2) Evaluation of Alternatives

(1) Introduction of regulation of vehicle inflow into the central area of Tegucigalpa

Alternative 1 and Alternative 2 regulate the car inflow into the central area of Tegucigalpa. This regulation causes various problems as explained below.

- It will be very difficult to obtain mutual agreement on this regulation from the established citizens.
- It will be very difficult to obtain sufficient parking space outside the central area within such a short time.
- A changeover from the private car use to public transport use by the high income class is not easy due to problems of personnel security.

From the above-mentioned reasons, the introduction of the vehicle inflow regulation (Alternative 1 and Alternative 2) was concluded not to be recommended for the time being. However, if safe and easy access to the central area of Tegucigalpa can be secured and sufficient parking lots are constructed near the central area, the introduction of this measure should be reexamined.

(2) Evaluation of Alternative 3 and Alternative 4

Alternative 3 and Alternative 4 were compared from various aspects. From the transportation aspect, the congestion of Alternative 4 decreases much more than Alternative 3. Alternative 3 retains the some congested sections in the road network such as Calle 12 in the central area of Comayagüela, Boulevard Comunidad Europea, and Boulevard Fuerzas Armadas. In Alternative 4 the congested road section of more than 1.0 point will completely disappear.

The economic evaluation also indicated the high internal rate of return (IRR) of 25.5% , which is highly feasible. On the other hand, the IRR of Alternative 3 is not feasible, because IRR is 0.

From the results of the above evaluation, the introduction of the construction of a toll road was determined not to be recommended. As a result, alternative 4 was adopted as the most desirable master plan projects. Fig. 10.3 shows the recommended projects in alternative 4.

10.5 Master Plan Projects by Term

The projects listed for the Master Plan were categorized into three groups below, considering their urgency, construction cost, ease of fund procurement, benefit, etc. The criteria for categorizing projects is explained in the following;

Short Term	: Project packages to strengthen the north-south transportation axis and the east-west transportation axis
Mid Term	: Project packages which introduce bus lanes, bus ways and road-improvement projects to accommodate the vehicle overflow resulting from the introduction of bus lanes and bus ways
Long Term	: Projects to strengthen the radial roads connecting Anillo Periférico

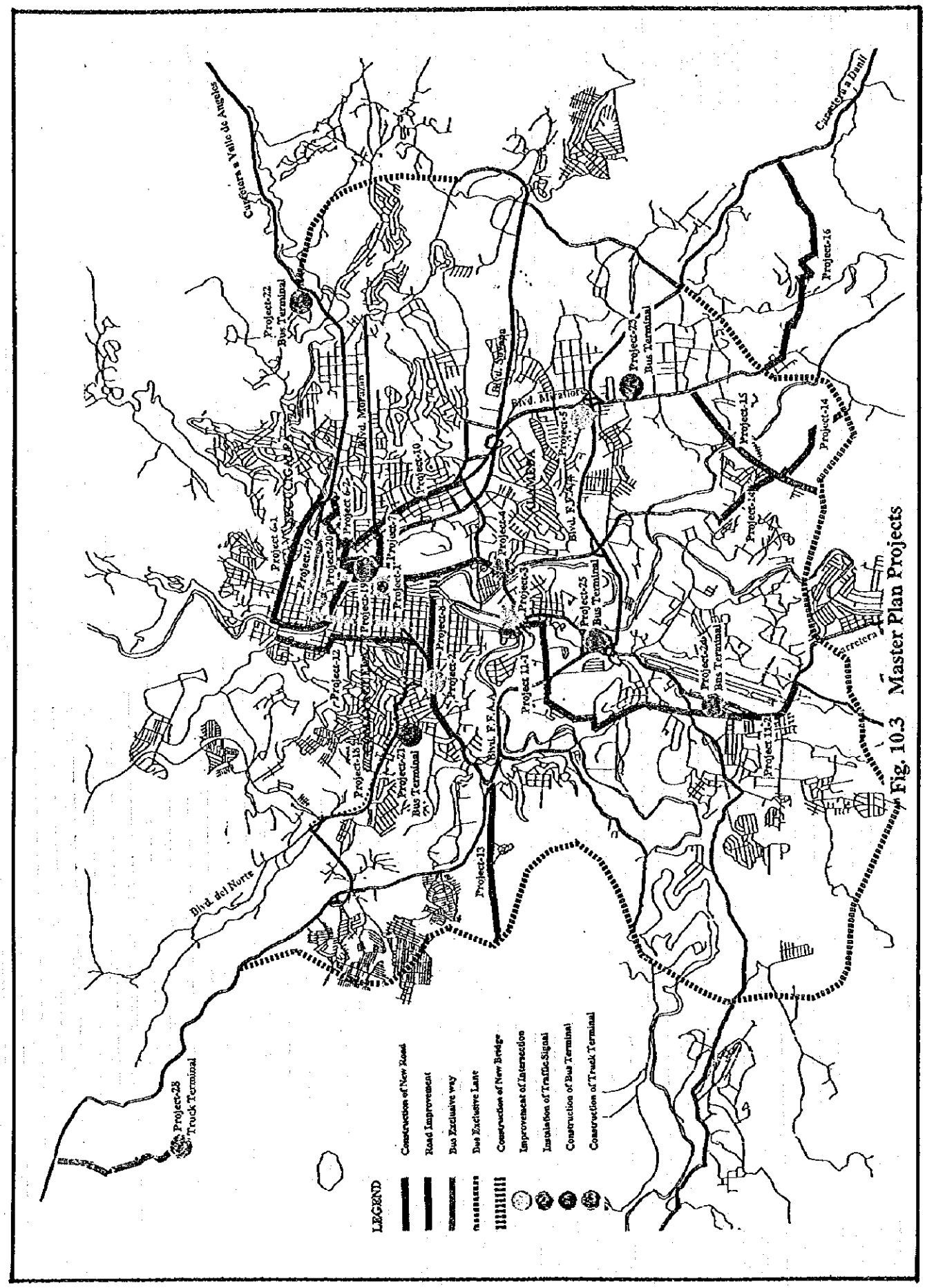

Fig. 10.3 Master Plan Projects

Table 10.2 shows the comparison of "Short Term", "Middle Term" and "Long Term". The internal rate of return (IRR) shows that the project package planned in each term is sufficiently feasible. Especially, the value of IRR of the short term indicates the highest value of 25.2 %.

Table 10.3 lists projects categorized by term. The location of projects is shown in Fig. 10.4(1) for the short term, in Fig. 10.4(2) for the middle term and in Fig. 10.4(3) for the long term, respectively.

Table 10.2 Comparison of Master Plan Projects by Term

Project Term	Short Term	Medium Term	Long Term
Construction Cost (US$1,000)	13,141	21,698	39,639
Saving of Total Vehicle Travel Time (vehicles·hour/day)	10,539	7,595	11,291
Saving of Total Vehicle Travel Distance (vehicles·km/day)	69,541	14,384	70,523
Average Trip Length (km/trip)	7.38	7.44	7.55
Average Congestion Rate (volume/capacity)	0.8	0.85	0.82
Average Travel Speed (km/h)	32.7	31.8	33.0
Internal Rate of Return (%)	25.19	14.97	13.18
Environmental Considerations	Negative Impact is small.	Negative Impact is small.	Negative impact is small.

