

together with formulating the built-up area linearly along the major transportation axes. Therefore, under this pattern the difficulties and problems in the above multiple nuclei decentralized pattern can be solved. As the radial roads, with exception of the sections near the central area, have already been developed and improved, the existing congestion in the central area and long commuting distance could be solved by making this development stepwise and make the formulation of nuclei flexible.

Considering the past development direction of the study area, at first the built-up area was developed towards Boulevard Santa Fé, then, Avenida La Paz, Avenida Las Proceres, and Boulevard Morazán, that is, the built-up area was expanded towards the east, then, the office building and restaurants were expanded towards the south, that is, along Boulevard Comunidad Europea and Boulevard Miraflores, and Boulevard José Cecilio Valle. Recently the development has been made along Boulevard Suyapa and some sections of Boulevard Fuerzas Armadas. Therefore, it can be said that the past development has been made along the principal radial roads, that is, under the above-mentioned linear pattern. However, at the moment there are very few roads connecting these built-up areas to each other, besides Boulevard Fuerzas Armadas. Since the future population will increase outside the Anillo Periférico as explained in Section 8.2.1, this Anillo Periférico will play an important role for connecting the existing or new-born suburban areas to each other. These suburban built-up areas will develop as nuclei in time. These built-up areas will not become as large as the present CBD area, concurrently, the study area would seem to develop under the linear and multiple nuclei pattern hereafter.

### **8.2.3 Allocation of Population and Workers**

Based on the above scenario, the future population and workers are allocated as shown in Fig. 8.2.3 and Fig. 8.2.4, by distributing the projected total population and workers of the whole study area as explained in Section 8.1. The population increment is quite large in the western and southern parts of the outer ring road. The expansion rates in these parts were projected at more than 100%. On the other hand, the number of workers was projected to increase in the nuclei such as Morazán, Suyapa, Miraflores and Santa Fé within the outer ring road. This different allocation of population and workers causes a large amount of commuting traffic flow between houses and working places. Therefore, it will be necessary to sufficiently strengthen the transportation network for these sections.

### **8.2.4 Formulation of Land Use Plan**

#### **1) Objectives**

Type of and use and transportation are reciprocally linked. Trips are generated based on type of land use and transportation affects the economics of location that distributes type of land use within an urban space. The social and physical characteristics of the city mold both land use and transportation, giving unique form to the city. This section presents an analysis of the physical characteristics that shape the land use plan, the objectives and assumptions that guided its preparation, and the resulting plan that integrates these elements with the findings about population and economics presented in Section 8.1.

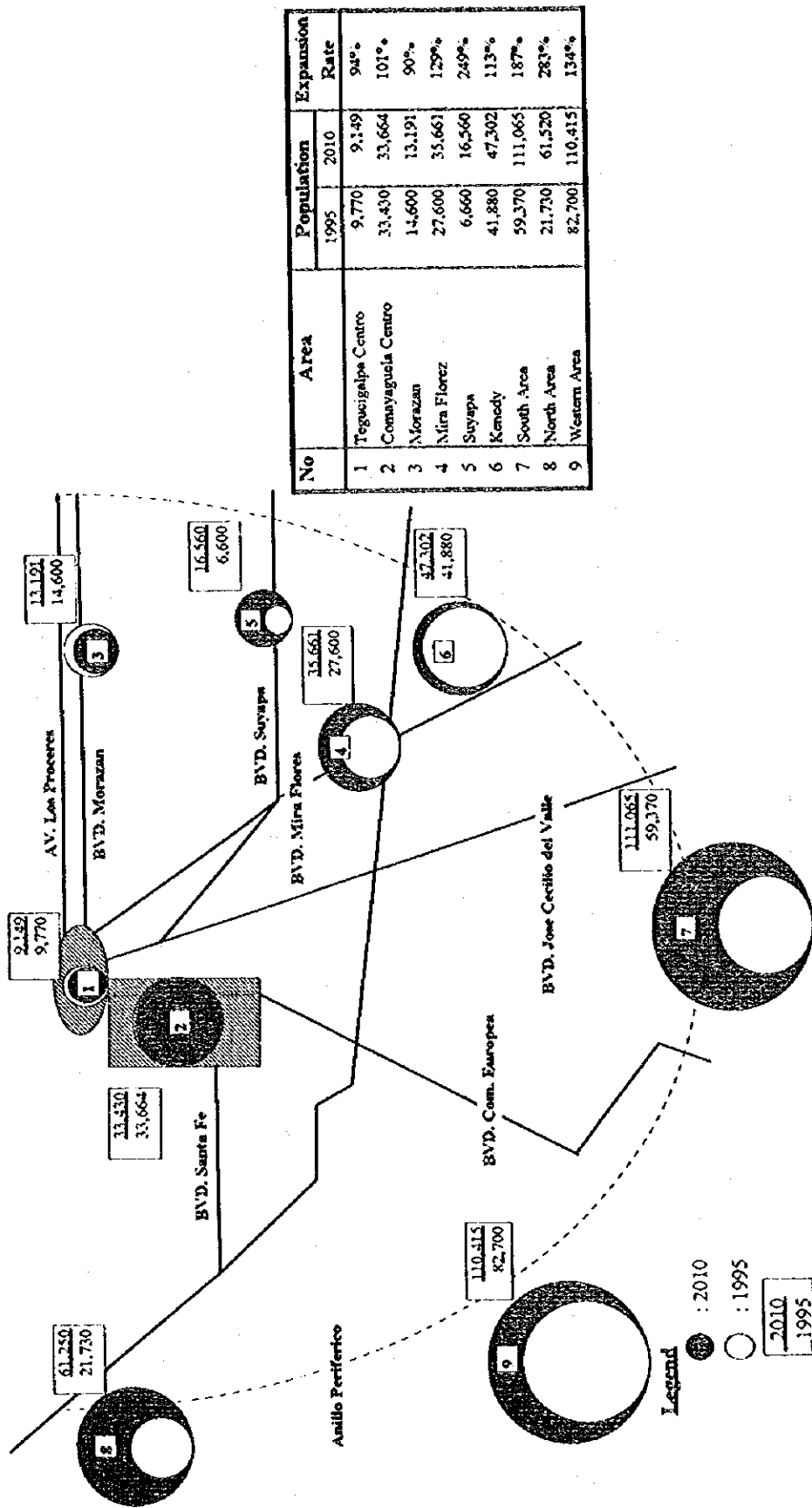


Fig. 8.2.3 Allocation of Future number of Population

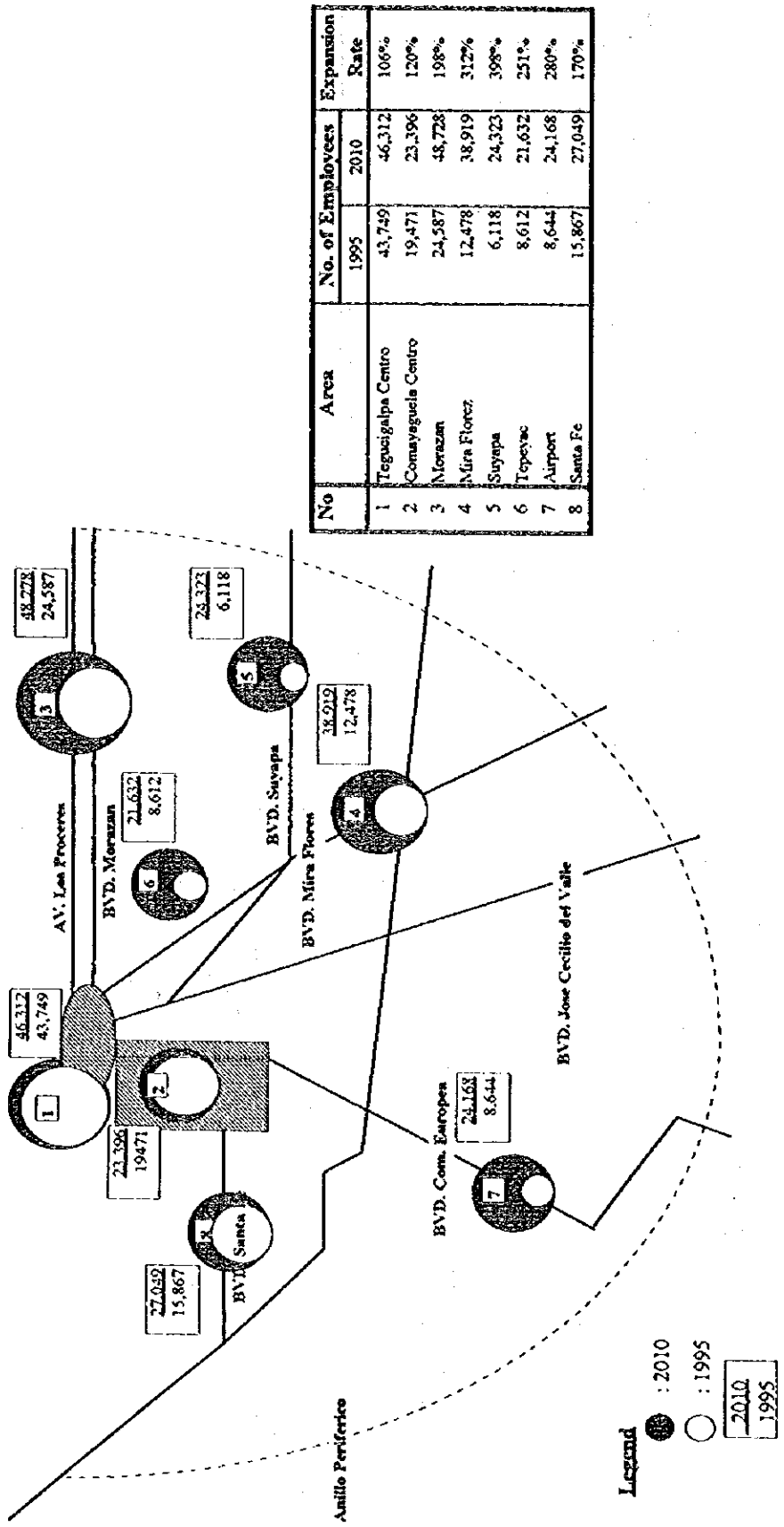


Fig. 8.2.4 Allocation of Future number of Workers

Projections of land use by origin and destination zones are presented in Appendix 8. Corresponding projections of population by origin and destination zones are also in Appendix 7. Together these two appendices provide the essential information for the projection of trips and transport planning.

Development of a land use plan for transportation planning is an objective this study. As discussed in Section 8.1, this plan can be developed further with plans for the distribution systems water and electricity, solid waste collection, the location of schools, and other basic urban services that together would comprise an urban plan. With an emphasis for transportation planning, the objectives of the land-use plan are three. A sustainable urban environment related to population growth, nonetheless, is the overriding objective governing the plan.

### **(1) Promote Sustainable Development and Environmental Protection**

Tegucigalpa has areas of steep slope and unstable soils cut by rivers and streams. The plan seeks to avoid construction in these areas to minimize risk of loss to property and life. The plan seeks to protect, if not enhance, the environment and downstream populations. The land capability analysis determined areas of risk for construction, water courses for protection, boundaries for reserves, agriculture and forests areas, and watersheds for protection. The residual land provided the areas for urban development. The objective is appropriate use of the land. Where new land is involved, it provides stream protection required by the Forestry Law. The plan provides for the creation of a regional park for future population use and protection of Pedregal wetland. Planning of areas southwest of the city took into account the likelihood of the availability of piped water and proposes that development depending on well water, use of septic pits or tanks be kept at a minimum.

### **(2) Accommodate, But Control, Population Growth**

The amount of land available for urban development is limited in relation to a growing population. Therefore, it should be used for the most specialized and best uses to attain the potential of the city. This city is a national governmental, university, financial, and services center. Analysis in Section 8.1 showed it does not have much competitive advantage in the manufacturing sector. Section 8.1 showed how control of growth, and the accommodation of a growing population, could be obtained by limiting manufacturing, especially type 2 manufacturing, to existing sites. The land use plan obtains this objective by limiting the amount of land available to new manufacturing growth. The plan sets reasonable, although high, residential densities to accommodate population growth. It provides additional land for commercial use, but restricts the central business district to its present size. This aims at the use of market forces to gain greater intensity of use and greater floor area ratios.

### **(3) Minimize Traffic**

The plan seeks to minimize traffic congestion and divert traffic to streets of sufficient existing capacity to carry traffic by locating and re-locating traffic generating land uses. It does this by diverting uses to carriers that have sufficient capacity, principally by:

- Minimizing central traffic generation by moving government offices out of the central area and concentrating this activity in the south in the existing government center. This activity

could be dispersed throughout the city, but in a situation of limited land, this alternative would displace other uses. The existing government center has sufficient land to absorb government activities without displacing other uses. The center is located on principal traffic carriers of present sufficient capacity. Additionally, those government activities that do not involve interaction among government offices and among the public can be moved to other locations outside the CBD.

- Minimizing central traffic congestion by moving financial and related office functions from center business district to an area expanded for this purpose along Boulevard Miraflores and Boulevard Suyapa. This follows a trend underway with recent construction and one that provides additional space for parking.
- Minimizing traffic congestion prohibiting trailer and large trucks from entering the city and providing a truck terminal, warehousing and distribution center at the edge of the city with access to the outer ring distributor road. This center would store goods for distribution assembly, break larger loads to smaller for distribution in the city by smaller trucks, and provide a center for truck services and repair. In addition to reducing traffic congestion caused by large trucks, it would reduce roadway destruction caused by heavier axle weights and reduce the cost of road maintenance in the city. The proposed site at Pedregal allows the interception of trucks before entering the city, but permits access to the ring road. Use of the ring road for truck delivery should minimize truck penetration of the city, further reducing traffic congestion.

