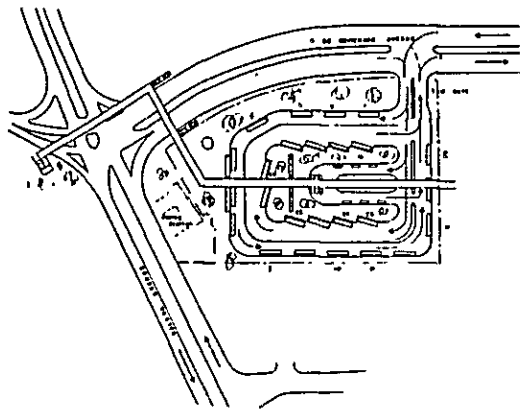
ALTERNATIVE -- 1



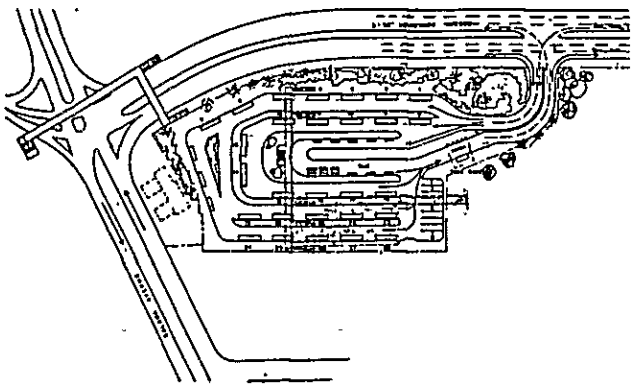
ALTERNATIVE -- 2



ALTERNATIVE -- 3



ALTERNATIVE -- 4



ALTERNATIVE -- 5 (SELECTED)

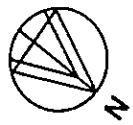


Fig. IV-1-17 ALTERNATIVE PLANS FOR CINCO DE MAYO BUS CENTER

Alternative 2:

Same as alternative 1 except that the orientation of platforms is different and exit is placed on the side toward the existing MIVI building, away from the entrance. Difficulty will be the setting of routes for buses leaving the center and returning to Ave. Balboa and buses running toward Corredor Norte.

Alternative 3:

Buses are to be parked aside island platforms in the shape of concavity, arranged in concentric pattern. The center land and stairs for passenger decks will be economized, but the total extension of the decks will be long and access to bus center building and commercial facilities will be poor.

Alternative 4:

Same as alternative 3 except that buses will be parked perpendicular to the platform, thereby further economizing land. Problem will be the flow of buses in opposit directions of clockwise and counter-clockwise.

Alternative 5:

Same as alternative 3 except that the arrangement of pedestrian decks is changed so as to eliminate the problem of that alternative.

These alternatives are evaluated as shown in Table IV-1-14, which shows a relative advantage of alternative 5.

TABLE IV-1-14 COMPARISON OF BUS CENTER ALTERNATIVES
(CINCO DE MAYO BUS CENTER)

Criteria / Alternative	1	2	3	4	5
1. Traffic hidrance on road	○	▲	○	△	○
2. Traffic hidrance at Entrance/Exit	○	△	○	△	○
3. Approach	○	○	○	▲	○
4. Circulation of bus in the Center	○	○	○	▲	○
5. Safety at arrival/departure	○	○	○	△	○
6. Passenger flow	△	○	△	○	△
7. Bus Transferring	△	△	○	○	○
8. Plentiness of greens	▲	▲	○	△	○
9. Simplicity of pedestrian deck	▲	▲	○	○	○
10. Occupied area	▲	▲	△	○	△
11. Design simplicity	○	○	○	△	○
12. Construction cost	▲	▲	△	○	△

Note: ○ = Good, △ = Fair, ▲ = Bad.

(2) Preliminary Design

The service station existing on Ave. Balboa will be retained and, if no business problems are involved, used as a function of the center. In addition to the arrival/departure berths, nine berths will be installed for the purposes of time adjustment and minor vehicle maintenance. Pedestrian decks will be on a level with, and will lead to, the center buildings and then connect with the pedestrian space extending toward Cinco de Mayo Plaza. If the commercial building spaces are insufficient to meet the demand, additional spaces can be created on top of the bus center building. Assuming that adequate parking spaces will be provided for cars within the commercial building, no such space will be created within the center.

2) Universidad Bus Center

This center will simply consist of two large bus bays, each having five berths and located across Via Bolivar (see Fig. IV-1-18). The platform for five buses will be quite long, consisting of 105m total length, 10m approach part, and 22m departure part. The platform will be separated from through way by a traffic island with a width of 1.0m. Because bus bays will be congested with maneuvering buses, two egresses will be cut open through the separation island.

The existing pedestrian bridge is to be used as is. The Veranillo Viejo side is nearly 70m away from the bridge, so the sidewalk in-between will be covered by a roof. At the intersection of the sidewalk and Calle Arturo del Valle, a signal which gives priority to pedestrians over vehicles will be installed. The pedestrian bridge will need another stairway opposite from the existing stairway.

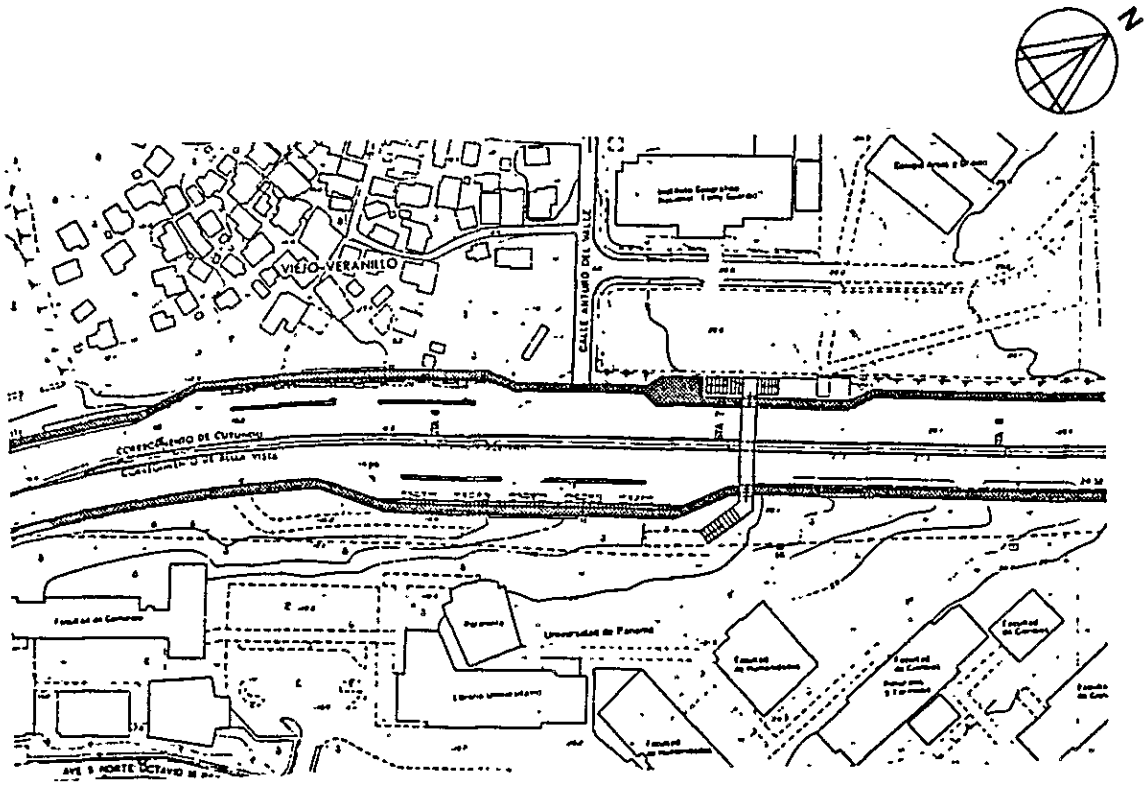
The width of the platform will be 6.45m in line with the sidewalk. Benches, kiosks, and telephone booths will be installed at portions of the platforms. Because almost all the passengers of buses that come to the university or the hospital by the way of Via Bolivar do not proceed toward Centro but return to San Miguelito way, more spaces and facilities for waiting passengers will be needed on the university side.

3) San Miguelito Bus Center

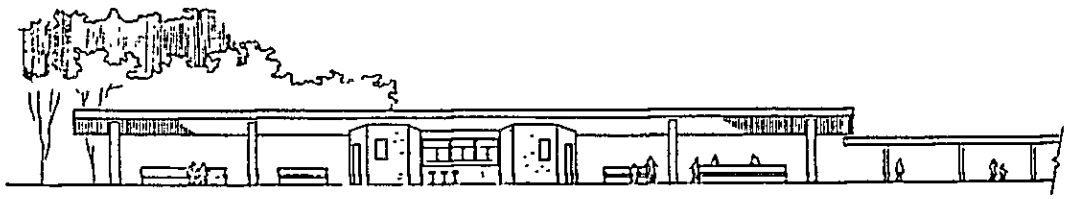
A study has resulted in the conclusion that the establishment of two bus centers across Via Ricardo J. Alfaro, connected by a bridge, will be inevitable so that buses which come through San Miguelito intersection can be directed into the center without interrupting normal traffic. On this premises, five alternative platform types and arrangements are considered (Fig. IV-1-19).

Alternative 1:

Bus bays will be installed on right side looking toward the intersection. Three different parking methods are used together in a complex, but there will be no place within the terminal where pedestrians will have to cross the line of bus flow.



(1) PLAN



(2) ELEVATION

Fig. IV-1-18 UNIVERSIDAD BUS CENTER PLAN

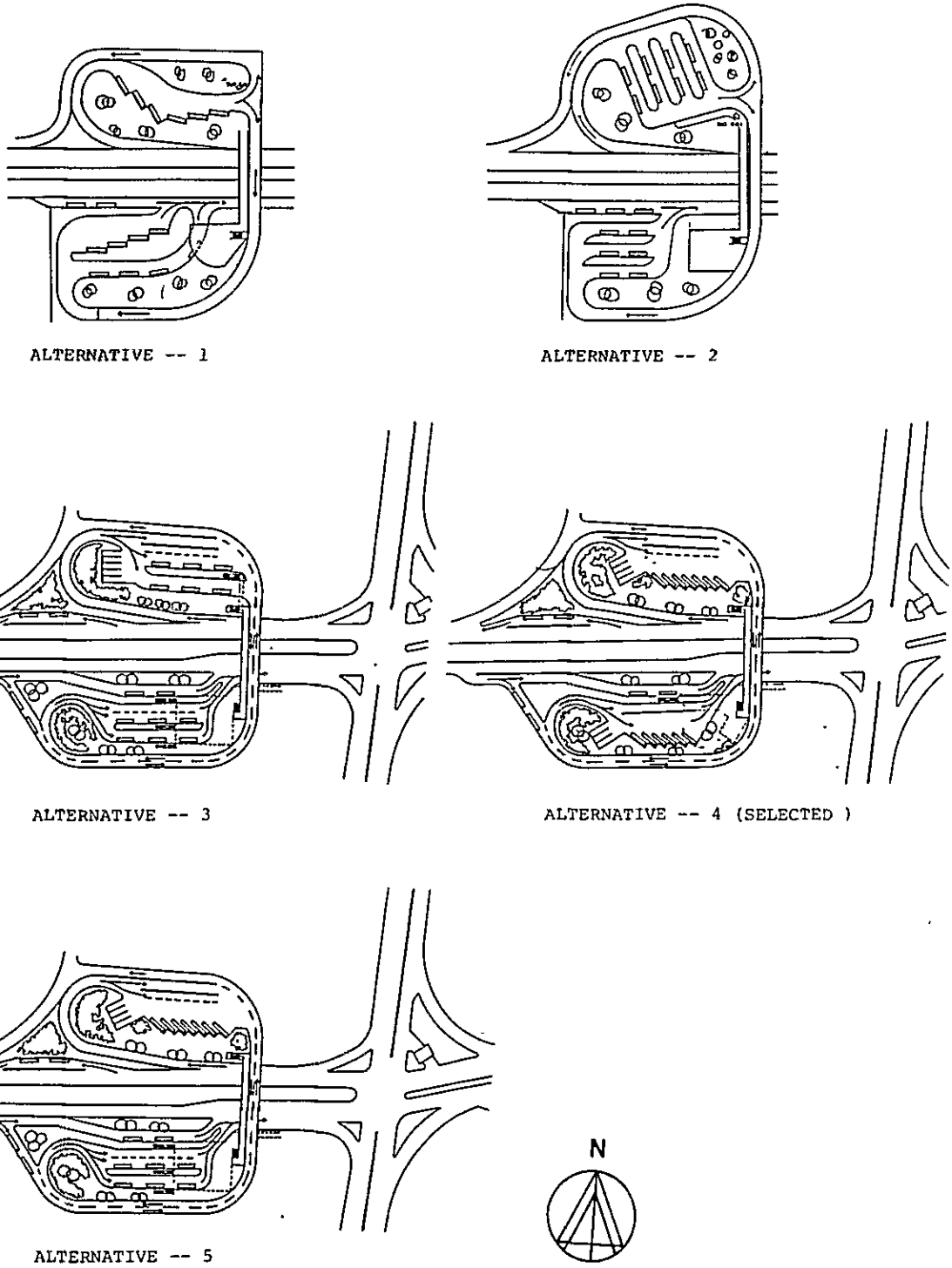


Fig. IV-1-19 ALTERNATIVE PLANS FOR SAN MIGUELITO BUS CENTER

Alternative 2:

The terminal closer to the hills will have island platforms arranged parallel to each other. Passengers moving from one platform to another will have to cross the line of bus flow. Pedestrians will be reluctant to use bridges to move between platforms, even when provided.

Alternative 3:

In both the centers, buses will be parked aside platforms arrayed parallel to each other. Land is economized because the center closer to the hills will also have roadside bus bay and, therefore, needs no exit. Six stairways will be needed for pedestrian decks.

Alternative 4:

Both the centers will have no island platform but buses will be parked at an angle. Moreover, passengers can change buses easily and safely, and the cost of constructing pedestrian bridges can be saved.

Alternative 5:

This is a hybrid of alternatives 3 and 4. Angle parking is used in the hillside center, where the installation of pedestrian decks will be difficult. Buses will be parked alongside island platforms in the other center. Five stairways will be needed for pedestrian decks.

The result of the qualitative evaluation of these alternatives is as shown in Table IV-1-15. Alternatives 3, 4, and 5 are almost same. However, the Alternatives which call fo island platforms will require passengers to use a connecting bridge, while those passengers who do not and instead cross the bus road will be prone to accidents. Hence, Alternative 4, which entails the lowest cost and which ensures the most convenient and safe passenger flow, is selected.

TABLE IV-1-15 COMPARISON OF BUS CENTER ALTERNATIVE PLAN
(SAN MIGUELITO BUS CENTER)

Criteria / Alternative	1	2	3	4	5
1. Traffic hidrance on road	△	△	○	○	○
2. Traffic hidrance at Entrance/Exit	○	○	○	○	○
3. Approach	△	△	○	○	○
4. Circulation of bus in the Center	△	○	○	○	○
5. Safety at arrival/departure	△	△	○	○	△
6. Passenger flow	○	△	○	△	○
7. Bus Transferring	○	△	△	○	○
8. Plentiness of greens	○	○	○	○	○
9. Simplicity of pedestrian deck	△	▲	△	△	○
10. Occupied area	▲	▲	△	○	△
11. Design simplicity	▲	△	○	○	○
12. Construction cost	▲	▲	△	△	○

Note: ○ = Good, △ = Fair, ▲ = Bad.

The alternative 4 will have the center building at the foot of the bridge on the right, looking toward the intersection. The construction cost of this center will mostly depend on the construction of the bridge on Via Ricardo J. Alfaro. Although this bus rerouting plan concieves of no bus route which will come from Centro way on Via Ricardo J. Alfaro and turn back from this center, this bridge will have enough width for two-way passage in order to leave open such a possiblity.

An important question is how to direct passengers from this center to the intersection. A reasonable solution will be to install a pedestrian deck from the center building to the pedestrian bridge at the intersection, but, if the land around the intersection is utilized heavily for commercial buildings, worth considering will be to have the line of pedestrian flow through such commercial buildings. A bird's-eye view of the center is shown in Fig. IV-1-20.

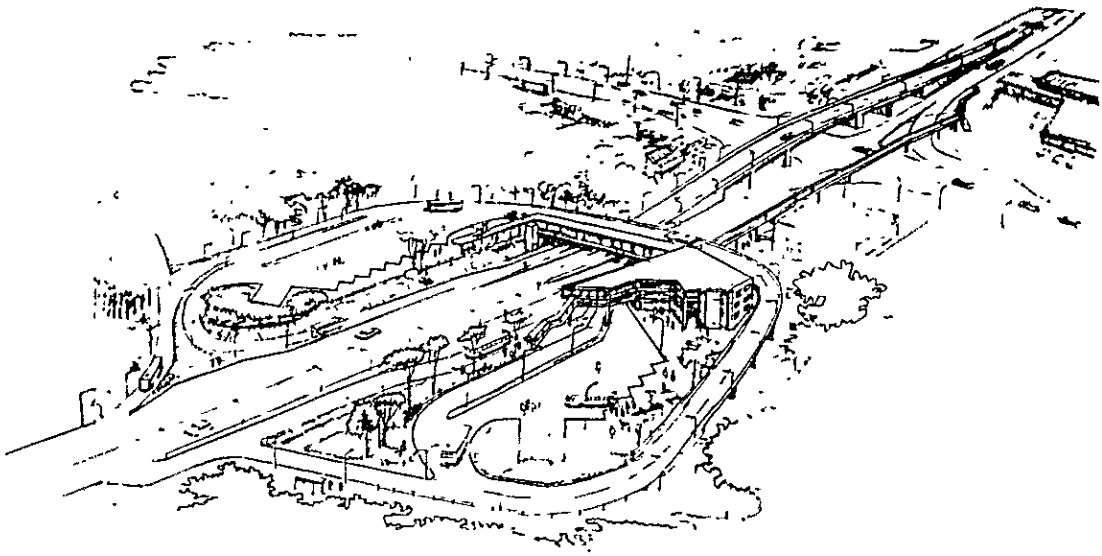


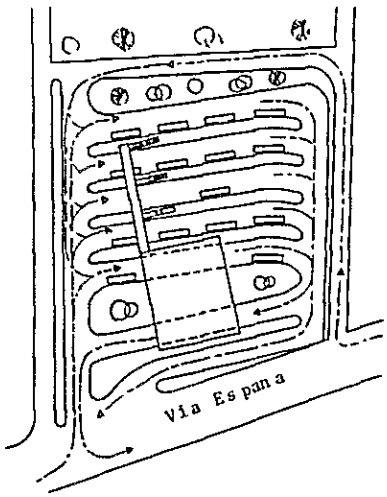
Fig. IV-1-20 BIRD'S EYE VIEW OF SAN MIGUELITO BUS CENTER

4) Chanis Bus Center

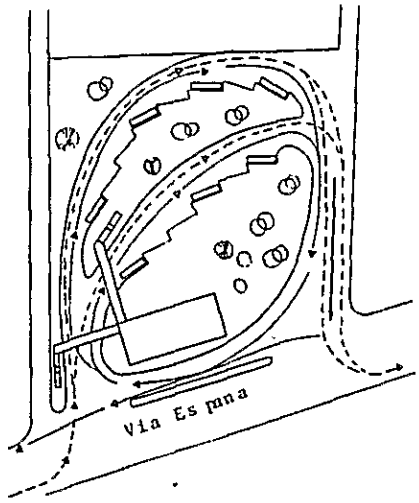
The most important question about this bus center is how to minimize the impact of the center upon the heavy daily traffic on Via Espana. Five alternatives, shown in Fig. IV-1-21, are considered.

Alternative 1:

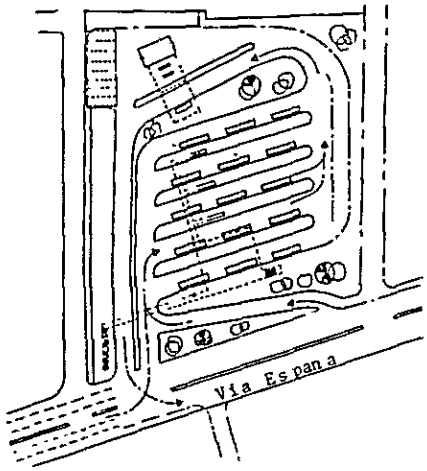
This alternative is to install entrance/exit at two locations and to have buses park alongside island platforms arranged parallel to each other. A greater number of stairways will be needed for pedestrian bridges than other alternatives, and, because the center will be surrounded by carriageways, passenger approach will be constructed.



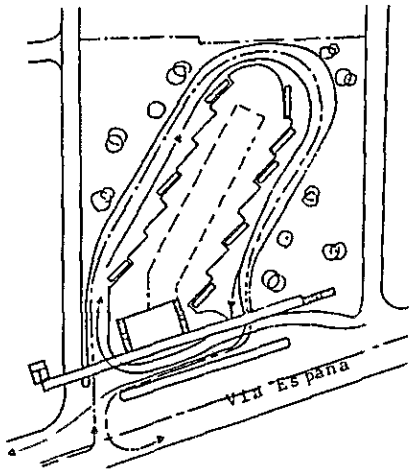
ALTERNATIVE -- 1



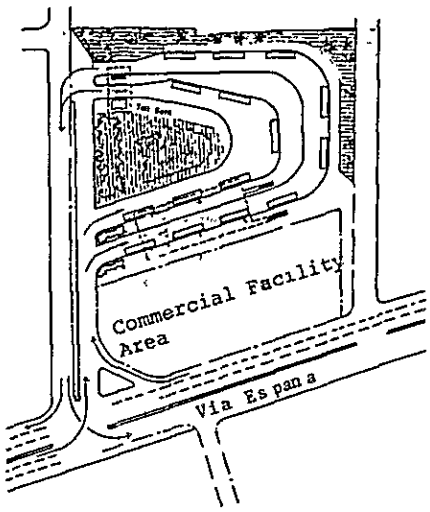
ALTERNATIVE -- 2



ALTERNATIVE -- 3



ALTERNATIVE -- 4



ALTERNATIVE -- 5 (SELECTED)

Fig. IV-1-21 ALTERNATIVE PLANS FOR CHANIS BUS CENTER

Alternative 2:

Signal traffic control will be needed at two locations, the entrance and exit, where buses will cross the road. The flow of buses inside the center will be smooth, but an oblique parking method is not recommended.

Alternative 3:

With one entrance/exit, buses will flow simply in one direction in the center designed as a compact facility, but the entrance/exit will be congested with through road traffic and the buses.

Alternative 4:

The island platforms of alternative 3 are combined into one, and buses are to be parked obliquely to it. A smaller space is needed than alternative 3, but bus maneuvering will require more time.

Alternative 5:

With one entrance/exit, the existing road is to be used for the departure of buses from the center. The flow of buses will not be complicated, and land can be economized.

The result of the qualitative evaluation of these five alternatives is shown in Table IV-1-16, from which the advantage of alternative 5 over others is evident.

TABLE IV-1-16 COMPARISON OF BUS CENTER ALTERNATIVE PLAN
(CHANIS BUS CENTER)

Criteria / Alternative	1	2	3	4	5
1. Traffic hidrance on road	▲	▲	O	△	O
2. Traffic hidrance at Entrance/Exit	▲	▲	△	▲	O
3. Approach	O	△	△	△	O
4. Circulation of bus in the Center	O	△	O	△	O
5. Safety at arrival/departure	O	△	O	△	O
6. Passenger flow	▲	O	▲	O	O
7. Bus Transferring	▲	O	▲	O	△
8. Plentiness of greens	O	▲	O	O	O
9. Simplicity of pedestrian deck	▲	△	▲	O	O
10. Occupied area	▲	▲	▲	▲	O
11. Design simplicitv	▲	▲	O	O	O
12. Construction cost	▲	▲	△	△	O

Note: O = Good, △ = Fair, ▲ = Bad.

It is recommeded that about 40m of wide land strip on the side of Via Espana be utilized for the construction of commercial building so designed to be unified with the center building for the high utilization of land and for smooth flow of passengers.

1.4.3 Construction Cost

(1) Estimation Method

Bus center construction consists of civil engineering work and architectural work. Civil engineering work will be on approach roads, passenger platforms, sidewalks, bridges, road appurtenance, and utilities facilities. Architectural work will be for the construction of the center building to house passenger service facilities and administration functions, a pedestrian deck connecting thereto, and toll gates.

The civil engineering cost has been estimated in the same way as road construction cost (see III-4). However, because nothing like a bus center building has ever been built in Panama, the required level of precision cannot be expected from the preliminary estimation of architectural cost by the usual simplified method such as the areal method, the volumetric method, and the unit use method. This cost, therefore, has been estimated by summing up the labor cost, machinary cost, and materials cost of each work item, calculated by multiplying the unit cost by the quantity, just as done in the stage of detailed designing.

