JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

GUATEMALA MUNICIPALITY
THE REPUBLIC OF GUATEMALA

THE FEASIBILITY STUDY ON THE PROJECT OF URBAN TRANSPORTATION IN THE METROPOLITAN AREA OF GUATEMALA

FINAL REPORT

EXECUTIVE SUMMARY

MARCH 1997

YACHIYO ENGINEERING CO., LTD.
CHODAI CO., LTD.

Applied Foreign Exchange Rates in
this report are:

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(As of January 1996)

Preface

In response to the request of the Government of the Republic of Guatemala, the Government of Japan decided to conduct the Feasibility Study on the Project of Urban Transportation in the Metropolitan Area of Guatemala of the Republic of Guatemala and entrusted the study to Japan International Cooperation Agency (JICA).

JICA sent a study team to Guatemala four times between September 1995 and December 1996. The study team was headed by Mr. Takeshi Yoshida and composed of members of Yachiyo Engineering Co., Ltd. and Chodai Co., Ltd..

The team held discussions with the officials concerned of the Government of Guatemala, and conducted field surveys in the study area. After the team returned to Japan, further studies were made and the present report was prepared.

I hope that this report will contribute to the promotion of the project and to the enhancement of friendly relations between our two countries.

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

March, 1997

Kimio Fujita
President
Japan International Cooperation Agency

March 1997

Mr. Kimio Fujita
President
Japan International Cooperation Agency
Tokyo, Japan

Dear Sir,

Letter of Transmittal

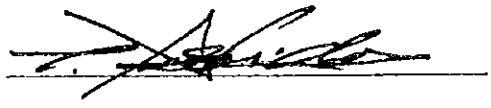
We are pleased to submit to you the report of the Feasibility Study on the Project of Urban Transportation in the Metropolitan Area of Guatemala. The report includes the advice and suggestions of the concerned authorities of the Government of Japan and your Agency, as well as the comments made by Guatemala Municipality and other authorities concerned in the Republic of Guatemala. The report consists of Executive Summary, Final Report and Drawings.

The report deals with the present and future conditions of urban transport in the Guatemala Metropolitan Area. The study aims to show the technical, economic and social feasibility of the nine transport facility projects which include toll highways, exclusive busways, bus terminals and a bus inspection and maintenance center, in order to resolve the serious traffic and transport problems.

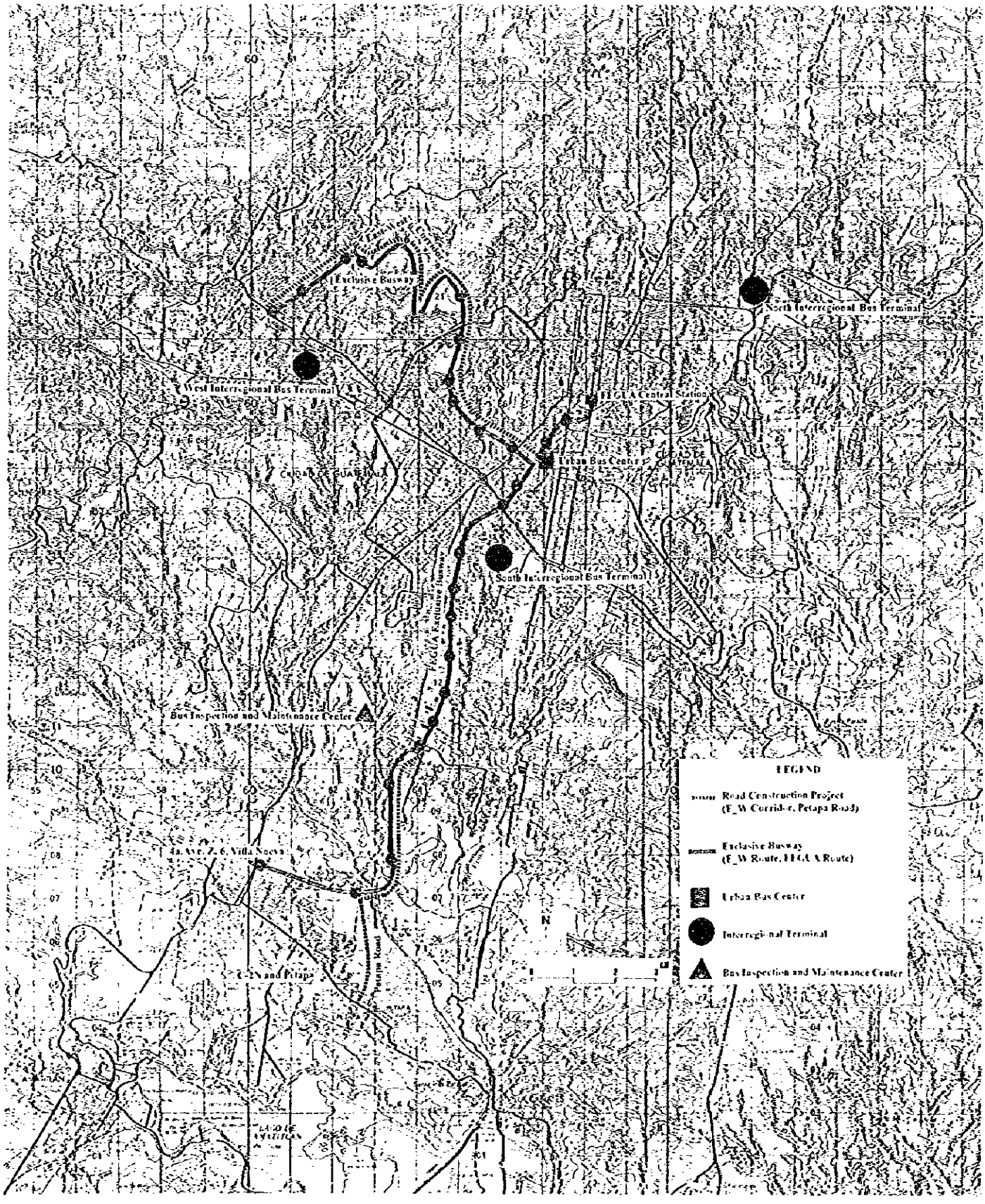
As a result of the evaluation of the projects from the various points of view, all of the projects are recommended to be implemented. Among them, Exclusive Busway FEGUA Route, Inter-regional Bus Terminals and Bus Inspection and Maintenance Center are strongly recommended to be constructed at an early stage.

We wish to take this opportunity to express our sincere gratitude to your Agency, Ministry of Foreign Affairs, Ministry of Transport and Ministry of Construction. We also wish to express our deep gratitude to Guatemala Municipality and the Governmental Agencies concerned in the Republic of Guatemala for the close cooperation and assistance extended to us during the Study. We hope this report will contribute to the development of the Republic of Guatemala.

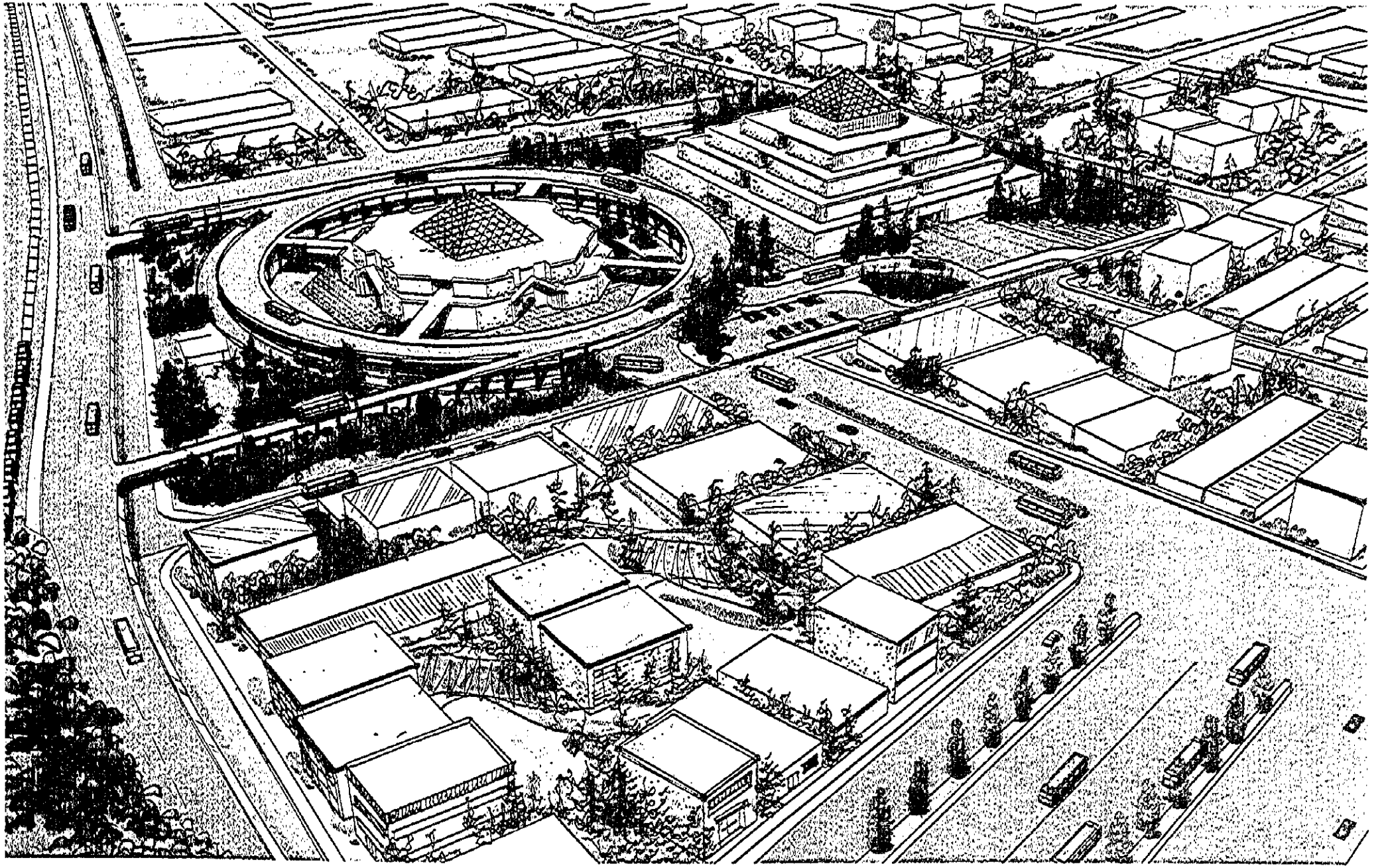
Truly yours,



Takeshi Yoshida
Team Leader
The Feasibility Study
on the Project of Urban Transportation
in the Metropolitan Area of Guatemala



Projects for the Feasibility Study



Perspective View of Urban Bus Center and Exclusive Busways

The Feasibility Study on the Project of Urban Transportation in the Metropolitan Area of Guatemala

Study Duration: September 1995 - March 1997
Requesting Organization: Guatemala Municipality

Outline of the Study

1. Study Background

Guatemala Metropolitan Area has been suffering from traffic problems such as traffic congestion, pollution, insufficient public transport service caused by recent population growth, expansion of urbanized area and rapid increasing car ownership, etc. The Master Plan Study on the Comprehensive Urban Transportation System in Guatemala Metropolitan Area was presented by Japan International Cooperation Agency and concrete development projects were recommended in The Master Plan.

2. Objectives

Objectives of the Study are ;

- To assess technical, economic and social feasibility of the projects recommended in The Master Plan.
  - **East-West Corridor**
  - **Petapa road**
  - **Exclusive Busway; - East-West Corridor Route**
    - FEGUA Route
  - **Urban Bus Center**
  - **Inter-regional Bus Terminal; - North Terminal**
    - West Terminal
    - South Terminal
  - **Bus Inspection and Maintenance Center**
- To pursue technology transfer to the Guatemalan counterpart personnel.

3. Study Area

The study area covers Guatemala city and its peripheral area.

4. Plan Outline

4.1 Project Outline

(1) East-West Corridor

East-West Corridor is planned to be constructed as a radial arterial connecting between the central district of Guatemala City and Mixco City, located in The Western part of the Metropolitan Area, whose population is increasing rapidly. It is planned to be a toll road with 4 lanes for ordinary vehicles a and 2 lane exclusive busway.

(2) Petapa Road

Petapa road is planned to be a radial arterial connecting between the central district of Guatemala City and San Miguel Petapa City located in the southern part of the Metropolitan Area. Although it has been developed as a 4 lane paved road up to Ciudad Real, there remains a section of poorly structured road beyond Ciudad Real. The project is for the road improvement and construction of 7.2 km total length between Ciudad Real and the center of Petapa city.

(3) Exclusive Busway

1) East-West Corridor Route

A two lane Exclusive Busway is to be established in the median of East-West Corridor. The total length is 12.2 km the same as The East-West Corridor.

2) FEGUA Route

An exclusive Busway is planned as a North -South direction transport axis between FEGUA central station and Villa Nueva City, a newly developing city located in The Southern part of the Metropolitan Area. It is established on the right of way of FEGUA between the central station and Ciudad Real, in the median of Petapa road between Ciudad Real and Villa Lobo river , and beyond Villa Lobo river it is to be a 2 lane own route up to Villa Nueva City. Total length of the Busway is 17.6 km.

(4) Urban Bus Center

An Urban Bus Center is planned to be a transfer facility for passengers between buses using The Exclusive Busway, urban buses using city streets and inter-regional buses from the Eastern area. It will be located on the site of the present wholesale market of Zone 4 where two Exclusive Busways cross over. It is not only to be developed as a large scale transport node but also as a business and commercial center.

(5) Inter-regional Bus Terminal

Extra-urban buses which are now categorized into one class should be classified into two categories ; commuter buses within the Metropolitan Area and inter-regional buses connecting the remote rural cities. The project aims at improvement of the efficiency of inter-regional buses operation using terminals and preventing those buses from entering the city center.

1) North Terminal

Planned to be established in the existing commercial center along CA9 highway.

2) West Terminal

Planned to be constructed together with a commercial center at the site of the border between Guatemala City and Mixco City along CA1 highway.

3) South Terminal

Planned to be constructed together with a commercial center close to the bullring near the intersection between Exclusive Busway FEGUA Route and Periferico extension.

(6) Bus Inspection and Maintenance Center

For the purpose of traffic safety of bus transport and pollution protection, the project is to conduct periodical inspections , undertake repairs using high level technology and training in maintenance techniques for buses.