## 2) Plan Assumptions

Basic conditions for planning land-use strategy:

- (1) Use of the Laguna Pedregal area, as proposed in the land use plan, for a truck terminal, residences, and regional park, instead use of the area for the relocation of Toncontin Airport. In addition to the advantages of the terminal facility, the land is essential for the accommodation of future urban population. As reasoned in Section 7.1 and supported by a JICA feasibility study, the Talanga site is superior to Pedregal as an airport site and does not have the aircraft operational problems that exist at Pedregal. The land use further assumes that there will be a follow-on study of the Pedregal site to determine the size and requirements of the terminal, the layout plan for residential use, and the plan for the regional park and the protection of the Laguna.
- (2) Relocation of Toncontin Airport at Talanga. Toncontin site should be redeveloped for commercial and residential purposes; adjacent military land should be sold for residential and recreational uses.
- (3) Use of growth controls as discussed in Section 8.1. Land is limited and a compact city minimizes transportation. The plan assumes that job creation will be in activities of the Central District economic specialization and restriction of those that are not. Primarily, there will not be issuance of permits for new Type 2 manufacturing sites. This follows the year 2000 plan concept of 1975 which emphasizes Amaratoca manufacturing growth and especially the manufacturing growth of San Pedro Sula as a national urban development policy.

- (4) Occupation of Ciudad Mateo at no greater the number of units than the 2,000, or less. There are now completed and occupation only should be permitted on stringent conditions in consideration of erosion control, sewage treatment, and other environmental aspects—or no use for the completed units. Reforestation of the site is also necessary.
- (5) Controls for protected land and enforcement of the Forestry Law in new developments. This further assumes no new development north of road consisting of Avenidas La Paz, Guttenberg, Jerez, and Carretera a Valle de Angeles and to the east of the present urbanized area. This assumes adequate control to direct urban development to the south and west.
- (6) Timely provision of water supply for the Laguna Pedregal area. This will most likely come from Zambrano (Rio del Hombre), and from the planned Rio Sabacuante project for water supply to the South of Tegucigalpa. The Laguna Pedregal with the truck terminal should have priority. Both areas would be supplied with water by the year 2000.
- (7) Development of a continuing planning process to monitor and enforce the plan.

### 3) Spatial Analysis

The land capability analysis was carried out for the most part on a map scaled 1: 10,000. (including Laguna Pedregal). Areas to the west and to the south were carried out on maps scaled 1: 50,000 as the only maps available. The study team also made the present land-use map through the reconnaissance survey in the study area. This present land-use map is shown in Fig. 8.2.5. As Fig. 8.2.5 shows, the city has developed within containing mountains (the semi-circular representations), and with the exception of hillside invasion, taking into account topography and hydrology. Suitable level areas for new commercial and manufacturing areas are few and the areas for new residential use are scattered. Many of the sites available for future residential use will require the use of earth moving equipment and consequently will be more expensive to develop than in the past.

Fig. 8.2.5 shows two large areas that can be planned as complete satellite city units, Laguna Pedregal and the areas to the South of Tegucigalpa in Las Mesitas, Santa Rosa, Germania, and Colonia Lomas de Tizatillo. A third large area, now under construction, is three kilometers Northwest of the airport. A third area for possible satellite city development exists in the La Omina-Horquetas area. With the increase of automobile use, longer commutes to the CBD can be expected. Future urban development would then take place in Santa Lucia, Valle de Angeles, Armeteca and other locations within 30 to 50 kilometers of the study area, in the North American pattern of the affluent seeking small-town living with central-city employment. This concept of satellite cities carries on concepts of the 1975 SECOPT year 2000 plan. Since plans were prepared for the area in this plan, they are not presented here. Land use and population details are presented in Appendix 8.



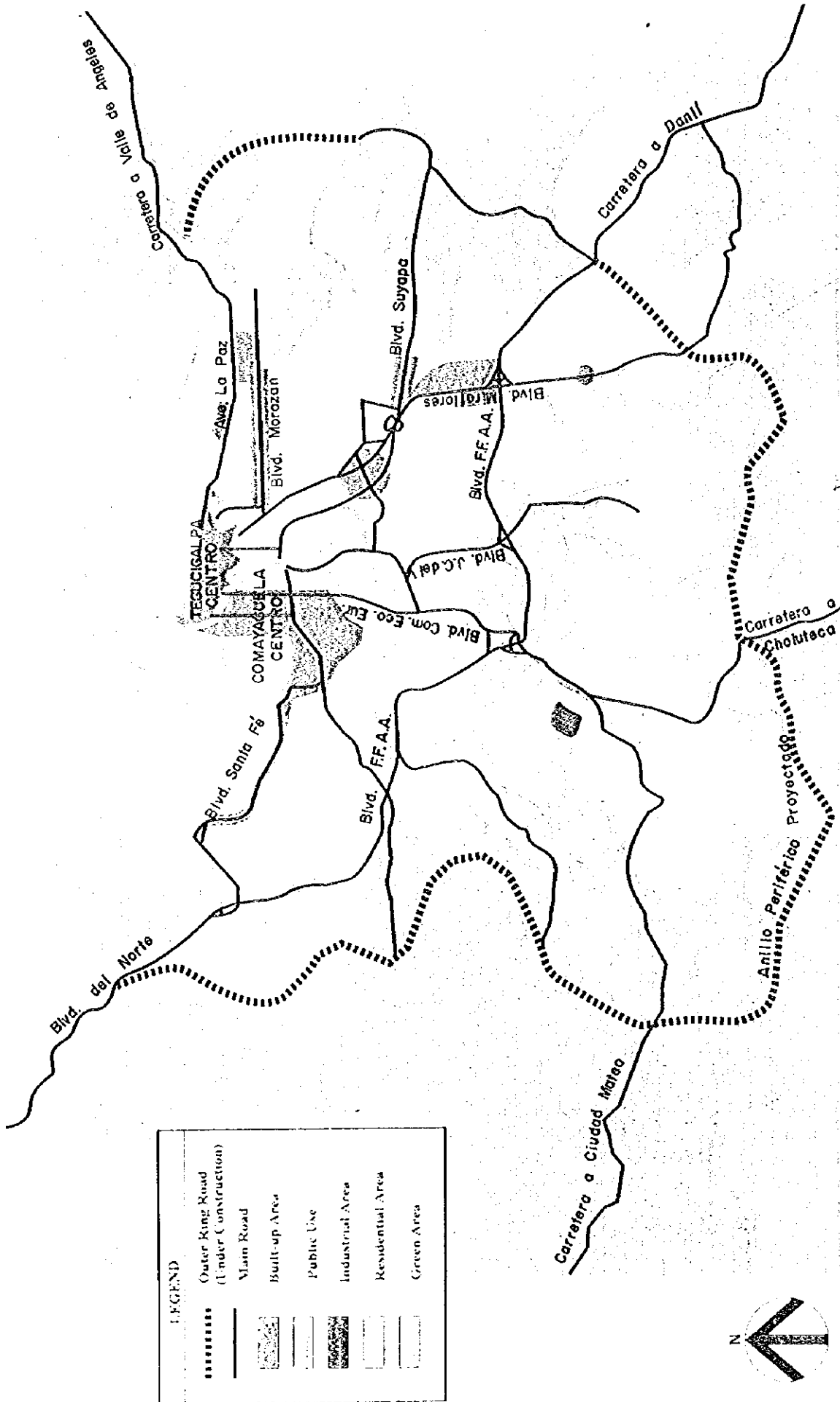


Fig. 8.2.5 Present Land Use Map



#### 4) Future Land Use Plan

Fig. 8.2.6 presents the land use plan for the year 2010, the original of which is at a scale of 1:10,000. The plan was largely determined by topography and hydrology. It includes the areas in stripes with the exception of the military area in the southwest. Land-use detail, Appendix 8, includes the areas of the plan to the south, shown in Fig. 8.2.6. The average population density is 300 persons a hectare, at one-hundred more per hectare than the present average. With the exception of commercial and public uses, there is little planned lateral growth. This was necessary to accommodate the projected population and to intensify non-residential land uses for the conservation of land. The colors of the map follow convention. Green represents open land, preserves, and agriculture. Blue is land in public use, including government, recreation, schools, and places of worship. The orange represents high density residential land; red is commercial, and purple is manufacturing. Table 8.2.1 summarizes the land use plan for the year 1995 and 2010.

**Table 8.2.1 Summary of Land Use by Use Category in Hectare, 2010,  
(Less Open Category)**

Land Use	Residential	Public	Commercial	Industrial	Total
1995 Study Area	3,441.2 (68%)	539.3 (11%)	986.6 (20%)	69.7 (1%)	5,036.8 (100%)
2010 Study Area	4,878.0 (67%)	764.0 (11%)	1,483.0 (20%)	123.0 (2%)	7,248.0 (100%)
Southern Area (Expansion)	371.9 (62%)	58.2 (10%)	158.7 (26%)	11.2 (2%)	600.0 (100%)
Total	5,128.1 (67%)	748.7 (10%)	1,016.5 (13%)	73.2 (1%)	7,665.0 (100%)

The percent commercial category remains about the same, as does also public, and industry. Commercial use was reduced in the plan by 7 %, but this is the category most likely to increase vertically to achieve the projected amount of space required. On this basis, and the assumptions used, the plan is judged to have met its objective of accommodating the population of 2010 and of constraining commercial growth.

#### 5) Zoning of Land Use

Based on the allocation of future population and workers, Future land use plan, the zoning was determined;

##### (1) CBD zone

The central area of Tegucigalpa is preserved as a historical, cultural, touristic district as well as a place of recreation and relaxation for the citizens. Therefore, most of the central administrative functions and office facilities are promoted to be transferred to the outside area as soon as possible to mitigate the present severe traffic congestion.



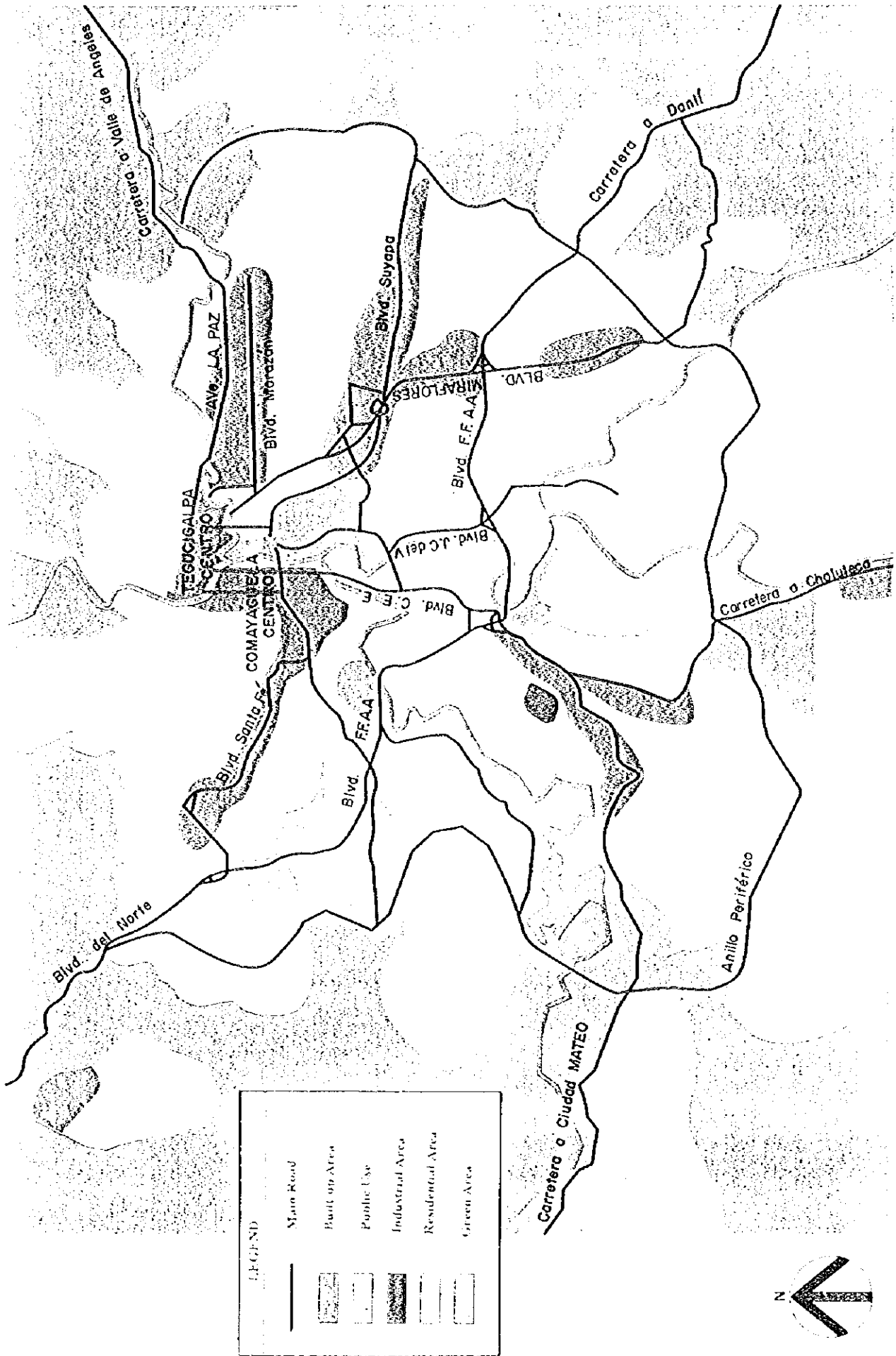


Fig. 8.2.6 Future Land Use Map

## (2) Sub-core zone

The built-up areas along the principal arterial roads have been developing as subcore districts, where new office buildings are on the increase. Therefore, it is necessary that these areas are developed in harmony with the surrounding land use.

## (3) Central administrative zone

The central government has already obtained the land in Centro Civico Gubernamental outside the CBD in order to transfer the central administrative functions concentrated in the central area of Tegucigalpa. Now only the Presidential House is located there, however, the other governmental functions are expected to be transferred soon from the CBD to this place, according to the suggestion of the Municipal Government.

## (4) New residential zone

At the moment residential areas have spread to almost all areas within the study area, even in unsuitable ones. The population is projected to increase by about 200,000 persons in the target year, and it will be difficult to accommodate such numbers within the study area. Therefore, the new residential area should extend toward the western and eastern areas outside the Anillo Periferico, judging from the limit of inhabitable land, water and electricity supply within the study area.