Table 10.3 Master Plan Projects

Term	Category	Prjt. No.	Project Description	Project Length(m)	Total Cost (US$1,000)
Urgent	Improvement of Intersection	1	Configuration Improvement andTraffic Signal Installation at Intersection of Subida al Estadio National and the Circular Road of the National Stadium	-	28
		2	Configuration Improvement at Intersection of Av. Cabanas and Blvd. Santa Fe	-	10
		3	Configuration Improvement at Intersection in Front of Institute Hondureno de Seguridad Social on Blvd. Comunidad Europea	-	318
		4	Traffic Signal Installation at Intersection of Blvs. Jose Cecilio del Valle and Calle Golan	-	44
		5	Approach Road Construction at Grade Separation of Blvd. Miraflores and Blvd. Fuerza Armadaz	-	165
Short-term	Improvement & Construction of Roads	7	Road Improvement of Estadio Nacional - Blvd Morazan up to the Intersection of Juan Manuel Galves	600	2,662
		8	Road Improvement of Calle Nickson - Calle 12 of the Central Area of Comayaguela - a new Bridge in the South of Puente de Juan Ramon Malino up to Blvd. Jose Cecilio de Valle.	2,520	3,248
		9	Road Improvement of Calle Isla - Jose Cecilio del Valle	2,100	3,500
	Bridge Const.	(8)	Bridge to calle 12	-	incl. 8
		11-1	Bridge to Av. 6	1,000	3,731
Mid term	Improvement of Roads	6-2	Inner Ring Road Construction Surrounding the Central Area of Tegucigalpa (South Section)	1,390	9,520
		11-2	Road Improvement of the Southern Section of Av. 6 - New Bridge - San Jose - Lomas de Toncontin	4,740	5,346
		12	Road Improvement of Av. 8 in the Center ofComayaguela	1,860	4,245
	Construction of Bus Terminals	21	Santa Fe	-	198
		22	21 de Octubre	-	198
		23	Miraflores	-	198
		24	Aeropuerto	-	198
		25	Las Brisas	-	436
		26	Estadio	-	1,220
	Bus Trans-portation	18	Introduction of Bus Exclusive Lanes	-	-
		19	Introduction of Bus Exclusive Ways	-	-
	Community Road	20	Introduction of Transit Mall	530	139
Long-term	Improvement & Construction of Roads	6-1	Inner Ring Road (North Section)	2,230	4,226
		10	Road Improvement of Blvd. Juan Manuel Galves	1,790	8,146
		13	Road Improvement of Anillo Periferico - Colonia La Fuente - Blvd. Fuerza Armadas	1,860	2,669
		14	Road Construction and Improvement of Colonia San Jose de la Vega - La Canada - Anillo Periferico	2,380	3,150
		15	Road Construction of Colonia Kennedy - Residential Plaza - Anillo Periferico	2,300	7,635
		16	Improvement of AnilloPeriferico - Colonia Loma de Jaleapa - Carretera a Oriente	3,115	5,243
	Parking Bldg.	27	Construction of Parking Building outside the CBD Area near Puente la Hoya		790
	Truck Termina	28	Construction of Truck Terminal in Laguna el Pedregal		7,780