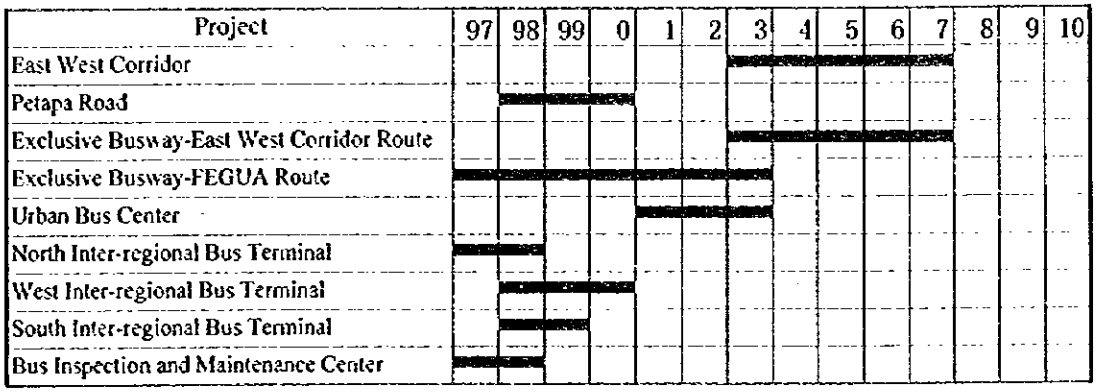
4.2 Project Cost

(Unit : Q1,000)

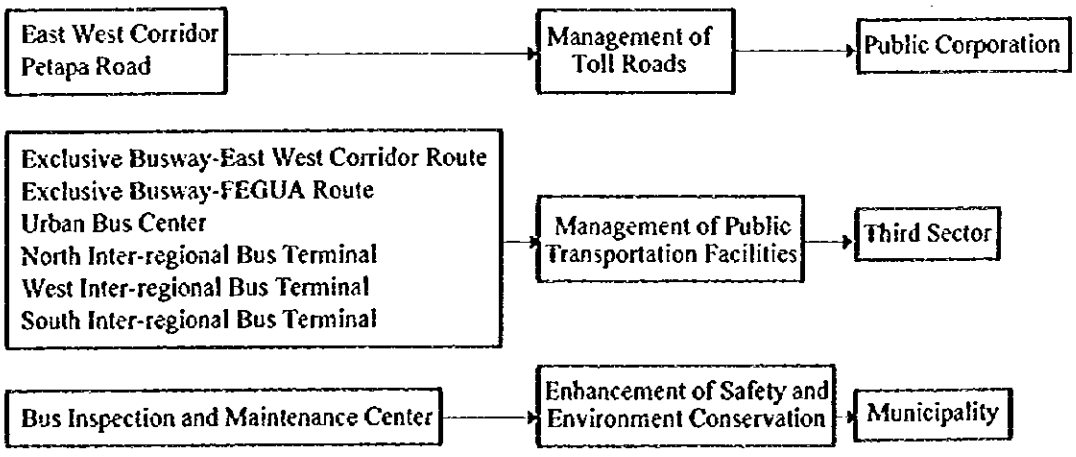
Name of Project	Foreign Portion	Local Portion	Land Acquisition	Total
E-W Corridor	148,450	198,040	55,946	402,436
Petapa Road	69,751	92,136	9,403	171,290
E-W Exclusive Busway Route	63,758	80,997	23,689	168,444
FEGUA Exclusive Busway Route	113,113	145,627	8,916	267,656
Urban Bus Center	117,434	78,289	-	195,723
North Bus Terminal	6,239	4,159	-	10,398
West Bus Terminal	20,753	13,835	15,000	49,588
South Bus Terminal	16,431	10,955	-	27,386
Bus Inspection Center	22,981	15,321	-	38,302
Total Investment Cost	578,910 (43.5%)	639,359 (48.0%)	112,954 (8.5%)	1,331,223 (100.0%)

4.3 Project Construction Schedule and Implementation Entity

Construction Schedule



Implementation Entity



4.4 Project Evaluation

4.4.1 Economic and Financial Evaluation

Results of the Economic Evaluation

	EIRR	NPV Q. million	B/C
Whole	28.5%	770	2.07
Roads	16.5%	73	1.30
- East-West Corridor	7.7%	-37	0.71
- Petapa Road	21.6%	79	1.69
Public Transport Facilities	30.2%	647	2.37
Exclusive Busways	37.8%	475	3.18
- East-West Corridor Route	11.3%	-3	0.94
- FEGUA Route	49.0%	568	4.53
Urban Bus Center	15.6%	30	1.27
Inter-regional Bus Terminals	25.8%	101	2.11
- North	91.8%	40	4.06
- West	29.2%	59	2.59
- South	17.2%	15	1.39
Bus Inspect. and Maintenance Center	44.1%	58	2.04

Summary of Financial Analysis

Project	Entity	Fund Source	Level of Charge	Value of FIRR
Toll Road	Public Corporation	• Foreign loan • Contribution	Toll rate: Q.3	8.37%
Public Transportation	Third Sector	• Foreign loan • Contribution • Private capital	Bus exclusive way: Q.5 Urban bus Center: Q.7.5 Inter-regional bus terminal: Q.10	6.44 %
Inspection	Municipality	• Prepared by the Municipality	Inspection: Q.250 Maintenance: Q.500	---

4.4.2 Environmental Impact Evaluation

Comparing to the "without project" case, total vehicle operating distance and total vehicle operating hours will be reduced in the "with project" case. This means the reduction of vehicle originated pollution such as air pollution and noise. Furthermore, after the commencement of operation of Bus Inspection and Maintenance Center, total exhaust materials will be reduced as a result of unit quantity reduction of exhaust gas and noise, and finally the total environment will be improved

Concerning the predicted negative impacts during construction and operation of the projects, appropriate countermeasures are recommended.

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EXECUTIVE SUMMARY

1. Introduction

Study Development

In response to the request of the Government of the Republic of Guatemala (hereinafter referred to as "Guatemala"), the Government of Japan decided to conduct a Feasibility Study on the Project of Urban Transportation in the Metropolitan Area of Guatemala (hereinafter referred to as "the Study"). Accordingly the Japan International Cooperation Agency (JICA), the official agency responsible for the implementation of technical cooperation programs of the Government of Japan, was entrusted to undertake the Study in cooperation with the authorities of Guatemala.

The preliminary study team, headed by Dr. Hisao Uchiyama, was dispatched by JICA to Guatemala and the Scope of Work for the Study was agreed on in April 1995. The full-scale site study in Guatemala began in September 1995 and continued until December 1996.

Scope of the Study

(1) Objectives

To assess technical, economic and social feasibility of the urgent/short term projects listed below, which are expected to lead to the solution of existing traffic and transport problems in the metropolitan area of Guatemala.

- New construction of East-West Corridor (Diagonal 3 - San Nicolas)
- Improvement of Avenida Petapa (50 Calle - San Miguel Petapa)
- Development of Exclusive Busway
  - East-West Corridor route (Diagonal 3-San Nicolas)
  - FEGUA route (Central Station - Villa Nueva)
- Urban Bus Center in the terminal area, Zone 4
- Inter-regional Bus Terminals
  - North terminal
  - West terminal
  - South terminal
- Bus Inspection and Maintenance Center

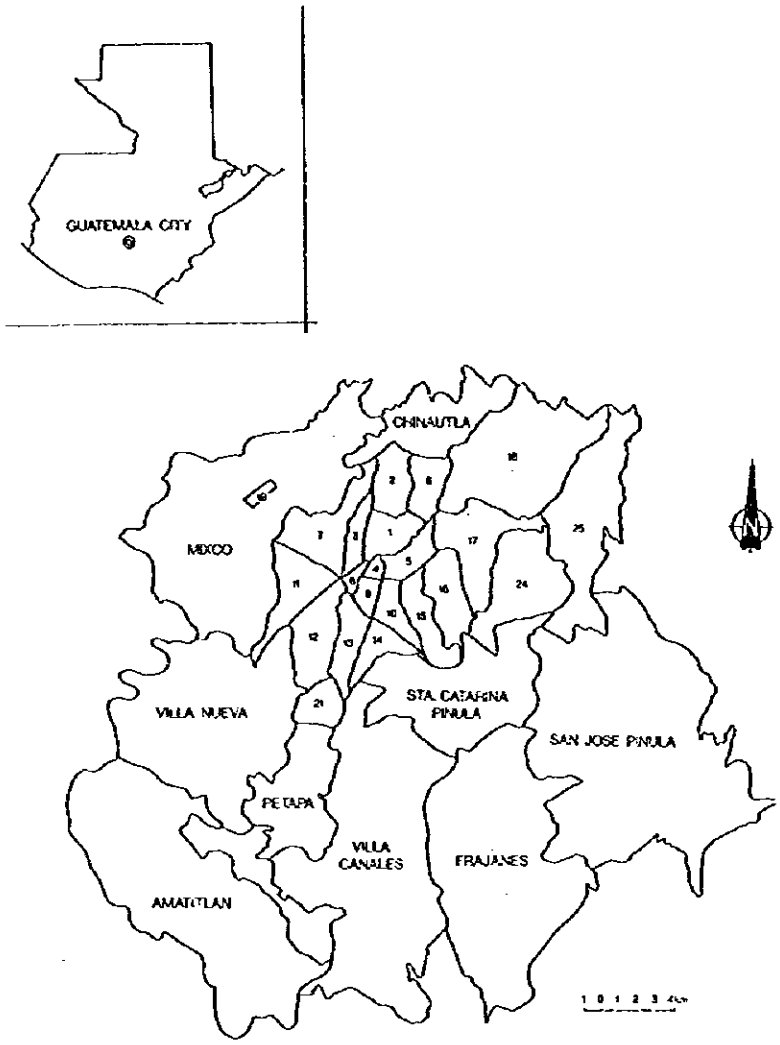
To pursue technology transfer to the Guatemalan Counterpart personnel during the course of the Study.

(2) Study Area

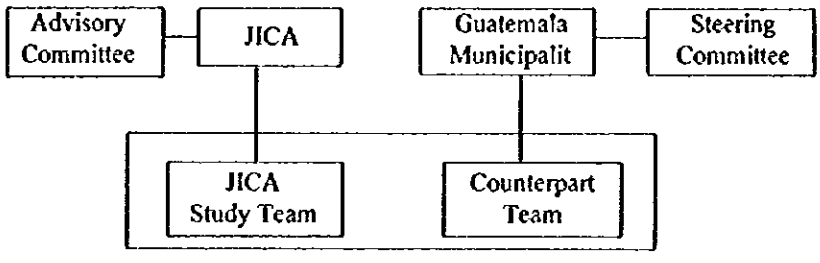
The Study Area covers Guatemala City and its peripheral area - Mixco, Villa Nueva, San Miguel Petapa, Santa Catarina Pinula, Villa Canales, Amatitlan, Fraijanes, San Jose Pinula, and Chinautla.

Study Organization

To conduct the Study, JICA has organized both the Study Team, headed by Mr. Takeshi Yoshida and the Advisory Committee, chaired by Dr. Hisao Uchiyama to give advice for the Study. The government of Guatemala has formed the Counterpart Team, headed by Mr. Edugar De Leon under the Municipality of Guatemala. The Municipality has organized the Steering Committee to facilitate the progress of the Study.



Study Area (Metropolitan Area of Guatemala)



Study Organization

2. Background of Project

The Metropolitan Area of Guatemala is located on a plateau approximately 1,500 m above sea level in the center of the nation. The geological features are composed of volcanic diluvial rock susceptible to erosion, which have created many deep valleys cutting into the hilly area.

The present-day Guatemala City was established in 1776, as the old capital in Antigua was destroyed by earthquake in 1773. As the capital, it has become an economic and cultural center and also the center of Central America.

Besides the increase in population in Guatemala Department, the Study Area population will rise from a 91.7% share of the Departments' population to 94.6% by the year 2010, at which time it is estimated to reach 3 million, 1.67 times the current scale. The rate of population growth will gradually decline, but will still keep an average 2.6% annual growth over the next 20 year period.

It is anticipated that the national economy will grow at an average rate of 4% after 1995. The role of the Study Area will be fulfilled by driving the national economy through the secondary and tertiary sectors. Therefore, it is anticipated that the growth rate for the GRP will expand at an average annual growth rate of 5% after 1995.

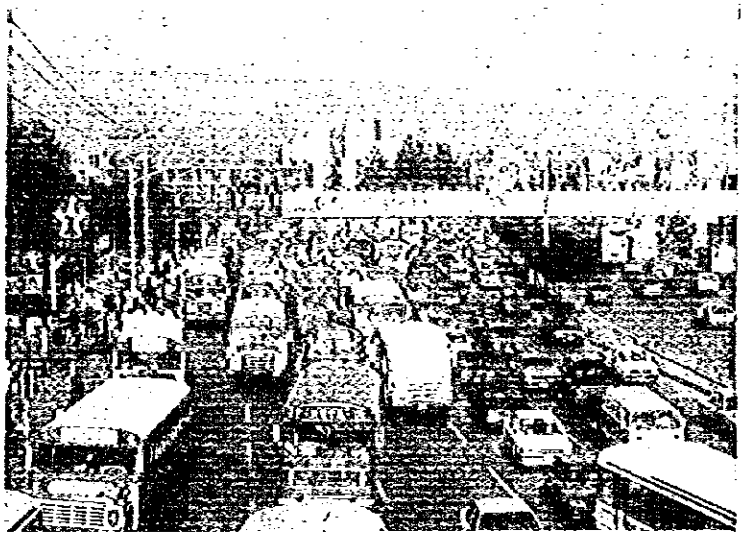
The future urban pattern of the Study Area is aimed to be the Polycentric/Corridor Pattern. New residential areas of 6,370 ha. are planned for a 639 thousand increasing population which cannot be absorbed in the existing urban areas. In Naranjo, a new residential area with commercial centers will be developed. On the southern axis, a new town center will be formed in Villa Nueva.

Therefore an increase in traffic will be inevitable and the conditions concerning transportation should be effectively improved to avoid loss to the national economy and degradation of people's life.

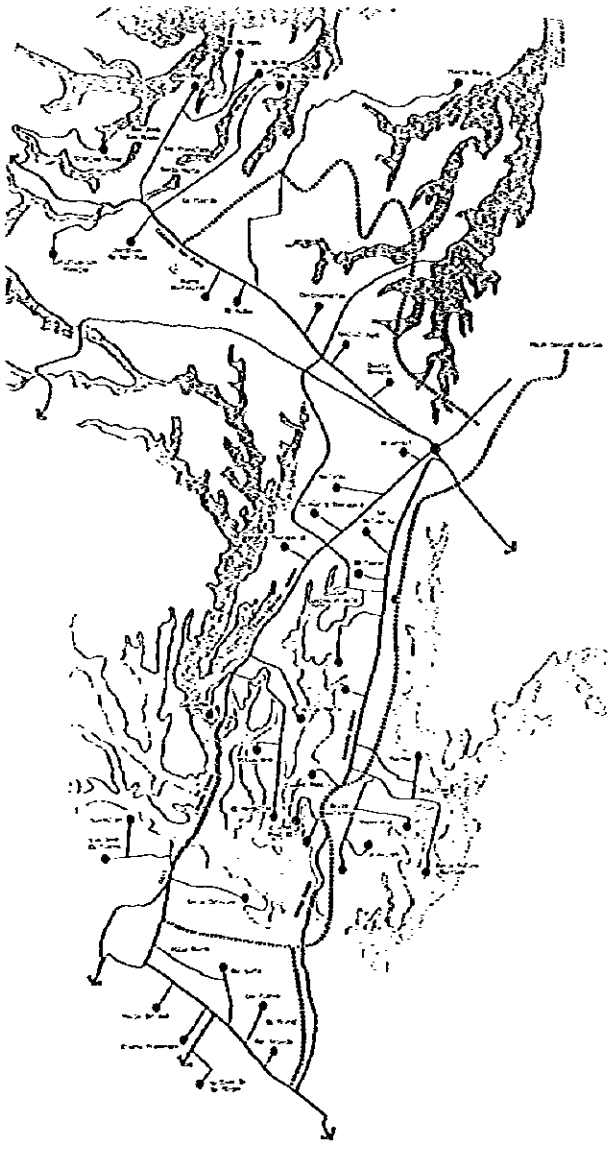
Actually the Metropolitan Area of Guatemala has been suffering from traffic problems such as traffic congestion, pollution, low level of service of public transportation, etc. Guatemala has made efforts to mitigate the problems by constructing new roads and grade intersections, traffic control improvement, however, the overall conditions have not yet been improved due to the sharp increase in numbers of cars, urban development, incomplete network of roads, etc.

The bus system is the sole means of public transportation, however, relevant organizations and administrations to provide the people with reliable and comfortable service need to be improved and strengthened.