(2) Labor, Machinery, and Materials Costs

The unit labor cost is based on the average wage of skilled laborers, heavy and special equipment operators, and drivers, as reported in the Construction Materials Price List (Lista de Precios de Materiales de Construccion), October 1983, by CAPAC. Machinery cost estimation followed the example of civil engineering cost estimation. The same is true with major structural materials, but, for various finishing materials, the unit cost has been based on said CAPAC data, and that of those not covered by CAPAC data has been determined based on market price revealed through a survey.

Construction materials are mostly imported (bricks being one exception), but the fact that domestic products are usually processed from imported raw materials or half-finished products has been taken into consideration in determining the foreign currency portions. Materials costs, as estimated, are shown in the list attached at the end.

(3) Land and Compensation Costs

Land price information is available from two sources. Land acquisition price per square meter has been estimated at 200 balboas for Cinco de Mayo Bus Center and at 180 balboas for San Miguelito and Chanis centers based on the market price data available from Servicios Comerciales, rather than tax assessment data from Ministerio de Hacienda. No land cost will be needed for Universidad Center to be built within the right-of-way.

With the exception of Chanis Bus Center, bus center sites are vacant land with few assets which will have to be compensated for. For the old brick or wooden 2-story apartment house located on Cinco de Mayo Bus Center site, the amount, equal to one-half the construction cost of low income houses, is estimated as compensation for vacating. Additionally, work will be necessary for the relocation of electric poles and water and sewage pipes.

(4) Indirect and Engineering Costs and Contingency Fund

The estimation of indirect costs, engineering cost, and contingency fund has followed the examples of road projects. The only exception is the contingency fund, estimated at 5% of land cost.

(5) Estimation Result

The total construction cost of the four bus centers is estimated at 16.07 million balboas in 1983 prices, of which 50% is land cost (see Table IV-1-17). This total can be depressed, however, to 11.33 million balboas, if no cost is required to the government land which constitutes the majority of Cinco de Mayo and San Miguelito Center sites. The foreign currency portion is estimated at 7.0 million balboas, or 25% of the total construction cost and 51.2% of such cost excluding land cost.

Of the four, San Miguelito Bus Center will require the largest construction cost (excluding land cost) due to the construction of a bridge over Via Ricardo J. Alfaro to connect the two centers across the road at an estimated cost of 400,000 balboas.

TABLE IV-1-17 CONSTRUCTION COST FOR BUS CENTERS

(Unit: B/.1000)

Facilities	Cinco de Mayo			San Miguelito		
	Foreign Portion	Local Portion	Total	Foreign Portion	Local Portion	Total
Road and Parking	190	118	308	113	76	189
Plartform and Sidewalk	35	28	63	24	17	41
Utility Work	83	102	185	60	63	123
Pedestrian Bridge	86	120	206	4	5	9
Building	337	484	821	452	564	1,016
Building Services	152	97	249	185	123	308
Others	126	215	341	72	94	166
Bus Center Bridge	--	--	--	377	392	769
Engineering	174	87	261	210	105	315
Contingency	178	187	365	224	216	440
Land Adquisition	--	462	462	--	2,408	2,408
Total	1,361	1,900	3,261	1,721	4,063	5,784

Facilities	Universidad			Chanis		
	Foreign Portion	Local Portion	Total	Foreign Portion	Local Portion	Total
Road and Parking	187	105	292	97	62	159
Plartform and Sidewalk	21	18	39	26	17	43
Utility Work	2	2	4	35	42	77
Building	25	29	54	190	295	485
Building Services	4	3	7	70	45	115
Others	11	11	22	107	66	173
Engineering	33	17	50	84	42	126
Contingency	42	27	69	91	85	176
Land Adquisition	--	--	--	--	1,872	1,872
Total	325	212	537	700	2,526	3,226

1.5. Evaluation and Recommendation

1.5.1. Investment Program

Investment schedule for the four bus centers has been formulated as shown in Fig. IV-1-22, under the following assumptions:

a) That the opening of the centers for service will be mid-1988 with project implementation immediately after the completion of this Feasibility Study, because a period of one year will be required for preparatory work (consent of parties concerned on the project, fund generation), another year for land acquisition and detailed designing, and about 20 months for construction work.

b) That the construction of Universidad Bus Center with large bus bays, whose construction will be easy and inexpensive relative to its importance and urgent need, will be started early 1985 and completed March 1986 (even though the simultaneous opening of the four centers is envisaged as a principle).

c) That the opening of Chanis Bus Center, which is of a simple design without any large structure and requiring only about 15 months for construction, will be about six months earlier than the opening of Cinco de Mayo and San Miguelito Centers even if their construction all starts at the same time.

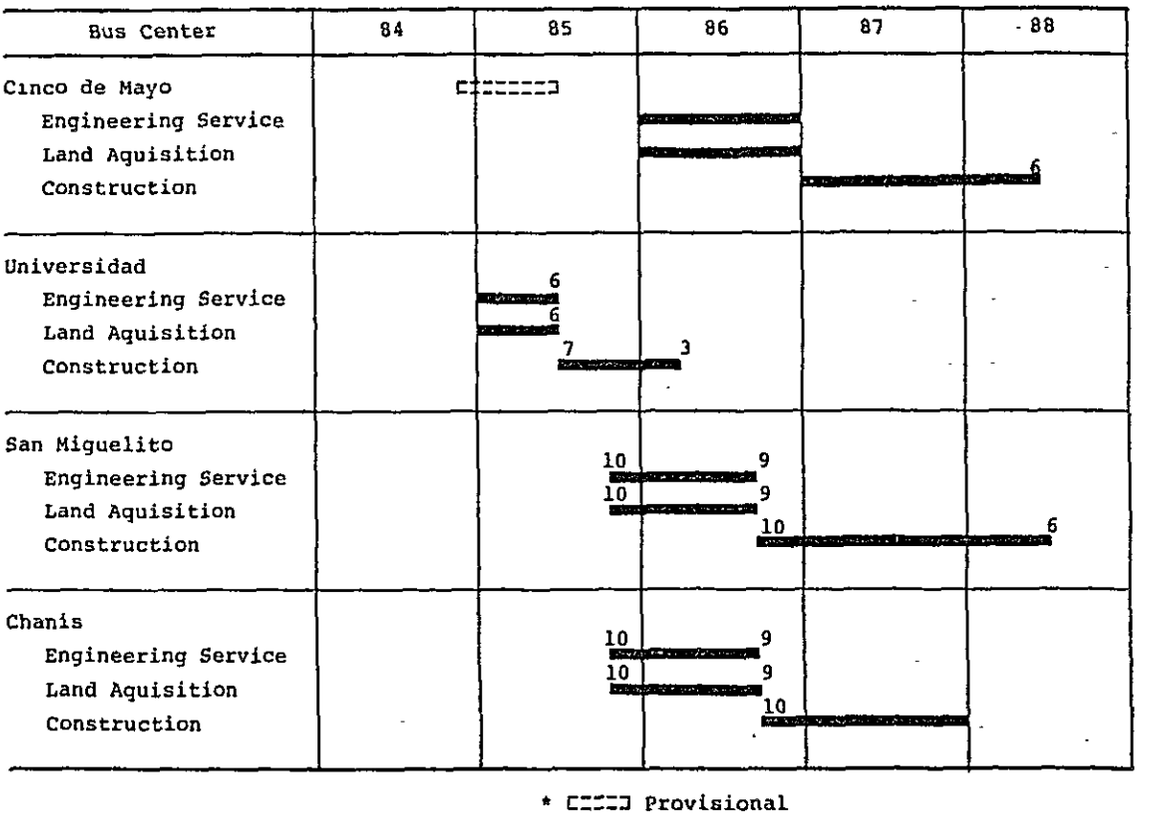


Fig. IV-1-22 IMPLEMENTATION SCHEDULE OF BUS CENTER PROJECT

d) That Cinco de Mayo Bus Center, for which demand is the strongest and which will play the most important role in bus rerouting, will be opened in 1985 with a minimum of facilities without large investment, so that the land site will be secured and the first step of bus rerouting will be started at an early opportunity (although this Center, with a small investment amount, will not be subject to this Study).

TABLE IV-1-18 INVESTMENT SCHEDULE OF BUS CENTER PROJECT

(1) Financial Cost (Unit: B/.1000 in 1983 price)

Bus Center	1985	1986	1987	1988	Total
5 de Mayo	0	565	1,988	708	3,261
Universidad	344	193	0	0	537
San Miguelito	461	2,417	2,062	844	5,784
Chanis	276	1,832	1,117	0	3,225
Total	1,081	5,006	5,167	1,552	12,807

(2) Economic Cost (Unit: B/.1000 in 1983 price)

Bus Center	1985	1986	1987	1988	Total
5 de Mayo	0	3,376	1,823	648	5,847
Universidad	315	178	0	0	493
San Miguelito	541	2,752	1,903	779	5,975
Chanis	275	1,805	986	0	3,066
Total	1,131	8,111	4,712	1,427	15,381

SOURCE: ESTAMPA II

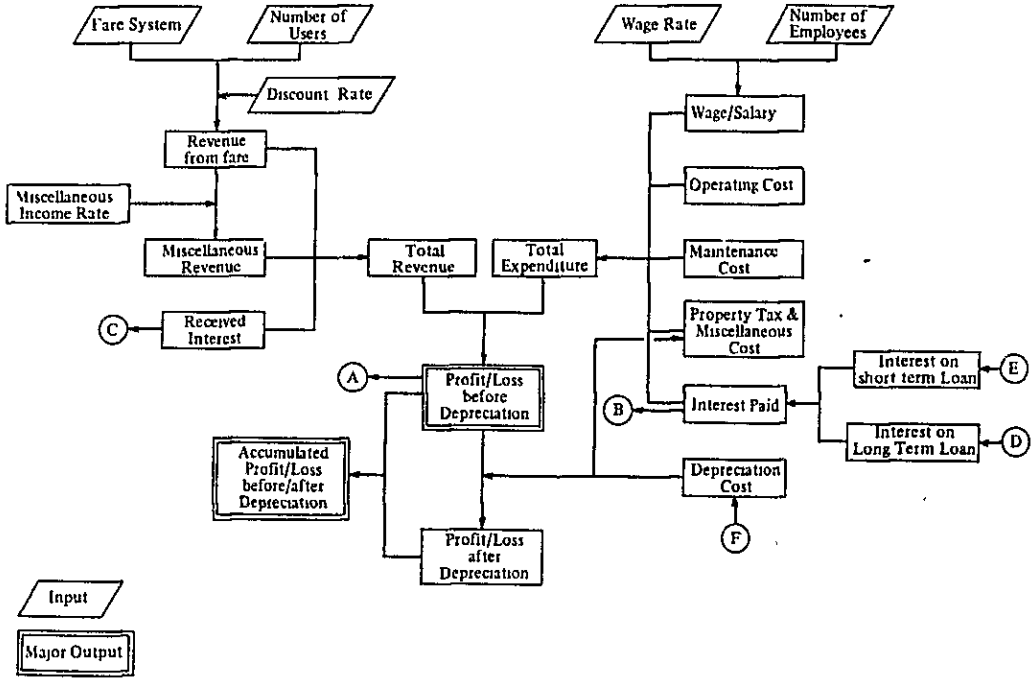
1.5.2. Financial Evaluation

Unlike roads, the bus centers and the bus maintenance center will be operated as revenue producing enterprises. Therefore, important questions in the evaluation of these projects are if they will be a viable operation and, if not, what conditions will make them viable.

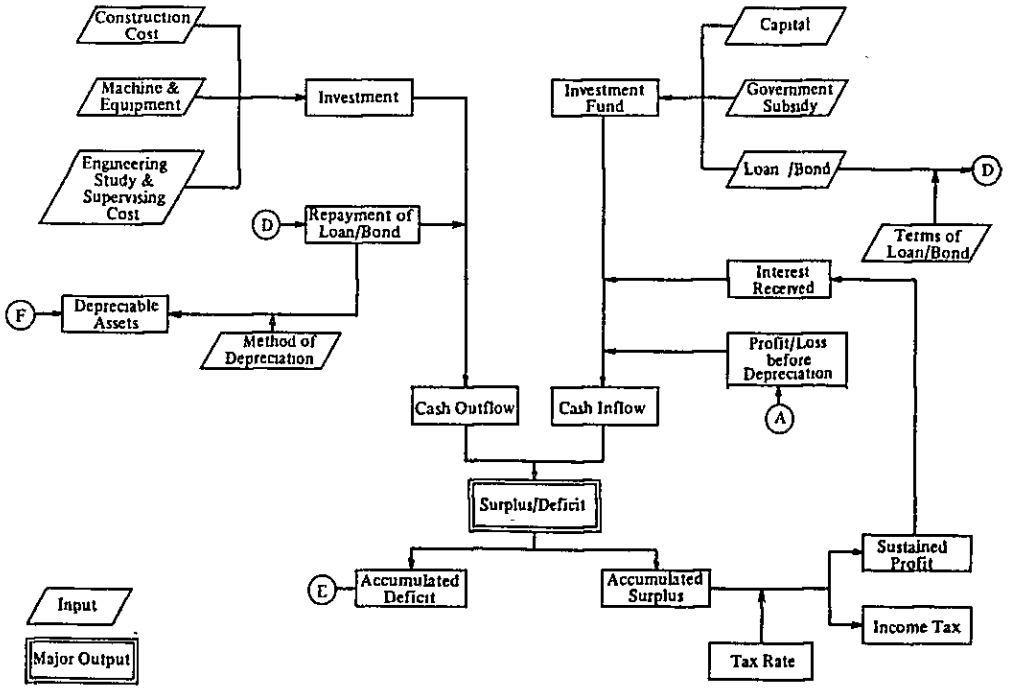
Public investment will be necessary and justified for these bus facilities in view of their public nature, but if their operation remains chronically unhealthy to the extent of requiring perpetual government subsidies, not only will they become a perennial financial burden but also their service will be inevitably deteriorated. It is imperative, therefore, that at least their current accounts show a surplus balance. From this viewpoint has the financial analysis of the bus centers been accomplished.

(1) Analysis Model

The same financial analysis model is used as in the Masterplan Study. The model structure is illustrated in Fig. IV-1-23. Model output is a pro-forma profit and loss statement, a pro-forma cash flow table, estimated discounted cash flow, financial internal rate of return, and other indices. The model is explained in detail in Chapter 14.2 of the ESTAMPA Masterplan Report.

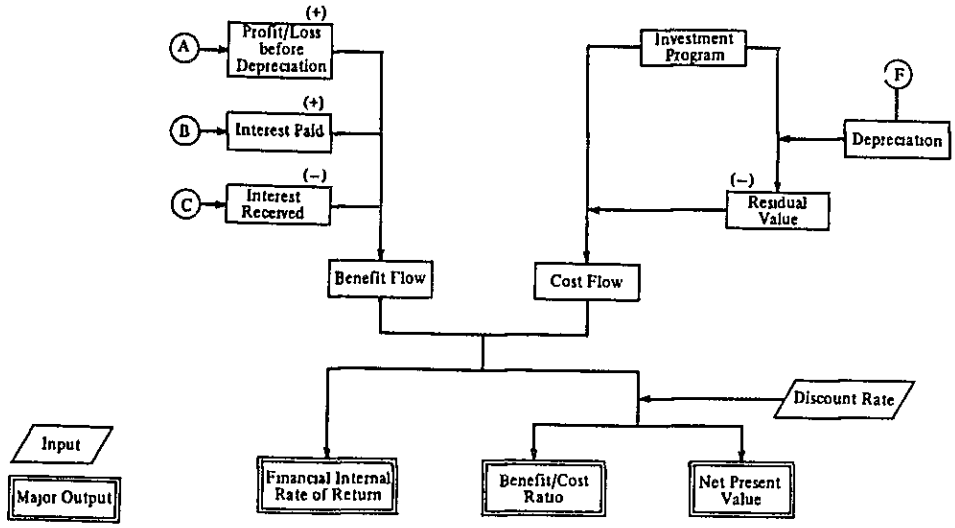


(1) PROFIT/LOSS STATEMENT



(2) CASH FLOW

FIG. IV-1-23 PROCEDURE OF FINANCIAL ANALYSIS



(3) DISCOUNTED CASH FLOW

Fig. IV-1-23 PROCEDURE OF FINANCIAL ANALYSIS

(2) Bus Center Revenues

(a) Income from Access Charges

Access charges at bus centers will be imposed on the buses using these centers. The cost will be 30 cents for one round-trip per vehicle. (For micro buses circulating in the Centro area, however, the charge will be 10 cents per vehicle as they will use the centers more frequently). For reference, the current charge imposed on inter-city buses at the bus terminal on Ave. B is 2 balboas per vehicle at each time of use. Furthermore, the study conducted in 1979 for the planning of the Colon Bus Terminal anticipated that the charge would be 50 cents for each usage for buses running between Panama and Colon and 25 cents per usage for local buses operating in and around Colon.

Table IV-1-19 shows the prediction of income from access charges based on the Bus Re-routing Plan described in Clause 2 (IV-1-2) of this Chapter. In short, the income will be 1.1 million balboas in 1990 and an increase of 2.5% in real terms is anticipated thereafter.

TABLE IV-1-19 REVENUE OF BUS CENTERS IN 1990

Unit: B./1,000 in 1983 prices

	Item	Cinco de Mayo	Universidad	San Miguelito	Chanis	Total
1.	Toll	368.6	222.7	229.5	289.0	1109.8
2.	Rent of Commercial Facilities	205.2	3.9	218.0	75.2	502.3
3.	Advertisement	180.0	38.4	144.0	48.0	410.4
4.	Miscellaneous	37.7	13.3	29.6	20.6	101.1
	Total	791.5	278.3	621.1	432.8	2123.6

In the Table, a charge of 30 cents is distributed to each center in proportion to the number of times it is used in order that the earning performance of each bus center may be compared to one another.

For example, in the case of a bus making a round-trip journey of Tocumen - Chanis - Chinco de Mayo - Chanis - Tocumen, 20 cents will be allocated to the Chanis Bus Center and 10 cents will be allocated to the Cinco de Mayo Bus Center.

(b) Income from Renting Commercial Facilities

Monthly rents for commercial facilities such as restaurants, kiosks, etc. will be determined as follows by referring to the ongoing rents of similar commercial facilities in the surrounding areas. For the Cinco de Mayo Center, which is located in the heart of the city, the rent will be 20 balboas/square meter. Rent for the other centers will be 12 balboas/square meter. The rental income, calculated by multiplying this basic rate by the actual area rented, will come to 502,000 balboas a year.

(c) Income from Advertisements

The bus centers are extremely suitable places for installing advertisements since many bus passengers congregate there. The number of advertisements should be regulated, however, so as not to spoil the beauty of the city facilities. When considering the sizes of the centers, the advertisement space will be 150m for the centers at Cinco de Mayo and San Miguelito and 80m for the other two centers.

The current advertising charges paid by and advertiser to the owner of the land or building are 100 - 130 balboas/m/month for Via Espana and 60-80 balboas/m/month for the area surrounding Via Once de Octubre. Modest charges of 100 balboas/m for the Cinco de Mayo Center, 40 balboas/m for the Universidad Center, 80 balboas/m for the San Miguelito Center and 50 balboas/m for the Chanis Center are anticipated. Accordingly, the expected income from advertisements will be 410,000 balboas a year.

(d) Miscellaneous Income

Additional miscellaneous income, such as cargo handling charges and lockercharges, etc. is estimated to be equivalent to 5% of the total income from the three sources described above.

(3) Bus Center Expenditure

Among a bus center's operation costs, the largest item of expenditure is personnel cost. Ohter items of expenditure include electricity, water, office supplies, transport and communications, insurance and so on. The maintenance cost of the facilities will be added to these. Table IV-1-20 shows a trial calculation under the assumption described below. The total expenditure in 1990 will be 656, 000 dollars (in 1983 prices).

TABLE IV-1-20 EXPENDITURES OF BUS CENTERS IN 1990
Unit: B./ 1,000 in 1983 prices

	Item	Cinco de Mayo	Universidad	San Miguelito	Chanis	Total
1.	Salary	115.7	87.8	87.8	83.0	373.8
2.	Electricity	9.7	2.5	10.2	7.5	29.9
3.	Water	15.5	0.4	3.1	2.0	20.9
4.	Office Supply	10.8	5.8	5.8	5.3	27.6
5.	Transportation and Communication	14.4	5.9	16.3	11.2	47.4
6.	Insurance	16.8	3.2	20.3	8.1	48.4
7.	Miscellaneous	9.1	5.3	7.2	5.9	27.4
8.	Maintenance	28.0	5.4	33.7	13.5	80.7
	Total	219.7	115.8	184.2	136.3	656.0

(a) Personnel Cost

Table IV-1-21 shows the trial calculation for the cost of personnel. Assuming that the Government and Private Sector Joint Committee, which is the supreme management organization, will also serve for the Bus Maintenance Center, half of the 2,500 balboas, which is the direct expense for meetings held once a month on average, is accounted for. Salaries for employees at the headquarters planned at Cinco de Mayo and the total personnel cost for all the centers are estimated to be 5,850 balboas/month and 25,300 balboas/month, respectively (both costs in 1983 prices). Although the number of employees listed for the Universidad Center will not actually be required as for the time being the Center is planned as a large bus stop, the required personnel cost when the Center's status is upgraded to that of a Center is given in the Table.

TABLE IV-1-21 MONTHLY WAGES OF BUS CENTER

(B/. per month)

Personnel	Head Quater		
	Monthly wage (B/.)	Number of Personnel	Total
Joint Committe			1,250
General Manager	1,200	1	1,200
Sub Manager	900	1	900
Administration Director	750	1	750
Operation Director	450	1	450
Secretary A	700	1	700
Secretary B	350	1	350
Secretary D	250	1	250
Sub-Total	4,600	7	5,850

Personnel	Monthly Wage (B/.)	Number of Personnel and Wage				Total Wage
		San Mig.	5 de Mayo	Univ.	Chanis	
Administrator	500	1	1	1	1	2,000
Secretary C	300	1	1	1	1	1,200
Accountant	300	1	2	1	1	1,500
Ticket Collector	250	2	2	2	2	2,000
Ticket Seller	200	3	3	3	3	2,400
Information Service	200	2	2	2	2	1,600
First Aid Service	250	1	1	1	1	1,000
Guardman	200	4	12	4	4	4,800
Maintenance Service	250	3	3	3	3	3,000
Supervisor	350	1	1	1	1	1,400
Inspector	300	1	1	1	1	1,200
Despatcher	200	4	6	4	2	3,200
Total	3,300	24	35	24	22	25,300

(b) Electricity Cost

The estimated monthly consumption volume of electricity by the four centers, based on the basic design, will be about 60,000KWH. The electricity rate charged by IRHE, Panama's national power company, is classified into two categories i.e. residential rate and industrial commercial rate. According to the tariff of the latter category (tarifa 31), the basic rate is 156 balboas. The proportional rate is 0.114 balboas/KWH for up to 25KWH, 0.086 balboas/KWH for up to 400KWH and 0.089 balboas/KWH for over 400KWH. Based on this tariff system, the annual electricity cost for the bus centers will be about 30,000 balboas.

(c) Water Cost

The total water volume that will be consumed by employees and passengers at the four centers is estimated at about 11,000 gallons (over 90% will be used in the public conveniences). Based on the current water rate (for commercial/industrial use) charged by the national water company IDAAN, the annual water cost will be about 20,900 balboas.

(d) Cost for Office Supplies

The cost for office supplies is estimated at 20 balboas/month/employee. The annual cost will be 27,600 balboas.

(e) Transport and Communication Cost

The number of vehicles and telephone lines necessary for each center is estimated in Table IV-1-22. The number of telephone lines shown in the Table only includes those lines for business use for the Bus Center's Management Division and excludes those (for business use in private sections such as restaurants and public telephones.

TABLE IV-1-22 VEHICLES AND TELEPHONES FOR BUS CENTERS

Bus Center	Vehicles	Telephone Lines
Cinco de Mayo	4	10
Universidad	1	2
San Miguelito	3	4
Chanis	2	4
Total	10	20

The transport cost is calculated on the basis that each vehicle will be used for and average of four hours (100km) a day. When this figure is multiplied by the original unit of the vehicle operation cost given in Chapter III (III-5-1), the result will be approximately 10 balboas/day/vehicle. Given that one year consists of 300 operational days, the annual cost is estimated to be 3,000 balboas/vehicle. As the capital opportunity cost has been already included in this figure, the purchase cost of the vehicle need not be considered.

With regard to the telephone cost, using the basic rate for business use (20 balboas/month) charged by the national communication company INTEL, the annual total cost for the four centers will be 4,800 balboas.

(f) Insurasnce Cost

The buildings and facilities shall be covered by an accident insurance against fires and earthquakes, etc. The ongoing annual insurance rate for a two-storey permanent building is 6,000 balboas for an insured value of 1 million balboas. The rate will be applied to the construction cost, other than the land cost and the compensation cost.

(g) Maintenance Cost

The sum which is equivalent to 5% of the total amount of (a) - (f) will be appropriated as the cost for miscellaneous items.

(h) Maintenance Cost

The sum which is equivalent to 2% of the construction cost, other than the land and compensation costs, will be appropriated as the annual maintenance and repair cost for buildings and facilities.

(4) Prerequisites for Analysis

When the model for financial analysis is used, some prerequisites will become necessary, apart from those items described above. Some of these prerequisites are described below.