## (5) Industrial zone

Many small and medium scale factories are located within the Study Area. It is desired that these factories be transferred to the suburban area if possible. At the moment, a large industrial complex is planned by the municipality at Amarateca along Carretera al Norte near outside the study area. Therefore, in the future, the major industrial zone will remain only near the airport area.

## (6) Distribution Zone

Considering the large volume of commodity flow between Tegucigalpa and San Pedro Sula in the future, it is desired that the distribution center be constructed in the outskirts of the study area along Carretera del Norte. If not so, the large-scale trucks will enter the BD, and cause severe congestion in the study area. The area of Laguna El Pedregal is recommended, because it is located near the entrance of the study area along Carretera del Norte.

## (7) Recreational zone

In the study area there are only a few recreational areas; for example, El Picacho, Cerro Juan A. Lainez, etc.. However, recently the security around these recreational areas is getting worse, especially after sunset. It is important to attract citizens to these recreational areas by strengthening the security and improving not only the recreational facilities but also the access roads.

## **(8) Central Market Zone**

At the moment several large scale markets are scattered within the study area. Around these areas severe traffic congestion continues throughout the day. Among them, it is desired that the wholesale markets be transferred outside the Anillo Periferico, since large number of trucks arrive and depart from there. El Loarque is the best place to construct the wholesale market because the municipality owns sufficient land. The above zoning is shown in Fig.8.2.7.

### **8.2.5 Various Urban Facilities**

The various urban facilities are planned in the Study Area in order to disperse the traffic congestion. The allocation of these urban facilities is shown in Fig. 8.2.8.

#### **(1) Truck Terminal**

Currently, truck terminals of various sizes are located in no particular order along Carretera al Norte, Boulevard Santa Fe, Boulevard Comunidad Europea, etc. At most of these truck terminals, large-size trucks including trailers are coming and going frequently. Therefore, traffic congestion is always occurring around these areas. Considering the origin and destination of these large trucks, they are mostly coming from or going to San Pedro Sula. Therefore, Laguna El Pedregal is recommended as the most suitable place to construct the truck terminal.

#### **(2) Bus Terminals**

Bus Terminals are categorized into two types; one is the urban bus terminal and the other is the inter-urban bus terminal. The former is recommended to be located at the existing automobile inspection place facing Calle La Isla, since it is very close to the central area. The latter bus terminals are located near the entrance points in the suburb from the outside regions. The recommended places are as follows;

- Calle Isala near the National Stadium for the intra-urban bus terminal
- Boulevard Santa Fe inter-urban bus terminal for the north direction (San Pedro Sula, Comayagua, Olancho, etc.)
- Avenida Los Proceres inter-urban bus terminal for the east (Valle de Angeles, San Juancito, etc.)
- Boulevard Miraflores inter-urban bus terminal for the southeast (Danli, etc.)
- Boulevard Cominidad Europea bus terminal for the south (Choluteca, Punta Raton, Nicaragua, El Salvador, etc.)
- Central inter-urban bus terminal for changing inter-urban buses (near the grade separation of Boulevard Fuerzas Armadas and Boulevard Comunidad Europea)

#### **(3) Market**

At the moment small and large markets are scattered here and there within the CBD area. Especially around wholesales markets, the traffic congestion is quite severe because of many large tracks. In order to avoid trouble caused by these large trucks, it is

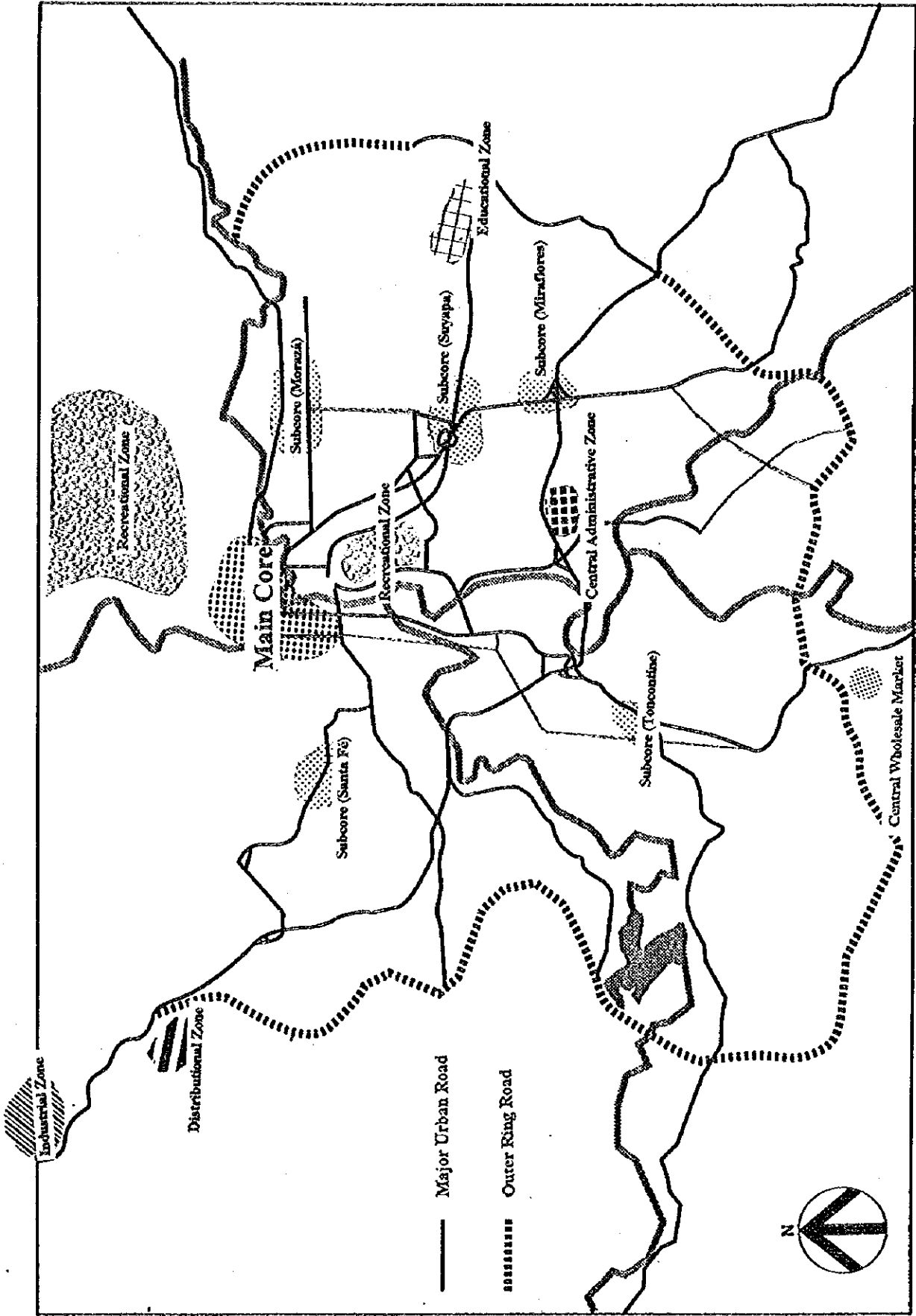


Fig. 8.2.7. Zoning of Land Use

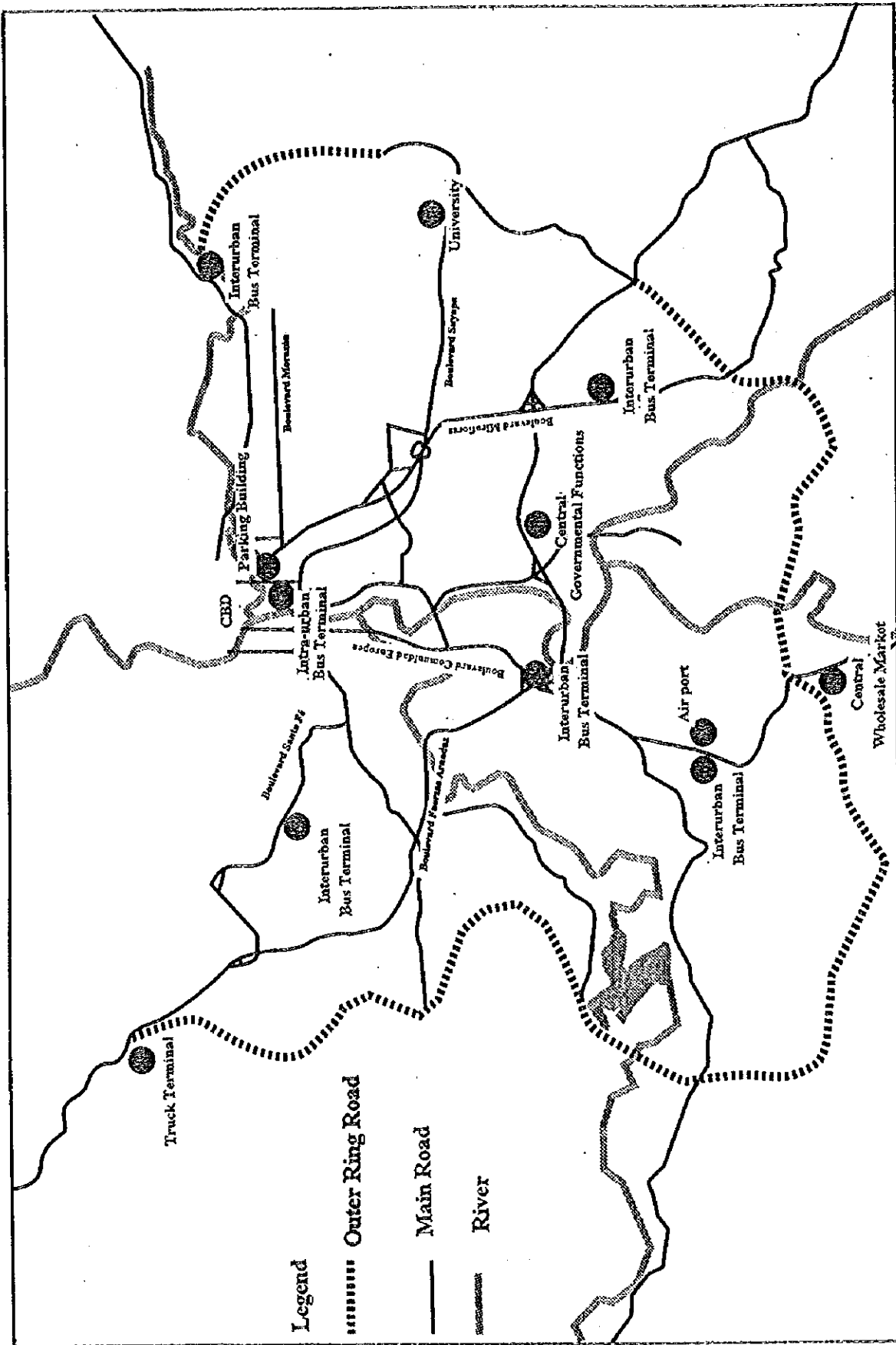
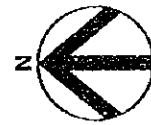


Fig. 8.2.8 Allocation of urban Facilities



recommended to construct a large market outside Anillo Periferico near Colonia Altos de Loarque since this land is owned by the municipality.

#### **(4) Parking Building**

Large-scale parking buildings are necessary to be constructed near the central area of Tegucigalpa in order to restrain the inflow of vehicles into the central area of Tegucigalpa. Since the municipality owns a tract of land just outside the central area (Calle La Isla), such a parking building is recommended to be constructed there.

### **8.3 Image of Future Urban Structure**

#### **8.3.1 Concept of Future Urban Structure**

Based on the aforementioned development pattern, the distribution of population and workers, future land use and the allocation of urban facilities, the concept of the future urban structure of the study area was formulated by the following basic concept;

##### **<<Concept>>**

- ① To distribute various functions located in the central area of Tegucigalpa to the outside of this area
- ② To foster sub-core districts
- ③ To develop new residential areas in an orderly manner
- ④ To establish the efficient transportation system

#### **8.3.2 Structural Image of the Urban Structure of the Study Area**

Based on the above concept together with the future land use, the location of urban facilities and the distribution of future population and workers, the following urban structural transportation networks should be strengthened;

##### **(1) Inter-urban principal arterial road**

This road is utilized as a nationwide principal road connecting the study area with other major regional cities such as San Pedro Sula, Danli, etc. In addition, in the study area this road takes a role of connecting multiple nuclei.

##### **(2) Intra-urban principal arterial roads**

These are major transportation axes connecting the following two points;

- West - east transportation axis connecting sub-cores of west and east
- North - south transportation axis connecting the central area of Tegucigalpa with the sub-core near airport and the southern part of the study area



### **(3) Principal roads**

These are principal radial urban roads within the study area connecting the center of Tegucigalpa with sub-cores and the central governmental area. Therefore, most of these roads formulate the radial roads from the center of Tegucigalpa.

### **(4) Ring roads**

Three ring roads are formulated in the network;

- Inner ring road to mitigate the traffic congestion or avoid the through-traffic within the center of Tegucigalpa
- Middle ring road to complement the west-east transportation axes as well as to exclude the through-traffic in the CBD area
- Outer ring road to facilitate the access from the central area and sub-cores to the newly developing residential areas outside the Anillo Periférico

The future urban structural image including the land use pattern and the structural transportation network is shown in Fig. 8.3.1.

### **8.3.3 Future Image of the Structure of the Central Area of Tegucigalpa**

The central area of Tegucigalpa is the face of not only the study area but also of Honduras. Although this area is already overcrowded by many vehicles, various activities continue to be introduced into this area. As suggesting by the policy of the municipality, through distributing the central administrative functions and office facilities toward the outside of this area, this area is required to be redeveloped as follows;

#### **(1) To make clear the characteristics of this area as a district of historical, cultural, tourist and recreational district.**

- To preserve not only the historical buildings but also residences
- To transfer the central administrative functions
- To disperse the office facilities

#### **(2) To improve the infrastructure from the viewpoint of the pedestrians**

- Introduction of pedestrian-only way
- Introduction of transit mall
- Introduction of community road

#### **(3) To improve the access by the public transportation**

- Introduction of exclusive bus way
- Construction of a bus terminal adjacent to the CBD

#### **(4) To exclude the through traffic**

- Construction of inner and middle ring road

**(5) To attract tourist and citizens**

- **Modernization of entertainment facilities such as restaurants, shopping complex, etc.**
- **Improvement of recreational facility**

The image of the future structure of the central area of Tegucigalpa is shown in Fig. 8.3.2.