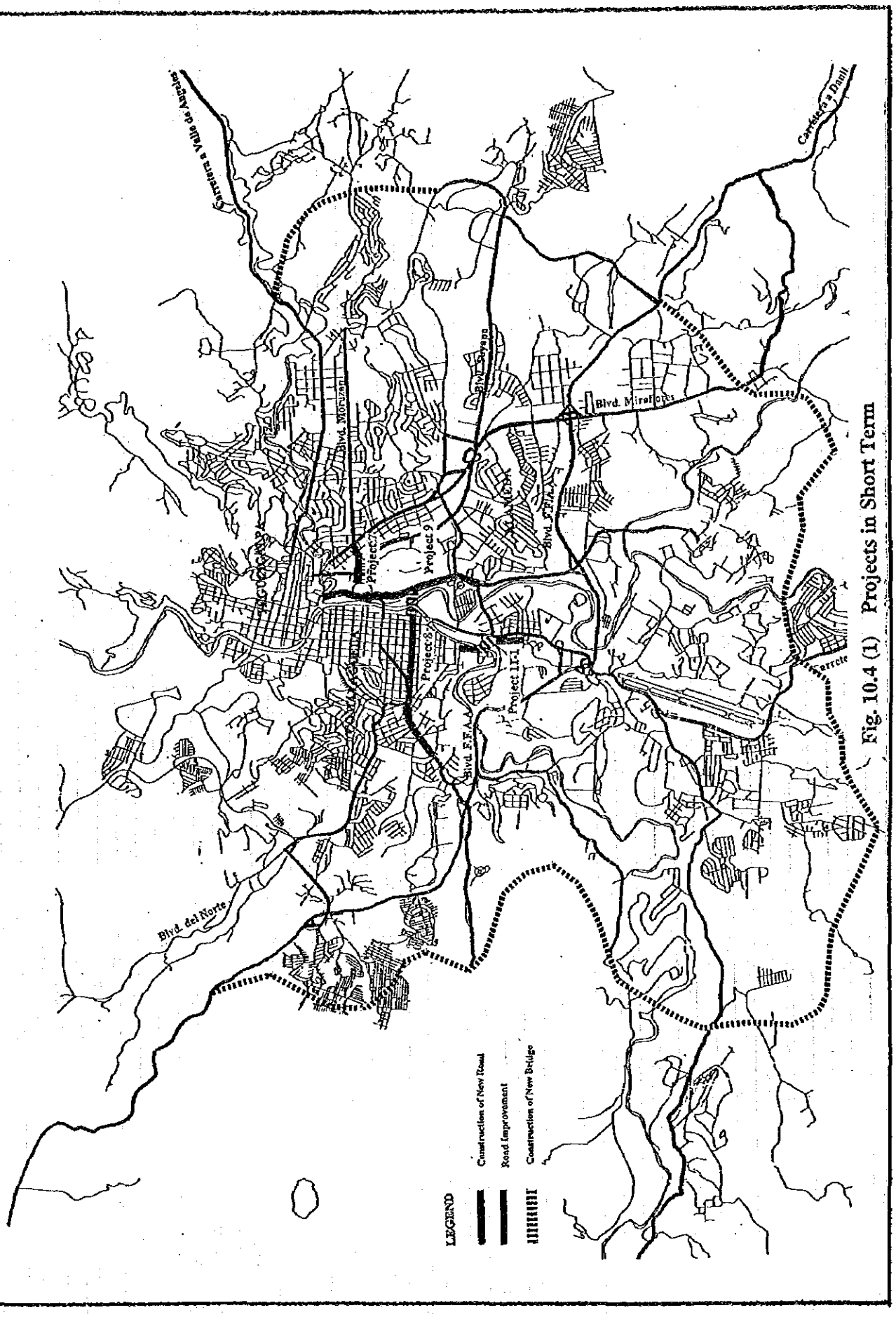

Fig. 10.4 (1) Projects in Short Term

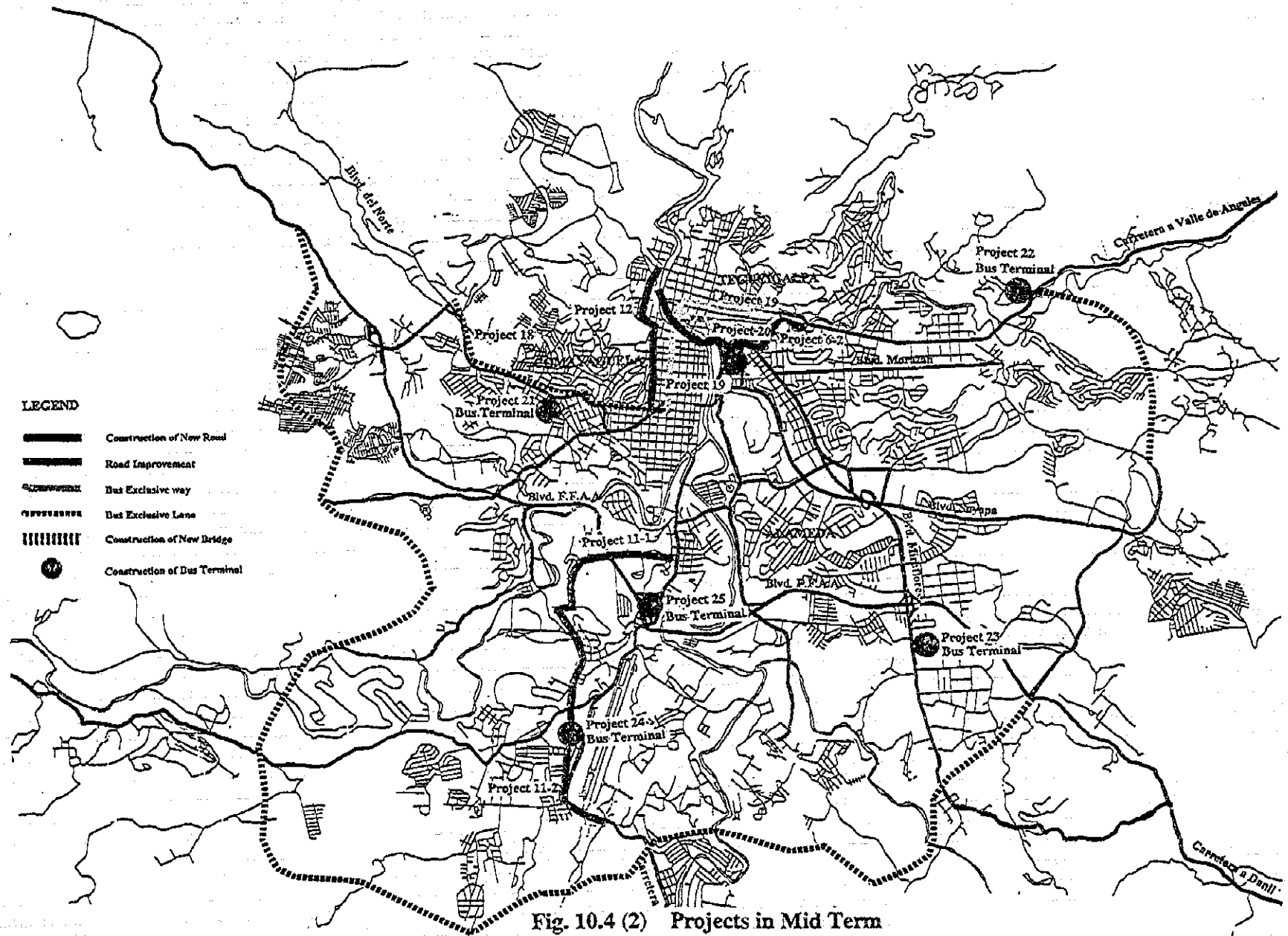

Fig. 10.4 (2) Projects in Mid Term

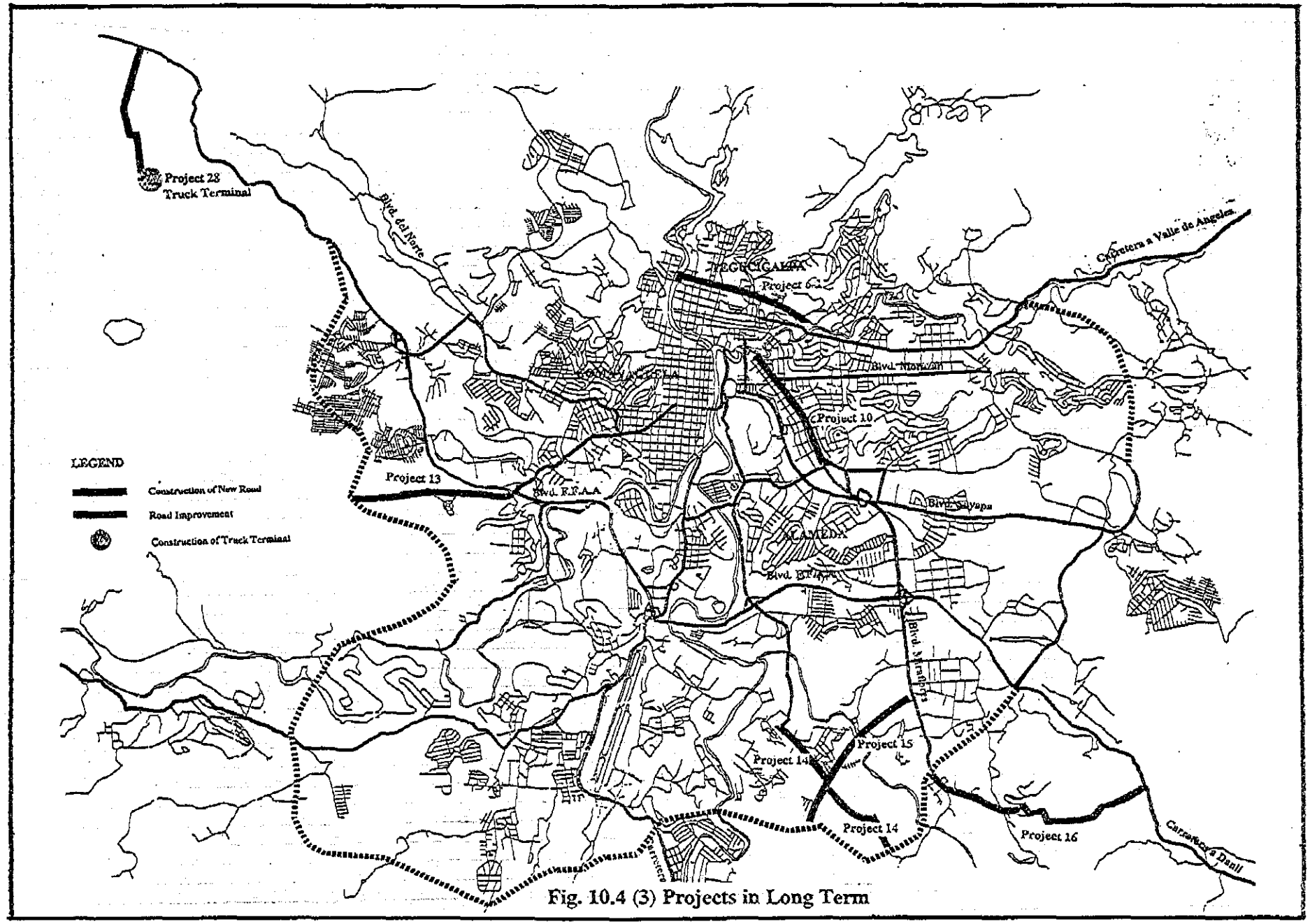

Fig. 10.4 (3) Projects in Long Term

10.6 Public Transportation Plan

1) Basic Issues of Planning

(1) Public Transport Dominance

The majority of the citizens using public transport rather than private transport is favorable from an urban and regional development point of view. Therefore, priority should be placed on public transport development to maintain good service and attract passengers.

(2) Public Transport Network Structure

For improvement without causing traffic congestion, a hierarchical structure should be introduced. This consists of a high capacity system along major routes and feeder services along branch routes

(3) Priority Measures for Pubic Transport

To support and promote efforts for service improvement by the bus operators, the government should give priority to the public transport by means of bus exclusive ways, bus exclusive lanes, bus terminals, bus stops and other non-physical measures.

2) Expansion of Fleet

Based on the results of traffic assignments, bus passenger demand and taxi demand is estimated, as shown in Table 10.4. On a basis of the present operational performance, it is estimated that the required number of bus units for 2010 will be about 2,000 units. The operational performance of taxis remains at the current level; it is estimated that the number of taxis required in 2010 will be about 2,200 units.

Table 10.4 Bus and Taxi Passenger Demand in 1995 and 2010

Year	Item	Bus Demand	Taxi Demand
1995	Vehicle- km (x 1000)	105.2	171.7
	Passenger-km (x1000)	4,569.8	435.6
2010	Vehicle-km (x 1000)	256.7	267.5
	Passenger-km (x1000)	9,168.6	680.7
2010/1995	Growth Rate in Vehicle-km	2.44	1.56
2010/1995	Growth Rate in Passenger-km	2.01	1.56

3) Future Public Transport System

In order to form the hierarchic structure of public transport, (1) interurban bus, (2) key route urban bus, (3) ordinary urban bus, (4) feeder urban bus are proposed as new categories of buses.

(1) Interurban Bus

The present interurban bus has directly entered the terminal which is scattered within CBD

and has caused problems, such as traffic congestion and lack of integration of interurban buses and urban buses, one of the system patterns shown in Fig. 10.5. The Decentralized Pattern is recommended in terms of passengers' convenience, alleviation of traffic congestion, and oversaturation in CBD.

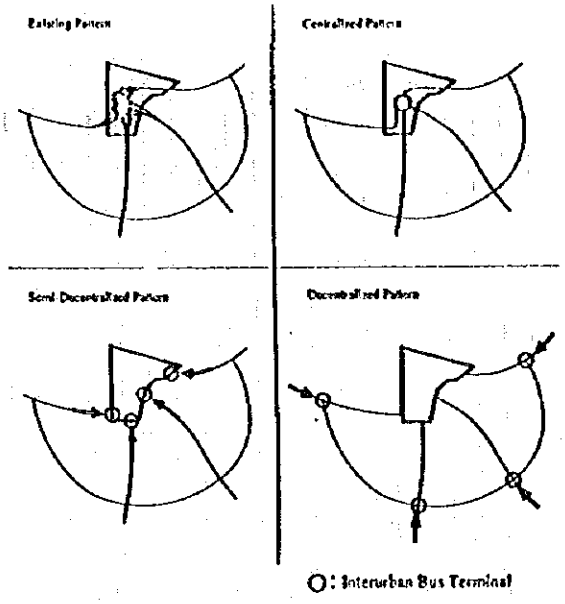

Fig. 10.5 Alternative Location Patterns of Interurban Bus Terminals

(2) Key route urban bus

Key route urban buses are operated on trunk roads connecting major OD pairs. The basic point of the key route bus is to increase capacity and to raise the service level while maintaining efficiency and alleviating traffic congestion along major routes. A system pattern is shown in Fig. 10.6, as an alternative to penetration of key route buses into CBD. Location of transfer functions are shown also. The Penetration Pattern is recommended both for passengers' convenience and for traffic reasons.

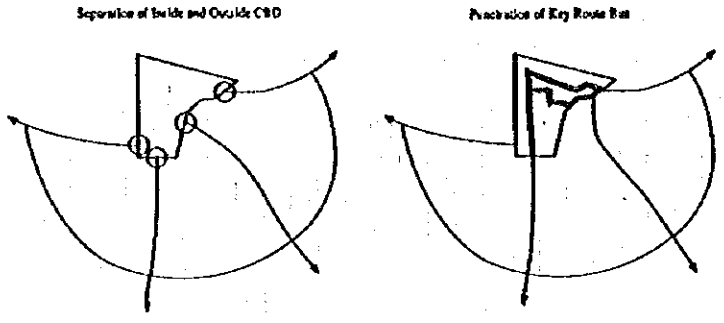

Fig.10.6 Alternative Patterns of Key Route Urban Bus Network

(3) Ordinary Urban Bus

Routes which do not become key bus routes are served by secondary urban buses.