(a) Capital Procurement

The capital required for the initial investment will be proveded by the paid capital and the loan. In the analytical procedure, the case where the project is entirely carried out by a loan is examined first. Only when the project is found not to be feasible financially, based on this analysis, will the introduction of paid capital be considered. Dividends for the paid capital are not considered here.

(b) Conditions of the Loan

The basic conditions of the long-term loan will be 3 years deferment, an interest rate of 10% and a repayment period of 15 years. If the management of the Center is still difficult under these conditions, the credit conditions will be eased by the introduction of a lower interest rate, etc.

The deficit caused by paying the interest during the construction period and generated after the opening of business will be compensated for by a short-term loan with an annual interest rate of 12%. Conversely, a 6% annual interest rate on deposits will be applied to a balance in the black.

(c) Depreciation

The depreciation periods for the constructed assets will be 30 years for civil engineering works such as roads and bridges, 20 years for buildings and 10 years for facilities and equipment.

The straight-line method will be used for civil engineering structures and buildings and the declining balance method will be used for facilities and equipment. Land is not subject to depreciation.

(d) Taxes

In view of the public character of the Bus Center Project, all taxes, including corporate income tax, enterprise tax, etc. will not be considered.

(e) Evaluation Indicators

The calculation method of the three indicators i.e. (i) internal rate of return (ii) net present value and (iii) cost benefit ratio is the same as used for the Road Project. In terms of financial evaluation, the recovery period of the investment of the timing to dissolve the accumulated deficit and the maximum capital demand etc. will also act as important indicators apart from the ones previously mentioned.

(f) Inflation

Although the calculation for the three indicators, such as the internal rate of return, etc. is based on real prices (1983 prices) without considering the effect of inflation, an annual inflation of 3% will be presumed for the analysis of secular changes in the financial contents of the Center Management body.

(5) Results of the Analysis

It has been found that it will be difficult to sustain the Bus Center Project as a profit-making business since the internal rate of return will be 9.2% in real terms under the above stipulated conditions. Therefore, the state land inside the construction sites at Cinco de Mayo and San Miguelito should be regarded as investment in kind from the Government. Accordingly, the appraised value of the land at 3.3 million balboas should be extracted from the investment capital.

The measures described above provide the basic case where the following analysis has been made.

(a) Balance

Fig. IV-1-24 shows the secular changes in the balance for each of the bus centers and for the total of the four bus centers.

When considering the four bus centers together, the accumulated deficit will steadily increase after the opening of business until it reaches about 6 million balboas in the 9th year (1997). The performance will then gradually start to show a recovery and will begin to show a profit from the 16th year onwards (2004). The balance will be more than 15 million balboas in the black in the 20th year of operation (2008).

An independent examination of each center shows that the Cinco de Mayo Center and the Universidad Center will show a profit from the very beginning because of large demand in the former and low investment in the latter.

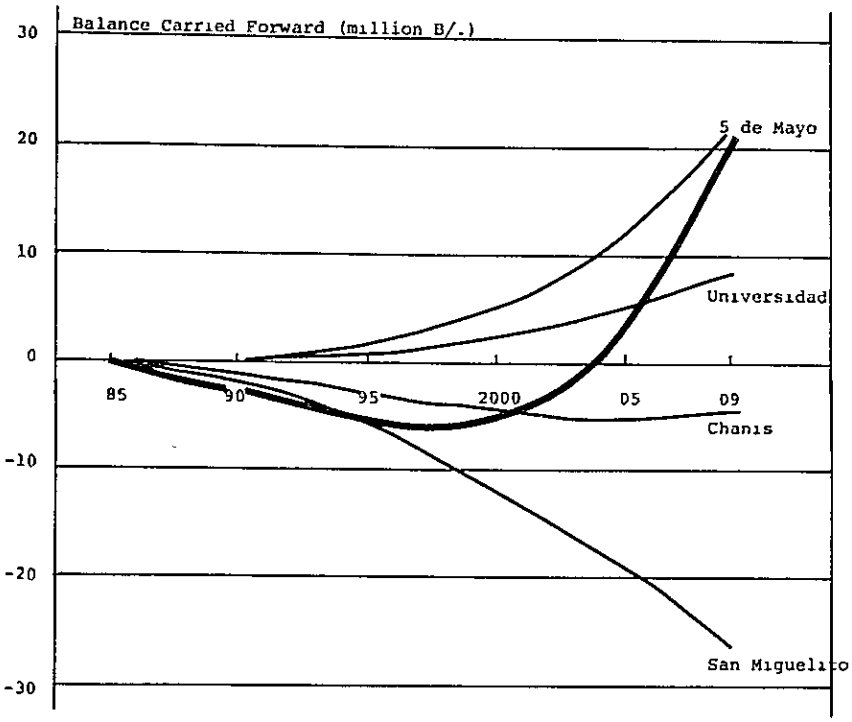


Fig. IV-1-24 TREND OF BALANCE CARRIED FORWARD OF BUS CENTERS

The accumulated deficit for the Chanis Center will reach 5.3 million balboas in the 16th year of operation (2004) but its performance will later recover showing a profit in the 28th year (2016) and onwards.

As far as the San Miguelito Center is concerned, it will not reach the break-even point by itself since its size is fairly large and it will require large investment to build a bridge over Avenue Ricardo J. Alfaro in order to connect the bus centers located on both sides of the street.

This project, therefore, presupposes that the management of the four centers be a single organization so that a deficit shown by any one bus center can be compensated for by the profit of one of the other bus centers, thus keeping the overall balance in the black.

If each center must be run independently, the San Miguelito Center should increase its income by widening its commercial facilities, etc.

(b) Evaluation Indicators

The cost benefit ratio and the net present value is 0.88 and -1.29 million balboas, respectively, under and internal rate of return of 10.6% and a discount rate of 12% for the four centers as a whole (Table IV-1-23).

Since these figures are given in real term, the management of the centers based on a commercial basis loan will be viable because the internal rate of return will exceed 13% in circumstances where the annual rate of inflation is 3%. Even so, the project cannot be said to be highly profitable.

TABLE IV-1-23 FINANCIAL EVALUATION OF BUS CENTERS

(1) In Real Term (in 1983 price)

Evaluation Indices	Four Centers as a whole	Cinco de Mayo	Universidad	San Miguelito	Chanis
1. Period of negative balance (years)	Bankrupt	2	2	Bankrupt	Bankrupt
2. Maximum Fund Shortage (million B/.)	Infinite	0.23	0.13	Infinite	Infinite
(of which year)		(1988)	(1987)		
3. Internal Rate of Return (%)	10.58	16.38	20.93	6.04	8.47
4. Net Present Value (million B/.)	-1.29	0.88	0.51	-2.12	-0.81
5. Benefit/Cost Ratio	0.878	1.34	2.00	0.54	0.70

(2) In Nominal Term (under 3% of inflation rate)

Evaluation Indices	Four Centers as a whole	Cinco de Mayo	Universidad	San Miguelito	Chanis
1. Period of negative balance (years)	16	2	2	Bankrupt	28
2. Maximum Fund Shortage (million B/.)	5.97	0.24	0.14	Infinite	5.28
(of which year)	(1997)	(1988)	(1987)		(2004)
3. Internal Rate of Return (%)	13.74	19.80	24.54	8.55	11.21
4. Net Present Value (million B/.)	2.10	2.08	0.93	-1.52	-0.23
5. Benefit/Cost Ratio	1.18	1.75	2.72	0.71	0.92

(c) Sensitivity Analysis

Table IV-1-24 shows the results of sensitivity analyses conducted on land cost, construction cost, income, etc.

TABLE IV-1-24 SENSITIVITY ANALYSIS OF FINANCIAL EVALUATION OF BUS CENTERS

Case	IRR (%)	NPV (Million	B/C
1. Base Case	10.58	-1.29	0.88
2. Land Cost=0	21.25	5.92	1.94
3. 10% up of Construction Cost	8.92	-4.02	0.75
4. 10% down of Revenue	8.83	-4.12	0.73
5. 10% up of Operating Cost	9.82	-2.30	0.83

If it is supposed that land owners use their land as investment-in-kind for the Bus Center Project, the internal rate of return will then become as high as 21.3% due to the free land cost, making the operation highly profitable. As a result, nearly a 10% dividend will be possible for investors. The possibility of the participation of land owners in the operation, therefore, should be examined in order to reduce the initial investment cost.

As the construction cost and the income have a more or less similar elasticity value towards the internal rate of return, a 10% rise in the construction cost or a 10% reduction in income will lower the internal rate of return by about 16%. An increase in the operation cost will not substantially affect the evaluation indicators.

1.5.3 Economic Evaluation

As the Bus Center Project is mainly aimed at improving the quality of the bus services, it is difficult to conduct a blanket measurement of the social benefits. Therefore, the results of the economic evaluation, which was carried out by converting into calculation prices the input of the financial analysis mentioned above, are described here. The social significance of the project will be considered in the next clause, 1-5-4.

The method of converting the construction cost from financial cost to economic cost is the same as used for the Road Construction Project (refer to III-5-1).

The main pillars are threefold: (i) deduction of tariffs on imported goods and distribution tax (ITBM); (ii) the application of wage in shadow price for unskilled workers (60% of wages in market price) and (iii) the adjustment of the land cost.

The result of the conversion into economic cost is shown in Table IV-1-18. The total investment capital will be 15.4 million balboas based on economic cost as against 12.8 million balboas based on financial cost. The former will become larger than the latter due to the addition of opportunity cost for the Government-owned land, excluded in the case of the latter.

No conversion has been made with the income. With regard to the operation cost, the potential wage has been applied to the personnel cost, the potential wage has been applied to the personnel cost. Moreover, the insurance cost has been reduced in accordance with the reduction in the asset value due to depreciation. The economic cost of vehicle operation is applied as transportation cost.

Table IV-1-25 shows the calculation results of the evaluation indicators together with the results of the sensitivity analysis.

The internal rate of return for the 4 centers together is 9.6%, 1% lower than the rate given by the financial evaluation. Other indicators also show a similar tendency with those in the financial evaluation but their actual values are slightly lower than those given in the financial evaluation.

TABLE IV-1-25 ECONOMIC EVALUATION OF BUS CENTERS

Case	Four	5 de Mayo	Universidad	San Miguelito	Chanis
1. Base Case					
IRR (%)	9.57	9.67	25.53	6.83	10.04
NPV (Million B/.)	-2.56	-0.91	0.76	-1.97	-0.44
B/C	0.80	0.81	2.63	0.59	0.83
2. Land Cost = 0					
IRR (%)	20.98	23.84	25.53	15.18	25.38
NPV (million B/.)	4.67	2.02	0.76	0.64	1.26
B/C	1.87	2.14	2.63	1.28	2.50
3. 10% up of Construction Cost					
IRR (%)	8.58	8.67	23.89	5.97	9.07
NPV (million B/.)	-3.87	-1.40	0.71	-2.48	-0.71
B/C	0.72	0.73	2.39	0.54	0.75
4. 10% down of Revenue					
IRR (%)	8.30	8.42	23.01	5.80	8.80
NPV (million B/.)	-3.82	-1.38	0.59	-2.33	-0.70
B/C	0.70	0.71	2.20	0.52	0.72
5. 10% up of Operating Cost					
IRR (%)	9.31	9.44	24.85	6.63	9.79
NPV (million B/.)	-2.82	-1.00	0.71	-2.04	-0.49
B/C	0.78	0.79	2.53	0.58	0.81

1.5.4 Conclusion

The Bus Center Project will bring about not only profit for the management body but also spill-over effects such as greater convenience for the users of buses, relief of traffic congestion on roads in the vicinity, a rationalisation of bus routes and the promotion of commercial activities at the Centers and the surrounding areas.

Taking the area surrounding the Cinco de Mayo Bus Ceter as an example, a trial calculation shows that the effect of the Center in relieveing traffic congestion will be equivalent to 8.3% of the construcion cost.

Although the profitability of the bus center is not very high, the construction and running of these centers, using funds on a commercial basis, will be viable if the Government offers state land as investment-in-kind.

The low profitability is the result of the low level of charges imposed on buses using the centers, due to the public character of their services. As the bus centers should run as non-profit organizations in principle, better conditions should be provided for the bus operators and the tenants of the commercial facilities if more Government investment and/or the introduction of low-interest funds are possible.

For example, if a loan with a 6% interest rate becomes available, the charge for the use of the centers could be made free.

As the time is ripe for the reorganization of the Panamanian urban bus routes, the early construction of these four bus centers is anticipated.

2. Bus Maintenance Center Project

2.1 Present Condition of Bus Maintenance

2.1.1. Bus Fleet

In the Republic of Panama are presently about 6,700 buses in total, of which about 53% are concentrated in Panama Province (Table IV-2-1). These buses are either public use buses (urban or inter-urban route buses) or private use buses (company buses and school buses). Those subject to the Bus Maintenance Center will be chiefly 1,088 urban buses (of which 910 buses are operative) in Panama City (Table IV-2-2).

TABLE IV-2-1 BUS FLEET REGISTERED IN PANAMA

	Public Use Bus					Private Use Bus in 1983	
Province	1976	1980	1981	1982	1983	School	Official/Private
Panama	1,574	2,106	2,106	2,251	2,231	996	345
Chiriqui	813	516	664	717	722	72	25
Cocle	470	360	370	410	439	9	60
Colon	350	360	370	406	393	42	100
Herrera	296	217	214	214	226	26	5
Los Santos	210	232	242	311	348	17	5
Veraguas	468	480	491	493	524	32	5
Bocas del Toro	62	25	26	37	37	--	10
Darien	--	--	--	--	40	--	10
Total	4,243	4,296	4,483	4,839	4,960	1,194	555

SOURCE: DINTRAT

TABLE IV-2-2 BUSES IN PANAMA CITY

Type	Year		1981	1983
Public Use	Urban Bus	Registered	1,455	1,088
		Under Operation	1,029	910
	Interurban Bus	Registered	638	---
		Under Operation	738	---
Private Use (Incl. School Bus)			---	1,749

SOURCE: DINTRAT

The aging of buses has been deemed a problem in Panama City in terms of operating and maintenance costs and the attraction of passengers. Particularly a large number of used buses imported during the 1970s have experienced frequent breakdowns and shortage of parts, and for this reason the Transport Operators' Cooperative (CPTT) decided in 1978 not to register any more used buses. Also, the police (DNTTT) has since 1982 operated under the traffic policy of not renewing the registration of superannuated vehicles. As a result, the number of buses operating in Panama City decreased by about 16% from 1981 to 1983.

Along with the scrapping of old vehicles, those made in various countries and other new large buses have been introduced. The average age of buses is still rather high at 8.5 years, but this represents an improvement by more than three years from the 11.6 years in 1981. Buses used for 16 years or more, which accounted for 16% of all buses in 1981, now represent only 6%. (See Fig. IV-2-1 for age distribution of buses). Also, larger buses have been introduced, as reflected by increase in the average number of seats per bus from the 47 in 1981 to 53 in 1983 (Table IV-2-3). These trends should be born in mind when estimating the number of buses in the future.

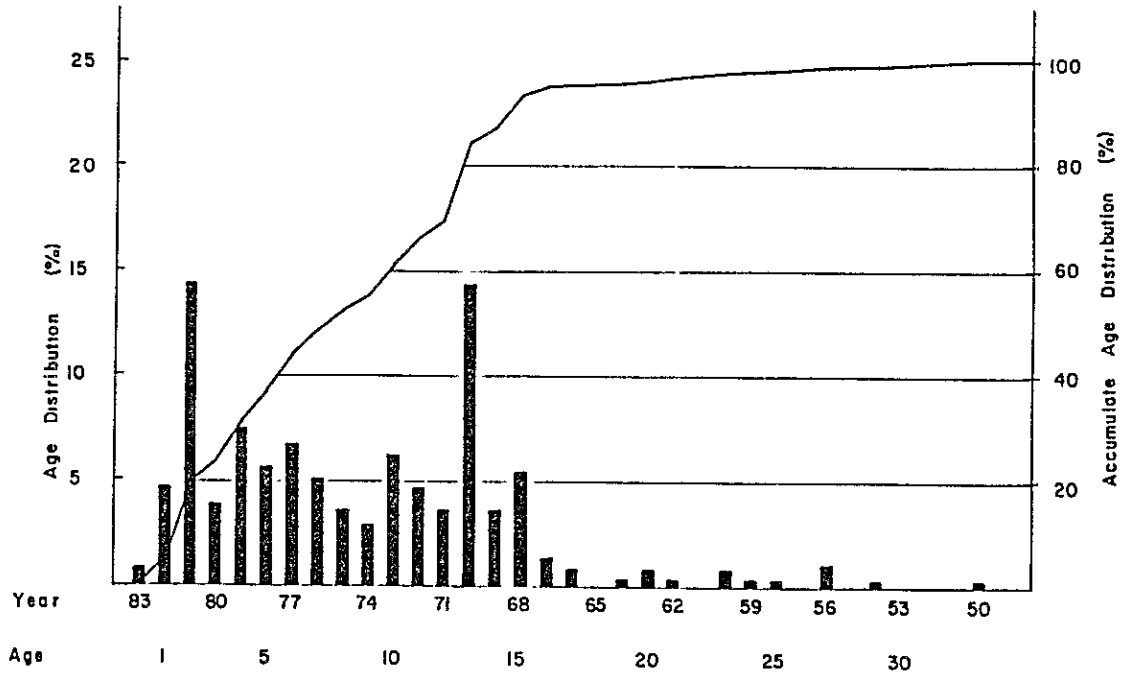


Fig. IV-2-1 VEHICLE AGE DISTRIBUTION

TABLE IV-2-3 VEHICLE SIZE DISTRIBUTION

Bus Size (No. of Seats)	Composition 1981	1983
16	5.2	0.6
24	0.5	---
30 - 36	6.0	3.2
40 - 44	30.0	22.8
45 - 48	7.1	7.4
50 - 54	5.6	7.7
55 - 59	42.2	44.5
60 -	3.4	13.8
Total	100.0	100.0
Average No. of Seat	47.0	53.0

SOURCE: ESTAMPA I for 1981 and ESTAMPA II for 1983.

Existing buses are of diverse models. A 30% sampling survey by ESTAMPA II resulted in the observation of 29 kinds of buses. More than 90% of all buses are made in the United States, and about half of the 90% are made by Ford Motors (see Fig. IV-2-2 and Table IV-2-4). More than 90% are of bonnet type (with protruding engine space under hood), and one-box type buses are few.

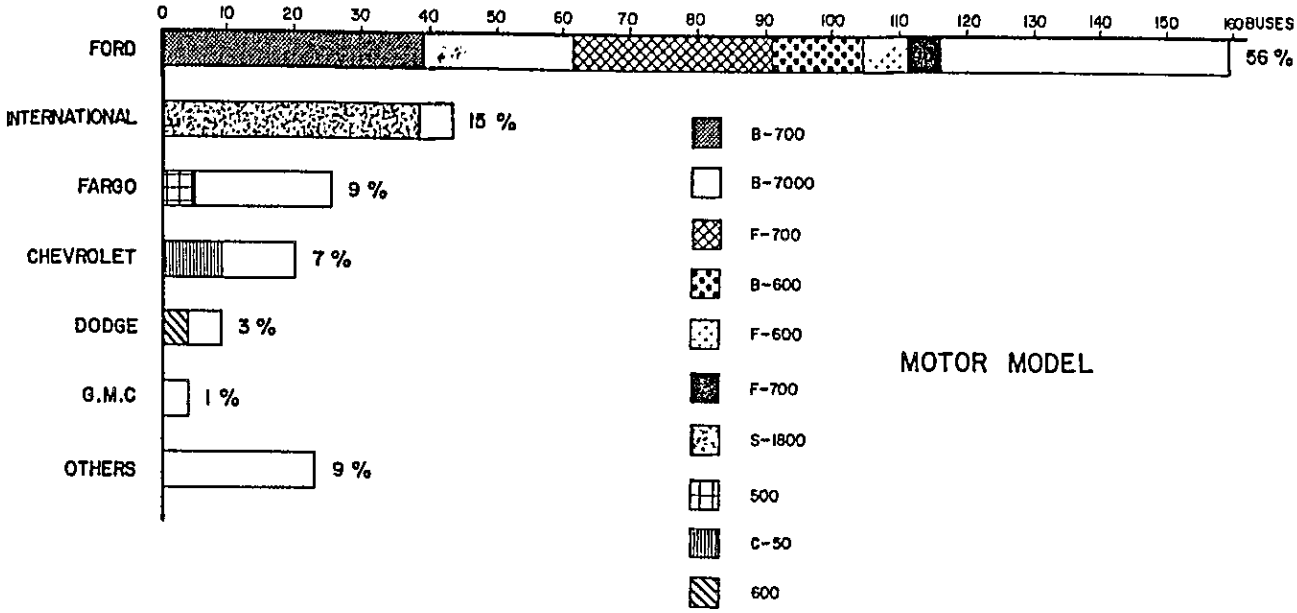


Fig. IV-2-2 NUMBER OF BUSES BY MAKER

TABLE IV-2-4 NUMBER OF BUSES OPERATED IN PANAMA CITY BY MAKER AND YEAR OF PRODUCE

Maker	Ford								International		Fargo		Chevrolet		Dodge		G.M.C
Model	B-700	B-7000	F-700	Ford-700	B-600	F-600	F-7000	Oth.	S-1800	Others	Farg-500	Others	C-50	Others	Dodge	Others	G.M.C
Year																	
1959	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-
1960	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-
1961	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1962	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-
1963	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-
1964	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-
1965	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1966	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	1
1967	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-
1968	2	-	-	1	-	-	-	1	-	-	-	2	1	3	1	-	2
1969	-	-	-	2	1	-	-	1	-	-	-	3	3	-	-	-	-
1970	4	2	6	3	-	1	-	4	-	-	3	7	1	4	1	2	1
1971	-	-	-	2	1	1	-	-	-	-	-	3	-	-	1	1	1
1972	3	1	2	-	-	-	-	-	-	-	-	-	-	1	-	-	-
1973	3	-	2	1	2	-	-	-	-	-	-	2	1	-	1	-	-
1974	2	-	-	-	1	1	1	-	-	-	2	2	-	-	-	-	-
1975	3	1	1	1	2	-	-	-	-	-	-	-	-	-	-	1	-
1976	3	3	1	-	1	-	2	-	-	-	-	-	-	-	-	-	1
1977	3	5	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-
1978	3	2	1	2	1	-	-	-	-	-	-	-	-	-	-	2	-
1979	3	5	1	1	-	-	2	-	2	1	-	-	-	-	-	-	-
1980	2	1	-	-	-	1	-	-	2	1	-	1	-	-	-	-	-
1981	3	-	-	-	-	-	1	-	24	3	-	2	-	-	-	-	-
1982	1	2	-	1	-	-	-	-	6	-	-	-	-	-	-	-	-
1983	-	1	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-

Note: Survived 249 buses out of 910 in August to September, 1983.
Source: ESTAMPA II

The number of various combinations of chasis and engine are even greater, because many old buses have their engines replaced. Many replacement engines are Caterpillar or Perkins engines (Fig. IV-2-3). By fuel, diesel engine represents 83% of all buses, and this is because the price of diesel oil is low under a preferential tax treatment. Because many high power engines are diesel, further increase in large buses will result in a higher ratio of diesel engines.

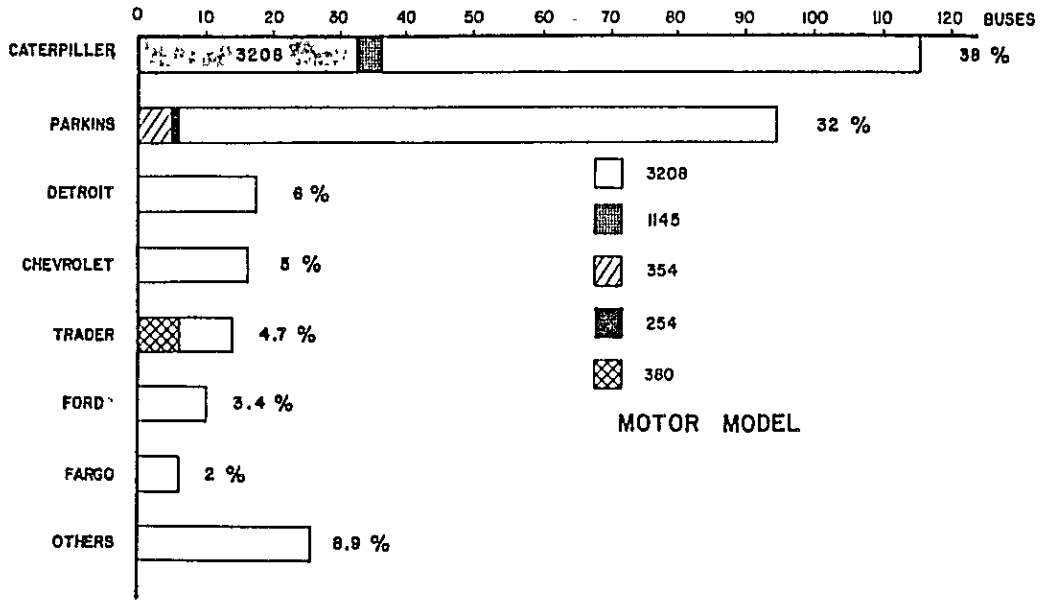


Fig. IV-2-3 NUMBER OF BUSES BY ENGINE MANUFACTURE

2.1.2. Status Quo and Demand for Bus Maintenance

The rate of accidents is particularly high for public use buses in comparison with vehicles of other types (see Table IV-2-5), and it figures that 80 buses out of 100 are a cause for accident each year. While this high accident rate is attributable in part to questionable skills and behavior of bus drivers and the bus rental system which forces the drivers to be in a hurry to catch passengers, the poor maintenance of buses is undoubtedly another cause for accidents. The decreasing of the accident rate is mandatory not only from the safety standpoint, but also for the realization of financially sound bus business through the improvement of bus operation rate.