In these circumstances, among the short/medium term projects proposed in the Master Plan (M/P), six projects, considered important, were selected as projects for the Feasibility Study (F/S). Emphasis is placed on public transportation and roads as measures to meet the rapid and large scale development of the Western and Southern areas.



Traffic Congestion of CA1 near Trebol Interchange



Geographic Conditions of Road Network

3. Road and Traffic Conditions

Person Trips

The total number of person trips per day in the Study Area, obtained by the Person Trip Survey conducted in 1990, were 3,423,142 trips. Within those trips, 3,386,252 trips (98.9%) were made by residents in the Study Area, while the remaining 36,889 trips were made by outside residents. Concerning the modal split, bus (large bus system) was the highest at 35.9%, followed by passenger car (18.7%), microbus (17.1%) and walking (16.3%).

Road Network in the Study Area

The trunk roads in Guatemala City consist of seven radial roads despite restrictions on their development caused by steep V-shaped valleys called "barranco". The border between the developed sections and the valleys form steep cliffs 50 to 120 m deep. Therefore, Periferico Road is only the ring road in the city which runs in a semicircle with a radius of 4 km in the west side of the city.

(1) Northward

In the northern area of the city, CA9, which has Belice bridge to the north-east, is the only major road available restricted by the deep valleys in the due north. CA9 is a four-lane road, which connects Guatemala City with the areas north of the city. (65,200 veh./day)

(2) Westward

There are two roads to connect with Mixco: one is CA1 with six lanes and the other is Calzada San Juan Sacatepequez with four lanes running adjacent to CA1. (CA1 : 86,000 veh./day; Calzada San Juan Sacatepequez 58,400 veh./day)

(3) Southward

Three roads connect the city with the southern districts: four-lane Petapa Road with Villa Nueva, Petapa and their neighborhood; and four-lane Avenida Hincapie with Villa Canales and its vicinity. CA9 road goes up to Puerto Quetzal on the Pacific coast connecting with CA2 in Escuintla. Avenida Hincapie was improved in 1994, so Villa Canales, satellite city south of the capital was connected with the capital much more smoothly. (CA1 : 70,200 veh./day; Petapa road : 54,500 veh/day)

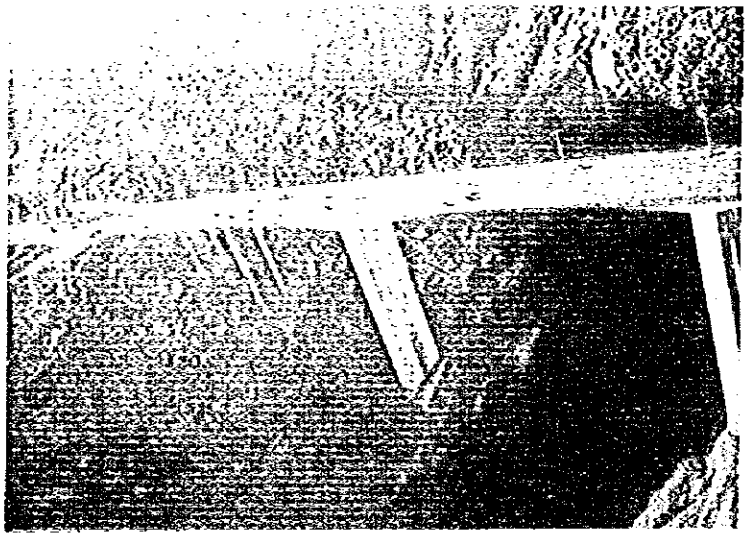
(4) Eastward

CA1 that leads to Santa Catarina Pinula, a satellite city east of Guatemala city, and further to San Jose Pinula, Cuilapa and El Salvador is a four-lane road. (82,000 veh./day)

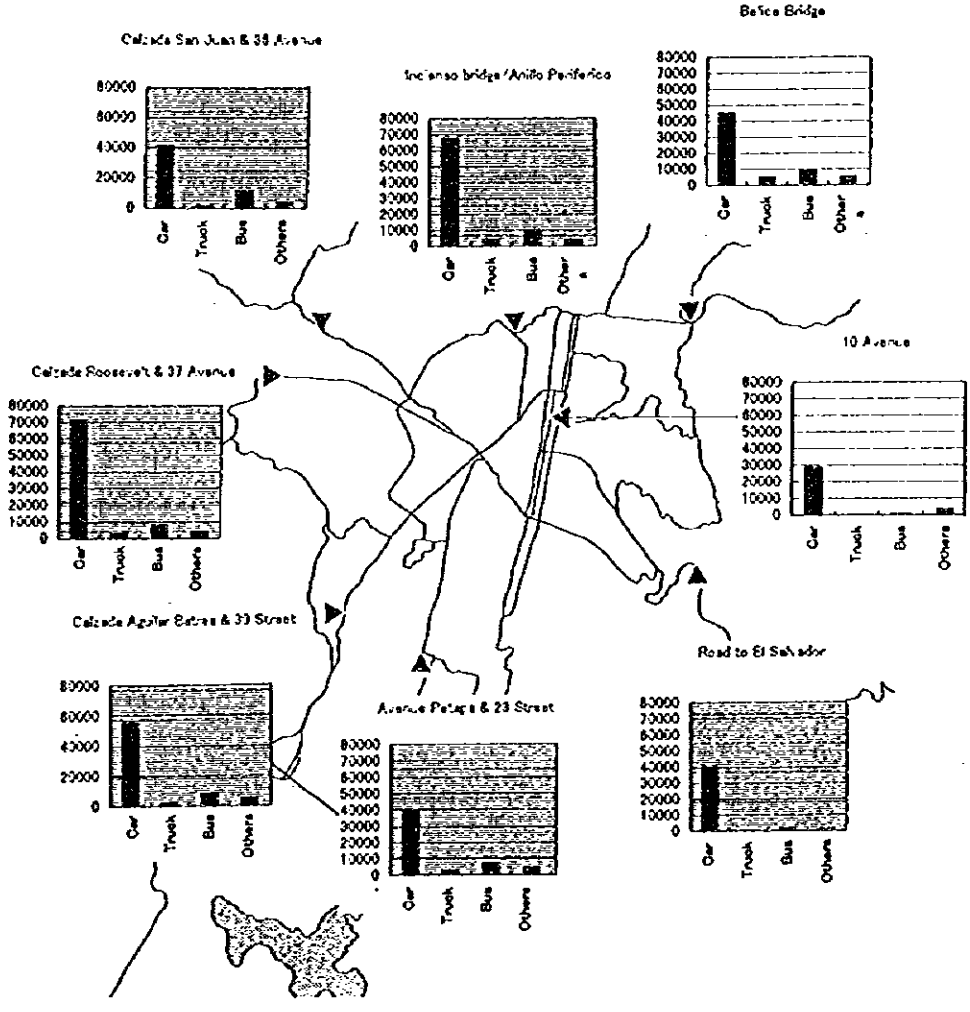
(5) Ring Road

Restricted by geographical configuration, specially by the deeply eroded valleys, the only ring road built in the city is Periferico, which runs west of the city forming a semicircle. Periferico, a six-lane road, directly links to CA9, runs along the outer edge of central district, and crosses, Calzada San Juan Sacatepequez (CA1) and Calzada Aguilar Batres (CA9).

The volume of traffic at Ing. M. P. Velez Bridge is counted as many as 86,500 vehicles a day. The volume of bus traffic including minibuses is as high as 10,100 a day.



Periferico Road running over Deep Valleys



Existing Trunk Road Network and Traffic Volume

4. Public Transport Conditions

Present Bus Transport System

There are 17 urban bus companies/associations operating 1,417 units for 81 routes and 13 microbus companies/associations operating 799 units for 52 routes besides Metrobus. There is no definite difference between buses and microbuses except that each bus is operated only by a driver while each microbus customarily has an assistant. "Preferential" buses are supposedly of higher quality than ordinary buses, but in reality the superiority is not always apparent. On the other hand, out of a total of 3,700 registered urban buses and microbuses, 1,800 or nearly 50% are 15 years old or over. This means that many already deteriorated buses and microbuses are still operating.

Currently, approximately 2,800 extra-urban buses are registered with the municipality as those with one trip end in the municipality, and they include approximately 1,200 units connecting destinations inside Guatemala Department with the municipality.

Existing Bus Transport Facilities

A number of bus stop facilities have been improved along main streets. Further improvement is needed including construction of bus bays wherever practical. In addition, more orderly use by both buses and passengers is required.

The terminal at Zone 4 with 86 bus berths and the surrounding area suffers from chronic congestion and confusion. The terminal at Parroquia Zone 6 is not so crowded but the Calle Marti or CA9 North in the urban area is congested partly due to the terminal. There are other off-street extra-urban bus terminals such as those near the FEGUA Central Station, some of which occupy the front road space. Moreover, there are a number of on-street extra-urban bus terminals in Zone 1, some of which degrade the environment.

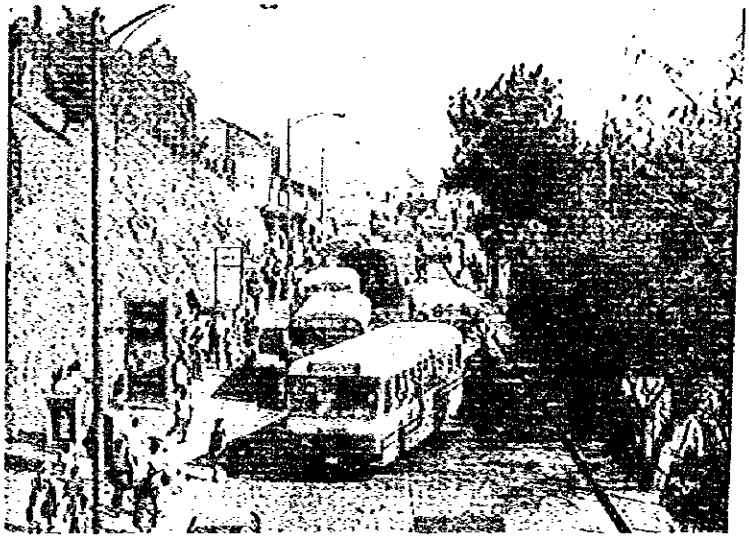
In most cases, buses do not have systematic maintenance. Many buses are maintained in an ad hoc way on the roadside. At present, inspection of urban buses older than 5 years of age is conducted once a week by the municipality. However, some of the criteria are not specific and the maintenance standard of the buses is also not high.

Bus Transport Issues and Requirements

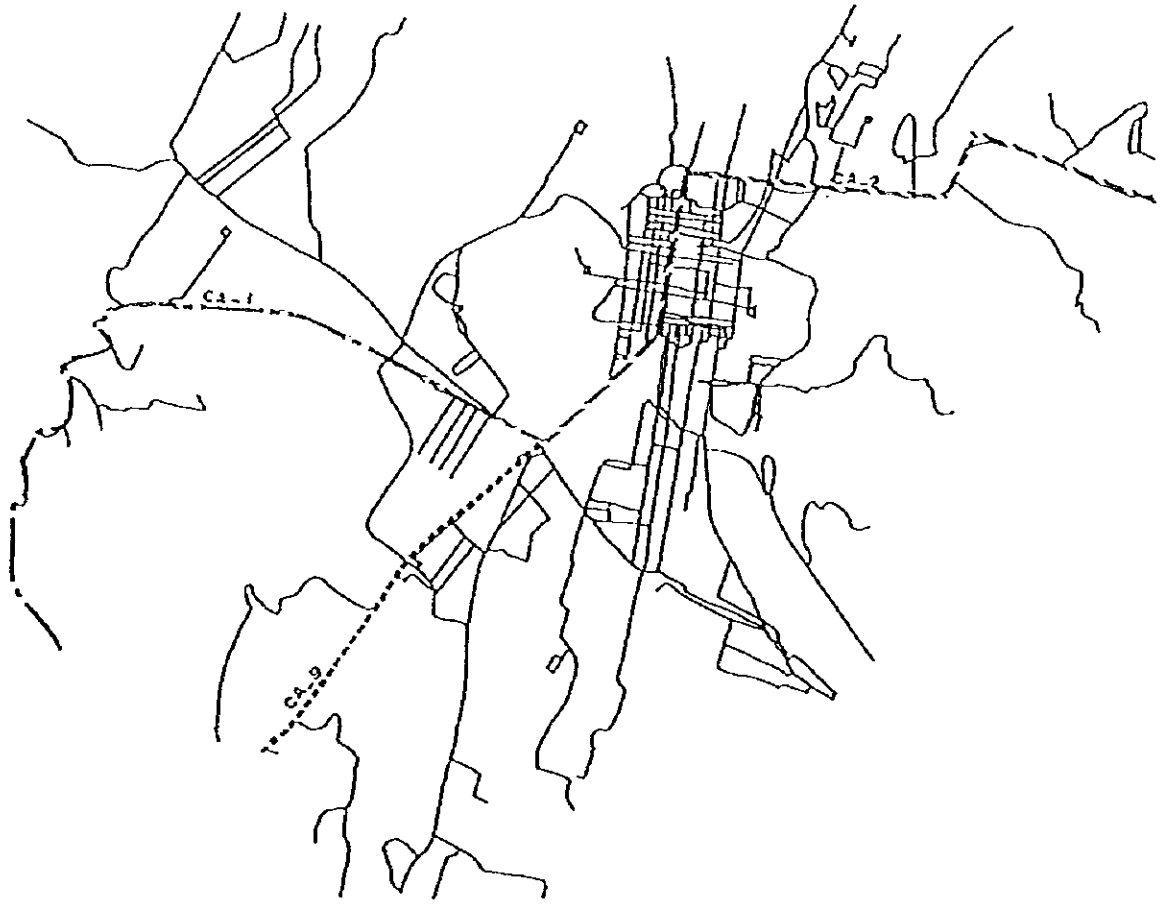
Major issues of the bus transport
(1) Lack of safety and low operation efficiency of buses
(2) Low service level of operation (service, accuracy, velocity, etc.) and comfort of buses
(3) Traffic disturbance and congestion by buses
(4) Environmental pollution by buses
(5) Government's financial burdens caused by buses

↓

Requirements
(1) Need for restructuring the urban and extra-urban bus system to be a hierarchical structure consisting of urban buses (key route buses, ordinary buses and feeder buses) and inter-regional buses
(2) Need for bus operation support infrastructure and facilities such as busways, a bus transfer center and inter-regional bus terminals
(3) Need for improvement of mechanical conditions of buses especially for environmental improvement by such means as a bus inspection and maintenance center with enforcement of operational and environmental laws and regulations



Buses - Major Transportation Mode for the Citizen



Route of Buses Network

5. Outline of Master Plan

Travel Demand

The trip production made by car owners can be calculated as 3,296,500 (53.9%) person trips in 2010, and that of non-car owner is 2,819,600. The total of both is 6,116,100 that is 1.8 times the present number of person trips.

A large volume of person trips is generated in the central district in the Municipality, especially in Zone 1, while the increase rate is 0.99. Increase of generation in suburban areas such as Mixco (2.09), Villa Nueva (2.94) and Zone 18 (1.70), is obviously great. The number of person trips between City Center of Guatemala and Mixco is the largest, and that between North-East Guatemala and the City Center follows. The person trip flow from Santa Catarina Pinula is not so large.

If the road service level is the same as the present ("Do-nothing" case), the number of private car trips reaches 2 million person trips (42% of the total number of person trips using vehicles).

Master Plan Network

The Master Plan Network was formulated strengthening the road network and the public transportation.