Secondary urban buses serve to connect minor OD pairs and to feed passengers to key bus routes. Most secondary buses should have capacity equal to or less than that of key route urban bus. They can share bus priority measures with key route urban buses along their routes.

(4) Feeder Urban Bus

The feeder service is a frequent service by microbuses and taxis(fixed route) to feed passengers to key route urban buses and secondary urban buses. Their service can be more flexible than higher category buses. For example, their stops can have flexibility such as Zone Bus system or Route Deviation System.

Concerning the fare system, the fare of feeder urban buses should be low. If passengers want to ride key route urban buses connected with the feeder urban buses, there is no need to pay for the feeder urban buses. They can share priority measures with connected key route urban buses.

4) Restructure of Bus Route System

Fig.10.7 shows the restructure plan of bus routes system which is proposed following the issue of hierarchic structure of bus system. This plan is proposed to cope with the increasing future demand ,taking into account the following;

- Efficient bus operation ,such as operating frequency and route length
- Maximum use of the proposed exclusive bus road
- Assurance of services in areas where public transportation is poor, such as the rapidly developing suburban areas.

In the bus route network planning, allocation of routes, operating frequency, allocation of units etc., are studied. Since these study items are mutually related and a decision in each step has a wide range of a freedom, these require detailed source material such as a rate system, financial status of operators, opinion of users; in order to propose an optimum system as a whole. In fact, the bus route network planning is frequently examined from experience from the point of view of financial status of operators. For this reason, the detailed bus route network plan should be examined by related organizations on the basis of bus future demand , considering the following matters:

- Match on demand characteristics of each zone.
- Sufficient consideration of opinions of regional residents, and the route convenient for inhabitants. That is, high operating frequency, few transfers and brief travel time to destination.
- For operators, the operating efficiency of bus should be high. That is, shortest possible total traveling distance small number of bus units on each route.
- It should be possible to modify a route flexibly when the future OD demand changes.

In addition, concerning taxi service, in the event that bus service improves, fixed-route taxis should not be needed, and therefore convert to standard taxis.

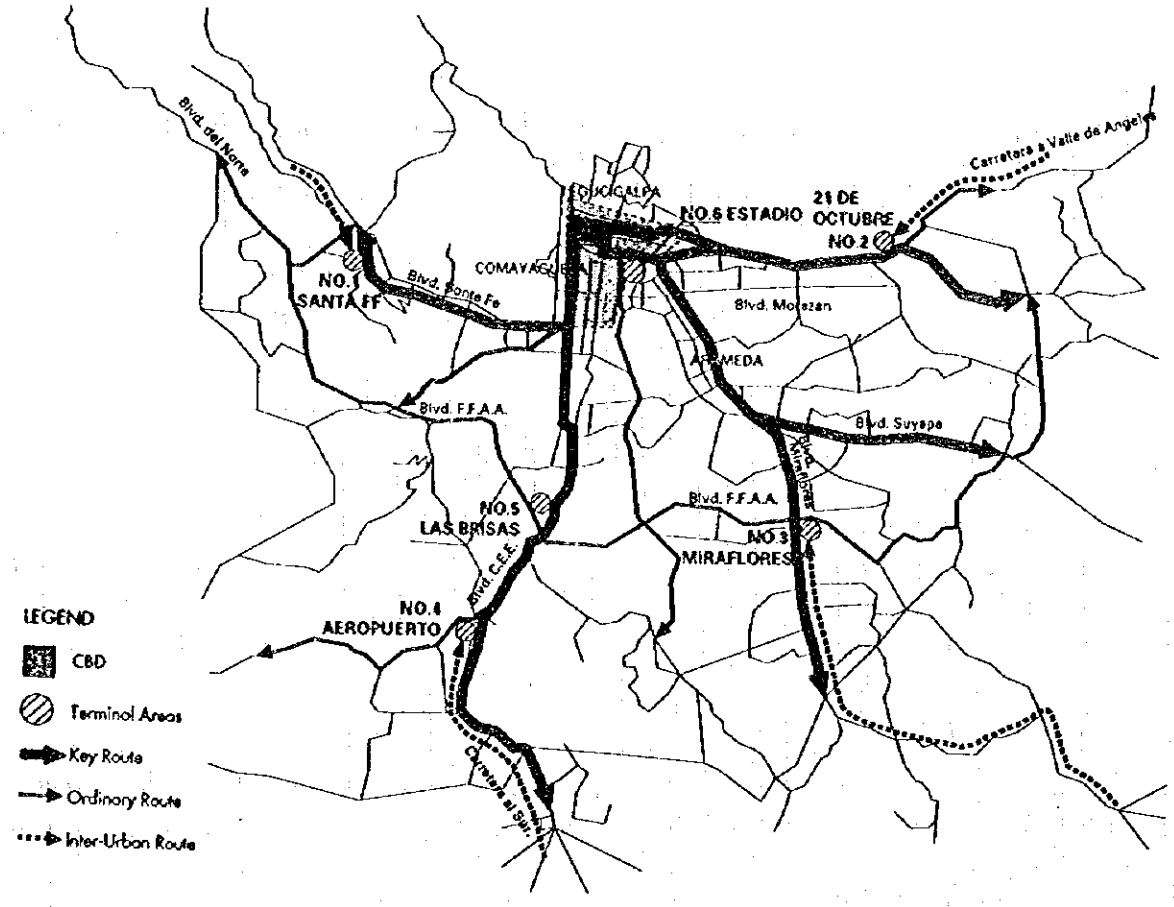

Fig. 10.7 The Proposed Bus Route Network in The Future

5) Development of Bus Terminals

With increased public transportation demand in the future, it is important to develop adequate facilities at the major terminals and transfer points. Based on the bus network, as well as the traffic flow and volume of bus passengers, the selected transportation terminal areas where the interchange function has been targeted for strengthening are shown in Fig.10.5. The characteristics and facility requirements of each area are summarized in Table 10.5.

Table 10.5 Characteristics and Estimated Facility Requirement

No.	Name of Terminal	Interchange Pattern	D/A Passengers Demand	Facility Requirements(m^2)
1	Santa Fe	Interurban⇔Urban	6,900	4,020
2	21 De Octubre	Interurban⇔Urban	2,500	4,020
3	Miraflores	Interurban⇔Urban	2,200	4,020
4	Aeropuerto	Interurban⇔Urban	10,100	4,020
5	Las Brisas	Key Route⇔Ordinary	28,000	6,240
6	Estadio	Terminal Bus Center	74,900	12,030

10.7 Traffic Management Plan

1) Traffic Signal

① The traffic signals installed in the study area seem to be somewhat old, therefore, at

some intersections the traffic signals do not function well. The periodical inspection and maintenance of traffic signals is required.

② There are some unsignalized intersections with rather heavy traffic volume. At some intersections it is recommended that traffic signals be installed (as "urgent projects"). At the following intersections the traffic signals should be required in the near future (excluding the intersections to be installed for the urgent project);

- Intersection of Boulevard Santa Fé and Carretera a Olancho
- Intersection of Boulevard Santa Fé and Carretera del Norte
- Intersection of Calle 9 crossing Avenidas in the central area of Comayagüela

③ Currently, on Calle 9 in the center of Comayagüela there are nine intersections. More than 50 % of vehicles passing on Calle 9 are going straight. Therefore, the introduction of a coordinated signal system is recommended at these intersections.

2) Traffic Signs

①While general information signs are not lacking, many more regulatory and directional signs are recommended to be installed as soon as possible not only on major roads but also smaller roads with high traffic volume.

② Since road markings are made by ordinary paint, it is recommended if possible, that they be drawn by hot paint so as not to be worn out so soon. If this is not possible, it is necessary to continue maintenance work.

3) Parking in the Central Area of Tegucigalpa

In the central area of Tegucigalpa about 2,000 vehicles per day are estimated to park on roads illegally. To eliminate these illegal parked vehicles, it is necessary not only to strengthen regulations against illegal parking but also to provide public parking lots with sufficient capacity. It is recommended that the parking lots be constructed not within the central area, but near the perifery area of the central area.

4) One-Way System in the Central Area of Tegucigalpa

In the central area of Tegucigalpa it is necessary to review the one-way system, because the recommended running direction for the exclusive bus way is opposite to the existing direction..

CHAPTER 11 PRELIMINARY DESIGN AND COST ESTIMATION

11.1 Road Design

Basic road design policies are as follows:

- In improvement sections of existing road, proposed vertical and horizontal alignment are planned based on the height of existing road surface and alignment of existing road to lessen construction cost and to mitigate adverse environmental impact such as resettlement destruction of cultural facilities and natural conditions.
- In new road sections, the horizontal alignment is conducted to avoid residences as much as possible in order to mitigate adverse environmental impact.