Average number of operation days per month slightly increased from the 22 days in 1981 to 24 days in 1983. This, it is presumed, was a result of said increase in new buses, reduction in the number of operating buses, and a slight improvement in accident rate. Conversely, average number of days spent in maintenance shop per month increased from 2.9 days in 1981 to 3.4 days in 1983. On the average, each bus is sent to shop twice a month and stays there for an average of 1.7 days each time.

From interviews with bus owners, the annual cost of bus maintenance is estimated at 5,352 Balboas in 1981 and 5,476 Balboas in 1983, and the annual cost of oil changes and other non-shop maintenance cost is estimated at 958 Balboas in 1981 and 887 Balboas in 1983.

TABLE IV-2-5 TRAFFIC ACCIDENT BY TYPE OF VEHICLES

	Type of Vehicles	Number of Cases		Cases per 100 vehicles registered	
		1978	1980	1978	1980
Private	Motorcycle	60	85	6.3	8.4
	Bicycle	55	64	1.3	2.1
	Car	3,853	4,223	9.5	7.8
	Bus	12	18	3.8	5.1
	Truck	140	178	14.2	7.6
	Other		1		3.4
	Total	4,005	4,420	9.6	7.8
Public	Car	883	964	25.0	25.7
	Bus	1,258	1,376	88.3	81.5
	Truck	1,092	1,233	18.2	14.0
	Other	11	8	19.0	13.8
	Total	3,244	3,581	29.5	25.0

SOURCE: CONTRALORIA GENERAL

Because inquiries at maintenance shops indicated that requests for periodical maintenance are very rare, it is believed that the referral of buses to maintenance shop, discussed above, is as a result of bus breakdown. On the other hand, a questionnaire survey of bus owners indicated that the rate of periodical maintenance was as high as 86%, although half of it indicated that periodical inspection/maintenance was not by a maintenance shop. Apparently, such maintenance is not according to the manufacturers manual but is a simple and inadequate one. If so, the owners' consciousness of the need of at least some kind of periodical maintenance will be helpful when a preventive maintenance system is introduced in the future. The owners advanced the following reasons for not utilizing a shop for the periodical maintenance of their buses: too expensive (70%), technically unreliable (20%), and no time (3%).

TABLE IV-2-6 FREQUENT FAILURES AND PARTS OFTEN CHANGED

Failure	Order of Incidence	
	by Owner/Driver	at Workshops
Break System	1	1
Transmission	2	2
Clutch	3	3
Engine	3	4
Differential Gear	7	4
Compresor	-	6
Suspension	-	6
Injection Pump	-	8
Electric System	5	8
Steering System	-	8
Tire, Wheel	6	-

SOURCE: Interview Survey by ESTAMPA II.

A questionnaire survey was conducted of bus owners, drivers, and maintenance shop people concerning parts frequently broken or replaced, and result was obtained as presented in Table IV-2-6. Also, the useful life of major parts was as shown in Table IV-2-7. The breakdown of brake system is particularly frequent, because urban buses are required to repeat stop and go due to signals and bus stops. The relatively high frequency of power train-related troubles is probably because of numerous old buses and of wild driving practice.

TABLE IV-2-7 DURABLE PERIOD OF MAJOR PARTS

Part	Durable Period (Month)	
	by Owner/Driver	at Workshop
Air Filter	2.2	7
Oil Filter	1.1	2.5
Fan Belt		3
Tire		3
Break Shoe Lining	3.9	3
Clutch Lining	6.1	3
Battery	13.8	11

SOURCE: Interview Survey by ESTAMPA II

2.1.3. Bus Maintenance Service

In Panam City there are some 50 maintenance shops (145 stalls), many of which are located in Rio Abajo and Juan Diaz along Via Espana and Via Bolivar (see Fig. IV-2-4). Shops are small with two to four stalls, and the average number of stalls per shop is 3.0 (see Fig. IV-2-5). The layout of a typical private maintenance shop is shown in Fig. IV-2-6.

Fig. IV-2-4 LOCATION OF SURVEYED WORKSHOPS

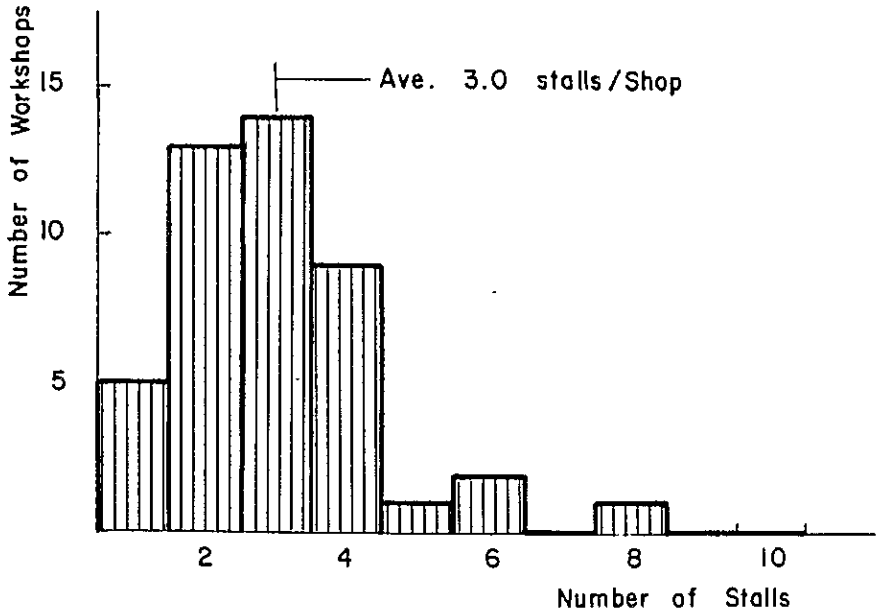


Fig. IV-2-5 WORKSHOPS BY SIZE

About 40% of shops have no roof to cover the work area, and 60% are of a very simple building. The floor is not paved, and work environment is spoiled by deposits of lubrication or waste oil. Although many shops are equipped with fundamental maintenance instruments, they are ill-maintainedand are left alone when out of order with shop workers relying on hand tools. For instance, it was observed that many floor jacks were broken and emergency jacks were taken out of cars and used to raise vehicles and that wheels and wooden pieces are inserted to uphold the raised vehicles.

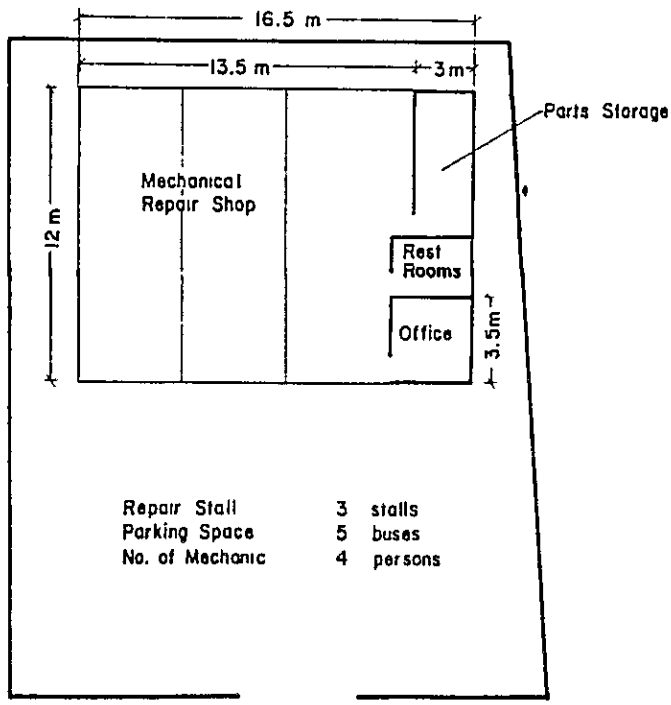


Fig. IV-2-6 TYPICAL WORKSHOP IN PANAMA

Some 180 mechanics are employed by maintenance shops with an average of 3.6 mechanics per shop and 1.23 mechanics per stall (2.0 mechanics per stall in the case of urban buses in Japan). Those mechanics work eight hours a day, six days a week. In addition to those employed mechanics, some 45 independent mechanics respond to bus owner's request and are engaged in repair work mostly on road. Rental shops are also available for those independent mechanics.

Because there are so many different kinds of buses and most of them are old, few maintenance shops have maintenance manuals distributed by bus dealers. Shops which have a manual usually do not have testers and inspection equipment to see if maintenance work is up to the manual standard or not. Thus maintenance in accordance with the manual is almost non-existent. Repair work is being done with experience-based artisan like skills and new mechanics are trained only through work experience under a system similar to that of apprentice. Average number of days needed for repair work is shown in Table IV-2-8.

TABLE IV-2-8 AVERAGE DAYS OF MAJOR REPAIRING

Unit	Repairing Days	Unit	Repairing Days
1. Engine	6 days	4. Differential Gear	2 days
2. Trnsmission	2 days	5. Brake System	1 day
3. Clutch	1 day	6. Injection Pump	2 days

SOURCE: Interview to Bus Maintenance Shop by ESTAMPA II

Systematic trouble-shooting and repairing is not adopted at ordinary shops, and the skill level of mechanics is not high. Therefore, special repair work requiring high skills and special instruments is beyond the capability of ordinary maintenance shops and is referred to specialized shops. The number and kinds of such specialized shops are shown in Table IV-2-9.

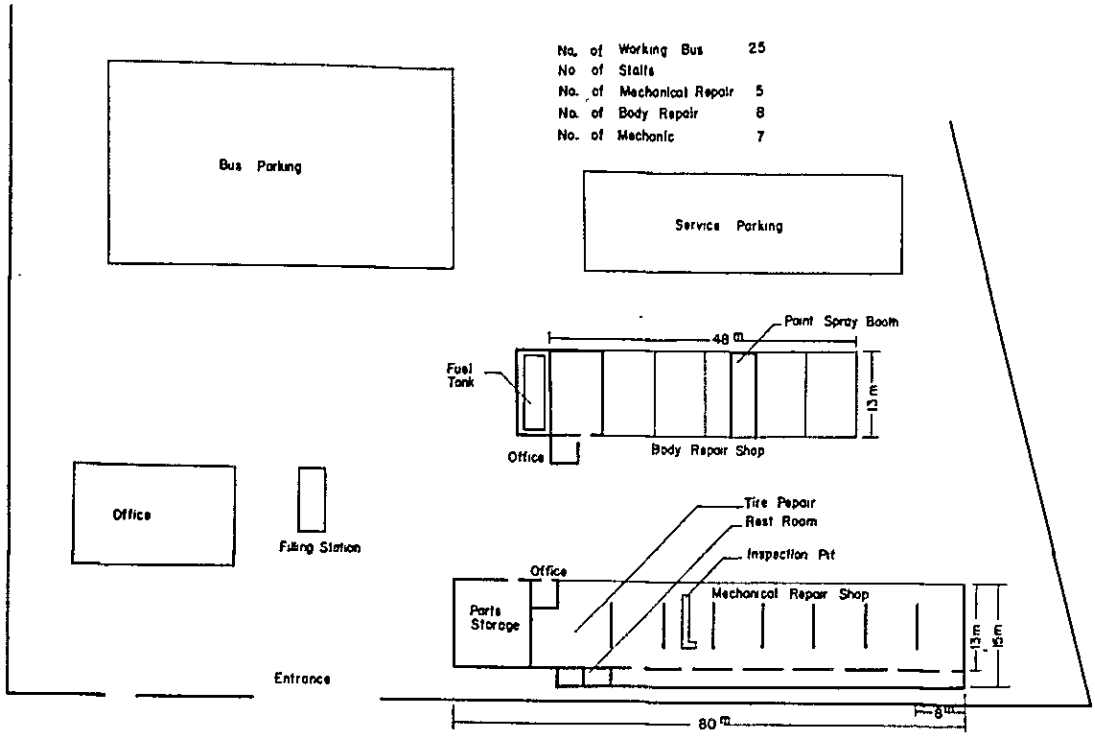
TABLE IV-2-9 SPECIALIZED PARTS REPAIRSHOPS IN PANAMA CITY

Specialized Parts Repairshop	Shops
1. Engine Parts Reconditioning	3
2. Injection Pump Repair	3
3. Electric Unit Repair	2
4. Radiators Repair	3
5. Body Repair	2

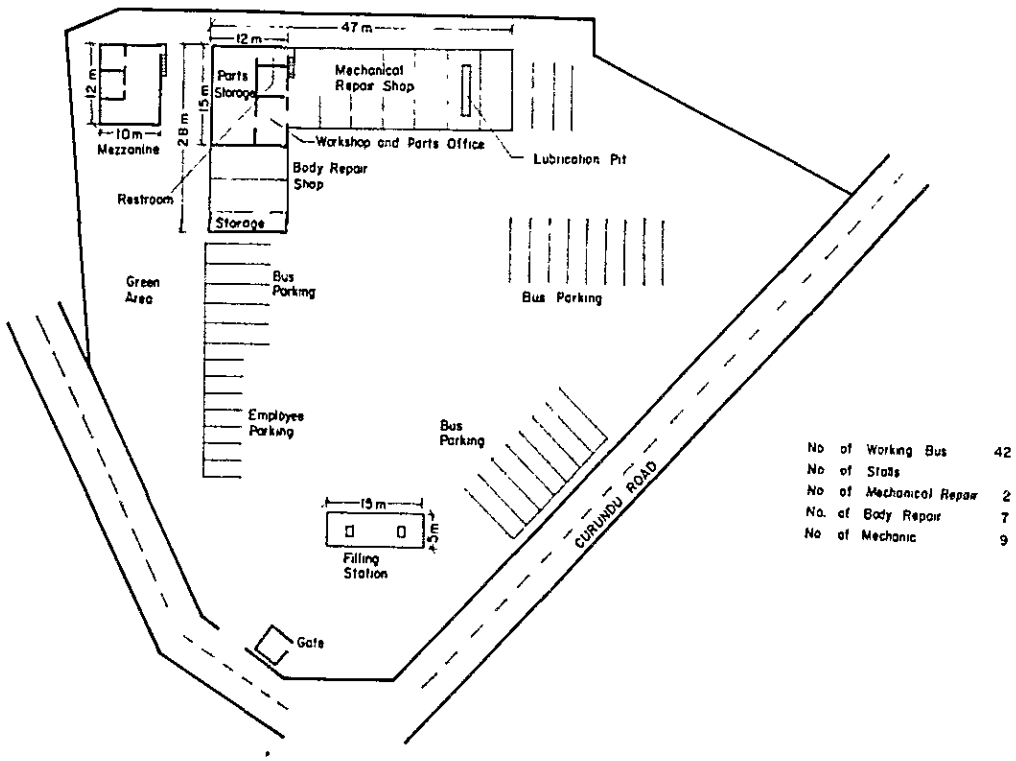
SOURCE: Interview to Bus Maintenance Shops by ESTAMPA II

The maintenance shops discussed so far are those which service the buses of SICOTRAC, the syndicate of one-bus owners. Other bus operators have their own shops. The layout of repair shop of SACA and that of COOMETRAP are shown in Fig. IV-2-7. The shop of SACA is functioning comparatively well, and, therefore, the Bus Maintenance Center planned under this Study will need not cover the buses of these two operation entities.

In summary of the above, the bus repairing capacity existing in Panama City can be estimated to be 145 stalls, which corresponds to 15.3% of all operational buses. Now, average number of repairing days is, as said earlier, 3.4 days per vehicle per month, which is 14.0 of 24 days. Thus, it can be said that the service capacity is presently somewhat higher than the demand.



(1) COOMETRAP WORKSHOP



(2) SACA WORKSHOP

Fig. IV-2-7 LAYOUT OF COOMETRAP AND SACA WORKSHOPS

Parts shops number 71 in total, distributed to locations as shown in Fig. IV-2-8. Of the 71, four handle used parts, two are large shops importing parts on their own, and the remainder are small shops which buy parts from vehicle dealers or large parts shops. Thus, parts prices vary somewhat from shop to shop. Some repair shops are at the same time parts shops. Upon interview, many bus owners complained the excessive time required between the ordering and receiving of parts and the resultant deterioration of bus operation rate.

Fig. IV-2-8 LOCATION OF PARTS SHOPS

2.1.4. Bus Maintenance System

1) Laws and Regulations

The only statutory base for vehicle maintenance is vehicle inspection by the Inspector General (Examinados por la Inspeccion General del Transito) provided for by Articles 8 and 9 of the Road Traffic Regulation (Reglamento de Transito), which is supplemented for enforcement by the circular (Comunicado) of the Traffic Police (DNTTT).

Said Article 8 stipulates that, only the vehicles inspected by the Vehicle Inspection General may be registered. Such vehicles must be in safe and properly maintained condition so that its operation will not be a danger to the society.

Subject to mechanical inspection are designated by said Article 9 as:

a. Lamps and horns
b. Steering wheels and direction indicators
c. Brakes
d. Tires and wheels (including spare)

Also required by Article 9 are the carrying of tools for emergency repair and a fire extinguisher (only trucks and buses) and the installation of a rear view mirror.

These stipulations are only conceptual, needing details on practical inspection of vehicles and maintenace standards (as criteria for judging the acceptance or rejection of each vehicle). However, in absence of such working rules, inspection is left up to the subjective judgment of individual inspectors, and the judgement can sometimes be unfair. Nevertheless, flexible administration of law to some extent must be accepted, because the enforcement of a high maintenance standard would be unrealistic in Panama, where a large number of old vehicles with low maintenance standard are still in operation.

2) Vehicle Inspection Center

Together with other commercial vehicles, buses are all inspected at the Paitilla Inspection Center, whose layout is presented in Fig. IV-2-9. The inspection is done in three stages: (1) vehicle identification to see if the vehicle is the registered vehicle, (2) eye observation of vehicle appearance to see if the required labels are placed and if the vehicle has any major damage, and (3) the following mechanical inspection:

a) Wheel alignment test: Tolerance: within 30 of manufacturer's standard

b) Front-end lifting test: Eye observation and confirmation by the inspector of steering operation

c) Headlight beam test: High beam, within 28 to 30 inches above the floor; Low beam, within 20 to 30 inches

d) Brake test: Inspection according to the manufacturer's standard with the use of Weaver tester

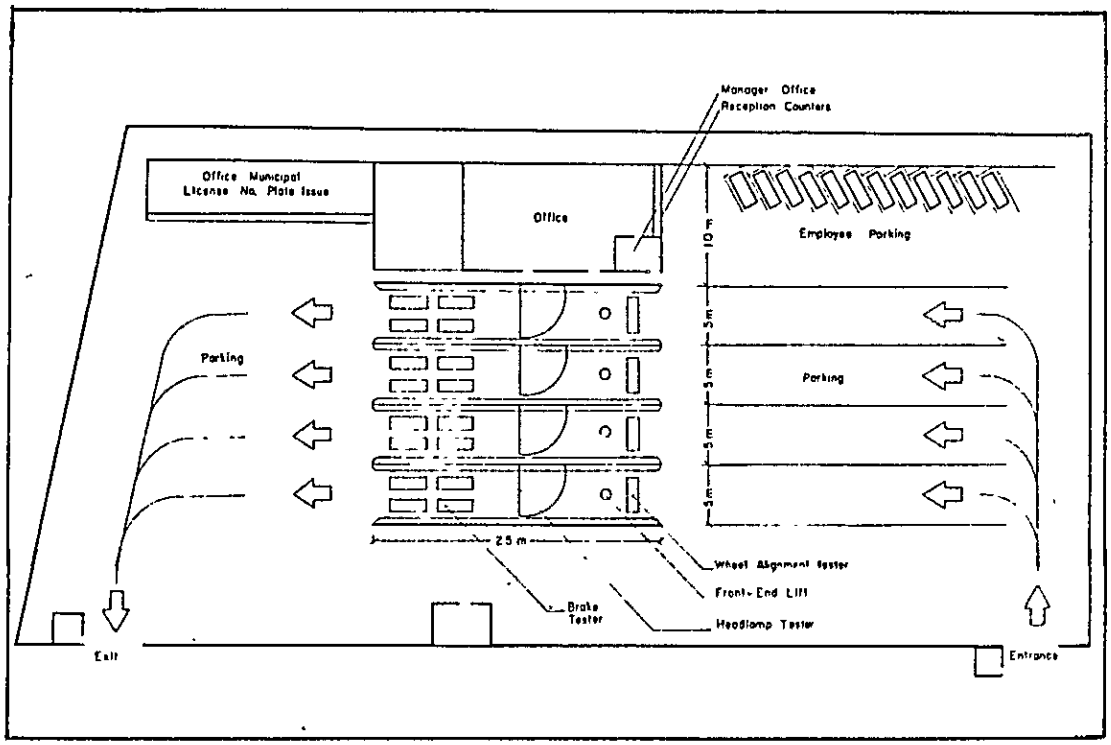


Fig. IV-2-9 PAITILLA COMMERCIAL VEHICLE INSPECTION CENTER LAYOUT

Time required for the inspection is 15 to 20 minutes per vehicle including about five minutes for passing through the inspection line and time for paper processing. Inspection fee is two Balboas, and re-inspection fee is one Balboa. Vehicles which return for re-inspection is about 5% of all vehicles. The above mentioned testing instruments are available but not necessarily used on every vehicle. They are used only when the inspector judges them to be needed.

2.2 Bus Maintenance Center Plan

2.2.1. Basic Idea

The bus repair service demand and supply problems, discussed under the previous title, are summarized as follows:

a) Vehicle Age : Many buses are old and the average age of all buses is high, and breakdown rate is high. As a result, maintenance is expensive and rate of bus operation is low.

b) Bus Types : So many types of buses exist, and used buses are imported. Maintenance is hardly done in accordance with the manual, and the acquisition of parts is difficult.

c) Maintenance : Periodical preventive maintenance is hardly ever done. This is one cause for the high breakdown rate.

d) Repair Shops : The number of repair shops is sufficient, but repair and maintenance instruments are not used effectively. Work is inefficient and work environment is poor.

e) Mechanics : In the absence of a system for the certification of mechanics qualification, few mechanics possess adequate skills.

Standardization of buses, systematic purchase of buses, accomplishment of periodical maintenance of buses, and training of mechanics have been obstructed by the fact that most of buses in Panama City are owned by one-bus owners. This situation has a historical background and may not be changed quickly. However, to leave the matter alone without making any efforts whatsoever will neither be desirable from urban transport policy standpoint in view of the importance of bus transportation, nor will it be good to the economy. Key to the solution of the above problems a) through e) will be the following policies:

a) Standardization of Buses : To reduce the number of kinds of buses and to increase the number of buses per each kind will facilitate the procurement of parts, the learning of bus maintenance skills, and the receiving of better services from the bus manufacturers.

b) Periodical Maintenance : The achievement of transition from the present "repair when broken" system to preventive maintenance system will result in the reduction of breakdown rate, the reduction of accident rate, and the improvement of operation rate.

c) Modernization of Maintenance Shops : The introduction and utilization of maintenance instruments and the improvement of work environment.

d) Education/Training of Mechanics : The provision of trainee mechanics with the opportunity for learning basic knowledge and skills.

e) Bus Owner/Driver Education : Education on laws and regulations governing transportation and traffic, economic vehicle maintenance, and rational business management. Particularly, to inculcate on drivers the law abiding spirit and good driving behavior will be critical to the reduction of traffic accidents.

As the means of materializing these policies, a comprehensive bus maintenance center is to be planned. The bus maintenance center will have the following functions, (a) bus inspection, (b) bus maintenance, (c) parts sypplying, and (d) education and training.

This Center will not only carry out vehicle inspection in accordance with the provisions of laws and regulations, but will also provide bus operators with the place of self-initiated inspection, repair, and maintenance. As a rule, bus maintenance will be done in accordance with the maintenance guide of the bus manufacturer, and numerical control will be effected. A high efficiency of maintenance work will be achieved and a safe work environment developed through the modernization of maintenance shop facilities. Also, depending on the future trend in the introduction of buses of various types, it may become sensible to limit the types of buses that may be maintained at the Center, which will lead to the improvement of work efficiency and the standardization of bus types.

To include a parts supply shop in the Center will allow easy procurement of parts by the repair shops and will facilitate the assessment of demand for each kind of parts and the achievement of parts inventory management. Also, if parts are readily available for selected types of buses, it will offer an incentive to own that type of bus and will contribute to the standardization of buses.

This Center will train mechanics on practical skill and basic technical knowledge chiefly through on-the-job training, thereby fostering and supplying able mechanics to the existing maintenance shops. Also, the Center will give lectures to bus owners and drivers at the time of periodical check of buses or renewal of drivers license, on sound and rational bus business management, the importance of periodical maintenance, and good driving behavior and law abiding spirit.