Road Network	Radial and Ring Road Network Improvement

a) To utilize the existing road network

b) To improve the most congested transport axes

c) To form a comprehensive road network pattern

d) To complete the unlinked road

Public Transportation	Introduction of Exclusive Busways and Bus Lanes

a) Introduction of Exclusive Busways and Exclusive Bus Lanes
In the main axes, exclusive busways and exclusive bus lanes will be introduces.

b) Reorganization to Hierarchical Public Transportation System

- Inter-regional Bus

  Reorganization and relocation of existing terminals to new terminals at intersections between interregional arterial routes and the Periferico.

- Key Route Buses

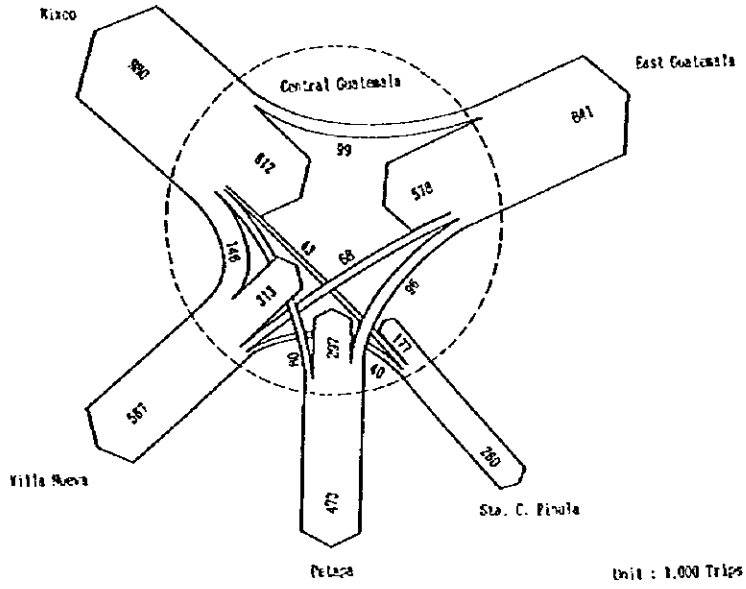
  The key route buses operate through selected north-south roads in the middle of the CBD.

- Ordinary Buses

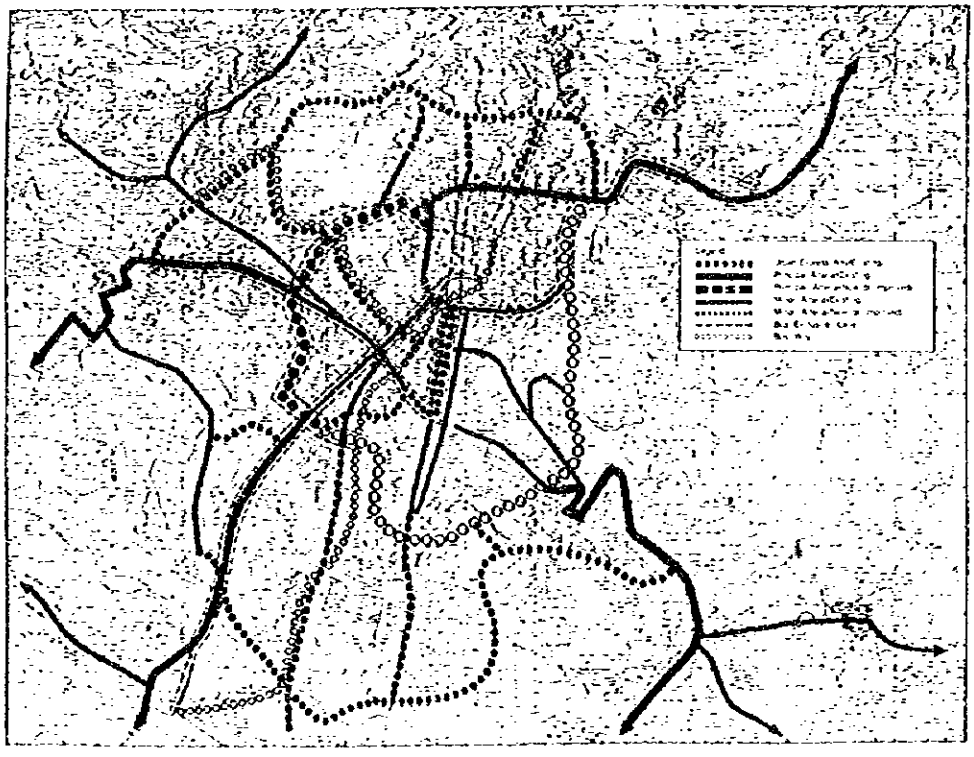
  In CBD, ordinary buses should operate along the boundary.

- Feeder Buses

  The operation areas are basically along branch roads and the feeder buses circulate mainly along the east-west direction connecting with the key route buses.



Principal Person Trip Flow



Transportation Master Plan Network

6. Planning Policy and Project Formation

The principle planning policies of the Study are same as those for the Urban Transport Master Plan.

a) The development of the transportation network shall be capable of growing as an integral part of the future urban land structure.

b) Coping with the future transportation demand.

c) Correcting the differences in the transportation services by area and society of income level.

d) The securing of the citizens' safety and maintenance of good environment.

e) Effectiveness with reasonable investment

The following premises are considered for project formation :

a) Planning year for the evaluation of the projects is the year 2010, the same as for the Urban Transport Master Plan

b) Traffic demand restriction policies shall be introduced.

c) Part of the right of way of FEGUA can be used for the exclusive busway, even if the cargo transport is operated by the private sector.

d) The function of the wholesale market for agricultural products shall be transferred to CENMA.

e) The urban residential development project in Naranjo area shall be implemented.

f) Some part of the Master Plan network , such as Periferico Tramo and Periferico Intermedio shall be constructed in an early stage.

g) Extra urban bus will be classified into two categories ; neighboring city commuter bus and inter-regional bus.

Before entering into preliminary design work of the projects, the subject projects should be identified through alternative studies. Two types of alternatives, function alternatives and site location alternatives are mainly examined. From various viewpoints, such as facility grade, adequate function, benefit, project cost, construction difficulty and environmental impact etc., alternatives are studied and the most adequate alternative was selected for each project.

East-West Corridor

Naranjo urban development route (Alternative B) was selected because of ease of construction and consideration of the impact on the social environment.

Petapa Road

The middle route (Alternative B) was selected as the most economically efficient route.

Exclusive Busway (East-West Corridor Route)

Same as East-West Corridor.

Exclusive Busway (FEGUA Route)

Partially grade separated structure alternative was selected for reasons of traffic safety and cost benefit analysis.

Urban Bus Center

Multiple floor structure alternative was selected, considering its function as an urban core.

North Inter-regional Bus Terminal

Location in Atlantida (Alternative A) was selected because of the importance of the commercial function.

West Inter-regional Bus Terminal

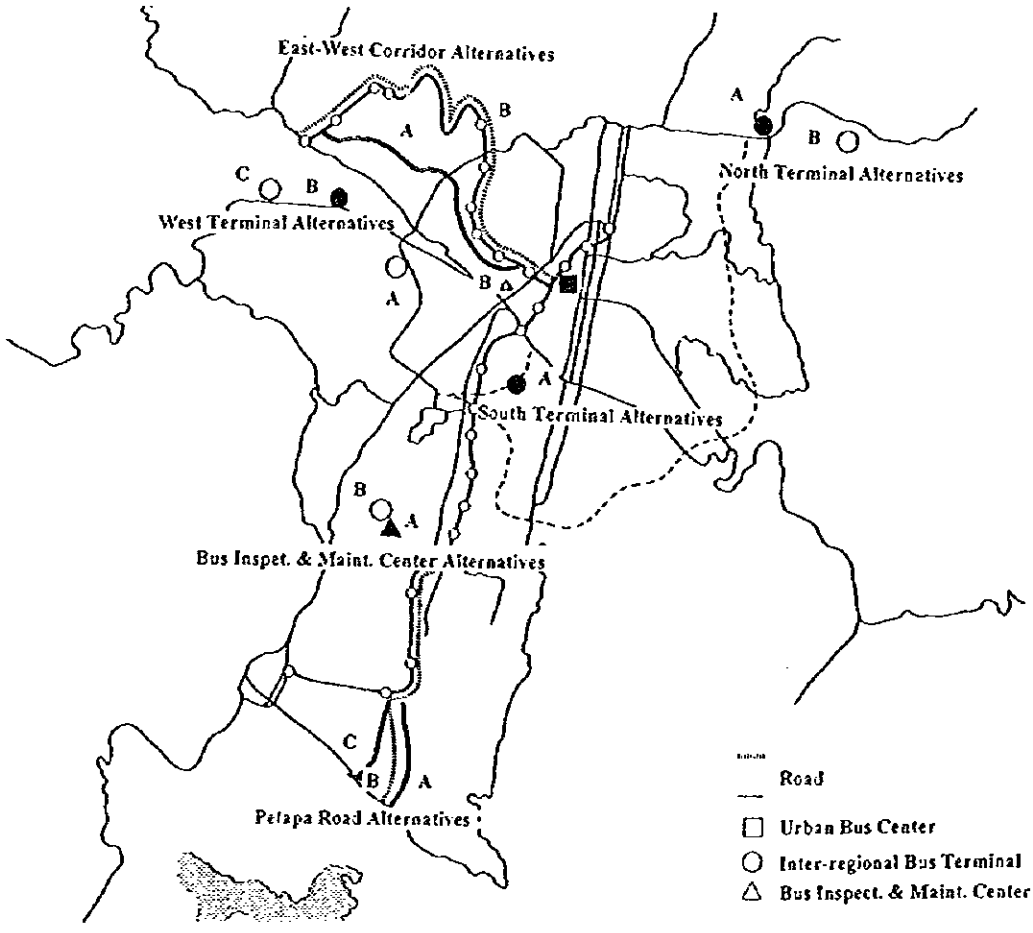
Location on the border between Guatemala City and Mixco City (Alternative B) was selected by reason of traffic conditions.

South Inter-regional Bus Terminal

Location close to Periferico Tramo (Alternative A) was selected because of traffic conditions and land availability.

Bus Inspection and Maintenance Center

Function alternative including maintenance training was selected considering the need for urgent solution of existing problems, and the site close to SENMA (Alternative A) was selected.



Location of Project Alternatives

7. East - West Corridor

Roles and Functions

The East - West Corridor is planned to be one of the important radial arteries from the city center to western areas in the Guatemala Metropolitan Area. There already exist two trunk roads from the center toward west. The one is Calzada Roosevelt (CA1 West) and the other is Calzada San Juan Sacatepequez, both of which connect the city center and Mixco City. However, the rapid increase of population in the western districts of the Metropolitan Area has been worsening the congestion of the two roads and requires another trunk road.

The project can be divided into three components according to conditions along the route sections such as widening of the existing road (Boulevar San Nicolas), construction of a new road as a part of the residential development project in Naranjo area and construction of a new road in the built-up area between Periferico and the Urban Bus Center in Zone 4. The road has four carriageways in both directions with a designed speed of 60 km/h and attached with a two-lane exclusive busway between the two pairs of carriageways. The total length is 12.2 km including a total of 680 m of bridges.

Traffic Demand

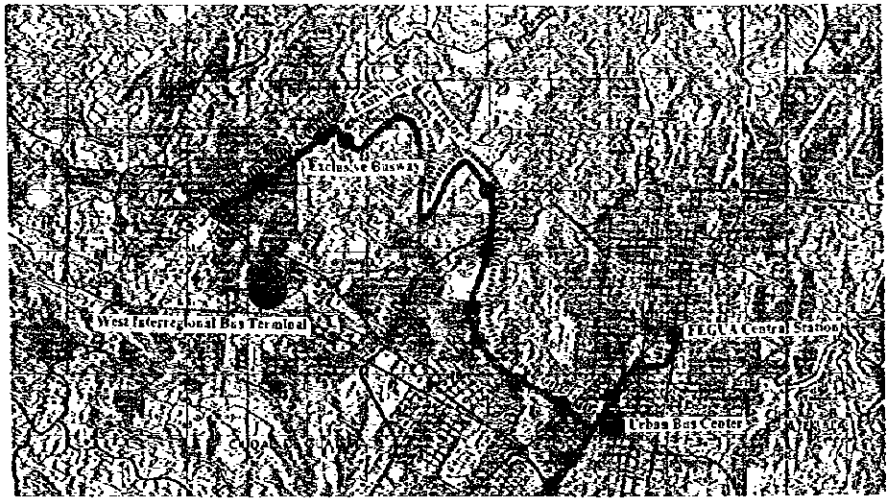
Traffic demand on E-W Corridor in year 2010 is estimated as follows;

(Unit : Passenger Car Unit / day)

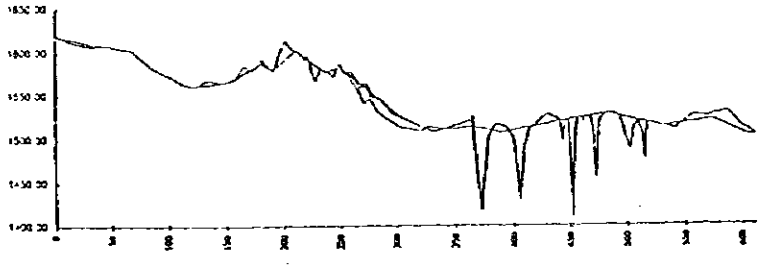
Section	Traffic Demand
Urban Bus Center - Kaminaljuyu	45,100
Kaminaljuyu - Periferico	45,700
Periferico - Naranjo	43,900
Naranjo - Monserrat	39,500
Monserrat - Calzada S. J. Sacatepequez	31,000

Project Cost

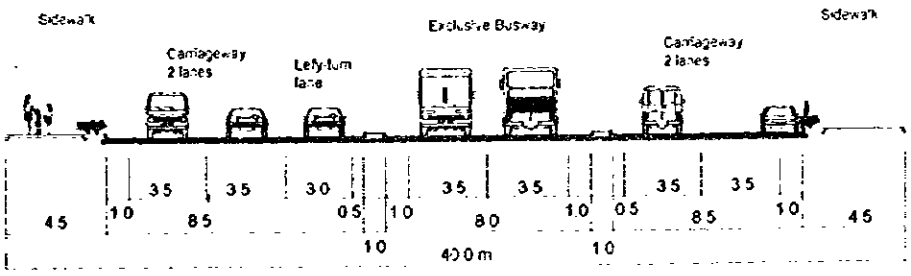
	Foreign (US$1,000)	Local (Q.1,000)	Total (Q.1,000)
Direct Construction Cost	15,370	125,899	220,273
Indirect Cost	4,611	37,770	66,081
Engineering Service	1,998	16,367	28,635
Compensation	0	55,946	55,946
Contingency	2,198	18,003	31,499
Project Cost	24,177	253,986	402,436



Location Map of East - West Corridor



Profile of East - West Corridor



Typical Cross Section of East - West Corridor

8. Petapa Road

Roles and Functions

The existing Petapa Road has four lanes from the city center only to Ciudad Real. The section between Ciudad Real and San Miguel Petapa is a two-lane dirt road. At present, most commuters from the rapidly growing residential areas around San Miguel Petapa are obliged to detour through Calzada Aguilar Batres (CA9 South) saturating the road capacity.

The planned project is to open up a new four lane artery to meet the growing demand of the commuters by constructing new road sections in addition to improvement of the existing road.

The total length of the project section is 7.2 km including a total of 900 m of bridges. A exclusive busway is attached at the median along the section between Ciudad Real and Villalobos River.