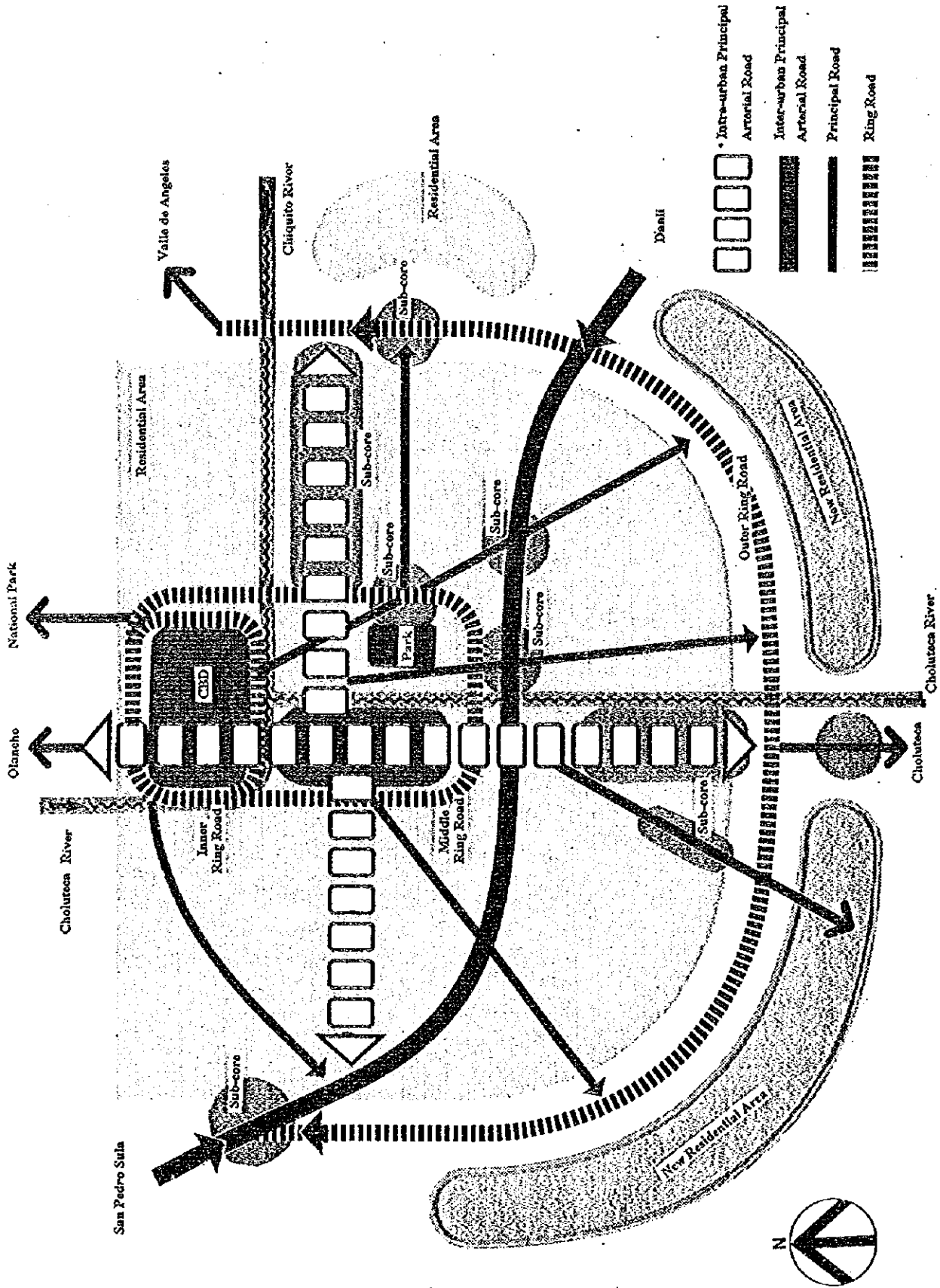


Fig. 8.3.1 Image of the Future Urban Structure

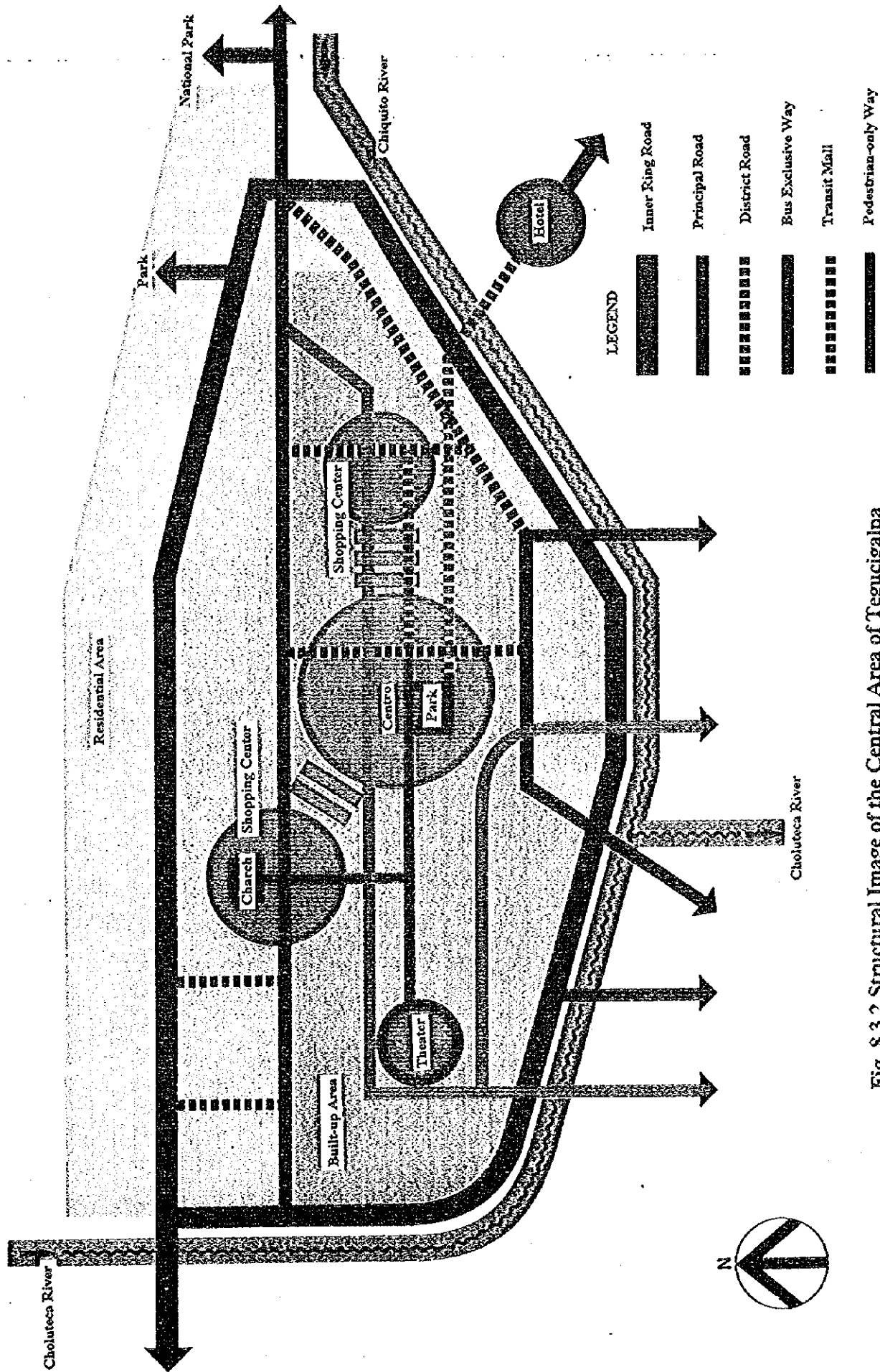


Fig. 8.3.2 Structural Image of the Central Area of Tegucigalpa

## **CHAPTER 9**

# **FUTURE TRAFFIC DEMAND**



The above four-step method was applied only for the intra-trips by persons living within the study area. As for trips by persons without the study area and trips made outside the study area were projected by the simple growth rate method. Since the number of outside trips is very small (about 2% of the total trips), this exerts almost no influence upon the accuracy of forecast.

## 9.2 Socioeconomic Framework

In order to forecast the future traffic demand, the future socioeconomic framework is necessary to be set. Although main socioeconomic indicators are explained in Chapter 8, these indicators are summarized here as necessary for forecasting the future traffic demand.

### (1) GDP

The past GDP of Honduras has been for the most part increasing with an annual growth rate fluctuating from -1.4 % to 6.2 % per annum during the past 7 years, as shown in Table 9.2.1. The average growth rate was 2.9 % per annum from 1989 to 1995.

**Table 9.2.1 GDP from 1989 to 1995**

(Unit : Million Lempiras)

Year	1989	1990	1991	1992	1993*	1994*	1995*
GDP	5,161	5,166	5,334	5,634	5,985	5,901	6,113
Growth Rate	4.3	0.1	3.3	5.6	6.2	-1.4	3.6

Note: 1978 constant price

\* Not final

It is very difficult to estimate the future growth rate from the past trend of Honduran economy, because the Honduran economy has been affected by the world economic situation. Through discussion with staff of the Central Bank of Honduras, it was agreed that 3 - 5 % was reasonable to be set as a future growth rate of Honduras. However, considering that at this moment there seem to be no bright perspectives for the future world economic situation, the study team set the future annual growth rate of 3.0 %.

There were no economic indicators related to the study area. However, judging from the positive aspect that the study area leads the nation's economy and the negative aspect that recently most of the industry is developed outside the study area (San Pedro Sula and Amaratéca), the economic growth rate in the study area is also set at 3 %.

### (2) Population and number of households

The population of the entire republic is forecast by SECPLAN until 2010. However, there is no information of the future population of the study area. Therefore, based on the 1988 census data, at first the population of study area in 1995 was estimated by the Cohort survival model. Then, this estimation was modified by examining the land use area measured from the existing land use map made by the study team. The future population in the study area was also projected by the Cohort survival method and the future land use map. As a result, the population of the study area was estimated as shown in Table 9.2.2.

Based on the past trend of the family size, the future average family size was assumed 4.13 persons per family. The number of household is also shown in Table 9.2.2.

**Table 9.2.2 Future Population and Number of Households in the Study Area**

	Items	1995	2010	Expansion Rate
Population	Study Area	674,920	872,083	1.29
	Honduras	5,462,795	7,648,997	1.40
Household	Number	150,880	211,158	1.40
	Members	4.47	4.13	0.92

**(3) Number of Workers**

The number of workers was projected, at first step, with the location quotient methods, then modified land use classification. The projection is shown in Table 9.2.3.

**Table 9.2.3 Number of Workers**

Year	1995	2010	Expansion Rate
Commercial	142,679	214,486	1.50
Industrial	51,642	91,374	1.77
Total	194,321	305,860	1.57

**(4) Land requirement**

The existing land use was surveyed through site reconnaissance survey. On the other hand, the future land requirement was calculated by the process explained in the Chapter 8. The land requirement is shown in Table 9.2.4.

**Table 9.2.4 Land Requirements (Unit: ha)**

Land Use	1995	2010	Expansion Rate
Residential	3,441	4,878	1.42
Commercial	987	1,483	1.50
Industrial	70	123	1.76
Public	539	764	0.71
Total	5,037	7,248	1.44

**9.3 Model Building**

In the four step method, at first, the total trips are forecast, then, the more detailed parts of trips are forecast one after another. This is because the total trips can be forecast much more accurately, compared with the more detailed parts of trips. Therefore, prior to the projection of trip generation and attraction, the total number of trips produced in the whole study area (trip production) were forecast.



### 9.3.1 Trip Production

In this Study the trip production was forecast with the "trip production unit" (defined as the average number of trips per day per person). In this method it is necessary for the premise that the trip production unit as individual attributes do not change so much. Here, the following three conditions were examined;

- 1) whether the trip production of individual attributes by zone is stable or not
- 2) whether the population by individual attributes is possible to forecast or not
- 3) whether the significant difference can be found for the composition of population by individual attributes

The above conditions were examined for population by age, population by occupation, population by industry, population by car ownership, etc. As a result, the population by car ownership was adopted.

The analysis of the person trip survey results shows the significant difference of the production unit between the car ownership and non-car ownership for their composition of trip purpose. Therefore, the trip production unit by car ownership and by trip purpose is adopted as an individual attribute. This trip production unit is shown in Table 9.3.1. The trip production unit here is calculated as "gross trip production unit" (The number of trips by individual attributes is divided by the persons including persons who made no trips).

**Table 9.3.1 Trip Production Unit**

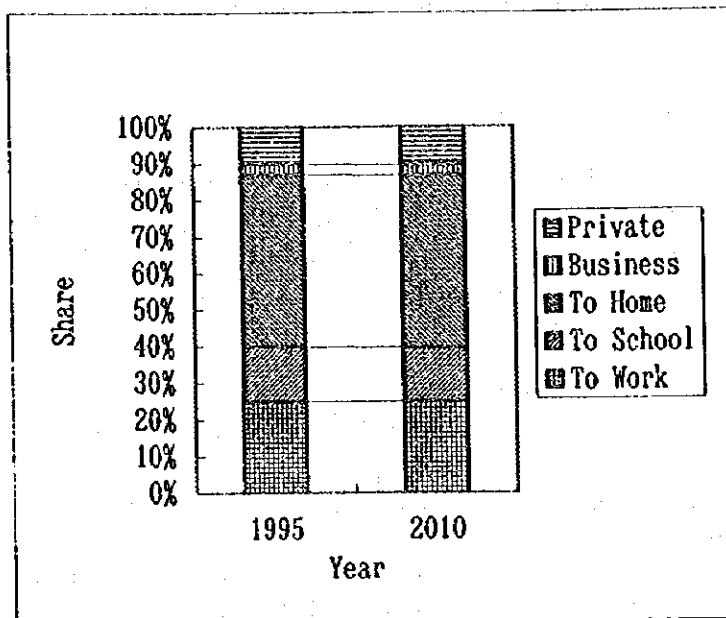
Trip Purpose	Car Ownership	Non-Car Ownership
To Work	1.08	0.64
To School	0.43	0.44
To Home	1.80	1.28
Business	0.19	0.05
Private Matter	0.45	0.26
Total	3.95	2.66

The future trip production by trip purpose was projected by multiplying the future population by the trip production unit. The projection is shown in Table 9.3.2. The total number of trips in 2010 by persons living within the study area was projected at about 2.37 million trips (about 1.75 million trips in 1995). The expansion rate was 1.36 times, compared with that in 1995. The expansion rate of trips made by persons belonging to car-owning households was 2.12, considerably high, compared with 1.12 of non-car-owning households. The share of the trips made by persons belonging to car owning households increased from 27.9 % in 1995 to 36.5 % in 2010, reflecting per capita income increment. Fig. 9.3.1 and 9.3.2 show the future trip production by purpose and by mode, respectively.