This Bus Maintenance Center must be planned in the scale that enables the efficient utilization of human resources and facilities, or the scale at which economy of size can be enjoyed. Of course, to invest in an unusually large scale from the outset will not only be risky but will also bring about undesirable competition with the existing maintenance and parts shops. Therefore, the Center shall be planned to cater to the needs of about 10% of urban buses in 1990. Also, the Center will be planned with emphasis on the fields where facilities investment is beyond the capability of private maintenance shops or where highly specialized mechanics are needed. In this sense, this Center will be the initial step forward in the direction of modernizing bus maintenance business in Panama and is a pilot project in nature.

2.2.2. Site Location

Curundu Norte area was conceived of as the site of Bus Maintenance Center by ESTAMPA Materplan. However, this location is not necessarily suitable anymore due to the facts that a large natural park has been planned in this area and that Universidad Bus Center plan has been reduced to a group of large bus bays. So, Previous Albrook Airfield and Las Mananitas (presently the land for bus repair shop of COTUM) and vicinity are added to Curundu Norte area as candidates for preliminary assessment. The result is as shown in Table IV-2-10.

TABLE IV-2-10 COMPARATIVE EVALUATION OF THE ALTERNATIVE SITES FOR BUS MAINTENANCE CENTER

Site / Criteria	Albrook Field	Curundu Norte	Las Mananitas
1. Bus Acces Route	○	○	▲
2. Proximity to transito	○	△	▲
3. Infrastructure			
3-1 Aqueduct	○	●	○
3-2 Drain Systems	○	●	●
3-3 Electricy	○	●	○
3-4 Acces Roads	○	●	△
4. Existence Structure	△	●	○
5. Land Use in Vecinity	△	△	▲

Note: ○ Good △ Fair ▲ Bad ● No Exist

The advantage of Albrook Airfield is evident from qualitative assessment. Of the items assessed, proximity to DNTTT as the authority for bus inspection and the granting of franchise, and the maintenance of a harmony with land use in the vicinity area are particularly important. In these regards, Albrook Airfield is most suitably situated in that this area in its entirty has been designated as institutional and industrial area and that this area will be very convenient for inter-urban buses to utilize the Center, should they be added to vehicles subject to Center service. For these reasons this Study shall plan the establishment of the Bus Maintenance Center in Albrook Airfield.

Although this Bus Maintenance Center is in pursuit of the advantage of concentrated presence at one location of various functions related to bus maintenance as a pilot plan, dispersed locations of bus repairing and parts supplying would inherently be for the greater convenience of the users, provided that adequate quality of service is guaranteed. Therefore, when second and third bus maintenance centers are in demand in the future, such center should be opened at various suitable locations rather than enlarging this particular center.

Land use in Albrook Airfield is subject to continued study by the Government of Panama, and the exact location of this Center may not be picked at this time. Functionally, it would be desirable that the Center be located next to DNTTT, but land around DNTTT is already used for other purposes. In consideration of access by buses, the next best would be land on the south side of Corredor Norte. If this is not available either, then the site will have to be in the land on north side of Corredor Norte where the land is reserved for future development (see Fig. IV-2-10).

This Study will plan the construction of the Bus Maintenance Center on either of these sites discussed in the above, rather than selecting an exact site, and will design the Center on a typical land. Design under such a condition is believed sufficiently realistic for the purpose of feasibility study in view of the great freedom of site selection in Albrook Airfield, where topography is flat and a large number of unused lots exist.

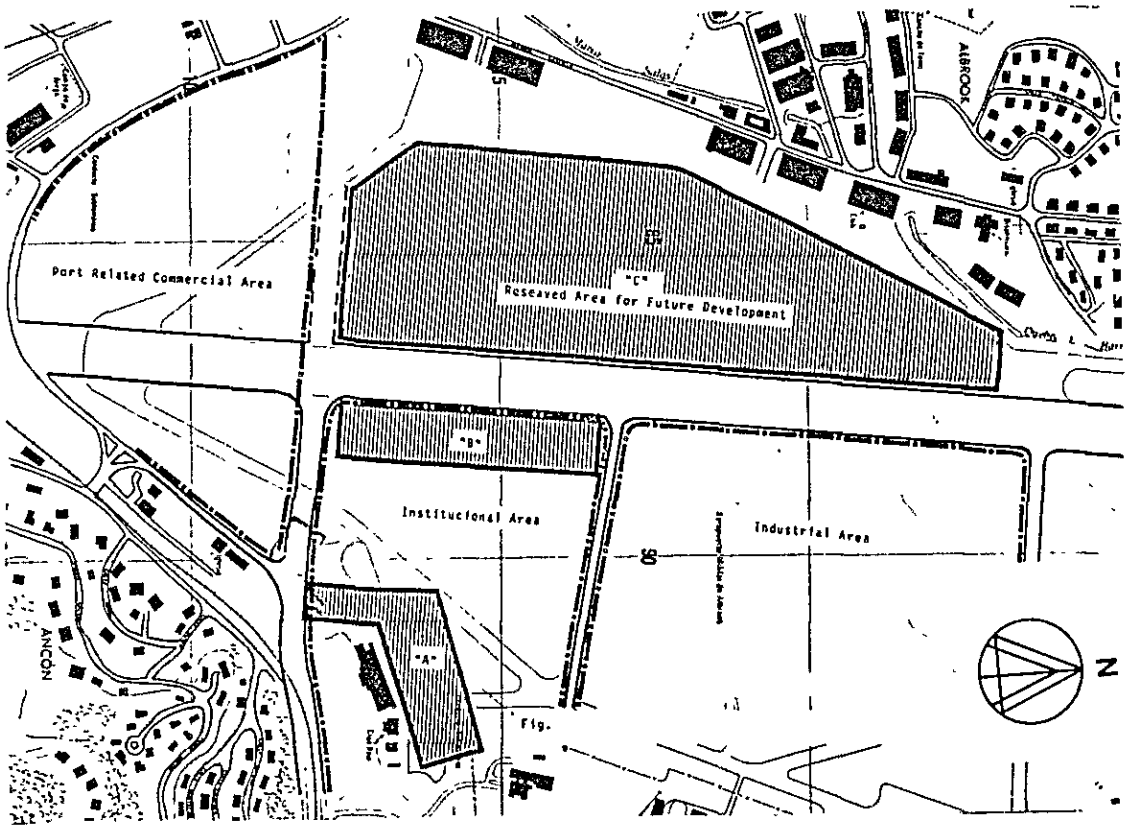


Fig. IV-2-10 ALTERNATIVE SITES FOR BUS MAINTENANCE CENTER IN ALBROOK AIRFIELD

2.2.3. Facility Plan

In response to said four functions, this Center will have Bus Inspection Center, Bus Maintenance Center, Parts Supply Center, and Training Center. Supplementary facilities will be fuel supply station and bus wash station.

1) Bus Inspection Center

The Bus Inspection Center will be equipped with major testing instruments such as alignment tester, brake tester, speedometer tester, exhaust gas tester, and headlight tester, which will be connected on-line for central control. The large vehicle inspection line equipped with the latest facilities will have the capacity of inspecting 80 vehicles per day. Any surplus capacity will not be wasted but used effectively for the inspection of inter-urban buses.

2) Bus Repair Center

(1) Light Repair Shop

Periodical maintenance including inspection, adjustment, replacement of parts, oil change, and so forth, will be done. To achieve high efficiency of maintenance work, a lift will be installed in the shop.

(2) Heavy Repair Shop

Engine and major component overhaul will be done. Established will be central bus repair space, a parts cleaning space, an engine dismantling space, an engine testing room, and a unit dismantling space. An overhead crane will be installed for dismounting, mounting or moving of engine and other heavy units.

(3) Specialized Repair Shop

This will be a shop for specialized repair work requiring special instruments and specialized mechanics and will consist of;

(a) Engine Parts Regeneration Shop;
Engine blocks, engine heads, cylinders, valves, crank shafts, and other major components of engine will be worked on and regenerated. Various cutting and grinding machines will be installed.

(b) Fuel Injection Pump Repair Shop;
Diesel engine fuel injection pumps and nozzles will be taken apart for adjustment. Specialized testing machines will be installed.

(c) Electric Appurtenance Repair Shop;
Starters, generators, and other electric appliances will be taken apart for repair. Specialized testing machines will be installed.

(4) Body Repair Shop

The sheet metal processing, frame correction, and painting of chassis will be done. Welding equipment, sheet metal processing tools, and painting booth will be installed.

3) Parts Supply Center

This will be a warehouse type building having a modular slot system of columns and movable partitions to house a large number of stores and shops. Each slot will have a reception office, a commodity acceptance and issuance counter, and a multi-layer (shelves, etc.) type storage.

4) Training Center

Classrooms and facilities necessary for courses will be installed. The on-the-job training of mechanics will be done in repair shops.

5) Fuel Station

Diesel oil and gasoline fueling, greasing of chassis, lubrication, oil change, and the supply of oils to repair shops will be done. Fuel pump meters and a lubricating pit will be installed.

6) Bus Wash Station

The pre-repair cleaning of the bottom part of buses will be done.

These centers will be closely related to each other but will be functionally independent and managed separately (see Section 2.2.4.). Each center will have an office, parking space, and employee welfare facilities.

2.2.4. Management Plan

The Bus Maintenance Center is to offer comprehensive service concerning the maintenance and repair of buses. Various service units of the Center are organized as shown in Fig. IV-2-11. While some units should be operated by the government and some by private organization, depending on the nature of the service, the Center as a whole should be managed by a government-private joint organization in order that such units will maintain linkage with each other as the integral parts of an organic whole so as to achieve the purpose for which the Center is established. For this reason, a board of directors consisting of government and private representatives is established above the general manager of the Center (see Fig. IV-2-12).

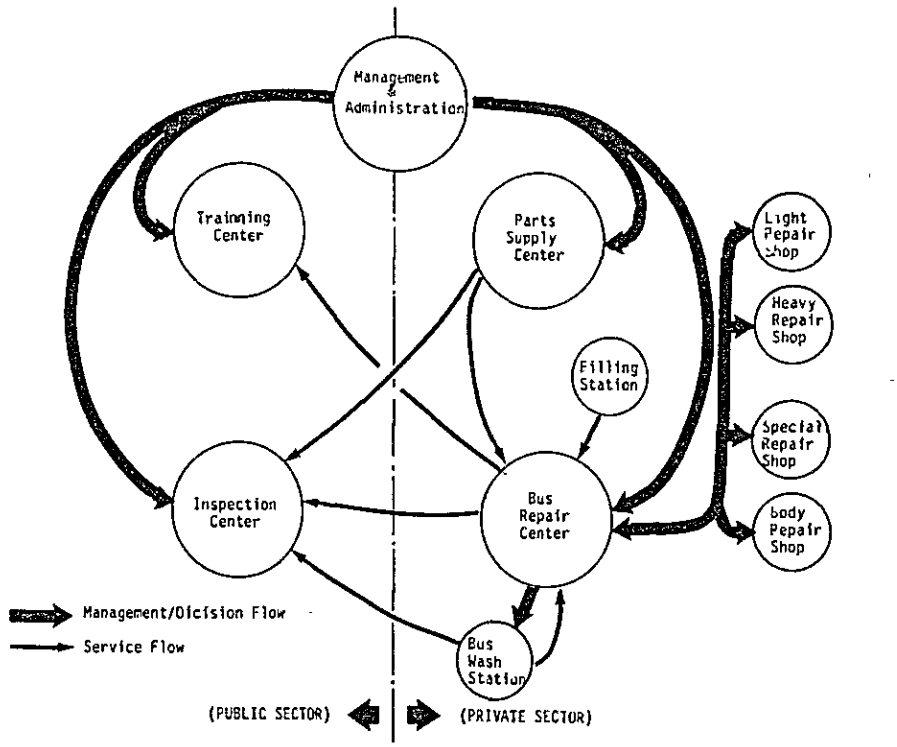


Fig. IV-2-11 RELATIONSHIP AMONG FUNCTIONS OF BUS MAINTENANCE CENTER

Vehicle inspection at the Center shall be carried out by the Traffic Police (DNTTT) as it is now. The training of mechanics and lectures for bus owners and drivers should be given for the purpose of improving the quality of public transport, as a part of non-profit businesses of the Center and, therefore, should be achieved by the government also.

Parts supply center and repair center are sectors suitable to and shall be left up to private operation. In fact, parts supply and vehicle repair have been operated as profit seeking business in Panama City and, therefore, technical know-how of these businesses have been accumulated in the private sector. Land, building, and equipment including some heavy equipment if needed will be invested and prepared by the Maintenance Center Authority. These can be either consigned to or rented to private firms for operation; which should be the case depends on the future analysis of their profitability and business environment in Panama. Whichever the case may be, there are two matters demanding special consideration:

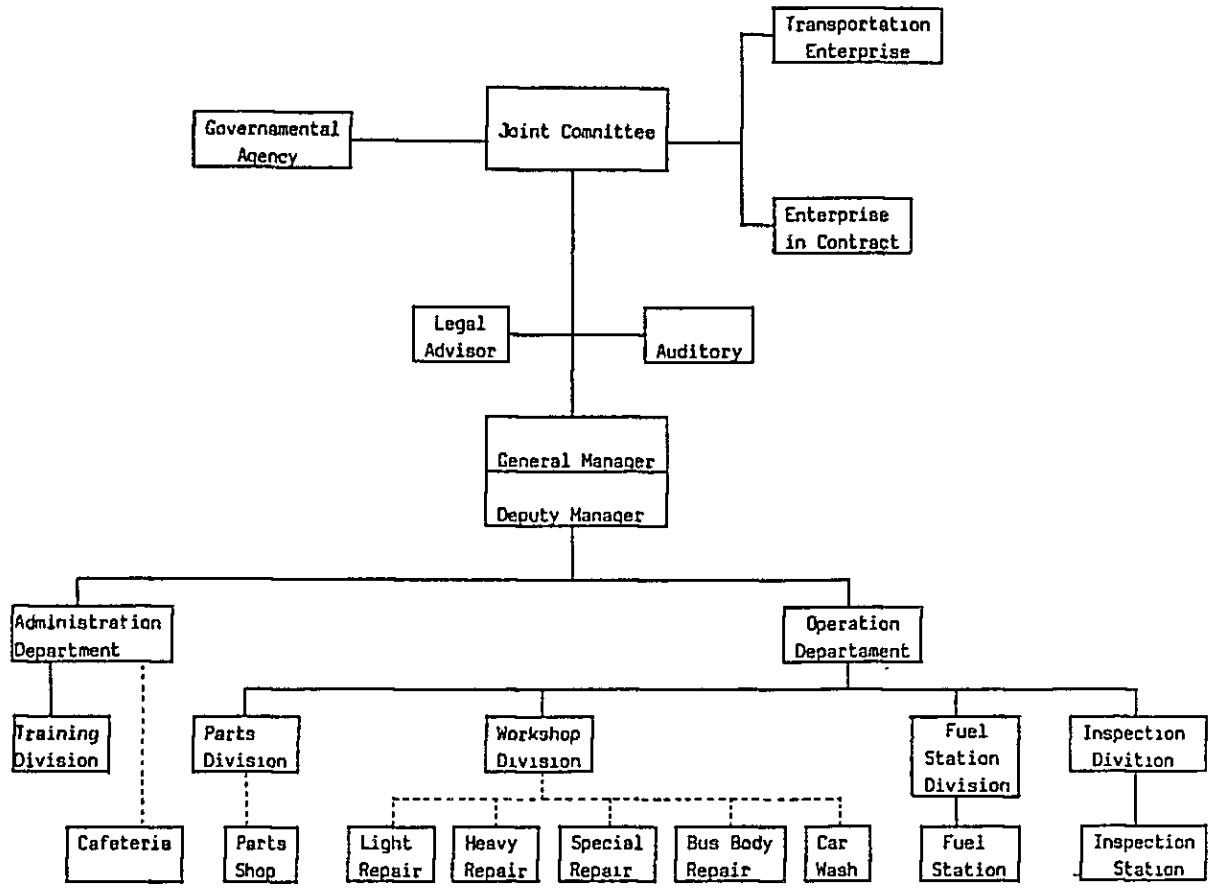


Fig. IV-2-12 ORGANIZATION OF BUS MAINTENANCE CENTER

a. The generation and sustenance of high quality technology and service within the Center, particularly in the repair center. A technical and management promotion group should be established within the Center organization for the purpose of stimulating and guiding the development of such technology and service in the private-operated centers.

b. The avoidance of competition/friction between the Center and the existing private maintenance shops and parts shops. Useful in achieving this will be the relocation of existing shops to the Center, rather than having new businesses participating in the Center. The selection of the existing shops for location in the Center will naturally be made on the criteria of their business achievements, capital strength, and technical capability, but, in addition, it will be important that, of those existing shops, entrepreneurs who are agreeable to the purpose of Center establishment and who will be cooperative on the training of bus mechanics be selected.

The fuel supply station of the Center will be operated by CPTT as other service stations in the City. Vehicle washing station will be suitably operated by the repair center in view of functional relationship between the two.

The Bus Maintenance Center will need a total personnel (excluding directors) of about 150 including the private operations, and the number of trainee mechanics will be about 20 (see Table IV-2-11).

TABLE IV-2-11 EMPLOYEES OF BUS MAINTENANCE CENTER

Division	No. of Employees
1. Administration Office	13
2. Bus Inspection	10
3. Mess Room	7
4. Training Center	6
5. Parts Warehouse	36
6. Light Repair Shop	12
7. Heavy Repair Shop	29
8. Specialized Workshop	15
9. Body Repair Shop	14
10. Bus Washing Area	1
11. Fuel Filling Station	4
Total	147

SOURCE: ESTAMPA

2.3. Preliminary Design and Construction Cost

2.3.1. Design Conditions

The Bus Maintenance Center is planned as a pilot project for the purpose of achieving a qualitative improvement of bus maintenance capabilities in Panama City in 1990, when the necessary number of operational buses will be about 1,000. Most of the 1,000 will be large 60-seat buses (see the previous Sub-Chapter).

A rectangular site with only one side facing a road is assumed for the Center. This assumption will maximize the freedom of selecting actual Center site. If the selected site will have two sides facing road, design change will be easier than the reverse case.

The Center operation is assumed to be eight hours per day and 300 work days per year, which is generally the same as those of existing bus maintenance shops. The average bus operation distance is asssumed to be 110 kilometers in 1990.

1) Bus Inspection Center

Introduced will be one line of latest large vehicle inspection instruments capable of inspecting 80 vehicles per day. Not only public use buses but also school buses, long distance buses, and all other private use buses will be inspected at this Center. Established in the Center will be an office for issuing licence plates and classrooms for giving lectures to vehicle owners and drivers.

2) Vehicle Repair Center

The Vehicle Repair Center will have a space for 15 stalls and equipment. This will be enough to service 122 buses, if the present maintenance rate (the rate of the number of buses maintained to the total number of operating buses) of 14% remains constant in the future. If maintenance rate improves to 10% (presently Japanese average is 6%), this capacity will be enough to service 165 buses. The breakdown of the 15 stalls will be 6 stalls in the light repair shop, 6 stalls in the heavy and specialized repair shop, and 3 stalls in the body workshop.

Periodical and special maintenance will be done at the light repair shop. Total time needed for periodical maintenance will be 11 days per bus per year, as calculated by multiplying the following estimated numbers of days needed for each check by the following frequency of checks per year: 0.5 days for each one-month check (eight times per year); one day for each three-month check (three times per year); and four days for 12-month check (once a year). If the number of buses to be periodically maintained by this center is 100, total time needed will be 1,100 days, which will require 3 stalls, based on 300-day operation per year. Then, in order for the center operation to be stable and sound, it will be necessary that periodical maintenance contract be made with customers representing 100 buses. For special maintenance, whose volume of work will be about half of periodical maintenance, two stalls will be dedicated.

The number of stalls needed for engine overhaul at the heavy repair center is estimated at 0.5 based on the same calculation as periodical maintenance and assuming that 100 buses will be serviced once each five years and that seven days are needed to service each bus each time. However, in view of the fact that many non-contract customers will come to the center for engine overhaul, two stalls shall be allocated to this center. In addition, four stalls will be used for the maintenance of power train, steering, suspension, axle, and electric appurtenances.

The body workshop will have three stalls, one for periodical maintenance of chassis (requiring about two weeks per bus every six or seven years), one stall for the repair of accident-damaged vehicles (annual accident rate of 82% per vehicle, and average repair time of four days), and one stall for paint shop.

3) Parts Supply Center

Prepared at this Center will be a total of 10 shops, six shops handling automobile manufacturer's parts, two handling tires, batteries, and other common supplies, and one as a tool shop. The floor space needed for supply stock will be about 100 square meters per shop (each shop serving 200 buses, inventory for eight months, the ratio of automobile manufacturer supplied parts of 70%), with additional space for office and issuing counter, for a total of about 150 square meters per shop. It is believed, however, that this total floor space can be cut down to about 100 square meters by adopting a multi-layer parts storage (shelves, etc.). Then, a module of 10m by 10m can be adopted for those stores in the Center building.

4) Training Center

Aside from the lecture rooms for bus owners and drivers, a classroom for trainee mechanics will be prepared. A total of 20 trainees is assumed. Practical skill development shall be achieved chiefly through on-the-job training in repair shops.

5) Miscellaneous Facilities

The service station will have meters and space for fuel supply to two vehicles at one time, one vehicle space for lubrication, and one vehicle space for washing. Parking lot will have space for 40 buses and 115 cars based on the estimated number of employees at each center and the number of visitors (see Table IV-2-12 for breakdown).

TABLE IV-2-12 REQUIRED PARKING LOTS

Facility	Parking Lots for	
	Cars	Bus
1. Administration Office	6	--
2. Bus Inspection & Training Center	10	10
3. Mess Room	2	--
4. Mechanic Training Center	3	--
5. Parts Warehouse	60	--
6. Light Repair Shop	5	6
7. Heavy Repair Shop	9	16
8. Specialized Workshop	12	--
9. Body Repair Parking	6	8
10. Fuel Filling Station	2	--
Total	115	40

SOURCE: ESTAMPA

2.3.2. Preliminary Design

The various facilites satisfying the above design conditions are arranged on a rectangular lot of 200m by 125m as shown in Fig. IV-2-13. This figure represents a typical design, and if the actual site is different in terms of its shape and/or access conditions, this design will have to be changed accordingly. A typical floor plan for each Center building is shown in Fig. IV-2-14 through Fig. IV-2-17. The following governed these designs:

a) The Center administration building shall be placed in front. Then, in the order of frequency of people entering and leaving, Inspection Center, Parts Supply Center, and Bus Repair Center shall be arranged from front toward inner part of the premises.

b) The Training Center is not large enough to require an independent building. Therefore, mechanics training classroom shall be included in the Administration building and bus owner/driver lecture room, in the Inspection Center.

c) The Center premises shall have one vehicle entrance and exit each, and traffic inside the premises shall circulate in one way only. The Center administration building shall have a separate entrance and parking lots.

d) The Bus Wash Station will be mostly used by buses brought in for maintenance. Therefore, this Station shall be placed adjacent to the Bus Repair Center.

e) Each building is designed with a minimum essential space. If funds are available, it will be desirable that the second floor of administration building be given the additional space of one more span to create a multi-purpose hall.