Traffic Demand

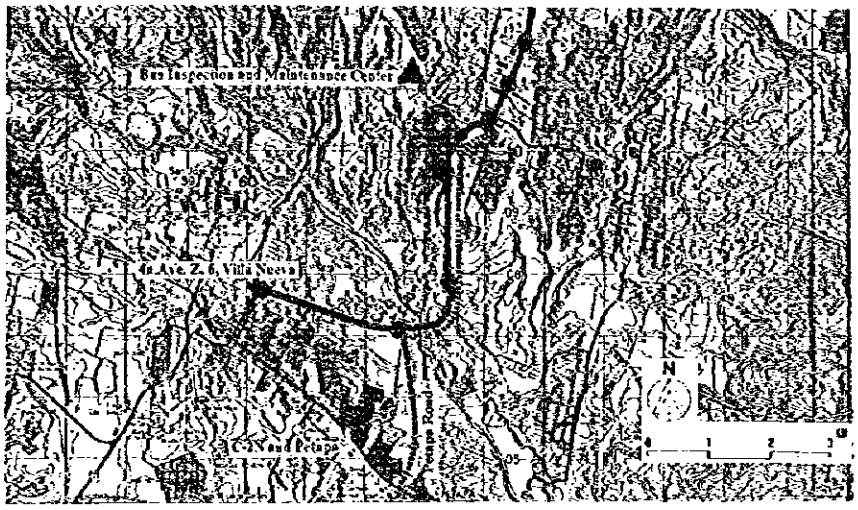
Demand for the Petapa Road is estimated as follows.

(Passenger Car Unit / day)

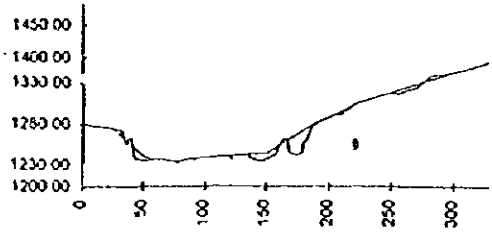
Section	Traffic Demand
Ciudad Real - Rio Villalobos	40,900
Rio Villalobos - Petapa	35,600

Project Cost

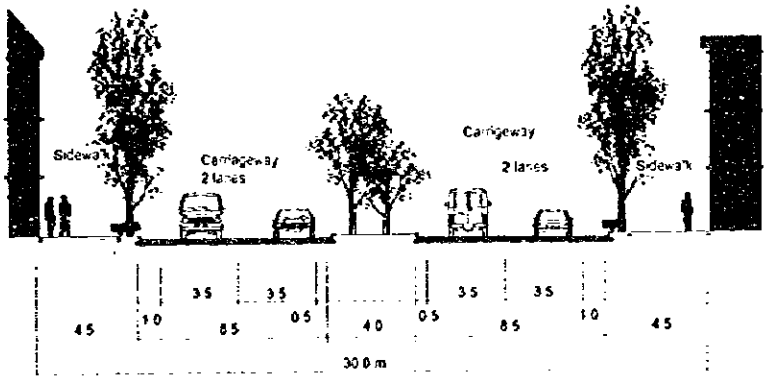
	Foreign (US$1,000)	Local (Q.1,000)	Total (Q.1,000)
Direct Construction Cost	7,222	58,573	102,916
Indirect Cost	2,166	17,572	30,874
Engineering Service	939	7,614	13,379
Compensation	0	9,403	9,403
Contingency	1,033	8,376	14,717
Project Cost	11,360	101,538	171,290



Location Map of Petapa Road



Profile of Petapa Road



Typical Cross Section of Petapa Road

9. Exclusive Busway - East-West Corridor Route

Roles and Function

Exclusive busway are to make the most use of buses along trunk routes mainly to serve commuters from population centers to the central business district (CBD) of the metropolitan area.

The two-lane East - West Corridor Route is expected to serve large trip demand between the CBD and the western cores of population such as Florida and Naranjo. Reflecting steep topography and sparsely inhabited land use along some sections of the route, bus stop intervals are as long as 1,100m on average.

The total route length is 12.2km including a total of 680m of bridges. The whole route is planned at the center of the East - West Corridor, and the preparation of a rail transit system is considered in this construction plan. Major sections of the route form a main radial artery and the west most section constitutes a part of the outer ring road.

Traffic Demand

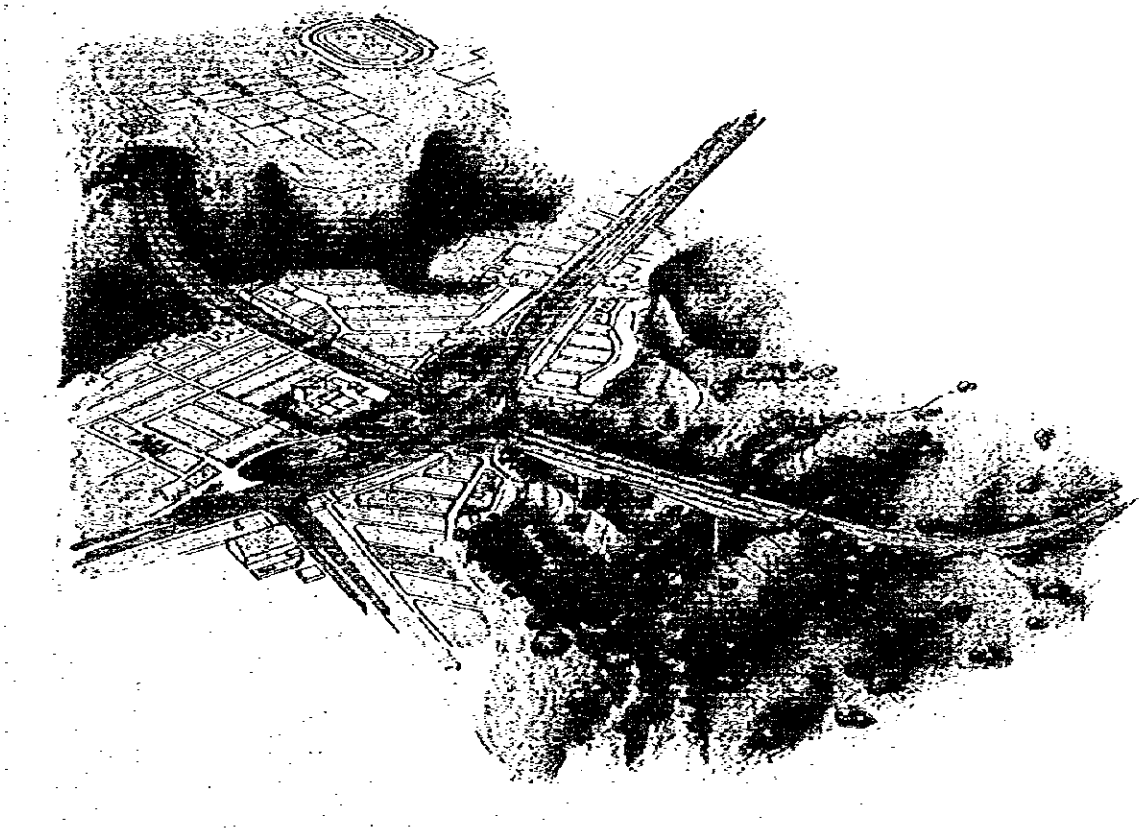
Estimated daily traffic at a section surrounded by the Periferico reaches 9,400 buses while traffic along the Florida area is a little less than 5,000 buses.

(Unit : Buses)

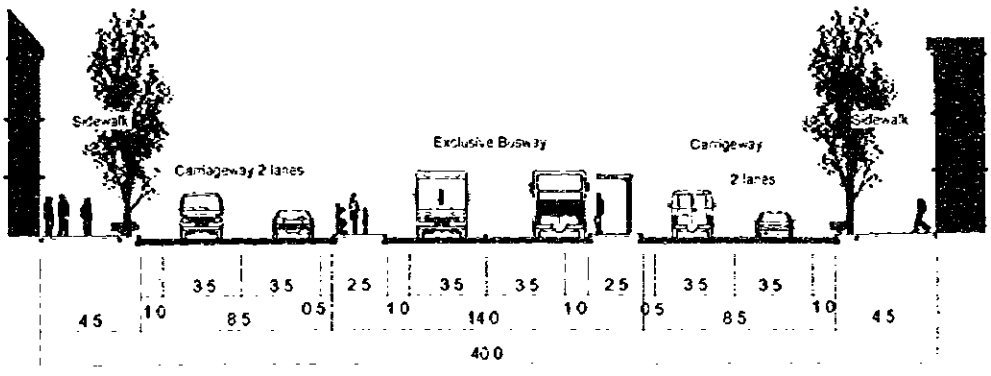
Section	Traffic Demand
Urban Bus Center - Kaminaljuyu	9,400
Kaminaljuyu - Periferico	7,200
Periferico - Naranjo	8,900
Naranjo - Monserrat	8,350
Monserrat - Calzada S. J. Sacatepequez	4,900

Project Cost

	Foreign (US$1,000)	Local (Q.1,000)	Total (Q.1,000)
Direct Construction Cost	6,604	51,491	92,024
Indirect Cost	1,980	15,447	27,607
Engineering Service	858	6,693	11,963
Compensation	0	23,689	23,689
Contingency	943	7,363	13,159
Project Cost	10,384	104,685	168,444



Perspective View of Corridor E-W and Exclusive Bus Way where Interchange with Periferico



Typical Cross Section Exclusive Busway E - W Corridor Route

10. Exclusive Busway - FEGUA Route

Roles and Functions

The FEGUA Route is to utilize the right of way of FEGUA for bus operation between the FEGUA Central Station and Ciudad Real and construct a new busway to Villa Nueva. The two-lane route will be a radial artery parallel to Petapa Road with direct access to the planned Urban Bus Center. The average bus stop interval is 800 m. It is expected to serve large trip demand between the CBD and the southern cores of population such as Villa Nueva, San Miguel Petapa and Villa Canales. The busway will also serve inter-regional buses to and from the South Inter-regional Bus Terminal.

The total length is 17.6 km including a total of 2,830 m of bridges. By operating on elevated sections, it is possible to maintain punctual bus service. Between Ciudad Real and Rio Villalobos, the route is planned at the center of the Petapa Road and between the river and Villa Nueva, the busway will mostly be on bridges not attached with an ordinary vehicle road.

Traffic Demand

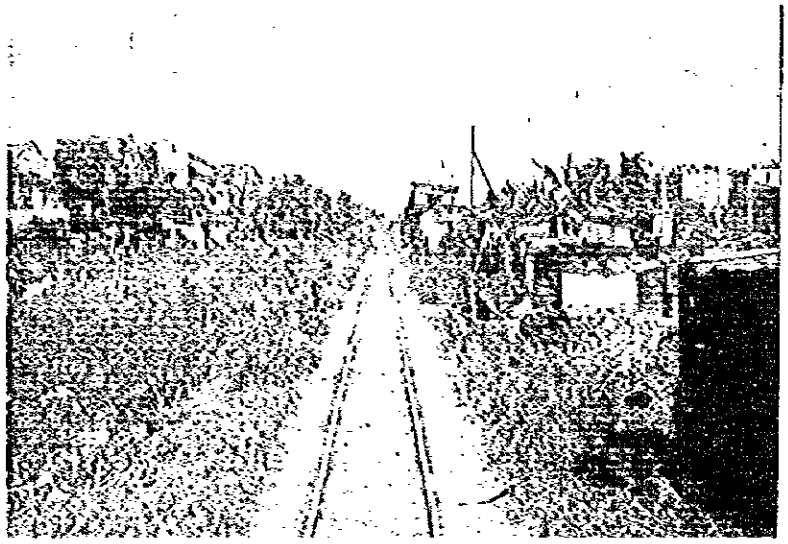
Estimated daily traffic is around 10,000 buses along most sections of the route.

(Unit : Buses)

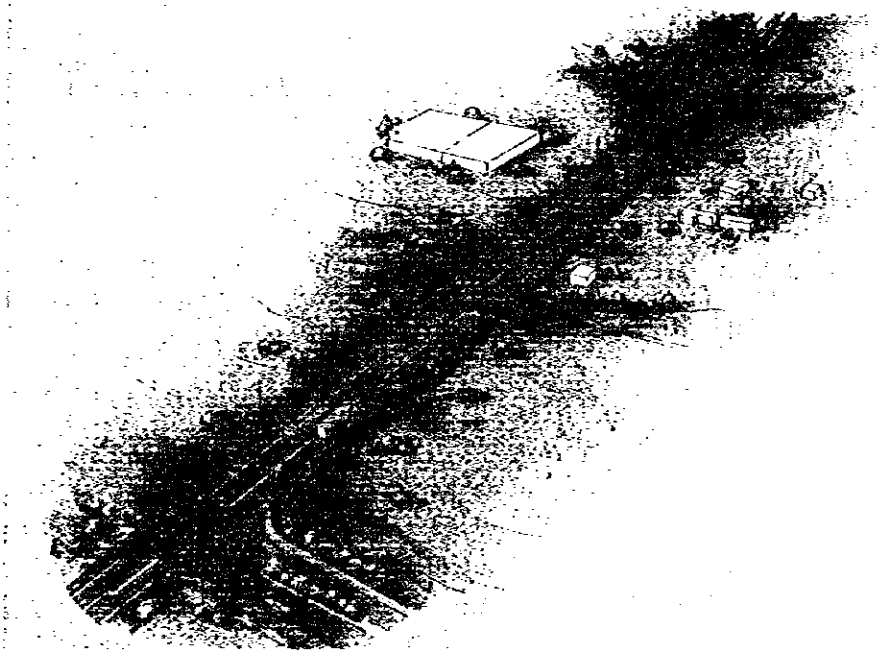
Section	Traffic Demand
FEGUA Center Station - Urban Bus Center	9,900
Urban Bus Center - CA1	9,200
CA1 - Periferico	10,300
Periferico - Ciudad Real	9,800
Ciudad Real - Rio Villalobos	9,800
Rio Villalobos - Villa Nueva	8,400

Project Cost

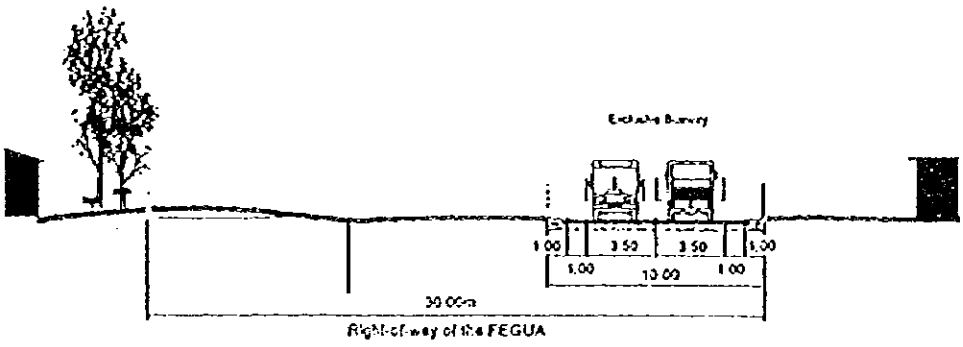
	Foreign (US$1,000)	Local (Q.1,000)	Total (Q.1,000)
Direct Construction Cost	11,711	92,578	164,448
Indirect Cost	3,513	27,773	49,346
Engineering Service	1,522	12,035	21,383
Compensation	0	8,916	8,916
Contingency	1,674	13,238	23,521
Project Cost	18,422	154,543	267,656



Right of Way of FEGUA



Perspective View of Rio Villa Lobo Bridge of Petapa Road and Exclusive Busway (FEGUA)



Typical Cross Section Exclusive Busway FEGUA Route

11. Urban Bus Center

Roles and Functions

The center is located at the junction of the two busways and can be the hub of major urban bus routes for smooth transfer among them. It is also a new urban center to integrate various urban functions.