Applied geometric design standard for road design is the Central American Standard. Where lacking, AASHTO design standards are referred to.

Road class in the study area is secondary class.Proposed roads are for be located in mountainous area; applied design criteria is shown in Table 11.1.

Table 11.1 Summary of Design Criteria

Item	Unit	Design
Design Speed	kph	40
Minimum Vertical Curve Length	%	8 (9)
Minimum Vertical Curve Radii	m	50
Minimum Horizontal Alignment	m	450
Width of Carriageway	m	3.25
Width of Shoulder	m	1.75

Typical cross sections of two lane and four lane roads are shown in Fig. 11.1. Their typical cross sections are applied for roads and bridges.

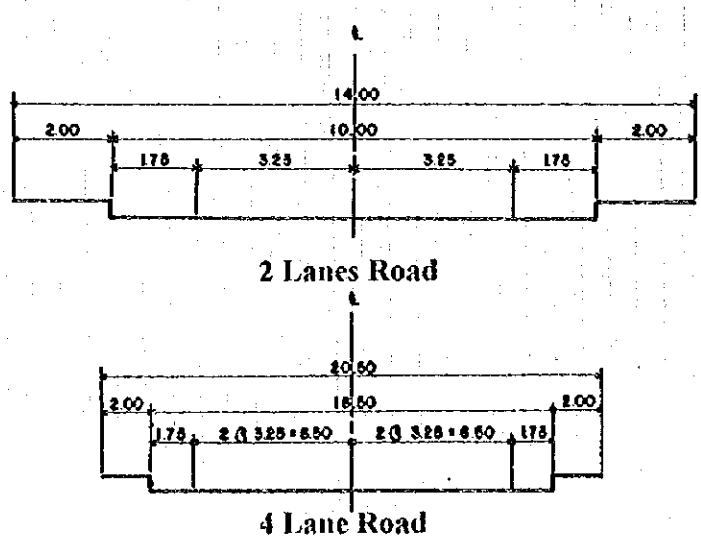

Fig. 11.1 Typical Cross Section

11.2 Structure Design

1) Basic Policies of Structural Design

In the Study, the structure design standard in Honduras follows AASHTO specifications. Design load to be applied is HS20-44.
Concrete bridges will be adopted for the Project for the following reasons:

- Standard bridge type in Honduras
- Durability of concrete structure
- Lower initial and maintenance costs
  (Steel girder is imported material and expensive in Honduras)
- Utilization of local labors and materials such as cement, reinforcing steel and aggregates
- Bridge aesthetics; and
-Underpass(Box-Culvert) entails high initial and maintenance costs

As a result of overview of structure planning in the previous subsection, it was found that a total of 10 bridges are to be involved in the new construction.

2) Structure Design

10 bridges were considered in structure design as follows;

(1) Superstructure Design

Superstructure type is applied from Honduran standard. The relationship between span length and standard type of bridge are shown in Table 11.2.

Table 11.2 Superstructure Types by Span Length

Span Length(m)	Superstructure Type	Remarks
L<25	RC I-Girder	
25≦L≦30	PC I-Girder	Post tension system

(2) Abutments

Abutment type is designed based on Honduran standard. Table 11.3 shows abutment height and type.

Table 11.3 Abutment Type by Its Height

Abutment Height(m)	Abutment type
H≦6	Concrete Gravity Type
6<H≦12	RC Reversed T Type

3) Foundation Design

According to the results of soil investigation carried out by SECOPT's Feasibility Study and the

information of the Soil Department in SECOPT, spread foundations are required.

4) Overpass and Underpass

Since proposed road of Project-6-2 is located along a river, overpass plans and underpass plans are considered. As a result of consideration, overpass plan is adopted in regards to construction method, cost, etc.

(3) Summary of Major Bridges

Design features of major bridges are summarized in Table 11.4.

Table 11.4 Design Features of Major Bridges

	No1	No2	No3	No4	No5	No6
	Project 6-2 Mid Term	Project 6-1 Long Term	Project 8 Short Term	Project 11-1 Short Term	Project 11-2 Mid Term	Project 15 Long Term
Bridge Length	410m	100m	125m	120m	60m	100m
Span Length	5*25+30+7*25+30+2*25	4*25	5*25	4*30	2*30	4*25
Superstructure Type	PC I-Girder Post-tension System	PC I-Girder Post-tension System	PC I-Girder Post-tension System	PC I-Girder Post-tension System	PC I-Girder Post-tension System	PC I-Girder Post-tension System
Pier Type	T Type	Rigid Frame Type	Wall Type	Wall Type	Wall Type	Rigid Frame Type
Pier Height	7.0-11.5m	8.5-12.0m	9.0-13.5m	8.5-10.5m	10.5m	13.0-14.0m
Abutment Type	RC Reversed T Type	RC Reversed T Type	RC Reversed T Type	RC Reversed T Type	RC Reversed T Type	RC Reversed T Type
Abutment Height	9.0m	7.5,8.0m	8.0,9.0m	7.0m	12m	12m
Crossing Over Facilities	5a Ave. Ave. Juan Roman Molina	small canal	Rio Grande o Choluteca	Rio Guacerique	Boulevard Fuerzas Armadas Road	
Remarks	*along the right bank of the Rio Grande o Choluteca *to be constructed along riverbank protective wall *reconstruction of river protection	* near houses *inclined ground	*minimal thickness of slab concrete depending on vertical curve *piers arranged to avoid center of flow	*near curve of river *cross obliquely over the river	*guarding sight distance *pier located at middle of median	*inclined ground

11.3 Urban Facilities Design

1) Bus Terminal

The results of preliminary design, six proposed bus terminals are summarized in Table 11.5.

Table 11.5 Design Features of Bus Terminals

No.	Name of Terminal	D/A Passengers (persons/day)	Necessary Number of Berths	Layout Type	Facility Requirements (m^2)
1	Santa Fe	6,900	3	S	4,020
2	21 De Octubre	2,500	2	S	4,020
3	Miraflores	2,200	2	S	4,020
4	Aeropuerto	10,100	4	S	4,020
5	Las Brisas	28,000	6	P	6,240
6	Estadio	74,900	20	P	12,030

Note : S ; Saw Shape Model P ; Parallel Model

2) Truck Terminal

Preliminary design of truck terminal is carried out based on 10,000 tons/day for the design daily freight volume. The results of preliminary design, a site area of about 101,000 sq.m is required.

3) Parking Facility

Preliminary design of parking facility was conducted on the basis of 100 vehicles for the design parking capacity. According to the results of preliminary design, a site area of about 990 sq.m is required.

11.4 Cost Estimation

1) General

The estimate of the project cost is based on the results of preliminary design, quantity calculation of each work item, and the studies on construction method and operation and maintenance. The project cost consists of the following items.

Investment Cost
- Construction;
- Land Acquisition and Resettlement;
- Engineering Services;
- Supervision Services; and
- Physical Contingency.

The basic premises in estimating the project cost are as follows:

(1) The project cost is estimated by US$.
(2) Construction cost is estimated based on the preliminary design.
(3) Land acquisition and resettlement are estimated based on the preliminary design.
(4) Engineering services cost is assumed to be 4% of the construction cost and land acquisition and resettlement cost.
(5) Supervisory service cost is assumed to be 6% of construction cost.
(6) Physical contingency is estimated to be 10% of the total of construction cost, land acquisition

and resettlement cost, engineering services cost and supervisory services cost.

2) Construction Cost

The summary of estimated construction cost by each project shown in Table 11.6.

Table 11.6 *Summary of Estimated Construction Cost in 1996 Price*

Project No.	Construction Cost (1000US$)	Project No.	Construction Cost (1000US$)
Project - 1	23	Project - 13	490
Project - 2	8	Project - 14	1302
Project - 3	183	Project - 15	4221
Project - 4	36	Project - 16	3263
Project - 5	108	Project - 20	115
Project - 6 - 1	1296	Project - 21	164
Project - 6 - 2	4858	Project - 22	164
Project - 7	428	Project - 23	164
Project - 8	2227	Project - 24	164
Project - 9	1972	Project - 25	360
Project - 10	1258	Project - 26	1008
Project - 11 - 1	1969	Project - 27	653
Project - 11 - 2	2222	Project - 28	6430
Project - 12	1624		

3) Project Cost

The summary of project cost in 1996 prices is shown in Table 11.7.