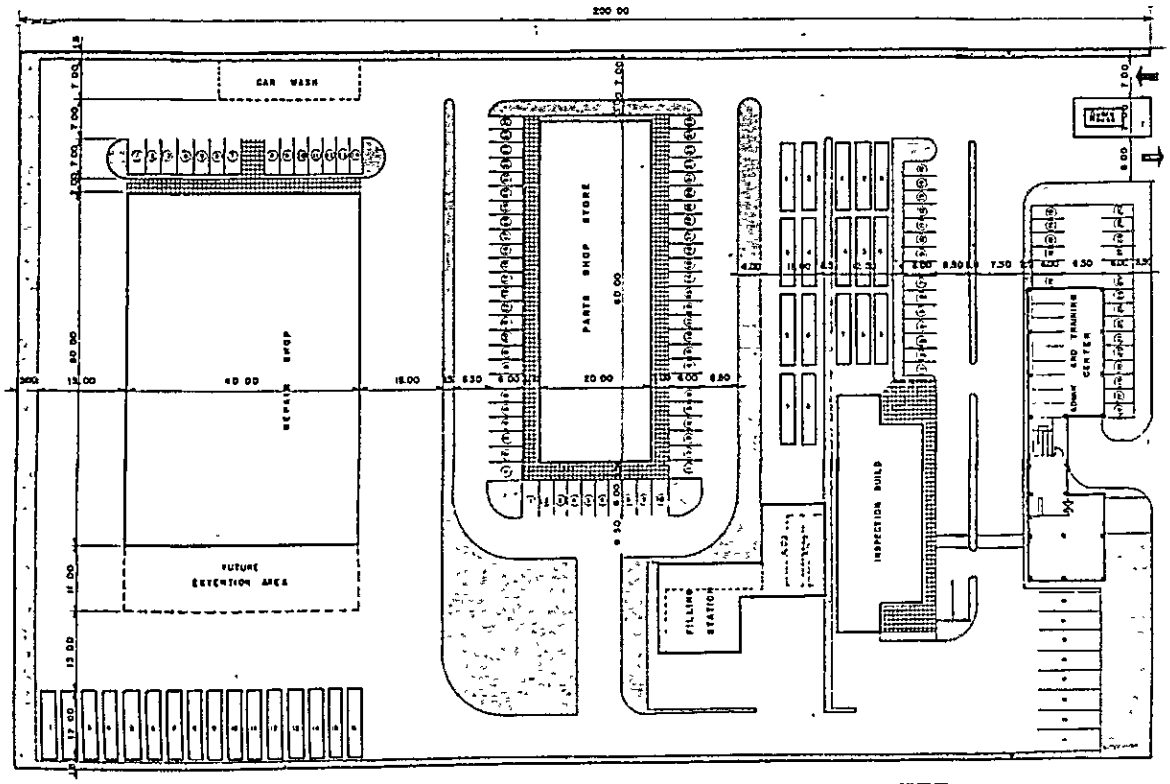


Fig. IV-2-13 LAYOUT OF BUS MAINTENANCE CENTER

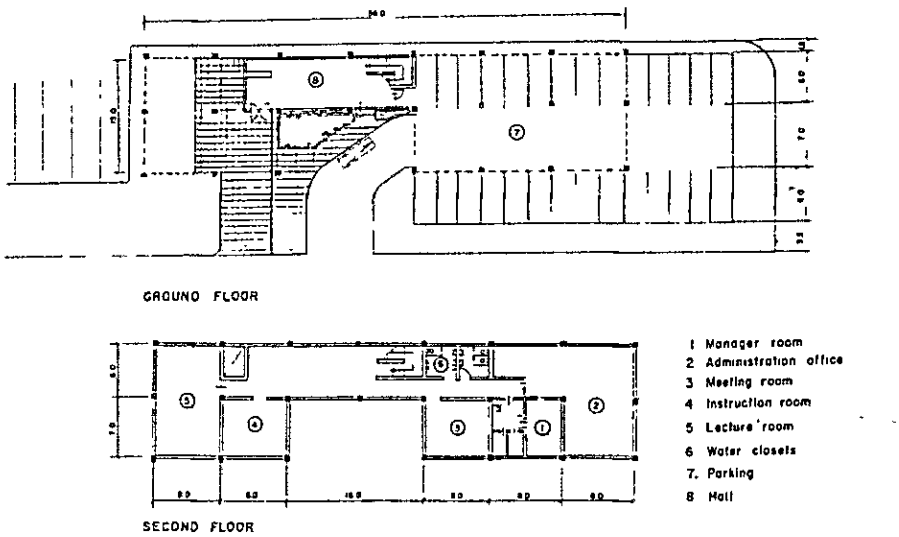


Fig. IV-2-14 ADMINISTRATION AND TRAINING CENTER

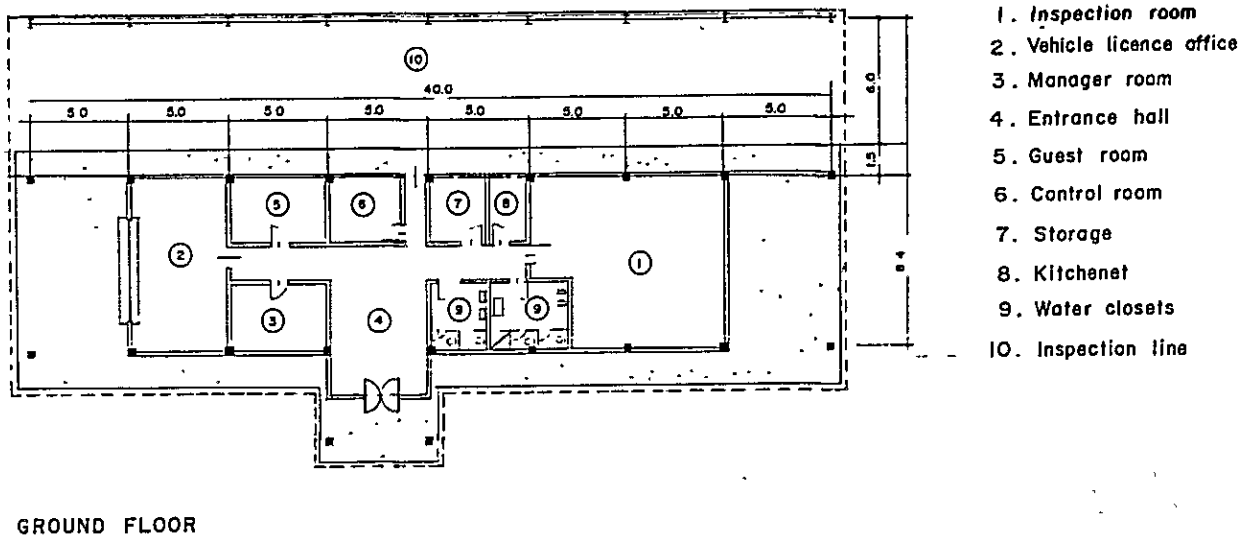


Fig. IV-2-15 VEHICLE INSPECTION CENTER

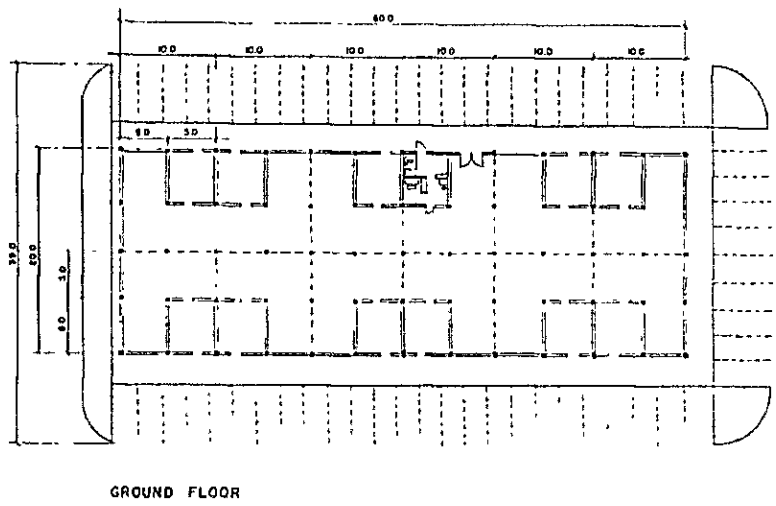


Fig. IV-2-16 BUS PARTS SHOPS

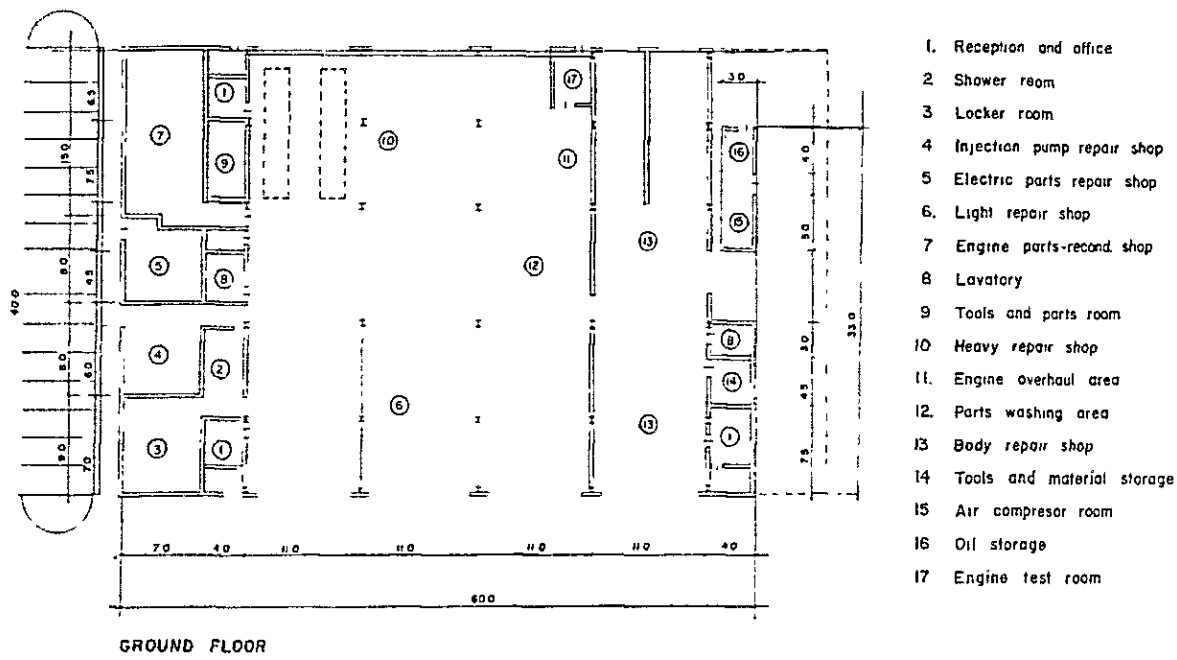


Fig. IV-2-17 WORKSHOP

2.3.3 Construction Cost

Tables IV-2-13 through IV-2-15 show the estimate of the construction cost. With regard to the cost for civil engineering work and building construction, the method of estimation used for the Road Construction Project and the Bus Center Project has been used here. With regard to equipment, the cost has been calculated based on prices in Japan for the reason of data availability. A detailed list of equipment prices is given in the attached. The transportation cost (transport fare and insurance fee) for equipment is given as an average of the transportation costs from the U.S. and Japan.

In the Table, the cost for communal facilities, such as passages and a guard room, etc. are distributed to the other rented facilities in proportion to the construction cost of each facility. The Repair Center shows the highest construction cost at about 3 million balboas, where some 1.4 million balboas (47% of the total) is accounted for by the cost of equipment. As the Repair Center has 15 stalls, the average construction cost per stall is about 200,000 balboas. The Parts Supply Center will cost about 1.5 million balboas and will have a total of 10 shops. The cost per shop, therefore, is 150,000 balboas.

As the land is owned by the Government, the land cost is not appropriated in the financial cost. The economic cost shown in the Table is the result of converting the financial cost, shown in market price, into the calculation price. It is used for the economic evaluation where the opportunity cost of the land is appropriated.

TABLE IV-2-13 CONSTRUCTION COST FOR BUS MAINTENANCE CENTER

Unit: (B/.1000 at 1983 price)

	Foreing Portion	Local Portion	Total
Common Facilities			
Road and Parking	297.29	179.12	478.41
Sidewall	7.32	4.02	11.34
Utility Work	118.59	117.95	236.54
Guard House	33.69	63.82	97.51
Others	61.16	54.63	115.79
Buildings			
Administration	293.15	317.85	611.00
Inspection	141.93	167.11	309.04
Filling Station	75.10	77.19	152.29
Parts Shop	262.17	350.17	612.34
Repair Shop	409.37	440.79	850.16
Engineering	277.79	138.89	416.68
Contingency	296.63	286.73	583.36
Land Adquisition	----	248.00	248.00
Total	2,274.19	2,446.27	4,720.46

TABLE IV-2-14 EQUIPMENT COST FOR BUS MAINTENANCE CENTER

(1000 B/. at 1983 price)

Facility	Main Equipment	Common Tool and Equipment	Total
1. Inspection Center	204.55	0.00	204.55
2. Fuel Filling Station	54.34	1.80	56.14
3. Light Repair Shop	81.31	84.89	166.20
4. Heavy Repair Shop	190.73	120.44	311.17
5. Specialized Repair Shop	285.48	56.60	342.07
6. Body Repair	201.15	81.32	282.47
7. Air Compressor	13.21	0.00	13.21
8. Parts Warehouse	327.27	0.00	327.27
Sub-Total	1,358.04	345.04	1,703.08
9. Freight/Insurance Installment Cost	326.55	82.97	409.52
Total	1,684.59	428.01	2,112.60

TABLE IV-2-15 CONSTRUCTION COST OF BUS MAINTENANCE CENTER BY WORKS

(1) Financial Cost

(Unit: B/.1000)

Facility	Civil	Building	Land	Equipment	Total
Administration	168.2	786.9	0	0.0	955.1
Common Facilities	0.0	0.0	0	0.0	0.0
Inspection Center	174.9	398.0	0	253.7	826.7
Filling Station	117.6	196.2	0	69.6	383.4
Parts Supply Shop	276.5	788.7	0	406.0	1,471.2
Repair Shop					
Light Repair	188.2	438.0	0	206.2	832.4
Heavy Repair	62.7	146.0	0	386.0	594.7
Engine Repair	62.7	146.0	0	290.0	498.7
Ingetion Pump	31.4	73.0	0	103.1	207.5
Electric Apparatus	31.4	73.0	0	42.0	146.4
Body Repair	94.1	219.0	0	356.0	669.1
Sub-Total	470.5	1,095.0	0	1,383.3	2,948.8
Total	1,207.7	3,264.3	0	2,112.6	6,585.2

(2) Economic Cost

Facility	Civil	Building	Land	Equipment	Total
Administration	155.6	718.3	34.5	0.0	908.5
Common Facilities	0.0	0.0	0	0.0	0.0
Inspection Center	174.9	353.0	35.9	253.7	817.6
Filling Station	117.6	166.9	24.1	69.6	378.2
Parts Supply Shop	276.5	730.0	56.8	406.0	1,469.3
Repair Shop					
Light Repair	188.2	371.0	38.6	206.2	804.1
Heavy Repair	62.7	123.6	12.9	386.0	585.3
Engine Repair	62.7	123.6	12.9	290.0	489.3
Ingetion Pump	31.4	61.9	6.4	103.1	202.8
Electric Apparatus	31.4	61.9	6.4	42.0	141.6
Body Repair	94.1	185.5	19.3	356.0	655.0
Sub-Total	470.5	927.5	96.6	1,383.2	2,878.0
Total	1,195.2	2,895.8	248.0	2,112.6	6,451.5

2.4 Evaluation and Recommendation

2.4.1 Investment Schedule

The schedule for the Bus Maintenance Center Project is made on the assumption that the actual execution of the project will start in 1985, following the completion of the feasibility study, i.e. arrangements for the construction site and the execution of drawings will be carried out in 1985 and capital procurement and the decision on a constructor will be made before the end of March, 1986, immediately followed by ground-breaking for the project.

As the period of construction is estimated to be 22 months, the work should be completed by the end of 1987 and the actual operation should start at the beginning of 1988. Civil engineering work will be carried out in the former half of the construction period and equipment installation will be carried out in the latter half of the period. Fig. VI-2-18 shows the schedule of execution.

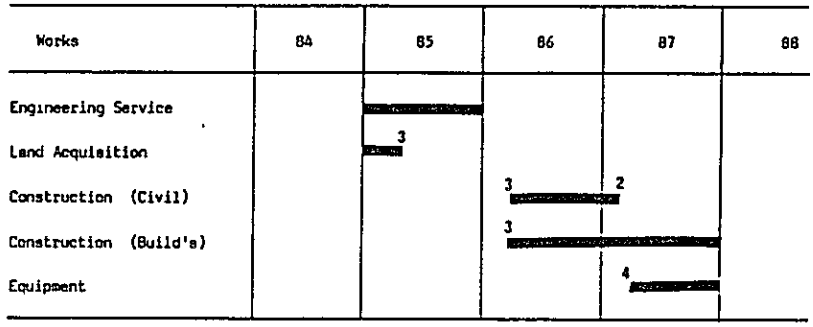


Fig. IV-2-18 IMPLEMENTATION SCHEDULE OF BUS MAINTENANCE CENTER

Table VI-2-16 shows the estimated investment amount for each year, calculated on the basis of the execution schedule given in Fig. VI-2-18. The Table also shows the financial and economic costs for comparison purposes. The economic costs will be used in 2.4.3 Economic Evaluation and the method of calculation is the same as in the Road Construction Project and the Bus Center Project. Despite the fact that 62% of the construction cost is invested for 1986, the entire project cost for 1987 exceeds the cost for 1986, due to the purchase of equipment in 1987.

2.4.2 Financial Evaluation

1) Method of Evaluation and Prerequisites

The method of financial evaluation is basically the same as the financial evaluation method for the Bus Center Project. In addition, the same financial analysis model is used. Only points which differ from the Bus Center Project and additional conditions will, therefore, be described below.

TABLE IV-2-16 INVESTMENT SCHEDULE OF BUS MAINTENANCE CENTER PROJECT

(Unit: B/.1000 in 1983 price)

		1985	1986	1987	Total
Financial Cost	Civil Work	35	735	163	933
	Bldg. Work	117	1,722	1,288	3,127
	Bldg. Service	15	226	172	413
	Land Cost	--	--	--	0
	Equipment	--	--	2,112	2,112
	Total	167	2,683	3,735	6,585
Economic Cost	Civil Work	32	684	153	869
	Bldg. Work	103	1,529	1,133	2,765
	Bldg. Service	14	208	158	380
	Land Cost	248	--	--	248
	Equipment	--	--	2,112	2,112
	Total	397	2,421	3,556	6,374

(1) The subject of analysis is the financial contents of the Bus Maintenance Center. However, since the Maintenance Garage, which is a major facility of the Bus Maintenance Center, and the Parts Supply Division are operated by private enterprises, the financial analyses of these tenants will not be dealt with here. As a result, the income for the Bus Maintenance Center as a management division consists of the rent paid by these tenants for their facilities. The working expenditure consists of the operation cost for the Management Division and maintenance costs for such communal facilities as the Management Building, roads and fences, etc.

(2) Facilities which are to be rented to private sectors are (i) the Maintenance Garage, (ii) the Parts Supply Center, (iii) the Petrol Station and (iv) the Automobile Inspection Garage. Private enterprises will purchase their respective facilities (buildings and equipment) from the Maintenance Center on a plan of 15 years installments. They will, therefore, pay the annual installments, management costs and maintenance costs for the first 15 years after the opening of the Center and will pay only management costs from the 16th year on.

(3) Since the current automobile inspection fee for a bus is only 2 balboas, it is obvious that the running of an Inspection Division cannot be profitably maintained. Accordingly, a plan should be made whereby a private enterprise is not charged for the initial investment for the facility as the cost of the facility should be regarded as public investment, even if the running of the automobile inspection business is entrusted to private hands. In short, the Automobile Inspection Center should be charged only for management costs and maintenance costs by the Bus Maintenance Center.

(4) It is presupposed that the financial burden on the tenants should be reduced as much as possible by making the Maintenance Center a non-profit organization. In the light of this, the purpose of the analysis should not be the examination of the Maintenance Center's profitability but the clarification of the financial conditions to provide suitable preferential treatment to tenants.

2) Income and Expenditure

Rent from the tenants (installment payments for facilities, maintenance and management costs) is the only income that the Management Division of the Bus Maintenance Center will receive. The installments are for a period of 15 years with annual interest of 7%. The reason for such a low rate of interest is that the customers should be able to enjoy high quality services from the tenants, thus reflecting the favourable conditions for the tenants. Under this condition, the annual installment payment will be equivalent to about 10% of the initial value (initial investment amount) of the facilities and will imply a 25% reduction in the installment payment under normal business interest rates (12%).

Management costs (operation costs including personnel costs in the Management Division) for the Bus Maintenance Center are distributed in proportion to the investment amount for each rented facility. Table IV-2-17 shows the estimated income. The annual income for the first 15 years (1988-2002) from the opening of business will be 945,000 balboas. The annual income will afterwards drop to 377,000 balboas as the only income will be the management costs. (Both figures are given at the 1983 price level).

TABLE IV-2-17 REVENUE OF BUS MAINTENANCE CENTER

(Unit: B/.1000)

Payer	Rent as Installment Payment	Share of Administration Cost	Total
Inspection Center	83	55	138
Fuel Filling Station	39	26	65
Parts Shop	149	99	248
Repair Shop	297	197	494
Total	568	377	945

Items of expenditure are personnel, electricity, water, transport and communicaitons, office supplies, insurance and maintenance, etc. The method of the expenditure calculation is the same as for the Bus Center.

TABLER IV-2-18 EXPENDITURES OF BUS MAINTENANCE CENTER

Item	Expenditures (Balboas)	
	Financial Cost	Economic Cost
1. Salary	237,600	154,440
2. Electricity	11,200	11,200
3. Water	140	140
4. Office Supply	13,680	13,000
5. Transportation and Communication	14,880	14,140
6. Insurance	39,500	0
7. Miscellaneous	15,850	9,650
8. Maintenance	44,060	39,650
Total	376,910	242,220

The basis of the calculation for the expenditure (Table IV-2-18) of the Bus Maintenance Center is as follows:

(a) The number of employees for the Bus Maintenance Center is 57 (for the Management Division only, private sector is excluded) and the personnel cost for these employees is about 240,000 balboas annually (Table IV-2-19).

TABLE IV-2-19 PERSONEL AND WAGES OF BUS MAINTENANCE CENTER

Personnel	No. of Personnel	Salary per Person (B/.per month)	Total Salary (B/.)
General Manager	1	1,200	1,200
Deputy Manager	1	900	900
Secretaries	2	350	700
Administrator-Director	1	750	750
Secretary	1	350	350
Account	5	300	1,500
Security Guard	6	200	1,200
First Aids	4	250	1,000
Janitor	5	250	1,250
Information	2	200	400
Training	10	300	3,000
Supplier	5	300	1,500
Inspector Director	1	750	750
Secretary	1	300	300
Supervisor of Parts Shop	2	500	1,000
Supervisor of Worshop	2	500	1,000
Supervisor of Fuel	2	500	1,000
Supervisor of Inspection	2	500	1,000
Secretaries	4	250	1,000
Total	57	8,650	19,800

(b) The monthly amounts of electricity and water used are estimated at 10,000KWH and 50,000 gallons, respectively.

(c) Office supplies are estimated at 20 dollars per person, per month.

(d) Four vehicles for business use and 12 telephone lines are to be provided.

(e) The cost for miscellaneous items is estimated to be 5% of the operation cost.
(f) The maintenance cost is estimated at 2% of the construction cost.

According to the calculation based on the assumptions described above, the operation cost for the Management Division of the Maintenance Center will be 377,000 balboas a year. This will be borne by four (4) private divisions in proportion to the sizes of their businesses.

3) Results of the Analysis

The FIRR is low at only 4.4%. The cost benefit ratio and the net present value under a discount rate of 12% are 0.57 and -2.36 million balboas, respectively. That facilities are provided at low rates of interest for the tenants and that the recovery of investment capital is not considered for the Management Division and the Automobile Inspection Division account for this low payability. As a result, some kind of supporting measures will be necessary in order to financially establish the management of the Bus Maintenance Center unless higher charges are imposed on the tenants.

Such possible measures are: (a) annual deficits will be compensated for by government subsidy; (b) the Government will bear part of the initial investment in order to reduce interest payment on the loan; and (c) the introduction of a low-interest loan. However, as the only example of the Panamanian Government granting a permanent subsidy to private enterprises is tax reduction, the analysis was carried out based on a combination of (b) and (c).

As a result of examining a number of possible cases, the following combination was found to be appropriate for viable management.

(a) The Government will invest a further 826,000 balboas for the construction of an Automobile Inspection Division due to its strong public character, on top of 248,000 balboas for the land cost. The aggregate 1,074,700 balboas will constitute 16.3% of the total investment amount.

(b) The introduction of a long-term loan with an interest rate of 7% or lower.

If these two conditions are met, the balance of the Bus Maintenance Center will, after a certain period, go into the black. The transition of an accumulated balance under a long-term loan with an interest rate of 7% (12% for a short-term loan) is shown by Fig. IV-2-19.

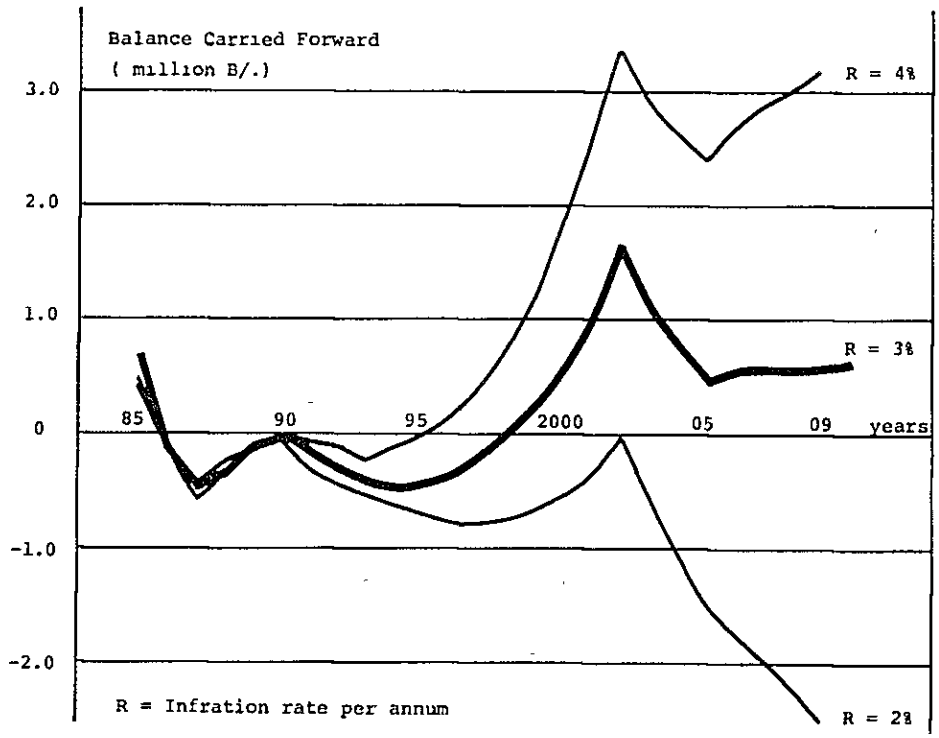


Fig. IV-2-19 TREND OF BALANCE CARRIED FORWARD OF BUS MAINTENANCE CENTER

If the annual rate of inflation is assumed to be 3%, the accumulated deficit will be annulled in the 12th year (1999) after the opening and the accumulated profit in the 15th year will be 1.6 million balboas. Following this, the accumulated balance will reduce to about 500,000 balboas as rent will no longer be paid in. The balance will then be more or less stabilised, with maximum capital demand of 438,000 balboas in 1994.