Major functions are as follows:

1) Functions as Public Transport Center
- Exclusive Busway - FEGUA Route
- Exclusive Busway - East West Corridor Route
- Other urban bus routes including feeder buses
- Inter-regional bus routes via CA1 East
- Taxis

2) Functions as Urban Center
- Commercial, business, service and cultural centers including a retail market
- Urban amenity such as a plaza

Traffic Demand

The center serves 9 urban bus routes and 3 inter-regional bus routes via the Exclusive Busway - FEGUA Route and 11 urban bus routes via the Exclusive Busway - East West Corridor Route and ordinary roads such as the sixth and the seventh avenues.

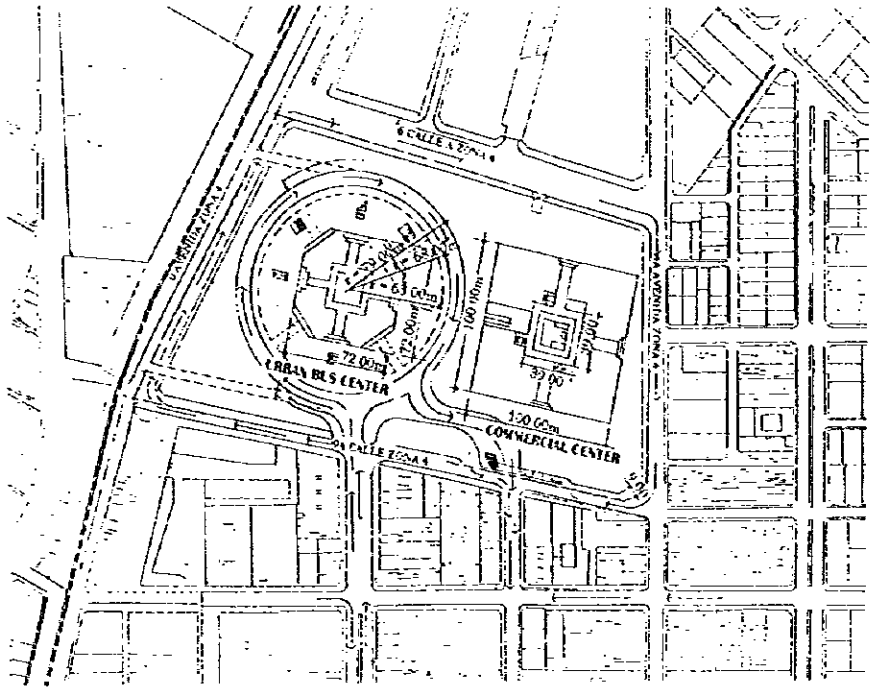
The peak hour urban bus traffic is estimated approximately at 480 buses in each direction of the FEGUA Route and the East West Corridor Route.

Based on the traffic estimation and grouping similar destinations, the required capacity of the center is estimated to be 43 berths. Therefore, 50 berths are planned allowing 7 extra berths.
- Exclusive Busway FEGUA Route (major urban routes) = 15 berths
- Exclusive Busway FEGUA Route (inter-regional via CA 1 East) = 10 berths
- Exclusive Busway East - West Route (major urban route) = 6 berths
- Other urban bus routes to/from 6th and 7th Avenues = 12 berths

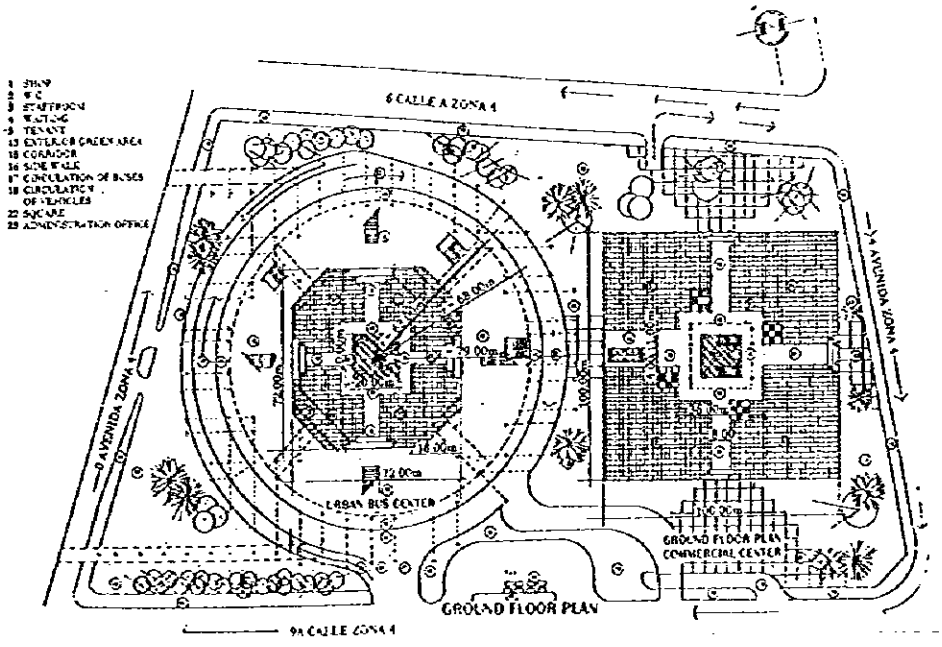
The total number of urban bus passengers is estimated to be approximately 244,000 according to the simulation, and inter-regional passengers to be approximately 31,000.

Project Cost

	Foreign (US$1,000)	Local (Q.1,000)	Total (Q.1,000)
Direct Construction Cost	11,757.80	48,128.50	120,321.39
Indirect Cost	3,919.30	16,042.80	40,107.30
Engineering Service	1,881.20	7,700.60	19,251.17
Compensation			
Contingency	1,567.70	6,417.10	16,042.78
Project Cost	19,126.00	78,289.00	195,722.64



Urban Bus Center Plan



Ground Floor Plan of Urban Bus Center

12. Inter-regional Bus Terminals - I

Roles and Functions

Traffic congestion at the Zone 4 Terminal forms a serious bottleneck for buses and other vehicles. Congestion on Marti Street (CA 9 North) is also chronic and still worsening.

The existing extra-urban buses should be reclassified into suburban buses and inter-regional buses. The former should become a part of the urban bus system of the metropolis. The latter should have new terminals on the periphery of the city center area. These terminals should have the following functions.

- Turning points of inter-regional buses
- Connection between inter-regional buses and the dense urban bus network
- New urban center functions such as market, commercial, business, cultural functions, etc.

Traffic Demand

Demands for the inter-regional bus terminals are estimated as follows.

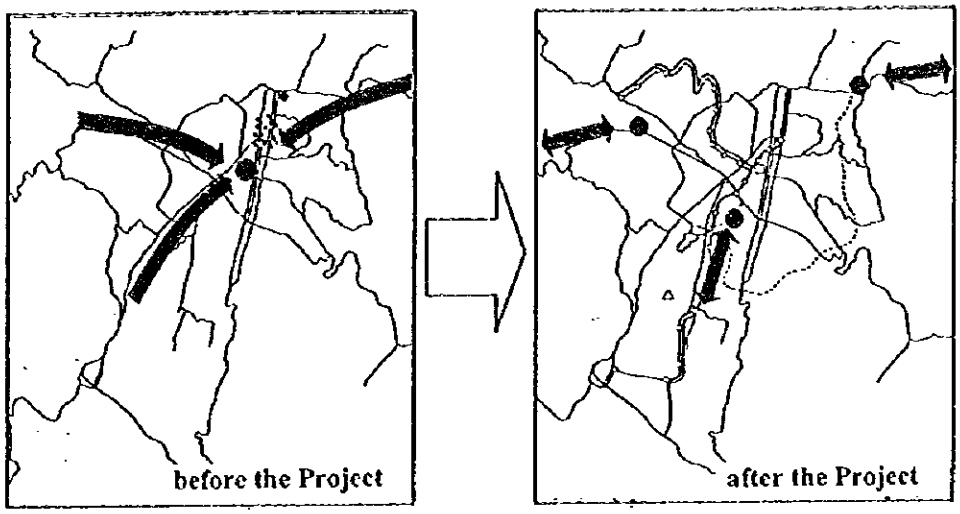
	North Terminal	West Terminal	South Terminal
No. of buses per day	263	447	396
No. of buses in the peak hour	39	67	59
No. of berths	20	34	30
No. of passengers per day	31,600	53,600	47,500
No. of passengers at the peak hour	800	1,300	1,200

North Inter-regional Bus Terminal

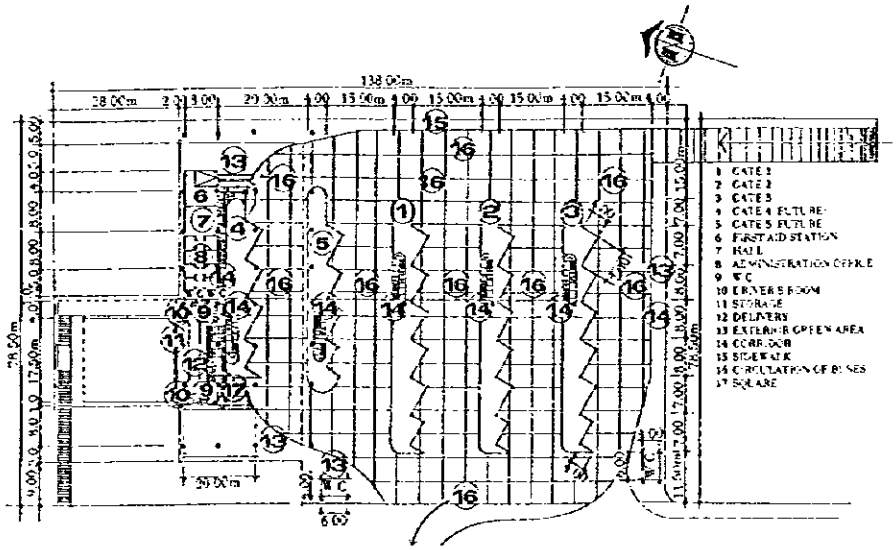
The North Terminal is located at Atlantida, the commercial center of the north-eastern districts of the city, near the intersection of CA9 North and the newly constructed eastern section of the middle ring road. As the north-eastern gateway of the city, the terminal can benefit from the road network and the urban development potential.

Project Cost

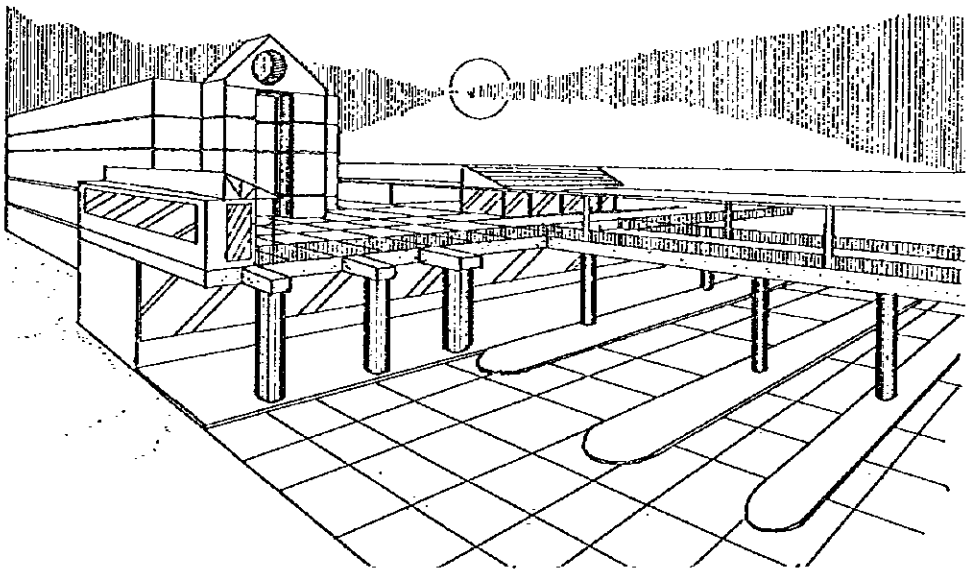
	Foreign (US$1,000)	Local (Q.1,000)	Total (Q.1,000)
Direct Construction Cost	624.60	2,556.70	6,391.74
Indirect Cost	208.20	852.20	2,130.55
Engineering Service	100.00	409.20	1,023.20
Compensation			
Contingency	83.30	340.90	852.36
Project Cost	1,016.10	4,159.00	10,397.85



Function of Inter-regional Bus Terminal



North Inter - Regional Bus Terminal Plan



Perspective View of North Inter - Regional Bus Terminal

13. Inter-Regional Bus Terminals - II

West Inter-regional Bus Terminal

The West Terminal is located at the boundary between Guatemala City and Mixco City along CA1 West. The terminal will accommodate buses from the west. An access tunnel crossing under the road is designed for buses taking advantage of the low level of the site so that the terminal is at ground level and a commercial center can be developed on the first floor.

Project Cost

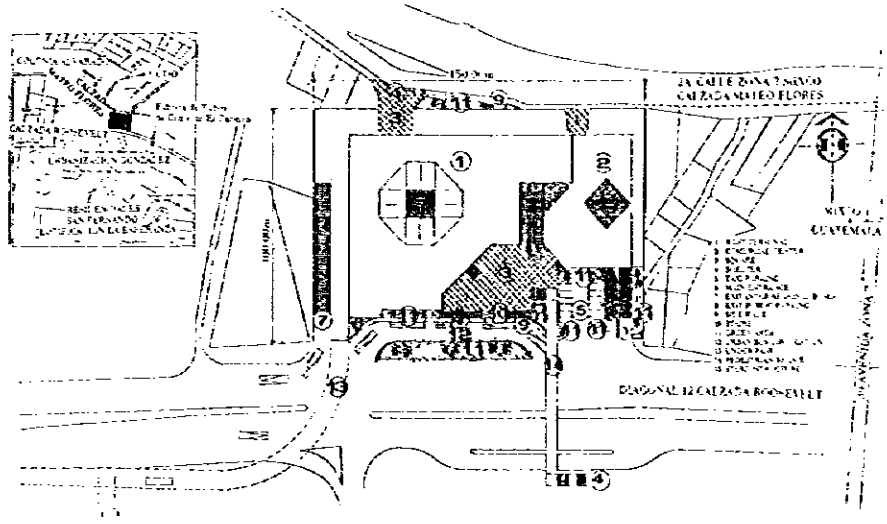
	Foreign (US$1,000)	Local (Q.1,000)	Total (Q.1,000)
Direct Construction Cost	2,077.80	8,505.10	21,262.79
Indirect Cost	692.60	2,835.00	7,087.56
Engineering Service	332.50	1,360.90	3,402.45
Compensation		15,000.00	15,000.00
Contingency	277.00	1,134.00	2,834.78
Project Cost	3,379.90	28,835.00	49,587.59

South Inter-regional Bus Terminal

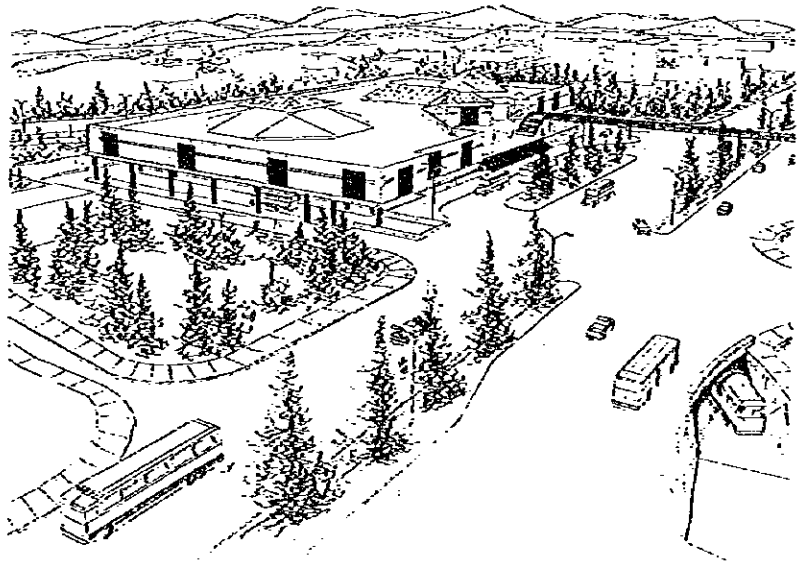
The South Terminal is located along a planned extension of the ring road with access to the Busway FEGUA route. Buses from southern departments can take the busway to reach the terminal.