**Table 9.3.2 Future Trip Production By Trip Purpose**

(Unit: Trips)

Trip Purpose/ Year	1995			2010		
	Car-Owning	Non-Car-Owning	Total	Car-Owning	Non-Car-Owning	Total
To Work	111,578 (27.3%)	320,418 (23.9%)	431,996 (24.7%)	236,410 (27.3%)	359,762 (23.9%)	596,172 (25.1%)
To School	44,482 (10.9%)	219,895 (16.4%)	264,377 (15.1%)	94,248 (10.9%)	246,630 (16.4%)	340,877 (14.4%)
To Home	185,997 (45.5%)	644,762 (48.0%)	830,759 (47.5%)	394,088 (45.5%)	724,050 (48.1%)	1,118,138 (47.2%)
Business	19,743 (4.8%)	24,898 (1.9%)	44,641 (2.6%)	41,831 (4.9%)	27,718 (1.8%)	69,549 (2.9%)
Private	46,708 (11.4%)	130,772 (9.8%)	177,480 (10.1%)	98,964 (11.4%)	147,073 (9.8%)	246,037 (10.4%)
Total	408,508 (100%)	1,340,745 (100%)	1,749,253 (100.0%)	865,542 (100%)	1,505,232 (100%)	2,370,774 (100.0)



**Fig. 9.3.1 Future Trip Production by Purpose**

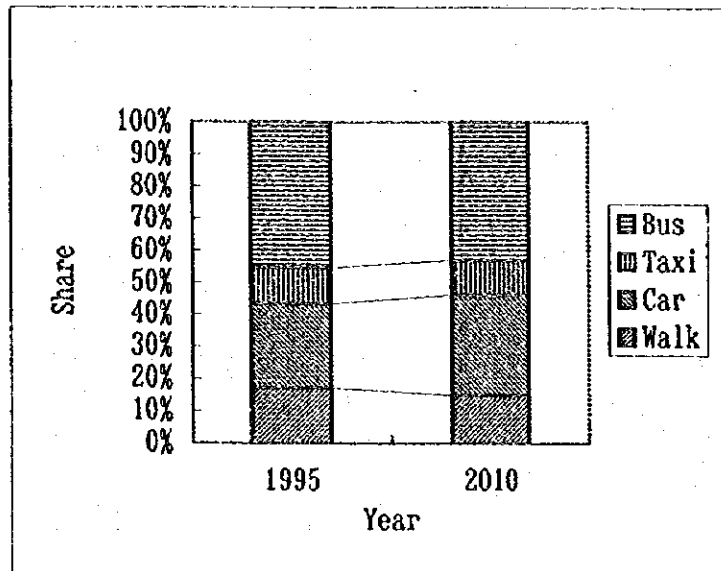


Fig. 9.3.2 Future Trip Production by Mode

### 9.3.2 Trip Generation and Trip Attraction Model

The trip generation and attraction by zone were projected by car ownership and by trip purpose with the regression analysis. The explanatory variables of this regression analysis were adopted from among socio-economic data such as population, number of employees, students, etc. The explanatory variables and model parameters are shown in Table 9.3.3. The symbols used in this table represent the following meaning;

- P<sub>n</sub> : Number of persons belonging to the non-car-owning household
- P<sub>c</sub> : Number of persons belonging to the car-owning household
- S<sub>s</sub> : Total number of students and pupils
- S<sub>n</sub> : Number of students and pupils belonging to the non-car-owning household
- S<sub>c</sub> : Number of students and pupils belonging to the car owning household
- W<sub>3c</sub> : Number of tertiary industrial workers belonging to the car-owning household
- W<sub>tc</sub> : Total number of workers belonging to the car-owning household
- E<sub>3</sub> : Number of tertiary employees by place of work
- E<sub>t</sub> : Total number of employees by place of work
- G<sub>i</sub> : Trip generation of zone i
- A<sub>j</sub> : Trip attraction of zone j
- R<sup>2</sup> : Multiple correlation coefficient

**Table 9.3.3 Model Structure of Trip Generation and Trip Attraction**

Attributes	Generation/Attraction	Trip Purpose	Regression Model	R <sup>2</sup>
Car Ownership	Generation	To Work	$G_i = 1.362 \times W_{c3} + 0.038S_s + 188$	0.922
		To School	$G_i = 0.763S_c + 30$	0.904
		To Home	$G_i = 0.057S_s + 0.667E_2 + 0.582E_3 + 248$	0.940
		Business	$G_i = 0.109W_{tc} + 0.044E_1 + 28$	0.921
		Private Matter	$G_i = 0.270P_c + 0.047E_1 + 10$	0.852
	Attraction	To Work	$A_j = 0.199E_2 + 0.459E_3 + 31$	0.953
		To School	$A_j = 0.173S_c + 0.301S_s - 350$	0.877
		To Home	$A_j = 1.206P_c + 432$	0.904
		Business	$A_j = 0.078E_3 + 1$	0.918
		Private Matter	$A_j = 0.144P_c + 0.151E_3 - 88$	0.924
Lack of Car Ownership	Generation	To Work	$G_i = 0.602P_n + 418$	0.940
		To School	$G_i = 1.176S_n + 354$	0.927
		To Home	$G_i = 0.924S_s + 1.967E_1 - 681$	0.977
		Business	$G_i = 0.018P_n + 0.049E_3 + 39$	0.880
		Private Matter	$G_i = 0.190P_n + 0.091E_1 + 111$	0.887
	Attraction	To Work	$A_j = 1.367E_1 - 323$	0.994
		To School	$A_j = 1.018S_s - 79$	0.975
		To Home	$A_j = 1.242P_n + 637$	0.951
		Business	$A_j = 0.108E_3 + 12$	0.946
		Private Matter	$A_j = 0.450E_3 + 15$	0.940

Generally, the summation of the trip generation or the summation of trip attraction of each zone is not equal with the aforementioned trip production. Therefore, the zonal trip generation or trip attraction is corrected to be equal with the trip production, with the rate of "summation of zonal trip generation / trip production" for the trip generation and the rate of "summation of trip attraction / trip production". The projected trip generation and attraction by zone is shown in Table 9.3.4.

Fig. 9.3.3 shows the volume and growth of trip generation, comparing the future trip generation and the existing trip generation. As can be seen in this figure, a large volume of person/trips is generated in the central areas of Tegucigalpa and Comayagüela, and in zones along Boulevard Santa Fé. On the other hand, the large increase of trip generation can be seen in zones of suburban area, especially, the western and southern areas of the study area.

Table 9.3.4 Future Trip Generation and Attraction by Zone  
(Unit: Trips)

Zone	Trip Generation					Total	Trip Attraction					Total
	To Work	To School	To Home	Business	Private		To Work	To School	To Home	Business	Private	
1	3801	2148	36318	1135	5096	48196	23113	5318	7929	1734	8095	46187
2	1850	791	113222	3294	6744	125901	77954	12231	2955	5822	26911	125313
3	2800	1507	17787	529	1800	24223	9089	6103	5215	676	3132	24215
4	3853	2373	2631	914	1334	10518	1091	691	7958	265	459	10504
5	6913	4228	4398	583	2476	18566	2182	993	13782	508	1139	18582
6	3147	1925	1349	245	1052	7717	647	384	6125	197	364	7717
7	4873	2954	6568	447	1827	16697	3198	1938	10085	375	1111	16706
8	3643	2248	2179	297	1247	5614	1154	471	7250	232	518	5605
9	4285	2181	25751	1017	2941	38185	17589	1997	8715	1313	6871	36185
10	3378	1801	40691	1358	3400	50626	29319	2888	7059	2143	10181	50636
11	2768	1848	6242	289	1100	11042	2948	947	5919	257	892	11056
12	1512	879	7638	265	892	11434	5389	265	3742	378	1621	11395
13	4871	2987	10489	567	2172	21086	8848	714	10331	577	2823	21091
14	4820	2864	55089	1664	4442	68879	36055	7126	10320	2741	12040	68882
15	5928	3490	53960	1831	4734	69743	34710	8653	12839	2504	11833	69739
16	8000	4695	12250	683	2813	28443	3349	9039	14152	496	1414	29453
17	4841	3068	3492	414	1706	13521	1998	683	9730	341	801	13533
18	6210	3928	12239	823	2914	23714	7954	803	11434	707	2780	23708
19	23893	15597	10103	1929	8133	59545	4141	4515	45837	1517	3652	59682
20	8604	5955	29058	1308	4801	50722	19228	1714	21200	1485	7107	50734
21	20292	13330	15894	1783	7238	58597	7858	4478	41176	1525	3569	58602
22	9534	5802	34375	1330	4933	55874	20269	6811	20436	1452	6923	55891
23	5412	3422	4068	472	1947	15321	2284	784	11011	368	899	15326
24	5872	3606	3627	476	1987	15302	1830	803	11504	374	852	15309
25	4127	2664	2008	317	1322	10438	738	910	8095	230	482	10455
26	4106	2479	3001	330	1411	11287	1116	1287	7993	287	595	11288
27	4318	2582	6132	433	1634	15145	3284	1187	9304	335	1054	15184
28	3700	1812	1634	431	1353	8930	723	722	6418	350	742	8925
29	6498	3240	8116	733	2574	21161	2992	4179	11872	631	1453	21143
30	3273	1618	2892	384	1287	8464	1738	358	6017	345	972	8466
31	1587	799	40181	1332	2820	48689	29728	650	3234	2307	10780	48710
32	2035	1211	3768	212	792	8018	2269	424	4270	199	654	8018
33	2555	1356	21126	781	2018	27818	14685	1334	5376	1117	5335	27827
34	3726	1834	24887	1061	2787	34255	17943	654	7511	1334	6814	34258
35	5945	2847	7087	788	2474	19141	3649	2150	10542	889	2118	19140
36	4387	2980	28923	1034	3068	39792	19483	2474	9369	1441	7026	39783
37	8190	3886	18260	784	2958	34179	3449	16443	11967	566	1744	34169
38	20709	12415	8370	1858	6918	50288	2178	9535	34517	1345	2695	50272
39	6427	3910	2800	522	2141	15800	886	1629	11989	429	872	15805
40	11996	6543	14989	1217	4584	39329	5014	8217	21715	1005	2382	39333
41	1569	1002	2526	157	614	5968	1599	187	3503	138	551	5962
42	2778	1745	5796	313	1174	11806	3821	375	6144	314	1152	11806
43	8087	5299	2874	625	2664	19349	1304	1102	15454	470	1029	19354
44	3386	2177	7153	365	1359	14440	4255	1189	7118	428	1454	14441
45	1465	794	1272	110	461	4102	451	437	2921	89	211	4109
46	6472	4223	2377	500	2114	15696	1106	883	12500	379	812	15690
47	19892	12687	22918	1886	7676	65139	12192	5615	41136	1683	4819	65145
48	8383	3645	22021	1032	3383	38444	5827	16919	11752	830	3124	38452
49	9513	2593	59809	599	2270	74784	3437	63659	5887	344	1462	74789
50	4073	1881	7822	438	1590	15834	2390	5238	8417	414	1375	15834
51	6855	4477	1483	509	2187	15519	829	686	12621	385	802	15523
52	14401	8598	9500	1258	5025	38882	2818	6341	26452	1003	2257	38881
53	8426	4333	8564	972	3427	25722	4491	2290	15508	823	2618	25728
54	21090	10692	23824	2619	9036	87061	13550	5115	38535	2235	7625	87060
55	5743	3640	5950	536	2178	18047	3678	818	11575	474	1440	18055
56	14494	8874	21745	1427	5814	52154	10649	7179	28976	1128	4207	52138
57	5078	3178	2124	396	1701	12477	875	684	9938	327	658	12482
58	8834	6049	23171	1154	4376	44584	13412	4361	20635	1174	4992	44574
59	8816	5423	1761	748	2931	19677	951	1173	15836	592	1138	19684
60	8428	4222	4421	1025	3292	21388	2425	1278	15016	831	1832	21382
61	15090	9527	18522	1435	5857	50431	9733	4238	32139	1179	3143	50432
62	21024	10156	24349	2793	9011	67333	12853	7806	38097	2426	8155	67337
63	21731	10843	11755	2760	8630	55719	8036	4773	37281	2183	5422	55695
64	25252	12158	10876	3354	9969	61809	6059	6049	41349	2580	5571	61808
65	5516	3482	10083	588	2280	21949	8200	1049	11918	606	2171	21942
66	8790	5668	2374	686	2921	20439	1273	1178	16299	532	1155	20437
67	7758	4835	17543	896	3370	34396	10105	3380	16409	607	3580	34391
68	55298	34359	48719	4237	17828	160838	7029	49780	93527	3064	7161	160861
69	1177	722	517	84	292	2772	147	378	2153	26	53	2755
70	1231	751	1120	78	344	3530	384	513	2458	58	130	3529
71	5204	3331	3500	430	1792	14257	1788	724	10559	365	821	14257
72	3488	2171	3651	298	1190	10788	1519	1452	7050	298	523	10780
73	1512	952	518	88	402	3472	175	126	2981	45	118	3455
74	9780	6326	5493	796	3309	25706	2088	2538	19029	619	1434	25708
75	0	0	2805	0	0	2805	1795	870	0	14	125	2804
76	0	0	507	0	0	507	506	0	0	0	0	506
77	0	0	9	0	0	9	5	1	0	0	0	6
78	0	0	169	0	0	169	168	0	0	0	0	168
79	0	0	1844	0	0	1844	1699	84	0	119	0	1882
80	0	0	4177	0	0	4177	2619	1385	0	125	29	4158
81	0	0	652	0	0	652	656	0	0	0	0	658
82	0	0	1378	0	0	1378	733	413	0	144	105	1395
83	0	0	451	0	0	451	438	0	0	0	3	439
84	0	0	774	0	0	774	768	0	0	3	0	771
85	0	0	146	0	0	146	142	1	0	0	0	143
86	0	0	196	0	0	196	161	0	0	0	23	184
87	0	0	1044	0	0	1044	349	0	0	204	447	1000
88	0	0	476	0	0	476	451	29	0	0	0	480
89	0	0	1166	0	0	1166	1069	0	0	0	111	1180
90	0	0	92	0	0	92	87	0	0	0	0	87
91	0	0	351	0	0	351	345	1	0	0	6	353
92	0	0	0	0	0	0	0	0	0	0	0	0
Total	596379	345245	1114234	70061	245643	2371582	596379	345245	1114234	70061	245643	2371582