As shown in Fig. IV-2-19, the transition of the accumulated balance is extremely sensitive to the rate of inflation. A 1% increase in the rate of inflation will cause a rapid increase in the profit. Conversely, a 1% decrease in the rate will increase the deficit thus making the management of the Maintenance Center impossible. As a 1% increase in the rate of inflation is more or less equal to a 1% reduction in the interest rate for a loan, the introduction of a loan with as low an interest rate as possible should be considered in order to make the project viable.

Table IV-2-20 shows the result of the sensitivity analysis on the cost of construction, income and operation cost. The evaluation indicator is rather sensitive to income but not so sensitive to the others.

TABLE IV-2-20 SENSITIVITY ANALYSIS OF BUS MAINTENANCE CENTER

Case	IRR (%)	B/C	NPV (Million B/.)
Base Case	4.39	0.57	- 2.36
Construction Cost 10% up	3.20	0.51	- 2.96
Revenue 10% down	1.99	0.44	- 3.18
Operating Cost 10% up	3.30	0.52	- 2.67

2.4.3 *Economic Evaluation*

When the economic evaluation is carried out by the conversion of the construction cost and the operation cost, both shown in market prices, into calculation prices, as used in the Bus Center Project, the internal rate of return, the cost benefit ratio and the net present value will be 6.9%, 064 and -1.98 million balboas, respectively. Although the content of evaluation will slightly improve in comparison with the financial evaluation, the project still cannot be described as feasible.

However, since the Bus Maintenance Center should be considered a non-profit operation in the same way as the Bus Center, and since a low level of rent which does not meet the interest rate of a commercial base loan is introduced from the beginning, it is not surprising that the evaluation indicators are low. In evaluating a project such as this, the social benefits that will be produced by the project should be strongly considered.

Although the social benefits of the Bus Maintenance Center are to be created through the achievement of the planned target of the Center described in IV-2-2, the most direct effect will be the reduction in the cost of vehicle maintenance, due to the high level of bus maintenance. Although this may sound paradoxical, it is generally understood that the more preventive maintenance is carried out, while breakdown servicing is taken for granted, the lower the annual maintenance cost will be.

Owing to a lack of sufficient data, it is difficult to estimate the reduction amount which could be achieved. However, based on interview studies, the annual cost of vehicle maintenance in Panama is 5,400 -5,500 balboas, nearly 30% higher than that in Japan. This may be partly explained by the old age of the vehicles in use there but there is still a strong possibility that savings in the maintenance cost can be anticipated.

It is expected that the long-term activities of the Maintenance Center will eventually raise the technical standard of repairs and bus operators will come to recognise the importance of preventive maintenance. If the vehicle maintenance cost can be reduced by 10% through these measures, the annual maintenance cost of all urban buses in the Panamic Metropolitan Area will be reduced by some 500,000 balboas. Furthermore, it can be anticipated that this effect will spread to cover private buses (owned by schools or companies and serving for specific demands), and large trucks, etc.

Other social benefits will include a reduction in the total number of buses required owing to a rise in the bus operating rate and a reduction in the number of traffic accidents and traffic jams due to a lower breakdown ratio, etc. It is difficult, however, to quantify the benefits of each.

2.4.4 Conclusion and Recommendation

It is necessary to construct the Bus Maintenance Center in order to improve the quality of bus services and to increase the bus operating rate. The Center will also play an important role in terms of the education and training of repair engineers, drivers and bus owners. We propose the early realization of the Center as it has great social significance.

Since management on a commercial basis is difficult, however, the following conditions should be met for the Maintenance Center to maintain sound financial contents.

(a) The Government will invest the cost of the land and the Automobile Inspection Center (1.1 million balboas).

(b) The introduction of a long-term loan with as low an interest rate as possible (7% or lower).

(c) Tenants will pay a rent which will be the equivalent of the repayment sum on a plan of 15 years installments with an interest rate of 7%, plus the operating costs of the Center's Management Division.

Should the actual conditions prove to be more favourable than those stipulated above and should the Center generate a profit, this profit should be returned to the tenants through a reduction in their financial burden.

APPENDIX

A. ABBREVIATIONS

B. ZONE CODE AND OD TABLE (YEAR2000)

C. DETAILED INVESTMENT PLAN FOR ROAD PROJECT

D. LIST OF EQUIPMENT FOR BUS MAINTENANCE CENTER

Appendix A ABBREVIATIONS

AASHTO	American Association of State Highway and Transportation Officials
AID	Agencia Internacional de Desarrollo
B/.	Balbas
BID	Banco Interamericano de Desarrollo
CAPAC	Camara Panamena de la Construccion
CBD	Central Business District
CIF	Cost, Insurance and Freight
COMETRAP	Cooperativa Metropolitana del Transporte
CPTT	Central Panamena de Trabajadores del Transporte
DINTRAT	Direccion Nacional de Transporte Terrestre
DNTTT	Direccion Nacional de Transito y Transporte Terrestre
ESTAMPA	Estudio de Transporte Urbano para el Area Metropolitana de Panama
FENACOTA	Federacion Nacional de Condactures de Taxis
FOB	Free on Board
GDP	Gross Domestic Product
GRDP	Gross Regional Domestic Product
IDAAN	Instituto de Acueductos y Alcantarillados Nacionales
IPHE	Instituto Panameno de Habilitacion Especial
IRHE	Instituto de Recursos Hidraulicos y Electrificacion
ITBM	Impuesto de Transferencia de Bienes Muebles
IRR	Internal Rate of Return
JICA	Japan International Cooperation Agency
MIG	Ministerio de Gobierno y Justicia
MIPPE	Ministerio de Planificacion y Politica Economica
MIVI	Ministerio de Vivienda
MOP	Ministerio de Obras Publicas
OD	Origin-Destination
OPDAC	Oficina de Planificacion y Desarrollo del Area Canalera
PCU	Passenger Car Unit
PT	Person-Trip
RENARE	Recursos Naturales Renovables
SACA	Servicio de Autobuses del Corregimiento de Ancon
SICOTRAC	Sindicato de Conductores del Transporte Colectivo
SERCOM	Servicios Comerciales
VOC	Vehicle Operating Cost

Appendix B ZONE CODE AND OD TABLE (YEAR 2000)

ZONE CODE

No.	Zone
01	San Felipe
02	El Chorrillo
03	Santa Ana
04	Calidonia Sur
05	Calidonia Norte
06	Curundu
07	La Cresta
08	Urraca-Campo Alegre
09	Obarrio
10	El Cangrejo
11	Punta Paitilla
12	San Francisco
13	El Golf
14	Vista Hermosa
15	Pueblo Nuevo
16	Loceria
17	El Dorado
18	Betania
19	Parque Lefevre
20	Chanis
21	Rio Abajo
22	Villa Lorena
23	Hipodromo
24	Juan Diaz
25	Pedregal
26	Nuevo Aeropuerto
27	Tocumen
28	Area de Paraiso
29	Amelia Denis de Icaza
30	Samaria
31	San Isidro
32	Los Andes No. 2
33	La Pulida
34	Cerro Viento
35	Las Cumbres
36	Chilibre
37	Fuerte Amador
38	La Boca
39	Balboa
401	Albrook Norte
402	Campo de Albrook
411	Loma Larga
412	Rio Cardenas
413	Parque Natural
414	Campo de Antena
415	Albrook Norte
42	Pedro Miguel
43	Cocoli
44	Arraijan Cabecera
45	Veracruz
46	Nuevo Arraijan
47	Barrio Colon y Pto Caimito
48	Barrio Balboa
49	Area de Guadalupe
50	Area de Pacora
51	Area Nuevo Emperador
52	Area de Mendoza
53	Area de Santa Rita
54	Distritos de Chepo y Chiman
60	Provincia de Darien
61	Provincia de Cocle
62	Prov. de Herrera y Los Santos
63	Prov. de Veraguas, Chiriqui y Bocas del Toro

ORIGIN-DESTINATION TABLE IN THE YEAR 2000

Motor Vehicle OD Unit : pcu

ZONE	01	02	03	04	05	06
01	1056	638	646	236	305	764
02	264	1127	838	392	188	80
03	679	970	5551	1172	760	125
04	263	385	956	2284	1813	144
05	182	305	786	1609	3646	160
06	156	67	213	94	155	119
07	176	129	989	244	483	82
08	345	272	1141	2239	1359	78
09	142	205	389	1155	460	28
10	195	113	362	1146	1269	151
11	132	102	640	650	843	85
12	90	52	297	568	380	47
13	157	223	506	577	496	44
14	16	53	289	242	367	45
15	85	206	417	276	403	81
16	113	364	125	135	249	19
17	155	447	460	403	934	45
18	227	148	540	353	699	72
19	99	103	327	91	202	65
20	96	120	296	150	252	26
21	76	179	243	1291	140	81
22	35	91	236	261	143	58
23	63	206	422	147	423	37
24	127	208	684	357	150	18
25	112	306	298	437	301	56
26	3	21	34	19	70	2
27	73	200	316	135	266	28
28	49	241	215	121	379	30
29	62	174	224	104	90	7
30	84	125	173	140	48	15
31	66	128	270	258	853	42
32	90	80	324	513	164	31
33	260	341	870	410	381	44
34	116	175	225	572	774	85
35	130	200	353	525	301	51
36	7	29	69	62	35	0
37	0	11	13	34	41	7
38	0	68	23	12	0	0
39	159	196	461	217	557	68
401	237	532	1111	551	537	105
402	69	152	319	158	155	32
411	145	289	714	580	558	102
412	75	152	377	307	294	53
413	24	50	122	100	96	17
414	36	74	181	147	141	26
415	26	54	132	107	103	17
42	31	83	165	144	220	18
43	12	34	39	15	78	18
44	145	178	292	94	61	5
45	45	57	105	77	313	1
46	266	1014	781	501	566	451
47	12	276	57	20	26	10
48	23	40	87	54	68	0
49	31	57	56	81	48	1
50	389	380	213	35	57	21
51	10	4	2	0	63	0
52	9	0	0	13	3	0
53	1	0	5	1	20	0
54	99	106	57	35	64	5
55	43	925	400	76	31	9
56	0	1	1	0	0	0
57	32	19	31	57	383	22
58	44	26	325	66	1466	16
59	0	0	0	0	0	0
60	0	0	16	0	0	0
61	59	66	529	172	27	1
62	58	8	130	67	18	0
63	29	4	146	41	6	3
TOTAL	8090	13589	27614	23130	25781	3853

ORIGIN-DESTINATION TABLE IN THE YEAR 2000

Motor Vehicle OD Unit : pcu

ZONE	07	08	09	10	11
01	109	395	277	238	376
02	102	330	141	202	272
03	1115	1399	589	514	824
04	619	1507	788	1011	864
05	408	1289	889	1313	756
06	41	89	34	114	74
07	1374	1169	807	506	726
08	1213	8150	3164	3507	1329
09	990	2520	3489	2055	1582
10	1331	3790	2038	8088	1984
11	742	3325	1433	1416	3991
12	647	1858	1096	661	1157
13	550	1440	1674	973	1431
14	391	815	450	839	478
15	302	1039	203	500	408
16	327	670	229	811	331
17	1085	3476	598	2324	1169
18	1348	2137	366	1120	666
19	263	456	217	1419	574
20	251	439	383	237	335
21	249	469	95	163	239
22	158	75	151	233	228
23	347	739	199	653	490
24	656	753	283	586	939
25	503	532	490	1335	915
26	4	92	43	47	28
27	70	411	629	293	582
28	321	268	241	50	437
29	51	117	190	141	352
30	176	151	397	91	276
31	150	380	141	177	430
32	78	360	185	129	417
33	291	716	387	579	1608
34	819	961	582	482	650
35	572	406	633	712	431
36	91	73	22	15	22
37	14	2	1	1	1
38	4	2	1	27	2
39	141	414	123	469	143
401	341	568	256	373	307
402	99	164	73	108	88
411	398	801	440	570	512
412	211	422	232	300	271
413	69	136	75	96	88
414	101	202	110	143	131
415	73	148	81	104	95
42	123	276	138	109	190
43	18	19	10	11	31
44	122	88	85	39	336
45	73	34	20	52	42
46	414	902	506	689	696
47	148	86	62	23	67
48	97	50	57	68	62
49	78	173	100	87	100
50	31	19	3	26	17
51	0	1	0	0	0
52	1	0	0	1	2
53	0	0	3	6	2
54	23	16	4	17	9
55	3	14	22	29	11
56	0	0	0	0	0
57	34	125	59	123	54
58	40	95	68	314	94
59	0	0	0	0	0
60	0	0	0	0	0
61	12	11	3	7	12
62	19	0	1	0	10
63	0	1	0	4	1
TOTAL	20431	47565	25866	37930	30745

ORIGIN-DESTINATION TABLE IN THE YEAR 2000

Motor Vehicle OD Unit : pcu

ZONE	12	13	14	15	16	17
01	83	175	96	96	86	185
02	89	138	104	102	373	975
03	439	674	447	432	249	718
04	903	651	308	429	259	825
05	432	694	436	350	391	881
06	13	63	27	154	62	59
07	457	445	373	191	250	942
08	2805	1727	855	1481	613	2771
09	1478	1840	867	527	417	908
10	947	1249	735	624	473	2356
11	1051	638	403	301	273	1129
12	2285	479	342	77	90	732
13	575	3407	374	381	561	869
14	420	481	1945	1465	241	816
15	149	525	859	2373	133	656
16	82	65	396	134	875	511
17	588	853	795	576	533	10143
18	376	344	678	694	569	1405
19	225	198	275	1078	59	554
20	62	159	185	114	49	40
21	120	319	315	288	44	196
22	84	161	186	186	45	98
23	190	434	412	391	173	529
24	187	290	256	190	191	655
25	107	99	167	235	205	435
26	43	31	17	20	3	100
27	181	254	278	151	95	139
28	113	167	108	271	267	584
29	39	108	72	242	109	216
30	103	72	105	225	144	251
31	35	117	126	174	101	302
32	28	69	92	269	201	275
33	110	147	333	303	325	319
34	302	281	404	235	384	389
35	92	167	236	602	331	1097
36	2	37	5	19	17	64
37	1	11	1	6	14	13
38	8	1	1	1	1	1
39	323	133	110	123	42	267
401	184	234	182	186	153	439
402	52	66	51	53	44	125
411	141	208	198	158	168	343
412	75	112	104	82	89	180
413	24	37	33	26	29	58
414	35	53	52	39	44	87
415	26	39	38	28	32	64
42	35	97	41	34	39	155
43	20	5	23	16	5	149
44	19	21	47	25	23	58
45	63	38	15	14	12	99
46	124	418	319	163	287	619
47	16	6	19	8	20	42
48	4	17	10	16	9	37
49	21	14	37	14	16	47
50	22	26	36	51	26	113
51	0	3	0	0	0	7
52	0	4	2	0	0	2
53	2	2	4	0	11	0
54	20	42	21	34	18	25
55	13	15	22	4	8	32
56	0	0	0	0	0	0
57	70	25	39	68	37	93
58	47	68	41	29	51	134
59	0	0	0	0	0	0
60	0	0	0	0	0	0
61	11	17	1	13	14	18
62	5	0	3	7	10	7
63	9	0	2	3	3	4
TOTAL	16565	19270	15064	16581	10396	36341

ORIGIN-DESTINATION TABLE IN THE YEAR 2000

Motor Vehicle OD Unit : pcu

ZONE	18	19	20	21	22
01	310	157	86	48	54
02	251	71	793	62	62
03	1116	635	352	295	308
04	1342	438	274	1099	252
05	844	449	294	102	222
06	37	51	19	50	38
07	1241	312	232	223	235
08	2696	745	718	455	265
09	458	190	320	237	365
10	1147	1276	173	172	327
11	544	386	330	235	237
12	342	181	91	71	38
13	383	278	130	325	201
14	733	314	210	317	160
15	647	711	68	478	218
16	431	257	78	86	54
17	1868	839	73	223	215
18	6565	310	184	338	82
19	551	4584	470	704	180
20	152	509	1364	1030	417
21	271	783	1339	2013	478
22	104	442	291	372	1350
23	310	806	787	248	236
24	202	568	166	707	236
25	191	156	131	377	236
26	23	21	27	24	105
27	80	358	149	570	553
28	189	463	125	430	168
29	782	628	100	116	84
30	76	73	13	64	64
31	47	54	87	158	55
32	170	49	34	114	9
33	843	260	739	466	568
34	39	291	57	598	143
35	211	179	39	156	75
36	22	72	4	30	21
37	43	1	5	7	1
38	12	1	1	1	1
39	219	191	56	94	60
401	363	262	160	151	163
402	103	76	46	42	46
411	177	120	123	140	81
412	92	63	65	74	42
413	30	21	22	24	14
414	45	31	31	35	19
415	33	22	23	26	15
42	33	42	13	114	20
43	34	76	72	10	30
44	27	20	4	18	73
45	21	18	4	5	54
46	214	175	110	111	102
47	3	15	3	9	3
48	14	2	8	33	5
49	8	9	3	14	3
50	32	40	6	51	32
51	0	0	29	1	17
52	0	0	0	0	0
53	1	0	7	12	0
54	15	33	5	4	11
55	31	22	4	5	0
56	0	0	0	10	0
57	173	70	31	71	29
58	76	34	21	45	8
59	0	0	0	0	0
60	0	0	0	0	10
61	9	43	0	0	0
62	4	3	2	0	0
63	13	0	0	3	0
TOTAL	27043	19286	11201	14103	9150

ORIGIN-DESTINATION TABLE IN THE YEAR 2000

Motor Vehicle OD Unit : pcu

ZONE	23	24	25	26	27	28
01	128	305	174	4	119	70
02	68	124	123	29	246	125
03	433	745	624	107	406	503
04	527	429	459	139	139	152
05	659	509	290	118	249	253
06	43	57	67	8	39	43
07	382	695	455	61	220	265
08	901	1176	836	106	623	305
09	695	207	578	61	299	267
10	849	771	2034	84	302	239
11	327	786	899	23	202	250
12	258	241	139	56	83	124
13	507	418	180	27	103	136
14	204	231	415	19	250	147
15	544	362	357	65	231	259
16	79	283	280	9	117	148
17	731	971	631	39	174	693
18	234	173	154	21	123	243
19	659	392	293	37	239	294
20	657	107	356	207	595	101
21	544	420	362	38	410	488
22	287	247	226	96	554	111
23	5822	2779	965	122	855	792
24	2553	7133	3031	357	1561	265
25	1045	3592	6802	1002	2873	268
26	104	301	340	0	988	451
27	677	1913	2115	681	5174	244
28	361	423	284	47	294	1840
29	200	393	181	25	228	954
30	163	103	254	15	117	522
31	103	330	297	66	234	240
32	97	314	275	14	487	409
33	1008	1887	1791	194	867	751
34	715	1453	1579	76	801	342
35	83	464	443	137	345	1096
36	54	34	133	17	55	56
37	40	42	0	0	2	12
38	57	84	26	0	17	5
39	211	301	86	8	91	66
401	271	341	155	24	259	281
402	77	99	45	7	74	80
411	187	219	230	53	223	166
412	98	113	121	28	117	87
413	31	37	39	9	36	27
414	47	54	58	13	56	42
415	35	39	42	11	40	30
42	71	77	40	9	43	49
43	7	11	58	4	38	4
44	100	123	31	14	33	30
45	7	12	48	3	9	25
46	206	245	340	32	242	177
47	20	14	57	8	49	50
48	31	23	85	4	159	13
49	10	42	57	23	110	3
50	105	363	253	98	1034	74
51	17	41	0	0	0	10
52	2	0	24	0	0	2
53	0	20	18	0	1	12
54	42	136	113	0	88	21
55	13	63	73	43	14	17
56	2	0	2	0	0	9
57	114	197	208	117	129	137
58	49	7	32	120	227	87
59	0	0	0	0	0	0
60	0	0	9	0	0	0
61	18	19	42	1	3	18
62	4	0	0	0	4	4
63	6	0	4	1	10	0
TOTAL	24579	34090	30818	4739	23772	14984

ORIGIN-DESTINATION TABLE IN THE YEAR 2000

Motor Vehicle OD Unit : pcu

ZONE	29	30	31	32	33
01	75	314	82	32	144
02	125	47	128	35	215
03	151	133	456	531	951
04	69	101	583	573	242
05	45	163	208	132	632
06	15	32	201	58	294
07	115	107	208	106	312
08	69	180	359	376	715
09	300	415	182	188	646
10	295	113	260	442	772
11	75	767	407	162	492
12	28	64	110	64	368
13	247	114	159	107	330
14	140	73	139	136	503
15	141	150	200	313	475
16	95	62	121	74	624
17	225	280	397	344	969
18	298	120	191	143	651
19	251	210	179	225	503
20	43	163	177	99	921
21	80	120	319	139	661
22	129	91	101	48	604
23	235	231	284	249	1690
24	290	240	415	264	1431
25	184	224	454	295	1312
26	27	48	45	31	654
27	271	167	236	745	510
28	660	654	234	346	930
29	1020	451	487	570	621
30	410	1085	1574	585	833
31	683	1058	2376	698	685
32	791	665	1705	1975	587
33	420	2400	722	474	7641
34	284	187	314	220	1530
35	1086	424	1886	1117	938
36	57	59	229	66	176
37	0	9	7	11	1
38	6	1	1	1	3
39	47	30	79	94	123
401	192	80	211	197	204
402	54	23	60	56	59
411	105	80	135	116	276
412	54	40	71	62	143
413	17	13	23	19	46
414	25	20	35	29	68
415	18	15	24	21	49
42	50	47	68	123	158
43	22	9	16	4	15
44	49	50	78	26	147
45	21	16	16	10	57
46	107	75	115	148	224
47	10	33	41	17	113
48	12	27	39	10	82
49	22	26	39	69	126
50	21	17	25	22	66
51	8	6	0	0	35
52	0	0	0	0	0
53	0	0	0	52	0
54	8	1	6	16	22
55	0	5	7	0	41
56	6	0	0	0	0
57	53	27	30	80	148
58	8	19	4	59	74
59	0	0	0	0	0
60	0	2	0	0	0
61	9	17	4	95	65
62	4	0	0	0	25
63	0	0	7	0	2
TOTAL	10357	12400	17269	13485	34134

ORIGIN-DESTINATION TABLE IN THE YEAR 2000

Motor Vehicle OD Unit : pcu

ZONE	34	35	36	37	38	39
01	40	153	17	1	4	112
02	143	290	31	8	25	214
03	812	525	179	44	17	368
04	845	728	104	4	197	236
05	580	620	196	52	4	348
06	71	76	11	1	6	60
07	571	867	163	3	11	139
08	1430	2202	124	23	11	243
09	536	1379	53	2	7	149
10	579	1282	31	1	17	192
11	690	280	92	2	8	141
12	300	76	20	1	4	189
13	537	161	63	1	6	153
14	383	382	12	3	6	74
15	352	859	60	10	20	111
16	298	331	25	1	6	21
17	474	1111	119	32	5	305
18	257	387	48	5	11	192
19	259	278	79	1	5	221
20	217	22	17	10	6	132
21	284	182	95	8	4	106
22	228	131	44	1	6	24
23	959	138	69	12	18	179
24	1472	413	54	42	42	103
25	2601	458	167	1	11	92
26	122	137	29	1	7	9
27	1709	354	36	2	22	106
28	582	751	238	1	10	66
29	181	592	102	1	7	37
30	146	156	124	10	8	44
31	191	4453	118	21	14	82
32	146	1198	41	17	8	108
33	1838	2404	124	9	29	144
34	4205	556	179	32	13	338
35	840	6530	524	29	6	105
36	169	563	1933	1	6	86
37	26	27	1	164	0	7
38	2	2	33	0	330	d
39	504	216	98	10	5	2375
401	228	415	95	5	57	144
402	64	119	28	1	16	40
411	176	367	122	21	31	210
412	93	193	65	9	16	110
413	30	63	22	2	6	35
414	45	93	32	4	8	53
415	32	67	23	2	6	39
42	39	302	150	6	10	71
43	6	16	2	1	2	30
44	19	82	10	4	13	231
45	11	8	10	1	6	51
46	169	301	131	22	44	244
47	49	58	32	1	6	49
48	33	6	29	9	12	54
49	70	59	34	1	3	101
50	74	27	19	0	0	1
51	0	0	3	0	0	0
52	10	0	0	0	0	0
53	0	21	0	0	0	1
54	71	22	0	0	0	4
55	3	26	16	1	0	0
56	44	0	0	0	0	0
57	77	351	271	21	9	238
58	91	35	193	7	1	20
59	0	0	0	0	0	0
60	0	0	0	0	0	0
61	35	2	14	0	0	0
62	10	1	0	0	0	0
63	0	2	21	0	0	0
TOTAL	27058	33906	6775	685	1168	9345