Project Cost

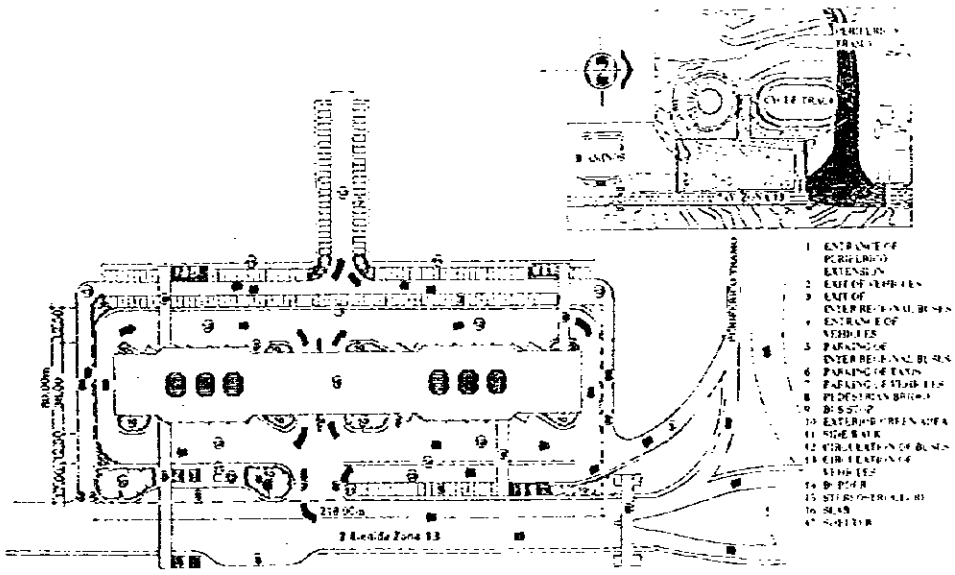
	Foreign (US$1,000 $)	Local (Q.1,000)	Total (Q.1,000)
Direct Construction Cost	1,645.20	6,734.40	16,835.93
Indirect Cost	548.40	2,244.80	5,611.98
Engineering Service	263.20	1,077.40	2,693.45
Compensation			
Contingency	219.40	897.90	2,245.02
Project Cost	2,676.20	10,954.50	27,386.37



West Inter - Regional Terminal Plan



Perspective View of West Inter - Regional Terminal



South Inter - Regional Bus Terminal Plan

14. Bus Inspection and Maintenance Center

The role of the center is to improve the mechanical condition of the urban buses of the Guatemala Metropolitan Area to achieve the following objectives. Some 3,000 urban buses will be inspected annually and the fleet will be increased to some 4,300 by 2010.

(1) Securing traffic safety

By improving the mechanical condition of the buses, traffic accidents caused by mechanical problems are reduced and safety conditions of passengers are improved. Traffic problems caused by buses are also reduced.

(2) Improving urban environment

By improving mechanical conditions especially related to exhaust gas equipment as well as engines, urban pollution such as air pollution, noise and vibration are reduced.

(3) Improving operational efficiency

By periodical inspection and maintenance, buses become free from breakdown and the operating costs are reduced resulting in an increase of the operational efficiency. For passengers, reliability and comfort are improved. For the government, financial and political burdens caused by buses can be reduced.

Approach of Bus Inspection and Maintenance Center

- Bus Inspection and Maintenance Center and related operational and institutional systems

↓

- Authorization of well conditioned buses for priority/preferential routes such as bus way routes and for use of the bus center and terminals
- Authorization of acceptably conditioned buses for minor routes
- Prohibition of poorly conditioned buses from operating certain or all routes including rural routes

↓

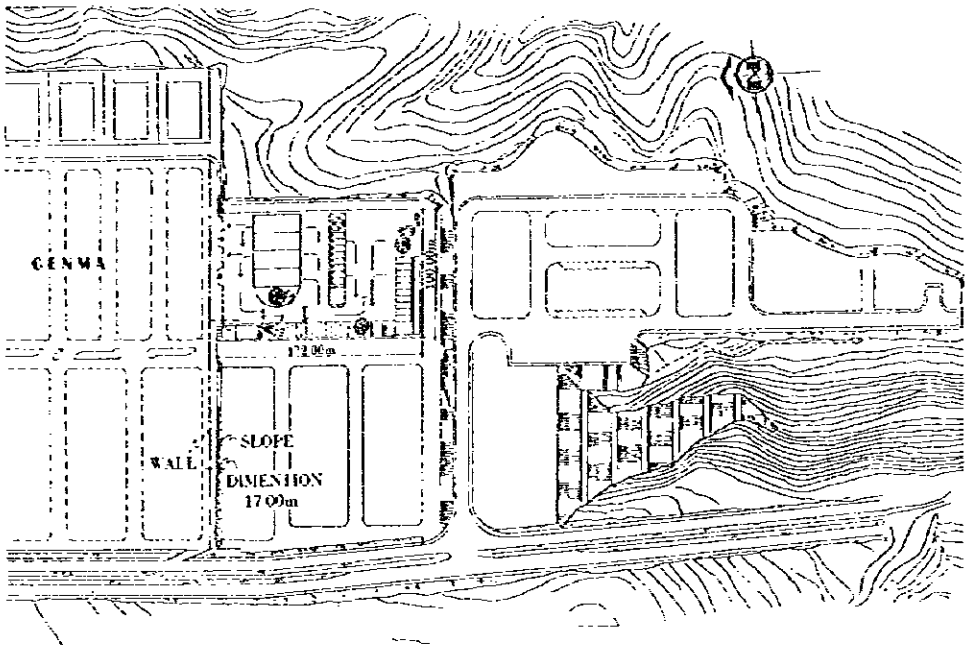
- Improvement in maintenance and repair
- Renewal of fleet

↓

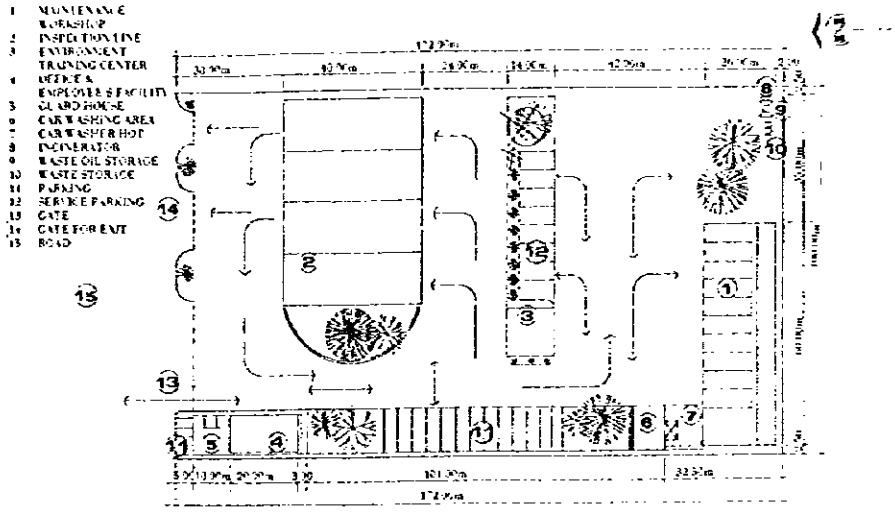
- General upgrade/improvement of mechanical conditions of urban buses

Project Cost

	Foreign (US$1,000)	Local (Q.1,000)	Total (Q.1,000)
Direct Construction Cost	2,588.60	10,595.90	26,489.90
Indirect Cost	554.30	2,268.90	5,672.30
Engineering Service	285.70	1,169.50	2,923.70
Compensation			
Contingency	314.30	1,286.50	3,216.30
Project Cost	3,742.90	15,320.80	38,302.21



Bus Inspection Center Site Location



Layout of Bus Inspection Center

15. Implementation Plan

Implementation Schedule

Implementation schedule of each project was principally decided by the following considerations;

- The progress of other related project such as the extension of Periferico
- Land availability
- Preferable order of construction
- Economic return of project
- Leveling annual investment amounts

The construction of FEGUA exclusive busway and Petapa road should be began at the earliest possible stage because of easy commencement of construction and the high rate of economic return. On the contrary the East-West Corridor and its exclusive busway should be delayed because of the difficulty of compensation in the built-up area and the huge investment cost.

Before the construction of the Urban Bus Center, the South and West Inter-regional Bus Terminals should be completed and the function of existing Zone 4 terminal should be transferred to these new terminals.

Considering the importance of traffic safety and environmental improvement, the Bus Inspection and Maintenance Center should be constructed and operated at an earliest stage.

Implementation Entity

In this Study, nine projects are recommended. Considering the existing poor financial situation, limit of staff, lack of management experience, etc., it is not appropriate for the Municipality to undertake the construction and management works of all these projects. Considering the unfavorable result of the financial analysis for the respective project, the following implementation entities are recommended on the basis of project function.

(1) Public Corporation

The Municipality establishes an independent organization with a self-supporting accounting system.

(2) Third Sector

The new organization is set up to implement the projects through financing the necessary equity and operating capital from the public sector and private sector.

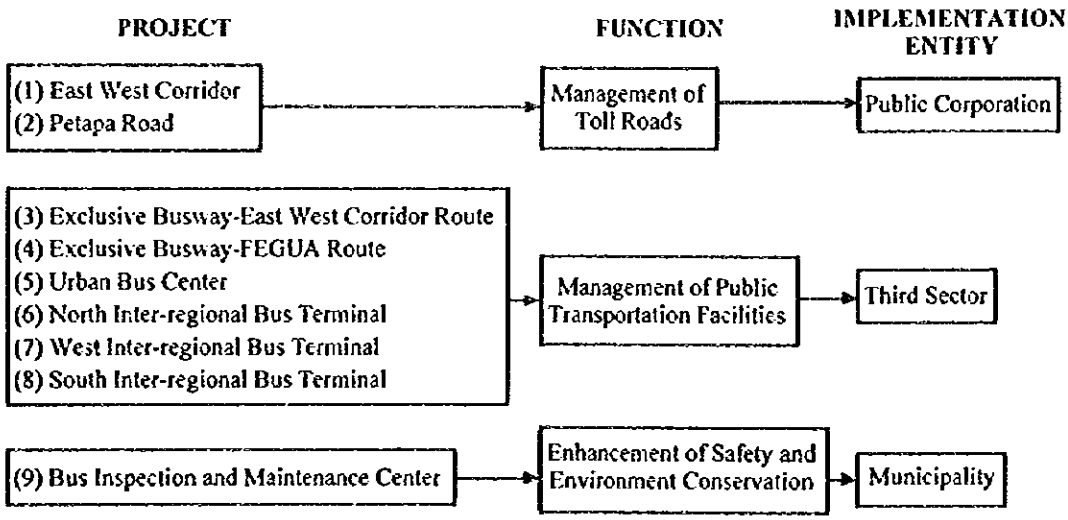
(3) Municipality

It is desirable for the Municipality to carry out the project if the sufficient revenue is not expected and the project is useful from the viewpoint of social welfare.

(Unit: Q 1,000)

CONSTRUCTION SCHEDULE	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
1. E-W CORRIDOR								35,414	45,210	107,271	107,271	107,271	
2. PETAPA ROAD			9,403	83,943	83,943								
3. EXCLUSIVE BUSWAY E-W CORRIDOR ROUTE								19,354	28,710	50,801	34,774	34,774	
4. EXCLUSIVE BUSWAY FEGUA ROUTE		2,568	49,795	47,226	47,226	34,447	58,530	27,863					
5. URBAN BUS CENTER						39,145	39,145	11,743					
6. NORTH INTERREGIONAL BUS TERMINAL		3,119	7,279										
7. WEST INTERREGIONAL BUS TERMINAL			15,000	13,535	20,753								
8. SOUTH INTERREGIONAL BUS TERMINAL			5,216	19,170									
9. BUS INSPECTION AND MAINTENANCE CENTER		11,491	26,812										
TOTAL	0	17,178	113,504	163,875	148,922	73,592	97,675	94,405	73,920	158,072	142,045	142,045	0

Construction Schedule



Development of Implementation Entity

16. Economic Evaluation

Evaluation Method

Economic evaluation of the Projects has been done through cost-benefit analysis of the differences between the case of "with Project" and the case of "without Project". Economic internal rate of return (EIRR), economic benefit-cost ratio (B/C) and economic net present value (NPV) are calculated as indicators of the economic evaluation.

Direct impacts of the Projects were considered and the followings were counted as benefits of the Projects:

(a) vehicle operating cost (VOC) saving

(b) travel time (TT) saving

(c) benefits from commercial activities

Economic Cost

Financial costs are converted into economic costs for the evaluation in viewpoint of the national economy, using following conversion factors:

- Deduction of transfer items such as duties and taxes
- Shadow wage of unskilled labor
- Actual land price

Economic Evaluation Result

The economic internal rate of return (EIRR) of whole project package indicates 29% and net present value (NPV) at discount rate of 12% will be Q. 770 million.

Compared with 17% of the EIRR of road projects, the EIRR of public transport facility project package shows 30%. Among the public transport facilities exclusive busway projects show a high return rate of 38% in EIRR. However, the construction of exclusive busway requires the existence of related road construction such as East-West Corridor and Petapa Road.

Because of close relationships with the exclusive busway projects, the economic evaluation of the Urban Bus Center alone is quite difficult. The EIRR shows a relatively low figure, however the result of economic evaluation including exclusive busway projects shows a enough high rate of return. The EIRR of the Urban Bus Center taking account of benefits from commercial activities will be 16%. There is fluctuation among EIRR of the three inter-regional bus projects, although integrated economic evaluation of three projects will be 26%, when commercial benefits are counted.

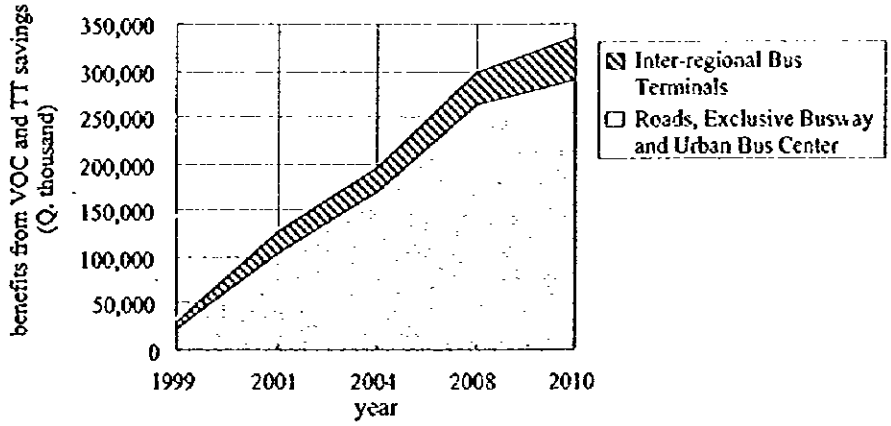
Although estimation of benefits of Bus Inspection and Maintenance Center in monetary term is quite difficult, the EIRR was calculated as 44%, considering reduction of traffic accidents, reduction of air pollution, increase in bus operation efficiency and improvement of fuel efficiency.