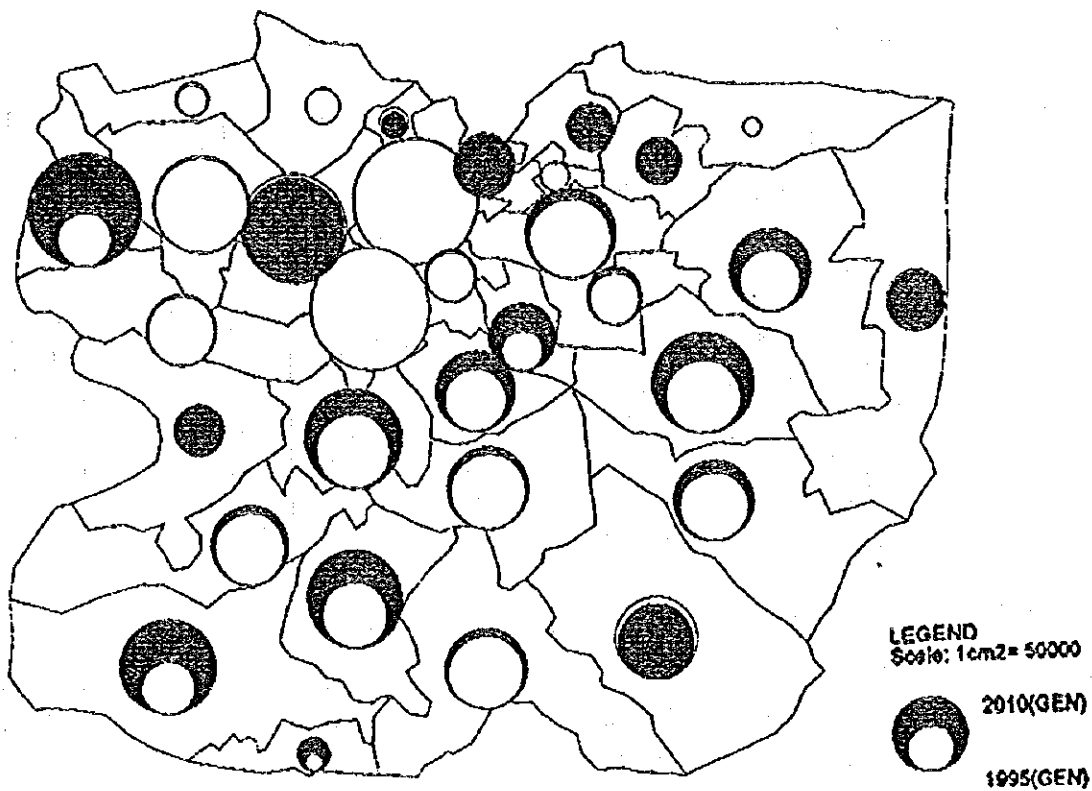


Fig. 9.3.3 Volume and Growth of Trip Generation by Zone

### 9.3.3 Trip Distribution

The trip distribution was forecast for the inter-zone distribution and the inter-zone distribution, separately. The former was to forecast the trips within zones and the latter was to forecast the trips between zones. The following models are employed;

#### (1) Inter-zone distribution Model

The inter-zone trips were forecasted by the following model, assuming that the inter-zone trips increase proportionally due to the scale of the trip generation, trip attraction or zone area. The model is as follows;

$$T_{ij} = k \cdot G_i^\alpha \cdot A_j^\beta \cdot R_i^\gamma$$

Where;  $T_{ij}$  : Inter-zone trips  
 $G_i^\alpha$  : trip generation of i zone  
 $A_j^\beta$  : Trip attraction of j zone  
 $R_i^\gamma$  : Area of i zone  
 $k, \alpha, \beta,$  and  $\gamma$  : Parameters

Table 9.3.5 shows parameters of the above model.

**Table 9.3 5 Parameters of Inter-zone Distribution Model**

Attributes	Purpose	k	$\gamma$	$\alpha$	$\beta$	R <sup>2</sup>
Car Owning	To work	0.3432	-0.0832	0.5483	0.2541	0.657
	To School	0.4410	0.4328	0.6064	0.2842	0.821
	To Home	0.0538	0.3908	0.3934	0.6903	0.830
	Business	6.1685	-0.0019	0.0895	0.3953	0.753
	Private	0.5302	0.4149	0.1783	0.6056	0.696
Non Car Owning	To work	0.0166	0.1931	0.8136	0.3602	0.768
	To School	0.0249	0.4185	1.0794	0.1839	0.868
	To Home	0.0083	0.3752	0.2994	1.0103	0.893
	Business	0.7094	0.3748	0.3191	0.4893	0.811
	Private	0.2854	0.1783	0.3921	0.5138	0.782

Note : R<sup>2</sup> indicates Multiple Correlation Coefficient

**(2) Inter-zone Trip Distribution Model**

As a result of trial and error in formulating the inter-zonal trip distribution model, the following Voorhees type gravity model was adopted to forecast the future inter-zonal trip distribution model.

$$T_{ij} = G_i \times \frac{A_j \times D_{ij}^a}{A_j \times D_{ij}^a}$$

- Where, T<sub>ij</sub> : Trip distribution between i and j zone
- G<sub>i</sub> : Trip generation from i zone
- A<sub>j</sub> : Trip attraction to j zone
- D<sub>ij</sub> : Distance between i and j zone
- a : Parameter

Parameters and multiple correlation coefficients are shown in Table 9.3.6.

**Table 9.3.6 Parameters and Multiple Correlation Coefficients of Inter-zone Trip Distribution Model**

Attributes	Purpose	$\alpha$	R <sup>2</sup>
Car-Owning	To Work	0.396	0.803
	To School	0.100	0.820
	To Home	0.296	0.816
	Business	0.124	0.668
	Private	0.568	0.574
Non Car-Owning	To work	0.680	0.870
	To School	0.300	0.701
	To Home	0.332	0.848
	Business	0.436	0.562
	Private	11.072	0.799

### 9.3.4 Modal Split

#### (1) Selection of model

Generally speaking, there are two approaches to the modal split model. One is called "Trip End Model", and the other is "Trip Interchange Model". In the former approach, the modal shares are determined before the estimation of trip distribution. The latter approach is that the modal shares are determined after the estimation of trip distribution. Considering the network improvement in the future, the latter model is desirable for application. Therefore, the trip interchange model is used in this study.

In the person trip survey conducted in this study, eleven (11) transportation modes were utilized. However, since it is too complicated to construct the modal split model for these eleven transportation modes, these modes were simplified to the three modes shown in Fig. 9.3.4.

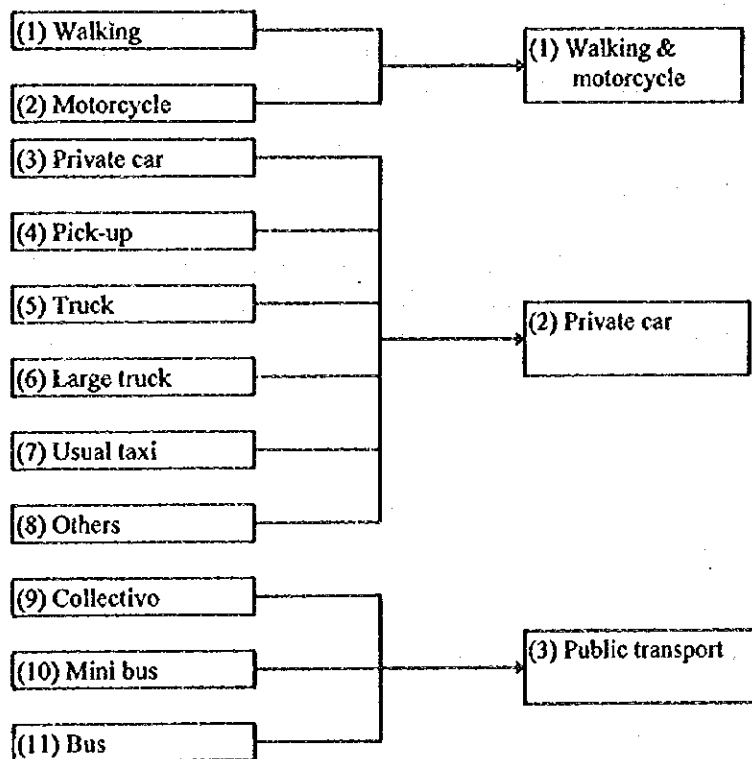
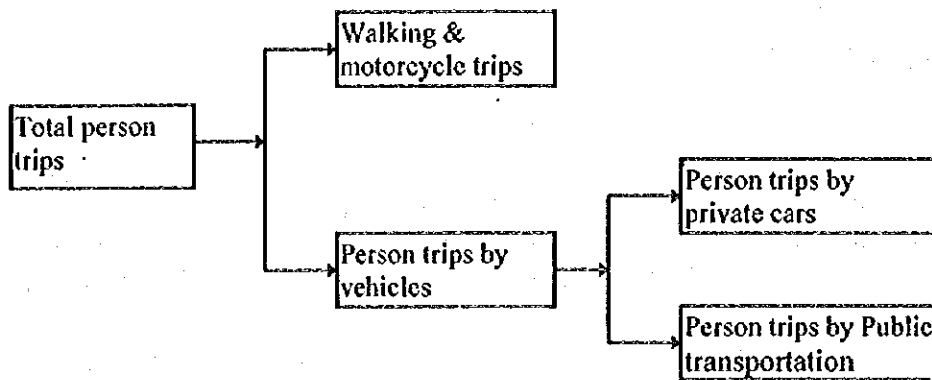


Fig. 9.3.4 Selection of Modes for Modal Split Model

#### (2) Modal Split Model

The trip distribution was split into the above three modes by the binary choice method. The binary choice is applied to the following three stages;





In this modal split model, the models were formulated for trips made by the car-owning persons (precisely speaking, persons belonging to car-owning households) and the non-car-owning persons (precisely speaking, persons belonging to non-car-owning households), since the analysis of the existing structure of the transportation demand identified that the main factor of the modal selection was completely different between the car owning and non-car owning. The modal split models are as follow;

Modal split model for "Walking and Motorcycle"

The share of the walking and motorcycle trips approaches gradually to almost zero at the distance of around 5 km. Therefore, the modal split for walking and motorcycle was modeled by the quadratic exponential curve with the explanatory variables of the distance between zones. The modal share curve is as follows;

$$R_w = a \cdot b^x \cdot c^{x^2}$$

Where,  $R_w$  : Share of walking and motorcycle  
 $x$  : Distance between zones  
 $a, b,$  and  $c$  : Parameters

The parameters of this model are shown in Table 9.3.7.

**Table 9.3.7 Parameters of Modal Split Model for Walking and Motorcycle**

Attribute	a	b	c	R <sup>2</sup>
Car Owning	1.4753	0.0453	1.7019	0.840
Non Car Owning	3.0239	0.0439	1.6101	0.880

Modal split for public transport and private car

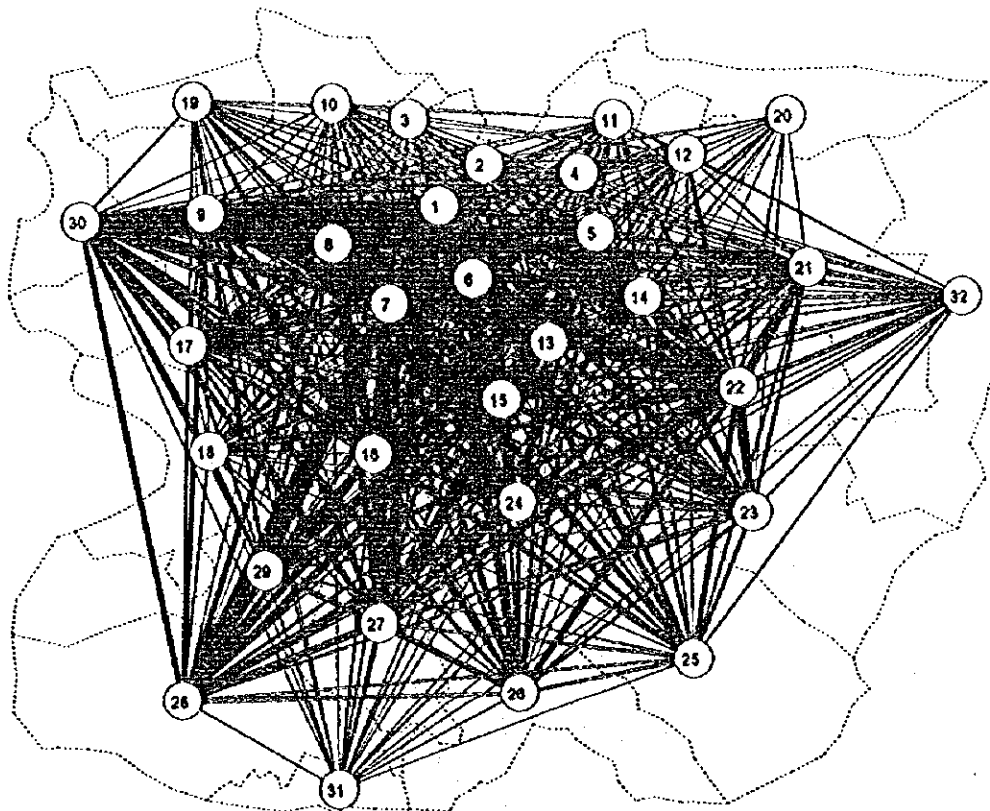
The relationship of the modal share between public transport and private car was examined thoroughly from the various aspects, however, no distinct characteristics could be obtained. Therefore, the existing pattern of modal share between zones was applied.