ORIGIN-DESTINATION TABLE IN THE YEAR 2000

Motor Vehicle OD Unit : pcu

ZONE	401	402	411	412	413
01	70	39	87	105	16
02	178	98	146	174	26
03	337	184	390	472	71
04	231	125	241	290	44
05	357	196	258	311	47
06	111	60	79	95	14
07	96	52	175	214	31
08	266	143	344	414	62
09	79	41	248	296	45
10	237	127	288	346	53
11	147	80	305	367	56
12	102	56	94	111	17
13	142	77	172	205	31
14	97	50	135	162	23
15	127	69	116	141	21
16	107	58	111	134	20
17	254	137	239	286	43
18	167	91	112	129	21
19	150	82	108	131	19
20	128	69	139	169	25
21	67	35	95	115	16
22	75	41	58	68	11
23	150	83	169	207	31
24	192	105	186	226	34
25	173	94	286	342	53
26	39	23	38	45	8
27	174	96	227	276	41
28	144	76	148	178	27
29	89	49	105	125	18
30	77	42	84	103	16
31	97	52	133	162	24
32	119	65	98	117	17
33	190	105	258	310	46
34	136	74	135	165	23
35	218	118	350	424	64
36	49	27	176	211	32
37	1	1	9	10	1
38	3	1	14	13	1
39	89	49	104	126	19
401	610	333	148	178	27
402	175	96	43	52	7
411	171	91	1649	1981	299
412	89	48	871	1049	157
413	28	15	282	339	52
414	42	23	417	502	75
415	31	16	302	366	55
42	56	29	55	65	10
43	10	5	30	33	6
44	101	55	263	315	48
45	40	21	59	73	10
46	187	101	245	294	45
47	58	32	77	93	13
48	55	30	68	81	13
49	47	25	31	36	6
50	0	0	487	585	87
51	29	16	0	0	0
52	0	0	0	0	0
53	0	0	0	0	0
54	0	0	796	963	144
55	0	0	7	7	1
56	0	0	0	0	0
57	95	51	2711	3270	491
58	0	0	534	643	96
59	0	0	0	0	0
60	0	0	0	0	0
61	0	0	0	0	0
62	0	0	0	0	0
63	0	0	0	0	0
TOTAL	7289	3959	15535	18700	2809

ORIGIN-DESTINATION TABLE IN THE YEAR 2000

Motor Vehicle OD Unit : pcu

ZONE	414	415	42	43	44	45
01	21	35	62	15	60	49
02	36	57	107	24	204	34
03	96	155	242	48	148	116
04	60	96	155	14	125	44
05	64	103	100	166	133	137
06	19	30	18	21	15	5
07	43	69	113	8	88	52
08	85	136	207	15	127	98
09	62	100	119	13	95	29
10	72	114	112	10	78	163
11	75	120	174	32	151	59
12	24	38	31	7	23	35
13	43	69	76	10	39	39
14	33	53	57	8	63	21
15	29	46	49	23	91	30
16	28	44	44	9	33	22
17	59	95	87	229	78	85
18	27	45	42	95	19	19
19	25	43	43	51	17	36
20	34	55	27	25	28	13
21	23	38	64	18	12	6
22	13	22	18	28	37	47
23	42	68	107	11	94	9
24	46	74	81	27	167	9
25	72	113	79	71	91	93
26	9	14	9	10	24	4
27	56	90	60	16	71	11
28	37	58	80	11	52	38
29	26	42	60	20	51	25
30	20	33	58	18	36	11
31	34	53	102	30	48	5
32	23	38	67	59	63	18
33	65	101	199	38	151	103
34	33	54	64	22	59	23
35	87	139	334	33	47	11
36	44	70	251	16	7	9
37	1	3	5	0	39	1
38	2	4	5	0	14	3
39	26	42	70	20	227	48
401	35	58	92	36	164	61
402	10	17	25	10	45	16
411	411	654	72	45	122	101
412	217	346	37	24	64	53
413	70	112	12	8	21	17
414	104	164	18	11	31	24
415	76	120	13	9	23	18
42	13	22	2017	22	47	46
43	7	12	19	450	148	17
44	65	104	240	90	3145	142
45	14	23	43	20	44	1347
46	61	98	90	116	849	232
47	19	31	82	18	303	35
48	16	27	71	5	335	9
49	8	12	32	50	264	9
50	121	192	0	4	0	47
51	0	0	8	0	174	0
52	0	0	0	0	21	0
53	0	0	0	0	5	0
54	199	317	0	0	0	0
55	1	2	27	0	101	0
56	0	0	0	0	0	0
57	675	1076	3	7	21	8
58	133	212	6	3	21	1
59	0	0	0	0	0	0
60	0	0	0	0	0	0
61	0	0	0	0	19	0
62	0	0	0	0	2	0
63	0	0	0	0	0	0
TOTAL	3849	6158	6485	2203	8834	3743

ORIGIN-DESTINATION TABLE IN THE YEAR 2000

Motor Vehicle OD Unit : pcu

ZONE	46	47	48	49	50
01	229	22	42	38	116
02	205	74	71	37	302
03	691	82	72	92	486
04	476	43	139	131	107
05	625	92	155	61	35
06	172	19	9	5	6
07	222	80	113	61	37
08	809	283	143	76	28
09	451	221	180	43	40
10	709	43	231	64	14
11	613	133	142	121	69
12	100	50	12	35	7
13	306	8	69	32	75
14	494	45	34	42	19
15	108	42	34	32	31
16	206	34	29	17	10
17	416	100	96	72	88
18	149	5	27	33	28
19	153	31	11	39	46
20	111	8	30	29	14
21	91	23	54	22	49
22	78	5	13	19	43
23	216	32	128	40	216
24	221	9	25	59	563
25	533	64	49	61	221
26	49	9	15	21	242
27	363	64	131	51	635
28	219	88	32	22	45
29	135	5	14	18	25
30	101	20	25	19	10
31	184	6	26	26	5
32	141	11	18	31	3
33	308	194	138	97	292
34	184	43	105	45	62
35	368	52	18	99	14
36	231	54	35	21	13
37	25	1	17	1	0
38	19	1	4	1	0
39	219	80	54	94	4
401	326	51	62	32	0
402	94	15	18	8	0
411	315	67	77	34	20
412	167	36	41	17	10
413	54	12	14	6	3
414	79	17	20	9	4
415	59	13	15	7	3
42	100	52	45	25	1
43	160	34	9	70	3
44	1340	412	530	153	1
45	228	48	6	11	0
46	9209	1857	1921	803	0
47	3234	12261	10722	4995	11
48	1718	8849	12419	7899	0
49	1572	4269	7536	6452	0
50	4	0	9	20	0
51	109	62	80	53	0
52	427	261	144	49	0
53	6	176	469	99	2
54	0	0	0	0	0
55	47	258	475	157	3
56	0	0	0	0	0
57	279	20	27	15	17
58	40	21	0	0	16
59	0	0	0	0	0
60	0	0	0	0	0
61	176	3	48	6	5
62	21	6	0	15	0
63	42	11	8	4	2
TOTAL	30736	30987	37230	22758	4101

ORIGIN-DESTINATION TABLE IN THE YEAR 2000

Motor Vehicle OD Unit : pcu

ZONE	51	52	53	54	55	56
01	6	7	1	34	56	0
02	6	0	1	107	993	1
03	1	0	49	346	430	1
04	2	25	2	36	65	0
05	104	1	11	22	55	0
06	0	0	0	6	15	0
07	0	9	0	11	16	0
08	0	0	9	24	23	0
09	14	0	0	5	52	0
10	0	1	6	35	76	0
11	6	0	0	30	2	0
12	0	0	3	20	35	0
13	2	2	0	60	31	0
14	0	0	5	37	26	0
15	0	1	12	35	19	0
16	3	4	0	20	2	0
17	4	0	5	70	57	0
18	0	2	10	33	24	0
19	3	0	6	38	23	0
20	23	0	0	5	7	0
21	0	0	4	19	27	11
22	13	0	0	21	6	0
23	18	11	0	50	192	2
24	47	0	37	154	29	0
25	0	16	21	152	16	3
26	0	0	11	3	2	0
27	0	1	0	63	2	0
28	3	0	9	10	15	8
29	9	0	4	10	28	0
30	6	0	0	2	0	0
31	0	0	14	0	8	0
32	0	0	0	4	19	0
33	32	12	0	28	7	0
34	0	0	0	33	38	132
35	0	2	13	56	31	0
36	1	0	0	1	22	0
37	0	0	0	2	0	0
38	2	0	0	0	0	0
39	5	2	6	0	37	0
401	253	0	0	0	0	0
402	72	0	0	0	0	0
411	0	0	0	2	75	0
412	0	0	0	0	37	0
413	0	0	0	0	12	0
414	0	0	0	0	18	0
415	0	0	0	0	14	0
42	0	0	0	0	0	0
43	0	0	0	0	0	0
44	161	43	0	0	0	0
45	2	0	0	4	12	0
46	86	528	5	69	41	0
47	217	238	323	1	304	13
48	7	91	472	0	523	0
49	64	98	142	0	284	0
50	0	0	10	0	5	0
51	0	0	0	6	5	0
52	0	0	8	0	12	0
53	12	27	0	0	0	0
54	6	1	0	0	8	0
55	9	11	0	1	0	0
56	0	0	0	0	0	0
57	11	0	1	2	18	0
58	4	1	0	0	7	0
59	0	0	0	0	0	0
60	0	0	0	0	0	0
61	5	3	0	7	0	0
62	0	0	0	4	0	0
63	0	0	0	1	0	3
TOTAL	1219	1137	1200	1679	3856	174

ORIGIN-DESTINATION TABLE IN THE YEAR 2000

Motor Vehicle OD Unit : pcu

ZONE	57	58	59	60	61
01	18	24	0	3	16
02	25	49	0	0	59
03	38	280	0	0	125
04	31	186	0	0	16
05	99	1069	0	0	34
06	21	38	0	0	0
07	37	54	0	0	11
08	103	89	0	11	5
09	96	58	0	0	15
10	104	304	0	0	51
11	133	98	0	16	3
12	60	47	0	0	40
13	49	142	0	0	31
14	20	31	0	0	19
15	74	96	0	0	44
16	17	61	0	0	22
17	179	142	0	0	54
18	128	97	0	0	16
19	79	89	0	0	19
20	28	23	0	0	13
21	77	69	0	0	0
22	45	22	0	0	11
23	114	67	0	8	140
24	323	236	0	0	83
25	168	43	0	0	17
26	48	256	0	0	2
27	180	203	0	6	6
28	179	67	0	0	31
29	78	4	0	0	42
30	33	21	0	0	18
31	51	0	0	0	0
32	97	37	0	0	3
33	80	82	0	0	4
34	95	120	0	0	1
35	177	96	0	0	22
36	234	305	0	6	22
37	36	14	0	0	2
38	10	0	0	0	0
39	321	760	0	0	14
401	235	0	0	0	0
402	67	0	0	0	0
411	465	21	0	0	10
412	245	8	0	0	4
413	80	2	0	0	1
414	117	3	0	0	2
415	85	2	0	0	2
42	77	0	0	0	9
43	42	1	0	0	0
44	23	37	0	0	18
45	0	32	0	0	0
46	8	0	0	0	2
47	14	12	0	0	28
48	25	13	0	0	24
49	44	0	0	0	16
50	15	19	0	0	43
51	8	0	0	0	0
52	3	0	0	0	6
53	4	0	0	0	0
54	5	0	0	0	4
55	19	93	0	0	0
56	0	0	0	0	0
57	0	82	0	39	27
58	3	0	0	0	3
59	0	0	0	0	0
60	0	0	0	0	0
61	16	17	0	0	0
62	9	5	0	0	0
63	19	7	0	2	0
TOTAL	5313	5733	0	91	1810

ORIGIN-DESTINATION TABLE IN THE YEAR 2000

Motor Vehicle OD Unit : pcu

ZONE	62	63	
01	68	7	9436
02	40	15	12001
03	144	125	32169
04	5	47	25677
05	13	21	25565
06	1	5	3575
07	21	3	18288
08	14	0	51729
09	7	4	28899
10	21	7	41475
11	15	5	27447
12	3	18	14874
13	13	10	20597
14	5	9	15692
15	6	17	16539
16	13	10	9974
17	31	21	38229
18	8	34	23833
19	15	4	18080
20	3	0	11502
21	9	3	14598
22	6	0	8716
23	34	20	25900
24	21	30	31059
25	0	27	31813
26	2	0	5154
27	10	3	23608
28	1	2	14540
29	4	4	11048
30	0	4	9772
31	0	0	17060
32	6	0	13572
33	9	9	35861
34	0	0	23031
35	3	0	26323
36	3	43	6295
37	0	0	746
38	0	0	841
39	0	9	11335
401	0	0	13255
402	0	0	3793
411	0	0	16365
412	0	0	8612
413	0	0	2788
414	0	0	4125
415	0	0	3008
42	0	0	6132
43	0	0	2026
44	11	0	10117
45	0	0	3510
46	0	0	29097
47	34	4	34710
48	2	5	34150
49	9	3	22802
50	8	5	5486
51	0	0	807
52	0	3	1009
53	0	0	1002
54	7	9	3672
55	0	0	3260
56	0	0	75
57	9	39	12846
58	2	7	5894
59	0	0	0
60	1	0	38
61	0	0	1672
62	0	0	466
63	0	0	424
TOTAL	637	607	987994

Appendix C DETAILED INVESTMENT PLAN FOR ROAD PROJECT

(1) New Road Construction Projects

ROAD	1985	1986	1987	1988	1989	1990	Total
Corredor Norte							
Corredor Norte West							
Corredor Norte-1	10	108	938	0	0	0	1056
-2	37	112	176	2115	1585	0	4025
Ave Villalaz Bridge	11	33	0	164	983	0	1191
-3	21	64	100	1205	903	0	2293
Subtotal	79	317	1214	3484	3471	0	8565
Corredor Norte East							
Corredor Norte-4	112	337	3989	4351	3264	0	12053
El Paical I.C. Br.	9	27	0	0	926	0	962
Autopista ACC. Br.	11	32	0	156	936	0	1135
Corredor Norte-5	31	96	168	1772	1328	0	3395
Subtotal	163	492	4157	6279	6454	0	17545
Corredor Norte Los Andes							
Corredor Norte-6	72	260	685	2983	1243	1243	8226
Rio Abajo Br.	6	19	0	92	555	0	672
Corredor Norte-7	30	89	0	2134	2037	849	5139
Subtotal	108	368	685	5209	5575	2092	14037
Total	350	1177	6056	14972	15500	2092	40147
San Miguelito Oeste							
San Miguelito-1	39	157	583	2200	1649	0	4628
San Miguelito I.C. Br.	18	53	0	229	1605	0	1906
San Miguelito-2	75	346	1575	4201	3152	0	9348
Quebrada Br.	13	39	0	190	1139	0	1381
Total	145	595	2158	6820	7545	0	17263
El Paical Ext.	22	65	0	125	1493	623	2328
Martin Sosa Ext.	43	128	0	563	2939	1224	4899
Martin Sosa Br.	10	31	0	0	1065	0	1106
Total	53	159	0	563	4004	1224	6003
Cerro Ancon Ext.	5	14	482	0	0	0	501
Total of New Road	575	2010	8696	22480	28542	3939	66242
Price Contingency	35	186	1092	3580	5539	905	11337
Total	610	2196	9788	26060	34081	4844	77579

(2) Road Improvement Projects

Road	1985	1986	1987	1988	1989	1990	Total
VIA ESPANA							
Via Espana-1	0	117	276	1548	2022	843	4806
-2	0	68	292	1457			1817
-3	0	61	0	0	261	1307	1629
Via Brasil Br.	0	133	0	1719	1720	0	3572
Via Espana-4	0	85	0	368	1837	0	2290
Total	0	464	568	5092	5840	2150	14114
VIA BOLIVAR							
Via Bolivar-1	0	25	109	546	0	0	680
-2	0	108	36	431	2006	0	2581
Via Boliver Br.	0	141	0	3636	0	0	3777
Total	0	274	145	4613	2006	0	7038
VIA EL PAICAL							
Via El Paical-1		353	915	1946	0	0	3214
-2		243	0	455	1458	5224	7380
El Paical Br.		125	0	0	3227	0	3352
Total		721	915	2401	4685	5224	13946
VIA CERRO ANCON							
Via Cerro Ancon-1		92	2965	3090	1974	0	8121
-2		59	0	0	225	1278	1592
Total		151	2965	3090	2229	1278	9713
SAN MIGUELITO I.S.	4713						4713
GRAND TOTAL	4713	1610	4593	15196	14760	8652	49524
Price Contingency	287	150	576	2421	2864	1989	8287
Total	5000	1760	5169	17617	17624	10641	57811
GRAND TOTAL	5610	3956	14957	43677	51705	15485	135390

Appendix D LIST OF EQUIPMENT FOR BUS MAINTENANCE CENTER (1)

Item	Equipment	Cost (B/.) Model	Qty
A.	Inspection Line	B/. 16,400	
1	Pit Jack	PJA-1000	2
2	Brake Tester	R-13	1
3	Head Light Tester	HT-201	1
4	Side Slip Tester	WG-500B3	1
5	Turning Radius Gauge	MB-38DX	1
6	Diesel Smoke Meter	DSH-20A	1
7	Air Chuck Gauge		1
8	Working Lamp	WL-30A	2
9	Ventilation Fan		2
B.	Bus Washing Station	B/. 6,600	
1	High Pressure Car Washer	CW-155A	1
2	Frame Lift	FLA-600L	1
3	Frame Lift	FLAX-800	1
4	Air Hose Reel	AR-910A	2
5	Air Compressor		1
C.	Filling Station	B/. 56,300	
1	Underground Tank	15000 lit.	1
2	Underground Tank	5000 lit.	1
3	Fuel Dispenser	SW-3 lit.	1
D.	Periodical Maintenance	B/. 59,700	
1	Auto Lift	WSL-200ESP	4
2	Floor Grinder	ABT-4	1
3	Drilling Machine	B13-SC,SB-2	1
4	Auto Parts Washer	APW-200B	1
E.	Heavy Pepair	B/. 62,400	
1	Parts Wacher	APW-200B	2
2	Parts Waxhing Stand	WS-50	2
3	Leaf Spring Press Beuch	LAHP-10A	1
4	Hyd. Press	MSP-150	1
5	Drilling Machine	HE-4300	1
6	Floor Grinder	ABT-4	2
F.	Engine Overhaul	B/. 19,800	
1	Valve Refacer	178-1-V	1
2	Valve Refacer	178-2-V	1
3	Piston Heater	PH-N3000	1
G.	Machine Space	B/. 42,000	
1	Brake Drum Lathe	BDL-350	1
2	Brake Shoe Grinder (L)	On the Car	1
3	Brake Shoe Grinder (S)	ditto	1
4	Air Power Rivetter	MB-500	1
5	Floor Grinder	ABT-4	1
6	Tool Grinding Machine	C-25	1
7	Drill Grinder	DG-80A	1
8	Universal Machine Tool	TCM-8B	1
9	Hack Sawing Machine	KILSER200	1
10	Jib Crane		1

Item	Equipment	Cost (B/.) Model	Qty
H.	Engine Rebuilding & Radiator Service	B/. 168,200	
1	Sylinder Boring Machine	275	1
2	Cylinder Horning Machine	260	1
3	Surface Grinding Machine	330	1
4	Crankshaft Grinder	2000/340	1
5	Radiator Test Tank	1000	1
6	Floor Grinder	GBT-2	1
7	Drilling Machine	B13SB	1
I.	Engine Dynamometer	B/. 59,400	
1	Engine Dynamometer		1
2	Jib Crane		1
J.	Injection Pump Test Room	B/. 70,700	
1	Diesel Fuel Pump Test Stand	HA-1125	1
2	Mobile Test Unit for Cummins PT Pump	HF-941	1
3	Comparator for Cummins PT Injectors	HA-285	1
4	Nozzle Test Master	HH-601	1
5	Parts Washing Stand	WS-25	1
K.	Electric Parts Repair	B/. 24,300	
1	Blasting Machine	FD-5	1
2	Dry Oven	CSHO-22SD	1
3	Generator & Starter Test Bench	FB-500	1
4	Mica Cutter & Lathe	F-180	1
5	Auto Parts Washer	APW-600S	1
6	Spark Plug Service Set	SP-309	1
7	Soldering Iron Set	30W,60W,150W	1
8	Car Cooler Service Set	GC-11	1
L.	Battery Service	B/. 4,200	
1	Battery Charger	HRC-7520	1
2	Battery Quuick Charger	HR-MAX100	1
M.	Pneumatic & Hydraulic Parts Service	B/. 99,300	
1	Power Brake Test Stand	HBT-78	1
2	Hose Fitting Clamping Machine	FT1208-X2-1	1
3	Hyd. Tester	Y-94	1
4	Brake Fluid Changer	BB-1000F	1
5	Wall Crane		1
N.	Tire Repair	B/. 14,600	
1	Tire Changer	MON-35PA	1
2	Wheel Balancer	FB-LP3	1
3	Tube Tester	TT	1
4	Air Compressor	CTV-222PA	1
5	Tube Vulcanizer Set		1

LIST OF EQUIPMENT FOR BUS MAINTENANCE CENTER (2)

Item	Equipment	Cost (B/.) Model	Qty
O.	Body Paint & Metal Sheet Work	B/. 185,700	
1	Frame Straightner	SR-SS-L	1
2	Arc Welder	AT-SS5-300	3
3	Spot Welder		1
4	Welding Fume Vacuum Cleaner	H	1
5	Rivet Forge	A-2	1
6	Floor Grinder	KBT-10	1
7	Hack Sawing Machine	KILSER200	1
8	Drilling Machine	KRTG-5	1
9	Circular Shear		1
10	Shearing Machine		1
11	Press Brake		1
12	Bending Roller		1
13	Paint Spray Booth		1
14	Paint Tank Set		1
15	Air Rotary Cutter	NRC-90	1
16	Needle Scale	JC-20	1
17	Air Impact Cutter	MC-121-A4	1
18	Air Double Action Sander	OMV-125	1
19	Elec. Drill	BU-PN3	1
		BU-PN2	1
20	Disc Grinder	PD-125A	1
		PD-180A	1
21	Elec. Polisher	NUP-SR	1
22	Infrared Rays Stand	TRB-24E	2
23	Disc Cutter	H-16B	1
24	Hydraulic Press	MSP-150	1
P.	Color Adjusting Room	B/. 2,700	
1	Color Adjusting Set	CA-S	1
2	Paint Rack	A-6126	1
3	Tool Rack	K-366	1
4	Work Bench	KT-464	1
5	Spray Painting Equipment	SPE-12	2
6	Air Transformer	RR-AS	5
Q.	Air Compressor	B/. 12,400	
1	Air Compressor	MCD-15B	2
2	Air Tank	SAT-600-85	1
3	After Cooler	ACS-370	1
4	Air Cleaner	SD-7B	3
R.	Parts Washing Area	B/. 36,900	
1	Parts Washer	CB-5	1
2	Parts Washer	APW-200B	1
3	Hot Water Car Washer	CWH-85B	1
S.	Hand Tool Set	B/. 12,400	
1	Hand Tool Set A	CU-600	15
2	Hand Tool Set B	CU-400	20

Item	Equipment	Cost (B/.) Model	Qty
T.	Assorted Tools	B/. 35,000	
1	General		-
2	Miscellaneous		-
U.	Pneumatic & Electric Tools	B/. 7,500	
1	Air Impact Wrench	AW-1600	6
2	Air Impact Wrench	AW-3200	4
3	Air Rachet Wrench	GT-R10	3
4	Filter Regulator & Lubricator Combination		4
5	Pneumatic Chisel	MC-121-A4	3
6	Elec. Hand Drill	BU-PN3	3
		NU-DH4	3
7	Elec. Hand Grinder	BLU-4	2
8	Elec. Disc Grinder	PD-125A	2
9	Air Blower Gun	AGA	20
V.	Assorted Gauges	B/. 11,300	
W.	Lubrication	B/. 8,400	
1	Powered Grease Lubricator	SKR-110A45	3
2	Powered Oil Lubricator	SKK-110A5	6
3	Drum Pump (Air Pump)		2
4	Lub. Hose Reel Set		2
X.	General Equipment	B/. 204,000	
1	Garage Jack (Air Hyd.)	MA-500	2
		MA-1500L	2
2	Frame Lift	MRM-80	2
3	Arc Welder	AT-SS5-300	1
4	Overhead Crane 5.0ton		1
5	Overhead Crane 2.0ton		3
6	Overhead Cranw 1.5ton		1
7	Blower for Exhaust Gas		7
8	Vacuum Cleaner	JE-30	3
Total			B/. 960,700

JICA