Sensitivity analyses were made for variation of demands and costs. Decrease in 10% of total trip production will result in decrease of 6% of the EIRR and Q. 269 million reduction of the NPV of the whole projects. Increase of 10% construction costs will cause 2.6% decrease in the EIRR of the whole projects. Sensitivity to the variation of operation costs or commercial benefits is rather low.

Estimated Benefits

(Q. thousand)

	VOC TT Savings, etc. (in 2010)	Commercial (in 2016)	Total
Whole	334,415	36,077	370,493
Roads	94,590	---	94,590
- East-West Corridor	41,609	---	41,609
- Petapa Road	37,544	---	37,544
Public Transport Facilities	239,949	36,077	276,026
Exclusive Busways	181,230	---	181,230
- East-West Route	23,722	---	23,722
- FEGUA Route	164,414	---	164,414
- Urban Bus Center	13,354	29,579	42,933
Inter-regional Bus Terminals	31,020	6,498	37,788
- North	6,592	1,164	7,756
- West	16,333	2,093	19,236
- South	7,258	2,431	9,689
Bus Inspect./Mainte. Center	14,414	---	14,414



Change in Benefits from VOC and TT Savings

Results of the Economic Evaluation

	EIRR (%)	NPV Q.million	B/C	EIRR (%)	NPV Q.million	B/C
	(with commercial benefits)			(without commercial benefits)		
Whole	28.5%	770	2.07	26.2%	644	1.89
Roads	16.5%	73	1.30	16.5%	73	1.30
- East-West Corridor	7.7%	-37	0.71	7.7%	-37	0.71
- Petapa Road	21.6%	79	1.69	21.6%	79	1.69
Public Transport Facilities	30.2%	647	2.37	27.3%	522	2.09
Exclusive Busways	37.8%	475	3.18	37.8%	475	3.18
- East-West Route	11.3%	-3	0.94	11.3%	-3	0.94
- FEGUA Route	49.0%	568	4.53	49.0%	568	4.53
- Urban Bus Center	15.6%	30	1.27	2.3%	-64	0.43
Inter-regional Bus Terminals	25.8%	101	2.11	21.4%	68	1.73
- North	91.8%	40	4.06	79.7%	33	3.51
- West	29.2%	59	2.59	26.0%	46	2.24
- South	17.2%	15	1.39	13.0%	3	1.07
Bus Inspect./Mainte. Center	44.1%	58	2.04	44.1%	58	2.04

17. Financial Evaluation

Necessary Cost

The total project cost is estimated at about Q.1,390 million, of which 41.7% is the foreign portion and the remaining 58.3% is the local portion. The local portion includes the land cost of Q.172 million. Since the land for Urban Bus Center, North Bus Terminal, South Bus Terminal, and Bus Inspection Center will be available for the Municipality, the Municipality does not need to pay for these cost, that is, about Q.58.7 million. Consequently, the necessary cost for realizing the whole projects amounts to Q.1,331 million.

Fund Source

In order to implement all projects the Municipality should prepare the above necessary fund, however, the Municipality is not in a good financial position to realize these projects. Therefore, the other financial sources should be sought. The following financial sources are recommended;

(a) Introduce the foreign loan from the foreign countries or international lending agencies

(b) Impose the surcharge tax upon the gasoline consumption allocated to the Municipality

(c) Collect the contribution for improvement of living environment and increment of property value along the project sites as a kind of capital gain

Financial Analysis

On the basis of the financial statements of Income Statement, Cash Flow Statement and Balance Sheet, the financial analysis was performed. According to the result of financial analysis for each project, only the Urban Bus Center Project showed the sufficient project viability (FIRR 8.94%). Other projects were not sufficiently viable under the reasonable tariff level. Therefore, according to the project characteristics, nine projects were categorized into the following three commissioning entities: (1) Toll road project (run by the public corporation), (2) Public transportation project (run by the third sector), and (3) Inspection project (run by the Municipality). The financial analysis was performed for these three implementation entities.

Financial Evaluation

From the viewpoint of the financial analysis, the three entities were judged to be viable under the conditions shown below.

(a) The toll road project by the public corporation is viable (FIRR is 8.37%).

(b) The public transportation project by the third sector is viable in case of introducing the contribution of 1,500 thousands Quetzales per year from the gasoline surcharge tax of 1%.

(c) The bus inspection center project is viable since the yearly deficit is within the limit of the Municipality compensation (about Q.500 thousands per year).

Necessary Project Cost

(Unit : Q1,000)

Name of Project	Foreign Portion	Local Portion	Acquisition of Land	Total
E-W Road	148,450	198,040	55,946	402,436
Petapa Road	69,751	92,136	9,403	171,290
Exclusive Busway-East West Corridor Route	63,758	80,997	23,689	168,444
Exclusive Busway-FEGUA Route	113,113	145,627	8,916	267,656
Urban Bus Center	117,434	78,289	26,400*	222,123
North Inter-regional Bus Terminal	6,239	4,159	1,900*	12,298
West Inter-regional Bus Terminal	20,753	13,835	15,000	49,588
South Inter-regional Bus Terminal	16,431	10,955	23,500*	50,886
Bus Inspection and Maintenance Center	22,981	15,321	6,800*	45,102
Total	578,910 (41.7%)	639,359 (46.0%)	171,635 (12.3%)	1,389,823 (100.0%)
Necessary Cost except Land Cost Owned by Government or Municipality	578,910 (43.5%)	639,359 (48.0%)	112,954 (8.5%)	1,331,223 (100.0%)

Note: The mark "*" is owned by the Municipality and the Central Government
(Total cost is 58,680 thousands Quetzales)

Revenue from Each Project

Project	Toll Rate	Tariff for Bus	Tenant	Parking	Advertise-ment	Inspection	Bus Repair
E-W Road	●						
Petapa Road	●						
Exclusive Busway-E-W Corr. Route		●					
Exclusive Busway-FEGUA Route		●					
Urban Bus Center		●	●	●	●		
North Inter-regional Bus Terminal		●	●	●	●		
South Inter-regional Bus Terminal		●	●	●	●		
West Inter-regional Bus Terminal		●	●	●	●		
Bus Inspect. and Mainte. Center						●	●

Summary of Financial Analysis

Project	Entity	Fund Source	Level of Charge	Compensation or Subsidy	Viability	Value of FIRR
Toll Road	Public Corporation	• Foreign loan • Contribution	Toll rate: Q.3	non	Viable	8.37 %
Public Transportation	Third Sector	• Foreign loan • Contribution • Private capital	Bus exclusive way: Q.5 Urban bus Center: Q.7.5 Inter-regional bus terminal: Q.10	non	Viable	6.44 %
Inspection	Municipality	• Prepared by the Municipality	Inspection: Q.250 Maintenance: Q.500	Compensation from 0.5% of gasoline tax increment	Deficit is within the coverage by the Municipality.	---

18. Environmental Evaluation

There are no procedural technical guidelines provided for environmental assessment in Guatemala, although implementation of an EIA is an obligation under the law. The study provides forecasts of environmental impact for each project, its evaluation, and procedures for counter measures based on results obtained by screening and scoring.

Surveys were conducted to assess existing environmental conditions of Guatemala Metropolitan Area. Urbanization has removed most species of wildlife and valuable plants. Endemic species which still grow in Barnacle are considered valuable, and required to be left as urban green.

Resettlement is one of the most critical impacts on social environment caused by the project implementation. Currently, many squatters occupy some parts of proposed site for Exclusive Busway - FEGRA Route. The FEGUA, Municipality and VIVIENDA have been conduction resettlement programs for the squatters, accordingly it is necessary to provide adequate dwelling conditions for them.

The pollution are in a critical condition brought about by transport pollution (air, noise) due to concentration of the population in the city and rapid motorization.

Air Pollution

One of the worst forms of pollution in Guatemala is air pollution, especially SPM (suspended particulate material). The measured result of SPM is shown in the Figure below. Compared with the US Environmental Standards, environmental conditions except CENMA Project site and a part of Classed Roosevelt (Zone 7) exceed the criteria. The reasons are considered to be dust from the unpaved roads and the exhaust gas from vehicles especially diesel vehicles, also from factories and garbage burning. Compared with the US Environmental Standards, the pollution by SPM is the severe condition.

Noise

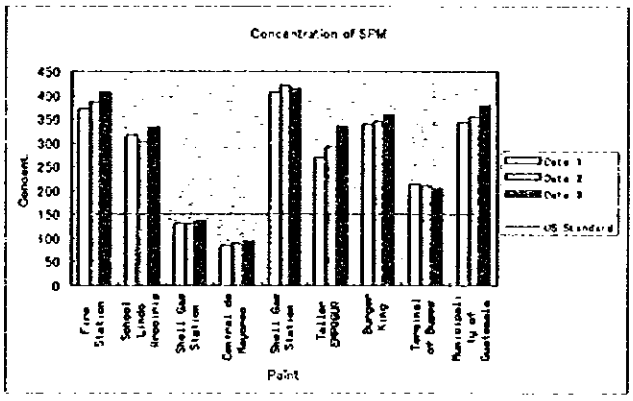
According to the measured result of noise level of existing cars in Guatemala City, the power level (PWL) exhausted by individual vehicles is higher by about 5 dB (A) than that of Japanese average small type and more than 10 dB (A) higher than that of a large type vehicle.

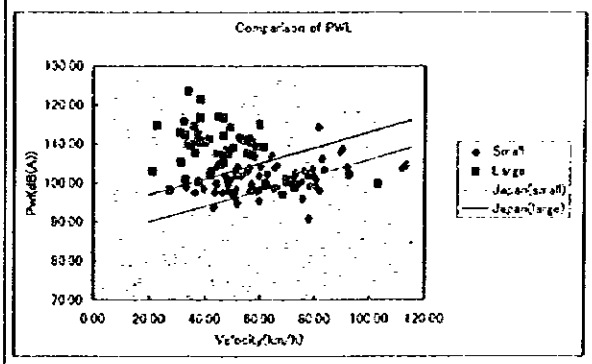
Then, if newly regulated vehicles are introduced and adequately maintained, car is introduced, the noise level from traffic will be reduced to 5 to 10 dB (A) in case of the same traffic volume.

Evaluation

Comparing to the "without project" case, total vehicle operating distance and total vehicle operating hours will be reduced in the "with project" case. This means the reduction of vehicle originated pollution such as air pollution and noise. Furthermore, after the commencement of operation of Bus Inspection and Maintenance Center, total exhaust materials will be reduced as a result of unit quantity reduction of exhaust gas and noise, and finally the total environment will be improved
Concerning the predicted negative impacts during construction and operation of the projects, appropriate countermeasures are recommended.

Air Pollution caused by Exhaust Gas of Buses





Summary of Environmental Impact and Countermeasures

Project	Impact	Countermeasures
E-W corridor (including Busway) Bus exclusive way on FEGUA	Resettlement	To plan lands for resettlement and adjust the social conditions, such as employment opportunities, commuting distance, and access to water, electricity, education and so on.
	Ruins and Cultural Heritage	A cultural property survey is required, particularly in areas with known previous human occupation like La Democracia Park.
	Soil and Erosion	• Reducing the area of ground clearance • Prompt replanting by endemic species and plant maintenance • Avoiding sensitive alignment • Controlling the speed and volume of water
	Landscape	Alignment characteristics should be selected to best fit the route with the landscape or into the landscape.
Improvement of Avenida Petapa	Air Pollution Noise	Motor vehicle noise and exhaust gas can be reduced at source (e.g., through assembling vehicle, selection of exhaust system, and vehicle maintenance) To introduce new regulations for cars.
Urban Bus Center Interregional Bus Terminal	Traffic and Public Facilities	Adequate parking areas and access line should be considered at the stage of detailed design.
Bus Inspection Center	Water Pollution	Adequate water treatment facilities are necessary to prevent pollution.

19. Conclusions and Recommendations

(1) Necessity of Improvement of Public Transport System

Considering the present tendency where vehicle traffic volume is increasing day by day, if a policy for improvement of the public transport system in Guatemala Metropolitan Area is not introduced immediately, a serious situation will occur in the near future. Therefore the subject projects of the Study were examined and recommended.

(2) Economic Evaluation of the Whole Project Package

Since the functions of the Projects are deeply related to each other, the examination of the whole project package should be considered first. The entire investment cost will be Q.1,331 million and the foreign currency portion will be 44% of the total amount. The economic internal rate of return (EIRR) of the whole project package shows a high return of 29%, and its net present value at a discount rate of 12% will be Q.770 million.

(3) Economic Evaluation by Project Category

Using the economic rate of return as the economic evaluation indicator by categorized project package, 30% of the EIRR of public transport projects will be better than the 17% of road projects. The exclusive busway projects show a high return of 38%.

(4) Implementation Schedule of the Projects

The order of the construction of the Projects was mainly decided by considering the relationship between the Projects. Also the result of economic evaluation of each project was considered in deciding the construction order. The construction of FEGUA Exclusive Busway and Avenida Petapa with high EIRR has priority. The construction of the Interregional Bus Terminals should the logically be completed before the construction of the Urban Bus Center. Considering the importance and the urgency for improving traffic safety and environment, the Bus Inspection and Maintenance Center should be constructed at an early stage.

(5) Financial Resources of the Projects

The principles to identify financial resources are public transport priority policy and beneficiaries pay policy. Therefore the introduction of a toll road system is recommended for the operation of newly constructed roads. Also some toll systems are recommended for the operation of the public transport facilities.

It is necessary to obtain foreign loans with favorable conditions for the foreign currency portion of the construction cost.

(6) Financial Evaluation of the Project Package

The financial internal rate of return (FIRR) for East-West Corridor and Petapa Road is 8.4% using a toll rate of Q.3. The FIRR for Public Transport Facility projects is 6.4% in the case of Q.5 of bus transit tariff of the Exclusive Busway, Q.7.5 of use fee of the Urban Bus Center and Q.10 of use fee of the Inter-Regional Bus Terminals. Concerning the Bus Inspection and Maintenance Center, even if a tariff system is adopted, it is very difficult to recover the investment cost. Therefore, it is expected to raise a special fund or donation from foreign governments or non government organizations for the construction cost and a subsidy from the surcharge of the gasoline tax for the operation.

(7) Organization of Project Implementation

The creation of a public corporation under the Municipality for the construction, operation and maintenance of the new roads is recommended.

For the Exclusive Busway, the Urban Bus Center and the Interregional Bus Terminal projects, the establishment of a mixed capital entity (third sector) is recommended.

The bus inspection and maintenance center shall be administered and operated directly by the municipality.

(8) Institutional Development

The reform and development of laws and regulations are essential for the creation of new organizations, support of operation and obtaining of fund resources.

(9) Consideration for Environmental Betterment

Comparing to the "without project" case, total vehicle operating distance and total vehicle operating hours will be reduced in the "with project" case. This means the reduction of vehicle generated pollution such as air pollution and noise.

Further more, after the commencement of operations of Bus Inspection and Maintenance Center, total exhaust materials shall be reduced as a result of reduction in unit volume of pollution, therefore overall environment shall be improved finally.

(10) Further Study

Further studies related to the Study are recommended as follows;

- Detailed design for the projects whose implementation is recommended in the early stages.
- Urban development study in the area where the development axis is the FEGUA exclusive busway.
- Urban environmental control study as the basis for a more integrated and developed center for the inspection of all types of vehicles.
- Studies related to the Master Plan such as traffic management plan, feasibility study on the middle and outer ring road, and urban planning study in northern and eastern part of the Metropolitan Area.

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