Table 11.7 Summary of Project Costs in 1996 Price

Project No.	Project Cost (US$)	Project No.	Project Cost (US$)
Project - 1	28	Project - 13	2669
Project - 2	10	Project - 14	3150
Project - 3	318	Project - 15	5243
Project - 4	44	Project - 16	139
Project - 5	165	Project - 20	198
Project - 6 - 1	4226	Project - 21	198
Project - 6 - 2	9520	Project - 22	198
Project - 7	2662	Project - 23	198
Project - 8	3248	Project - 24	198
Project - 9	3500	Project - 25	436
Project - 10	8146	Project - 26	1220
Project - 11-1	3731	Project - 27	790
Project - 11-2	5346	Project - 28	7780
Project - 12	4245		

11.5 Construction Plan

1) Construction Equipment

Several types of construction equipment for earthwork, paving work, and bridge construction are proposed.

2) Construction Time Schedule

It is proposed for the construction time schedule for each project that the term of compensation be basically 6 months and term of construction be 6 ~ 24 months. All projects should be completed within a maximum of 2.5 years. In addition, impleinentation schedule of each project is shown in Chapter 12.

CHAPTER 12 PROJECT LIST AND IMPLEMENTATION PROGRAM

This Master Plan aims to improve the traffic conditions in Tegucigalpa by projects to be executed continuously until 2010. For the execution of projects, the whole term of the Master Plan is divided into 3 terms with the following respective objectives:

Short term (1997-2000)	: To strengthen East-West and North-South transportation axes, and to mitigate traffic congestion in the central area
Mid term (2001-2005)	: To strengthen public transportation by the introduction of exclusive bus roads, lanes and bus terminals
Long term (2006-2010)	: To expand the road network in Tegucigalpa by road improvement around the city

The study team selected projects in accordance with the respective objectives taking account of the project scale, cost, and technical matters. Regarding the list of the selected projects, please refer to Table 10.3. Each project is described in detail in the description sheet of the Main Report.

Implementation program of selected project is prepared based on each objective of the term and engineering matters as shown in Table 12.1.

Table 12.1 Implementation Program

Term	Category	Prjt. No.	Project Description	Project Length(m)	Total Cost (US$1,000)	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Urgent	Improvement of Intersection	1	Configuration Improvement andTraffic Signal Installation at Interaection of Subida al Estadio National and the Circular Road of the National Stadium	-	28	28													
		2	Configuration Improvement at Intersection of Av. Cabanas and Blvd. Santa Fe	-	10	10													
		3	Configuration Improvement at Intersection in Front of Institute Hondureno de Seguridad Social on Blvd. Comunidad Europea	-	318	223	95												
		4	Traffic Signal Installation at Intersection of Blvs. Jose Cecilio del Valle and Calle Golan	-	44	44													
		5	Approach Road Construction at Grade Separation of Blvd. Miraflores and Blvd. Fuerza Armadaz	-	165	116	50												
Short-term	Improvement & Construction of Roads	7	Road Improvement of Estadio Nacional - Blvd Morazan up to the Intersection of Juan Manuel Galves	600	2,662	2,662													
		8	Road Improvement of Calle Nickson - Calle 12 of the Central Area of Comayaguela - a new Bridge in the South of Puente de Juan Ramon Malino up to Blvd. Jose Cecilio de Valle	2,520	3,248	650	1,624	974											
		9	Road Improvement of Calle Isla - Jose Cecilio del Valle	2,100	3,500		1050	1,400	1,050										
	Bridge Const.	(8)	Bridge to calle 12	-	incl. 8														
		11-1	Bridge to Av. 6	1,000	3,731		1,119	1,492	1,119										
Mid term	Improvement of Roads	6-2	Inner Ring Road Construction Surrounding the Central Area of Tegucigalpa (South Section)	1,390	9,520					4,760	2,856	1,904							
		11-2	Road Improvement of the Southern Section of Av. 6 - New Bridge - San Jose - Lomas de Toncontin	4,740	5,346						1,604	2,138	1,604						
		12	Road Improvement of Av. 8 in the Center ofComayaguela	1,860	4,245							1,274	1,698	1,274					
	Construction of Bus Terminals	21	Santa Fe	-	198														
		22	21 de Octubre	-	198														
		23	Miraflores	-	198														
		24	Aeropuerto	-	198														
		25	Las Brisas	-	436														
		26	Estadio	-	1,220														
	Bus Transportation	18	Introduction of Bus Exclusive Lanes	-	-														
		19	Introduction of Bus Exclusive Ways	-	-														
	Community Road	20	Introduction of Transit Mall	530	139														
Long-term	Improvement & Construction of Roads	6-1	Inner Ring Road (North Section)	2,230	4,226										1,690	1,690	845		
		10	Road Improvement of Blvd. Juan Manuel Galves	1,790	8,146											3,258	3,258	1,629	
		13	Road Improvement of Anillo Periferico - Colonia La Fuente - Blvd. Fuerza Armadas	1,860	2,669											1,868	801		
		14	Road Construction and Improvement of Colonia San Jose de la Vega - La Canada - Anillo Periferico	2,380	3,150												1,260	1,890	
		15	Road Construction of Colonia Kennedy - Residential Plaza - Anillo Periferico	2,300	7,635													2,291	5,345
		16	Improvement of AnilloPeriferico - Colonia Loma de Jaleapa - Carretera a Oriente	3,115	5,243													3,146	2,097
	Parking Bldg.	27	Construction of Parking Building outside the CBD Area near Puente la Hoya		790														
	Truck Termina	28	Construction of Truck Terminal in Laguna el Pedregal		7,780														
				Annual cost		3,773	3,938	3,867	2,169	4,760	4,460	5,316	3,302	1,274	1,690	6,817	6,164	8,956	7,442

CHAPTER 13 ECONOMIC EVALUATION

13.1 Objective

The objective of the economic evaluation is to examine the feasibility of 13 road projects, including bridge projects, proposed to deal with the traffic congestion in the study area from the nation's economic viewpoint.

13.2 Evaluation Method and Condition of Evaluation

Economic evaluation of each project is executed by comparative assessment of the accumulated benefit to the required cost in economic term by making a comparison between "With-case" and "Without-case". For the convenience of this evaluation, all the projects are assumed to start in 1997. The basic assumption of the evaluation is summarized as follows:

1. Construction period : Period planned in the implementation schedule
2. Evaluation period : 14 years from 1997 to 2010
3. Year of price : 1996
4. Exchange rate : US$1.0 = Lps11.7
5. Residual value : 0
6. Evaluation indicators : Economic Internal Rate of Return (EIRR)
   Net Present Value (NPV)
   Cost Benefit Ratio (B/C)

13.3 Project Cost and Benefit

Economic cost is calculated for each project cost and maintenance cost (0.17% of each project cost) by assuming the foreign portion and the local portion to be 53% and 47% respectively and by reducing tax portion. Vehicle operation cost saving and travel time cost-saving are counted as the benefits of the execution of the projects.

Unit cost of vehicle operation cost by vehicle type was calculated by using the basic data collected in Tegucigalpa in this study, and the unit value of the travel time by vehicle type is estimated by using the result of person trip survey as shown in the Table 13.1.

Table 13.1 Unit of Vehicle Operation Cost, Time Value by Vehicle Type

(Unit : Lempiras)

Type of Vehicle	Private car	Bus	Taxi (col.)	Taxi (priv)
Vehicle Operation Cost	2.4567	7.5031	1.4240	1.4240
Time Value	8.3	50.5	4.7	4.7

Project cost , maintenance cost and benefit in 2010 are shown by project in the Table 13.2

Table 13.2 Summary of Cost and Benefit in 2010

(Unit: 1,000Lps)

Project	Cost		Benefit (2010)	
	Project Cost	Annual Maint.	VOC	Travel Time
Project 6-1	49,444	84	11,663	31,752
Project 6-2	121,551	162	-1,937	29,727
Project 7	31,145	53	22,914	35,425
Project 8	38,002	65	27,868	32,839
Project 9	40,950	70	57,610	40,640
Project 10	95,308	162	27,441	34,985
Project 11-1	43,653	74	12,029	30,922
Project 11-2	62,548	106	13,153	36,446
Project 12	49,667	84	18,799	33,085
Project 13	31,227	53	27,692	37,290
Project 14	36,855	63	12,973	29,256
Project 15	89,330	152	37,425	34,586
Project 16	61,343	104	4,333	28,207

13.4 Evaluation

All the projects are evaluated to be feasible judging from the calculation of evaluation indicators as shown in the Table 13.3. Project 6-2 does not yield such a high figure of IRR, and it cannot be judged to be feasible against the increase of the cost by sensitivity analysis; however, it will make a great contribution to mitigation of congestion within the "Centro" and to the conservation plan for tourism. Therefore, due consideration should be taken into the cost in the further detail study.