### Modal split for bus and Collective

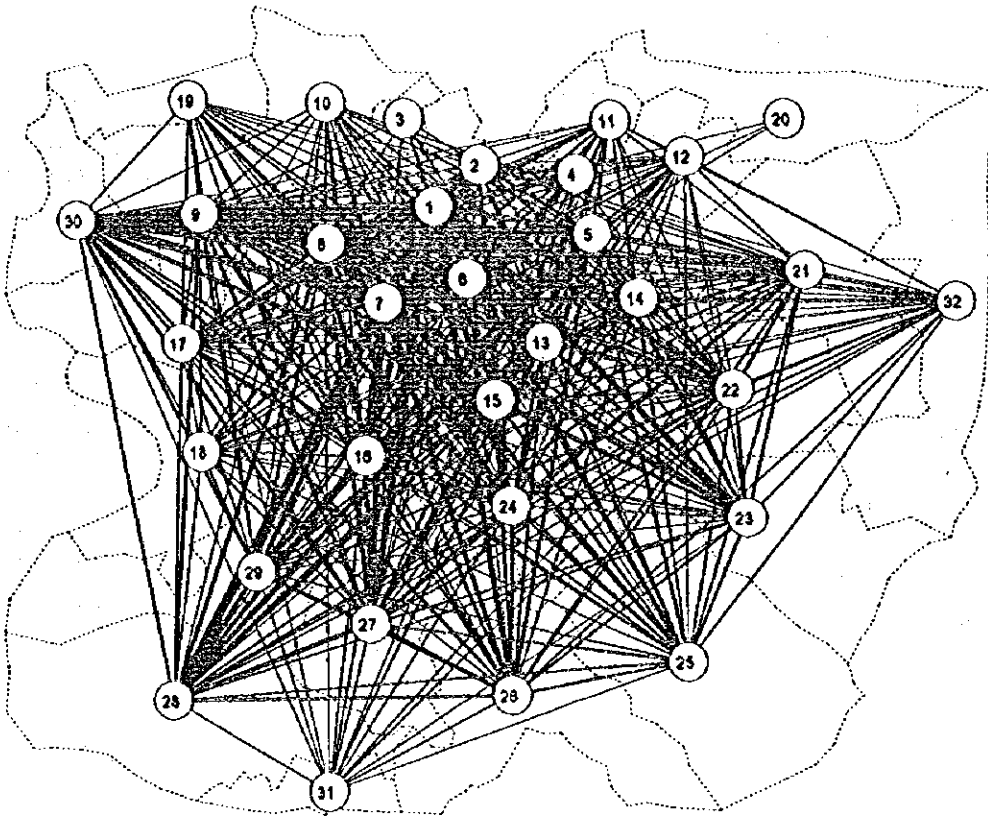
The trial and error was made repeatedly for obtaining passable parameters of the modal split model for bus and Collective (taxi carrying multiple customers), however, no reliable parameters could be estimated. Therefore, as the case of the modal split for public transport and private car, the existing pattern was applied in this modal split.

### (3) Results of the future trip distribution

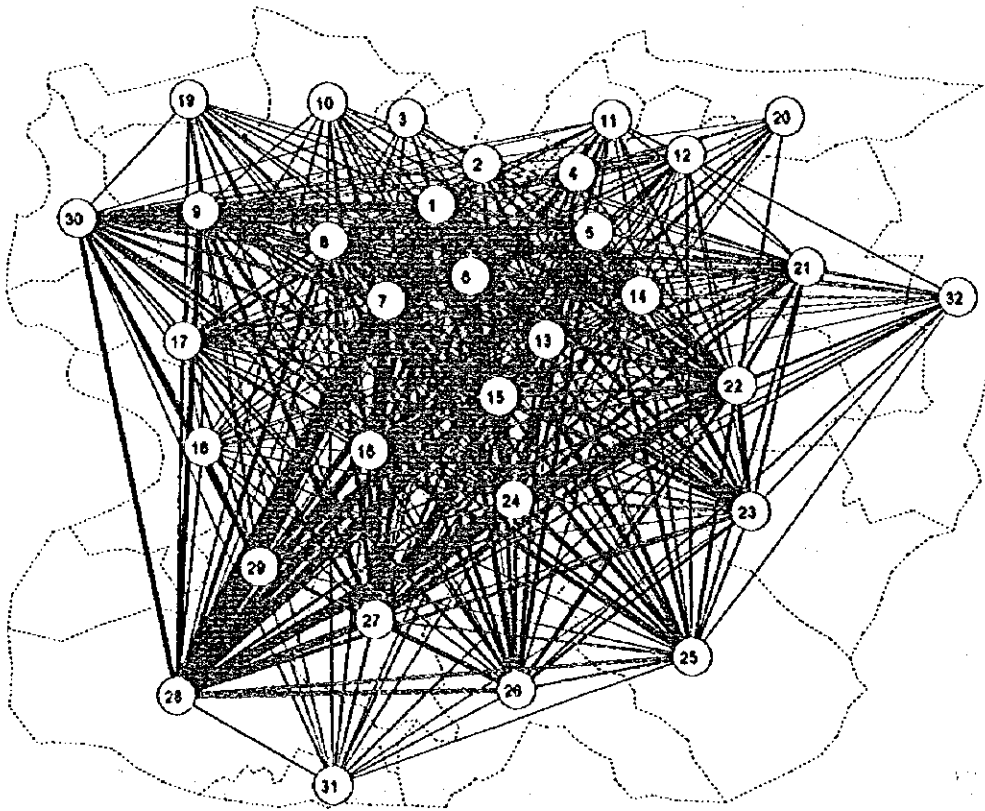
Fig. 9.3.5 (1) shows the total person/trip distribution between integrated traffic zones. As can be seen, the traffic still has a tendency to head to the central area of the study area. However, comparing with the present distribution pattern (See Fig. 5.2.12), the future trip distribution can be said to be dispersed further. The volume of trip distribution is larger between the central area and zones in the western part and between the central area and the southwestern area of the study area. Among these distribution trips, "To Work" trips mainly account for the majority, as shown in Fig. 9.3.5 (2). However, the trip distribution from the western parts is mainly made by "Bus", on the other hand, and the trip distribution from the southwestern part mainly is by "Private car". The trip distribution by "Private car" and "Bus" are shown in Fig. 9.3.5 (3)-(4).



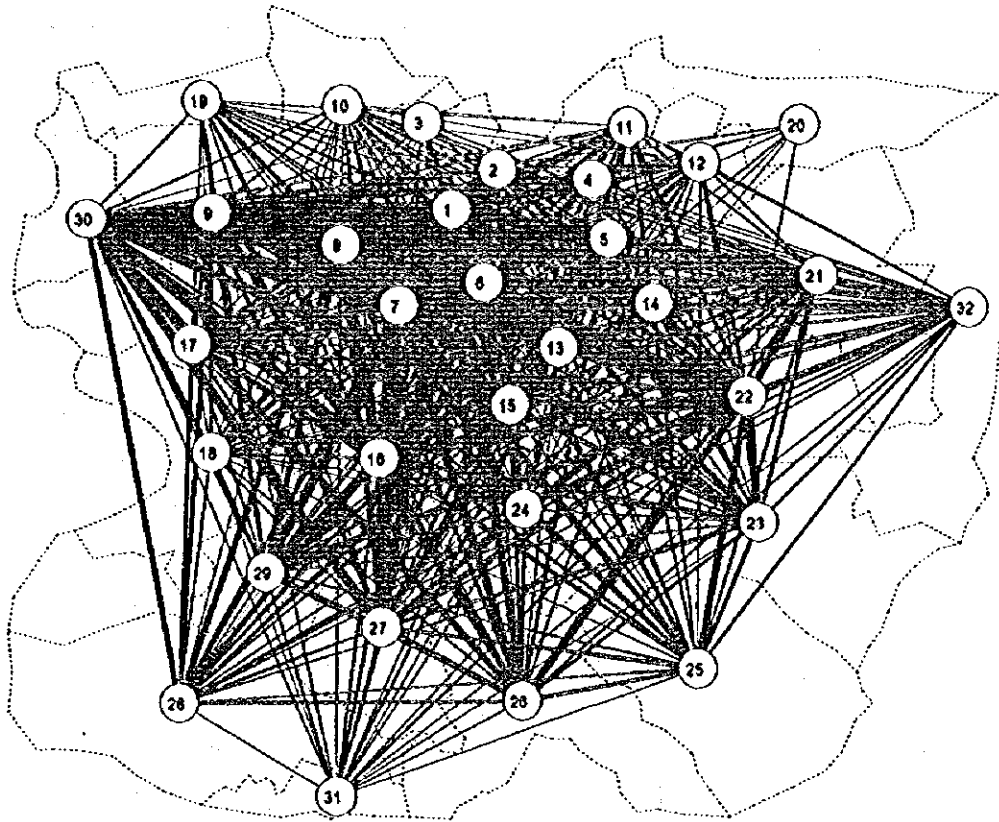
**Fig. 9.3.5 (1) Desired Lines of All Trips in 2010**



**Fig. 9.3.5 (2) Desired Line of Trips "To Work" in 2010**



**Fig. 9.3.5 (3) Desired Line of Trips by "Private car" in 2010**



**Fig. 9.3.5 (4) Desired Line of Trips by "Bus" in 2010**

### **9.3.5 Future OD Table**

The future OD table was formulated by purpose and by mode through the above-mentioned process. The future OD table of all purpose and all modes is shown in Table 9.3.8.

### **9.4 Traffic Assignment Model**

#### **(1) Method of Traffic Assignment**

With the future OD table, each OD trip was assigned on the roads. The QV method was adopted to assign the OD trips. In this method, at first, the minimum time route is searched on the road network for the trips from *i* zone to *j* zone. Then, OD trips are assigned on that minimum time route. If the OD trips are divided, every time the divided OD trips of all OD pairs are assigned on the minimum time route, the travel speed on each road section is re-calculated through the QV curve (Relationship of capacity and velocity of each link) of each road section. These steps are repeated throughout the number of divisions.

Table 9.3.8 Future OD Table

FUTURE OD TABLE TRIP PURPOSES "ALL PURPOSE" IS 2010

Table with 40 columns and 40 rows containing numerical data. The table is rotated 90 degrees clockwise. The columns are labeled 1 through 40, and the rows are labeled 1 through 40. The data represents future OD values for trip purposes in 2010.

## (2) Road network

In order to search the minimum time route from  $i$  zone to  $j$  zone, the road network should be memorized in the computer. For this purpose, the following information was input in the computer;

- Node number
- Link number
- Length of Link
- QV condition (relationship of capacity and velocity of each link)
- Information whether one-way road or two-way road
- Information of bus exclusive way or lane

## (3) QV curve

The QV curve is the relationship between the capacity and the velocity of each link as shown in Fig. 9.4.1. If the traffic volume on a certain link increases, the velocity decreases according to this relationship. In this Study this relationship was set on the basis of the "Highway Capacity Manual".

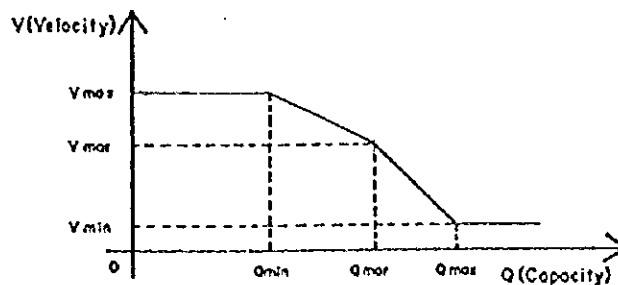
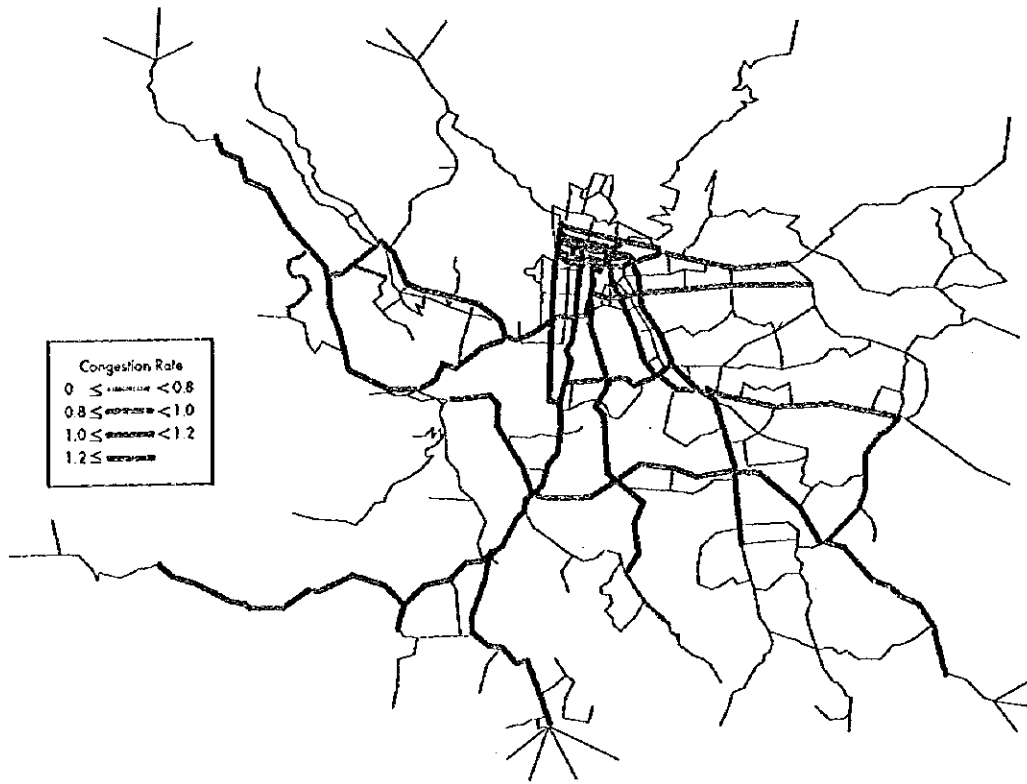


Fig. 9.4.1 Typical QV Curve

## (4) Future Traffic Volume Assigned on Existing Road Network

With the network and QV conditions mentioned above, the future OD traffic volume was assigned on the existing road network, that is, "Do-nothing case". As shown in Fig. 9.4.2, almost all major roads will become congested by 2010. Especially, the traffic from the west to the east through Calle 9 in Comayagutela and Subida to National Stadium, traffic from the central area to the airport direction, or traffic to Colonia Kenedy through Miraflores is forecasted to increase considerably. Therefore, it is necessary to make the urban transportation plan, taking the focus on the above congested roads.