Table 13.3 Result of Evaluation

Project	EIRR (%)	NPV(1000Lps)	B/C
Project 6-1	16.24	1,160,000	1.33
Project 6-2	13.64	811,000	1.12
Project 7	46.95	10,900,000	5.42
Project 8	36.38	8,160,000	4.03
Project 9	46.25	15,000,000	6.18
Project 10	19.72	4,430,000	1.66
Project 11-1	26.35	4,420,000	2.43
Project 11-2	22.71	4,330,000	1.98
Project 12	27.70	5,670,000	2.61
Project 13	46.05	10,900,000	5.67
Project 14	31.20	5,610,000	3.04
Project 15	24.91	8,050,000	2.21
Project 16	16.8	1,710,000	1.37

CHAPTER 14 MEASURES FOR PROJECT IMPLEMENTATION

14.1 Fund Source

(1) Fund Source for Road Projects

The budget for the road and bridge projects in the Municipality secures about 30 millions Lempiras per year. On the other hand, the total project cost for the execution of the Master Plan is estimated at 757 millions Lempiras (average 55 millions Lempiras per year), therefore, new funds should be considered for the execution of the Master Plan.

(2) Means for Procurement of Funds

1) Increase of budget of SECOPT and Municipality
As the Municipality, the principal body for execution of Master Plan, pushes forward with this work, one third of the municipal budget related to the road and bridge project will be expected to be allocated to this Master Plan. SECOPT will be expected to prepare about 15 million Lempiras for 3 years (1997-1999) of bridge construction proposed in this Master Plan, because SECOPT has participated in the bridge projects within the city so far.
2) Introduction of City Planning Tax
Execution of projects proposed in the Master Plan will cause increase of the price of land around the project roads and the benefit will be brought to the land owners. It will be recommendable to lay a tax on the landowners based on the concept that the benefit from development due to the road improvement should be returned to public. The revenue from this taxation should be used exclusively for the promotion of the Master Plan.
Assuming that the residential area, the commercial area and the industrial area in this study would be taxed and 120 Lempiras and would be applied to the unit price of land and 0.2% to the tax rate, the revenue from this taxation is estimated at 11 millions Lempiras in 1995 and 16 Millions Lempiras and in 2010 as shown in the Table 14.1.

Table 14.1 Revenue of City Planning Tax

(Unit: 1000Lps)

Year	1995	2010
Revenue by City Planning Tax	10,795	15,562

3) Introduction of Development Tax
Developers would enjoy various benefits by using project roads after the execution of the Master Plan. Introduction of development tax is desirable based on the concept that these developers should share the burden for road investment that brings them benefits. 132 ha will be developed annually on the condition that the developing is done equally every year until 2010. The revenue of development tax is estimated to be 7,920,000 Lempiras every year until 2010 as shown in the Table 14.2 on the assumption that 5% of the sale price of lands would be applied to this tax rate.

Table 14.2 Revenue of Development Tax

	Developed Area (m^2)	Unit Price/m^2 (Lps.)	Tax Rate (%)	Total Revenue (1,000 Lps.)
Revenue by Development Tax	1,320,000	120	5%	7,920

4) Introduction of Gasoline Tax

Introduction of gasoline tax as an earmarked fund for road improvement is desirable based on the concept that road users should share the burden of the cost of road improvement. At the present, tax portion of the gasoline price in Honduras is about 25%. If this percentage is raised by 5% to 30%, and this 5% would be applied to the gasoline tax rate, the revenue of the gasoline tax will be estimated to be 50 millions Lempiras in 2010 as shown in the Table 14.3.

Table 14.3 Revenue of Gasoline Tax

Year	Total Running Distance (1000km)	Fuel Efficiency (l/km)	Annual Fuel Consumption (1000l)	Gasoline Tax (Lps./l)	Total Revenue (Lps.1000)
1995	863,482	0.1	86,348	0.395	17,054
2010	2,555,000	0.1	255,500	0.395	50,462

5) Introduction of Motor Vehicle Tonnage Tax

The concept that those who will damage the road should share the burden of cost is also a principal concept for the fund of road works. In this study, 100 Lempiras per vehicle per year is applied to the tax for convenience. The revenue of this tax is estimated to be 18.6 million Lempiras in 2010 by using the number of registered vehicles forecast in the study area.

6) Foreign Fund

Foreign funds such as the loan from CABEI BID, BIRF etc. should only be considered to apply in case of the lack of domestic funds, as foreign funds remain as future debt.

(3) Fund Source Plan

Considering the several fund sources mentioned above, fund allocation is planned as shown in the Table 14.4.

Table 14.4 Fund Source Plan

(Unit: Lps1000)

Year	Project Cost	General Revenue		Tax				Foreign Fund	Total Fund	Repayment	Balance
		Munici	SECOPT	City Pl.	Develop	Gasoline	Tonnage				
1997	43,684	10,000	15,000	0	0	0	0	14,932	43,684	0	0
1998	46,075	10,000	15,000	0	0	0	0	17,137	46,075	0	0
1999	45,244	10,000	15,000	0	0	0	0	16,377	45,244	0	0
2000	25,377	10,000	0	12,384	7,920	0	0	0	32,473	-1,754	5,342
2001	55,692	10,000	0	12,702	7,920	0	0	0	84,689	-3,762	25,235
2002	52,182	10,000	0	13,020	7,920	52,913	0	0	88,313	-5,671	30,460
2003	62,197	10,000	0	13,337	7,920	56,518	12,867	0	105,958	-5,671	38,093
2004	38,633	10,000	0	13,655	7,920	60,124	13,686	0	108,687	-5,671	64,383
2005	14,906	10,000	0	13,973	7,920	63,730	14,505	0	111,402	-5,671	90,825
2006	19,773	10,000	0	14,291	7,920	67,336	15,324	0	116,581	-5,671	91,117
2007	79,759	10,000	0	14,609	7,920	70,942	16,143	0	126,431	-5,671	41,001
2008	98,924	10,000	0	14,926	7,920	74,548	16,962	0	132,811	-5,671	28,217
2009	104,785	10,000	0	15,244	7,920	78,154	17,781	0	138,055	-5,671	27,599
2010	87,071	10,000	0	15,562	7,920	81,760	18,600	0	141,284	-5,671	48,542

14.2 Organization for Project Implementation

To implement selected projects, the strength of "the Urban Development Division" and the cooperation with related agencies were proposed as the reform of the organization in the Municipality.

CHAPTER 15 INITIAL ENVIRONMENTAL EXAMINATION

This chapter summarizes the results of our initial environmental examination (IEE) in Tegucigalpa Urban Transport Project.

Purposes of IEE are 1) understanding of present environmental conditions at the site, 2) prediction of impacts arising from development projects. These target values are chosen following the principles that are 1) not to worsen the present condition, and 2) to respect the present standards which are already adopted by Honduran government or surrounding countries. In Central American countries, standards from W.H.O. or Pan-American Organizations are chosen.

Impacts arising from changes of site conditions and traffic volumes before and after development projects were predicted. The impacts are:

1) Positive impacts

(1) Relief from traffic congestion
This is a primary purpose of this master plan.

2) Negative impacts

(1) Relocation of inhabitants, public facilities and cultural inheritances
Relocation of inhabitants is quite a problem in consequence of enlargement or construction of road. Affected public facilities are a public hospital parking lot, an university athletic field and an orphanage. Affected cultural inheritances are the former presidential house, former ministry building, the former embassy house of Costa Rica and some beautiful old streets.

(2) Fauna and Flora
A small portion of a naturally preserved hill is cut

(3) Air pollution and noise
By the implementation of the project, air pollution such as NOx and CO would further worsen although suspended particulate matter is already too highly concentrated at present. Problems of noise from vehicles could also arise.

Tentatively proposed mitigation plans are:

Relocation of inhabitants, public facilities and cultural inheritances
Sufficient compensation will be made to affected inhabitants. Alternatives will be provided for the loss of present public facilities. However, to move cultural inheritances is very difficult since they are made of brick and are unrestorable once dismantled.

CHAPTER 16 MANAGEMENT AND OPERATION PLAN FOR MAINTENANCE

16.1 Present Situation of Road Management and Operation for Maintenance

Road Facilities in the study area are generally carried out maintenance and operation by ALCALDIA. In ALCALDIA, road maintenance is charge of Infrastructure Department.

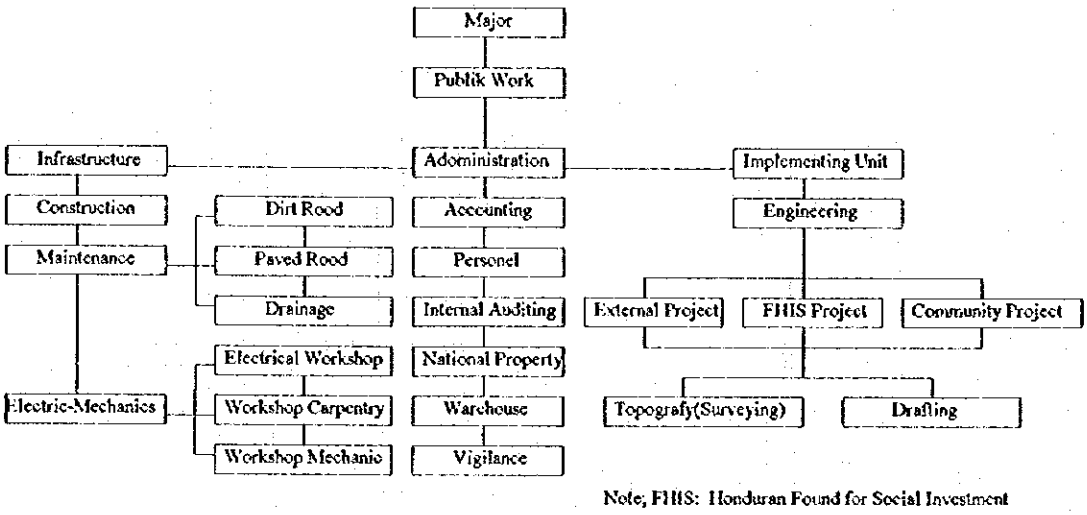

Fig. 16.1 Organization Chart of ALCALDIA

This department consists of three sections: construction, maintenance and electric. Present road maintenance is chiefly in the form of simple repairs (road pavement, etc.,) carried out according to maintenance budget in ALCALDIA.

16.2 Road Maintenance and Operation

1) Maintenance Inspection

Maintenance inspection is divided into routine inspection, periodic inspection and special inspection to perform the repair speedy. Details of each type of inspection are as follows:

(1) Routine inspection
Routine inspection of road structure and facilities, within the limits of visually observable damage is carried out on a daily, weekly or monthly basis.

(2) Periodic inspection
Periodic inspection is based on detailed inspection to be performed at certain time interval (1 or 2 times per year), such as the end of the rainy season. This inspection is carried out checking and testing the condition of various road structure and facilities on problem points such as bridge collapsing or landslide.

(3) Special inspection
Special inspection is basically the work to be carried out after they are damaged by road accident or natural causes.

Major inspection items and frequency are as shown in Table 16.1.

Table 16.1 Inspection Items and Frequency

Item	Inspection point	Inspsction Item	Frequency
Cut and Fill Slope	Slope,	Erosion, Landslide, Vegatation	Weekly
	Ditch	Debris	Weekly
Pavement	Surface, Base	Pothole, Hollow, Crack, Resettlement	Weekly
Drainage	Culvert, Ditch, Inlet,	Debris	Weekly
Bridge	Abutment, Pire	Damage	Monthly
	Curb	Damage	Monthly
	Drainage	Debris	Monthly
	Slab	Crack, Damage	Monthly
Bus Terminal	Facilities	Damage	Monthly

2) Required Vehicles and Equipment

ALCALDIA already maintains some equipment; however equipment for maintenance will be added on standby at the workshop of the ALCALDIA to smoothly perform maintenance as shown in Table 16.2.

Table 16.2 Required Vehicles and Equipment

Road Maintenance	Vehicles and Equipment Required
1.Inspection	Inspection car
2.Road Cleaning	Truck, Sprinkler truck
3.Vegetation Control	Truck, Mower
4.Asphalt Pavement and Shoulders	Grader, Vibration roller, Loader, Compressor Steel wheel roller, Truck, Asphalt distributor, Compactor
5.Bridge	Truck with small crane
6.Bus Terminal	Truck with small crane
7.Cut and Fill Slopes	Bulldozer, Loader, Truck

3) Organization for Maintenance

To keep the effective maintenance, the Infrastructure Department should consider the following in future.

- All engineers in this department should understand maintenance techniques.
- ALCALDIA should have relationship with other agencies or contractors to keep smooth maintenance.
- Data bases such as cross-sections, pavement structure, road length, etc., should be kept in this department.

16.3 Training of Inspections and Engineers

Since road maintenance is important for keep the road in satisfactory condition, engineers and staff who are in charge of maintenance work should be train as follows;

- Role of inspection
- Inspection method
- Preparation of inspection data
- Repair plan
- Operation of maintenance

CHAPTER 17 RECOMMENDATIONS

It becomes clear that the traffic congestion within the study area is getting worse year by year because of the disorderly sprawl of the housing area by the rapid increment of population. Therefore, the following points are concluded and recommended;

(1) Realization of master plan

①Implementation of urgent projects

Since the realization of master plan takes five to fifteen years, at places where the traffic congestion is especially severe, the urgent projects are desired to be implemented as soon as possible.

② To construct two new bridges during the short term

In the master plan, many projects are proposed. Among them it is identified that the east-west transportation axis and the north-south transportation axis should be strengthened in the short term. In order to strengthen these two axis, it is of utmost importance to construct two new bridges.

③ To continually implement the projects recommended in the Master Plan

It will take time to realize all the projects listed in the Master Plan. Therefore, it is very important to continue efforts for the realization of the master plan. In Honduras, the long term plan is apt to be neglected when political power changes hands. In order to avoid this situation, it is advised that the Master Plan be realized, despite political changes.

④ To reform the organization

At present several national governmental organizations are involved in the civil work projects in the study area because of lack of funds as well as planning and engineering staff in the Municipality. It is desired that as many necessary civil work projects be performed by the Municipality for itself as possible. For this purpose, it is concluded that the organization of the Municipality related to the transportation and city planning should be reformed as shown in Fig. 17.1., that is, under the mayor the Urban Development Division is strengthened and all the basic policy of the city planning and transportation is determined together with representatives from SECOPT, SANAA, AMDC, EUEE, etc. As for the concrete implementation of the policy, the following departments are in charge under this division.

- MANAGEMENT OF METROPLAN takes a role of the city planning.
- MANAGEMENT OF TRANSPORT AND VIAL MATTERS is in charge of the road planning.
- MANAGEMENT OF MARKETS is change of market planning.

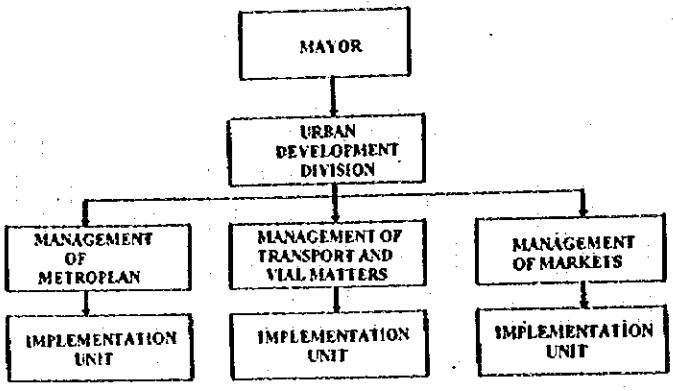

Fig. 17.1 Proposed Organization Related to Transportation

⑤ To make haste to complete the outer ring road (so called Anillo Periférico)

The Master Plan was formulated on the assumption of the completion of the outer ring road called Anillo Periférico, however, the work of this project is behind schedule. It is recommended to complete this outer ring road as soon as possible. Especially it is recommended to complete the section 2 of Anillo Periférico (from Colonia Altos de Loarque to Colonia Kennedy), because it greatly contributes in saving travel time between the southern part of the study area and the western part (Suyapa, Miraflores, Kennedy, The National Autonomous University of Honduras, etc.). In addition, it reduces congestion on Boulevard Comunidad Europea significantly.

⑥ To restructure the bus route network system

It is recommended that the future bus route network be changed into the system with fewer number of bus routes and more navigation frequencies on bus routes compared with the existing system. In addition, it is also recommended to examine a suitable tariff system including the allocation of subsidies.

⑦ To secure the financial sources for the projects

In order to realize the Master Plan, a large amount of funds is necessary. For some projects the cost may be provided by loan or donation from the international lending agencies, bilateral and/or multi-lateral agreement. However, since it cannot depend on the loan or donation for all of the project cost, the Municipality itself should seek the project fund source. Therefore, it is recommended to examine the possibility of application of the following measures as the financial sources for implementing the Master Plan projects;

- City Planning Tax
- Development Tax

- Automobile Fuel Surcharge Tax
- Automobile Tonnage Tax

(2) To continue road maintenance work

It is recommended to continue effective road maintenance such as drawing lane marking and stop lines, filling potholes and gaps on the roads, etc. Bad poor road maintenance decreases the road capacity through the speed-down and congestion around holes and gaps on the roads.

(3) To make use of various data obtained during the study

Several traffic surveys were conducted during the study and many important data were obtained. These data will be useful in analyzing the feasibility of new projects not to be examined in this Master Plan and for training the staff to follow the Master Plan.

(4) To conduct further study

Some projects require the further studies on detail design, detailed cost estimation, financial feasibility, etc. Before implementing the project, it is recommended to conduct further study on these as much as possible where necessary.

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