**Fig. 9.4.2 Traffic Assignment of Future Traffic Volume on Existing Road Network**

## **CHAPTER 10**

# **FORMULATION OF MASTER PLAN**





## **CHAPTER 10 FORMULATION OF MASTER PLAN**

### **10.1 Objective and Procedures**

#### **10.1.1 Objective**

The city of Tegucigalpa has a long history: it was founded in 1578 as a base for the exploitation of gold and silver. As being analogized from the gold and silver mine, this city is located in its hilly geographic configuration. Since Honduras became an independent country in 1821, the various governmental functions were gradually transferred from the former capital city, Comayagüa, to Tegucigalpa. In 1880, it was officially designated as the capital city and since then it has developed as the most important and largest city of Honduras. The population at the time of independence was less than 6,000 inhabitants, and by the 1950's reached more than 100,000. Now, Tegucigalpa is the most important urban center with more than 600,000 inhabitants.

Over the course of the city's history and through to the present, many governmental functions (called as Centro), population, business activities, etc., have agglomerated into the city center of Tegucigalpa. However, as seen in Fig. 10.1.1, the urban structure of the center of Tegucigalpa has not changed much since the end of the 18th century. The streets were built for the passage of horse carriages and not for cars, therefore, heavy traffic congestion occurs in every street in the center of the city. On the other hand, since urbanization has sprawled drastically due to the rapid population increase, many urban structural problems have materialized in recent years. Therefore, in this chapter, the Master Plan was established, based on the future development pattern of the urban structure, which can assist in ameliorating these problems and secure a favorable urban environment corresponding to the future urban development described in Chapter 8.

#### **10.1.2 Procedures**

The Master Plan was formulated based mainly on the present urban structure and the future development direction explained in Chapter 8. Therefore, the following procedures were taken to establish the Master Plan (Step 1 to 4 explained in Chapter 8);

**Step 1 - Basic consideration of the Master Plan**

To identify the basic consideration of the Master Plan, considering countermeasures to resolve the existing or future urban problems

**Step 2 - Examination of the past development direction and existing urban structure**

To understand the existing urban structure through the examination of the historical background of Tegucigalpa and the problems on the existing urban structure

**Step 3 - Selection of the future development pattern of the urban structure**

To select the urban development pattern through the comparison of the alternative patterns

**Step 4 - Determination of Urban Structure**

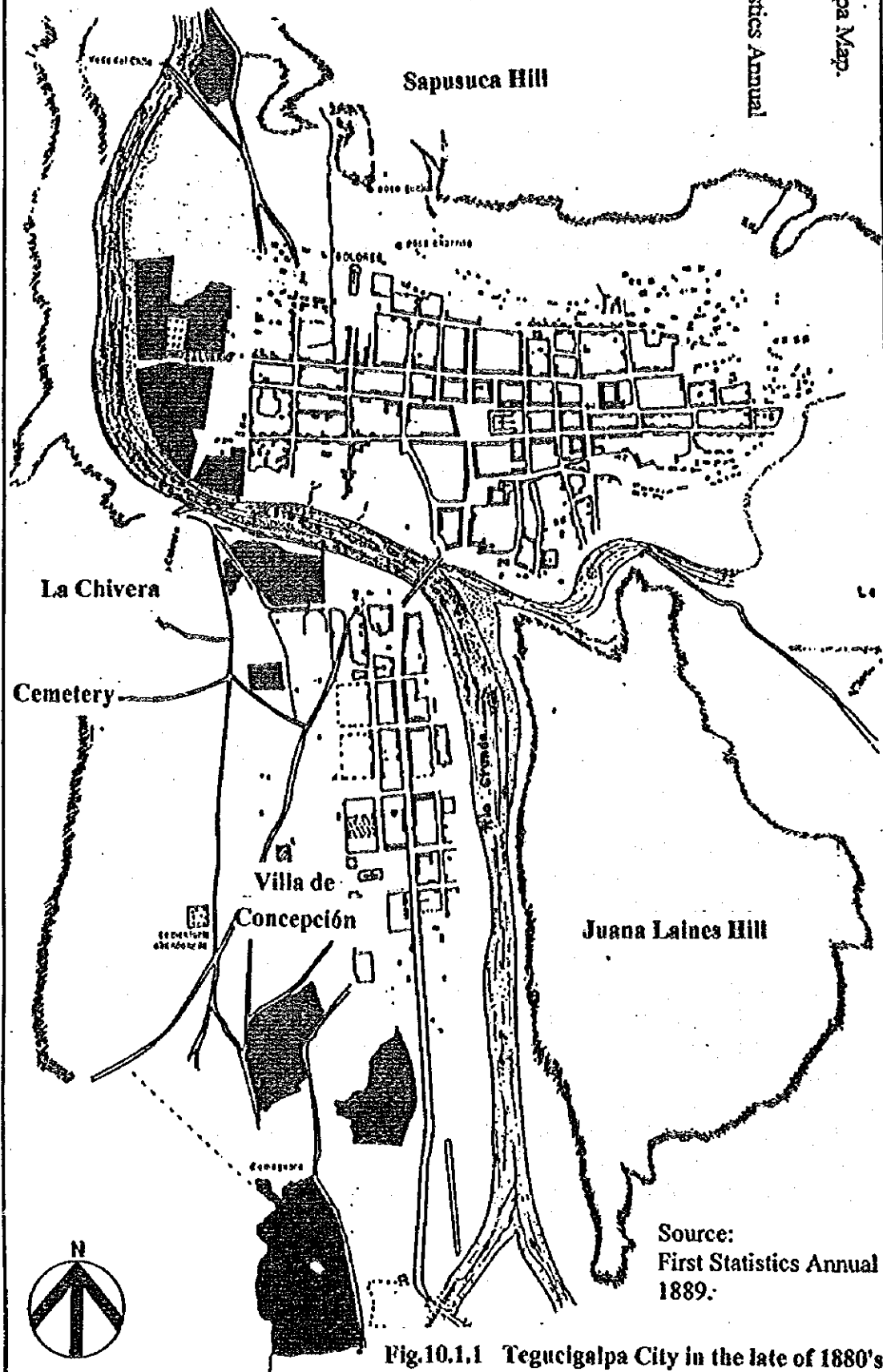
To determine the urban structure under the selected development pattern

**Step 5 - Establishment of Master Plan**

To establish the Master Plan with necessary and feasible projects

Tegucigalpa Map.

Source:  
First Statistics Annual  
1889.



Source:  
First Statistics Annual  
1889.

Fig.10.1.1 Tegucigalpa City in the late of 1880's

## 10.2 Basic Consideration of the Master Plan

Through the thorough examination of the present situation of the study area, based on the analysis of various survey results implemented by the study team, the basic consideration of the Master Plan was identified. This consideration mainly depends on the characteristics of being a capital city and a center of administration, business, culture, etc. of the country.

### 10.2.1 Position of the Study Area

The study area is located in a southern inland part of the country's territory, and takes its role as the center of politics, business, culture, etc., as the capital city of Honduras. Although the amount of inhabitable land in this study area is insufficient due to its hilly topographic features, many people have continued to concentrate into this area from rural areas. In addition, various central administrative functions and economic agglomeration have been strengthened in this metropolitan area more and more as a core city of Honduras. Therefore, all of the transportation axes start from this area to the after regional centers of Honduras. Fig.10.2.1 shows the location of these nationwide transportation axes.

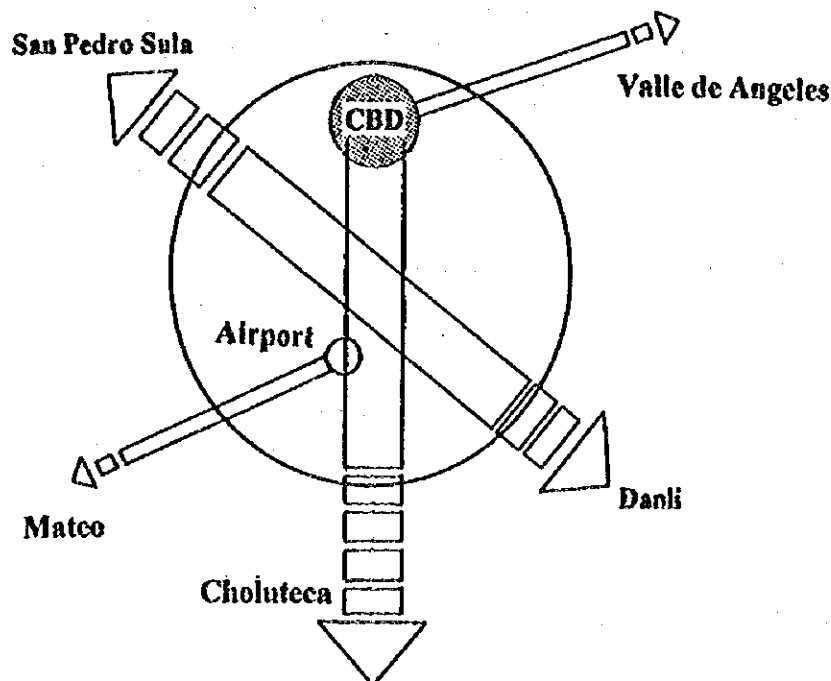


Fig. 10.2.1 Position of the Study Area in Honduras

### 10.2.2 Basic Consideration

In the study area, the living environment of the citizens has deteriorated year by year due to disorderly urban sprawl caused by the perpetual inflow of people from other regions a proper city plan and job opportunity. Therefore, it is desirable to reconstruct the city to this city which lacks so that citizens can enjoy a decent living, working and recreational environment. To this purpose, it is necessary to formulate the Master Plan realizing a high standard of various functions of administration, business, culture, recreation, education, etc., considering the future urban structure.

From this viewpoint, the following basic considerations were identified for the future of the study area;

### <<Basic Consideration of the Master Plan>>

- ① Formulation of the central administrative center as capital city:  
To transfer the various governmental organizations remaining in the Centro to the governmental area near the Presidential Palace for the smooth operation of the central administrative function as capital city of Honduras as well as for the decrease of traffic congestion in the central area of Tegucigalpa.
- ② Proper relocation of business facilities:  
To allocate the industrial and commercial facilities properly outside the Centro to revitalize the economic activities and to create job opportunity.
- ③ Creation of a comfortable living environment:  
To provide a comfortable living environment by improving the basic infrastructure such as housing and roads, an attractive urban landscape and basic services.
- ④ Formulation of base city for culture, education and recreation:  
To foster the national, cultural, educational, and the recreational function so as to be able to enjoy urban life in comfort.
- ⑤ Formulation of nationwide transportation axes:  
To strengthen the nationwide transportation axes by improving access roads from other regions.

## **10.3 Issues and Basic Idea of Countermeasures**

### **10.3.1. Issues to be solve**

From the results of the future traffic demand forecast in Chapter 9, the following goals were set in regards to transportation problems occurring in the study area in the future;

#### **(1) Tegucigalpa Centro**

- To mitigate congestion
- To eliminate through-traffic
- To secure pedestrian safety
- To promote the utilization of the public transportation
- To control on-road parking

#### **(2) Comayagüela Centro**

- To make the efficient use of Avenida 6
- To improve the principal west-east transportation axes
- To control on-road parking

#### **(3) Transportation Network**

- To improve certain sections of principal radial roads

- To improve access roads to the CBD area from the planned transportation facilities such as bus terminals, truck terminals, parking, etc.
- To strengthen the access to the airport and the new central administrative district
- To connect principal radial roads with Anillo Periferico (outer ring road) effectively
- To construct bridges at necessary places
- To improve the configuration at the necessary intersections

#### (4) Public Transportation

- To introduce the exclusive bus lane and way
- To secure the bus U-turn areas on the bus routes in the suburban areas
- To construct the bus bays on the necessary roads
- To rearrange the taxi stands (for "Colectivo") in the CBD

#### (5) Traffic Management

- To install traffic signals at necessary intersections
- To strengthen control of on-road parking
- To improve traffic lanes, traffic signs, etc.

### 10.3.2 Basic Idea of Countermeasures

Based on the future structural image of the study area, the basic idea of the countermeasures was examined.

#### (1) Redevelopment of the central area of Tegucigalpa

- To preserve historical and cultural buildings and houses
- To promote the central area as a tourist place
- To provide citizens with a place of recreation and relaxation
- To promote the location of restaurants, shops, etc.
- To transfer the governmental functions
- To restrain various kinds of office work activities
- To introduce a promenade or community road from the hotel district

#### (2) Redevelopment of the central area of Comayagüela

- To transfer street stalls and vendors from Avenida 6
- To utilize the Avenida 6 more effectively
- To revitalize the area as a business area
- To transfer wholesales market outside

#### (3) Improvement of access to the central area

- To improve the access to and from the planned bus terminal and the public parking lots
- To strengthen radial roads
- To improve the access to the airport and the central administrative district

#### **(4) Distribution of Urban Functions**

- To construct the intra-urban and inter-city bus terminals
- To construct a truck terminal
- To construct a parking building
- To promote the formulation of nuclei

#### **(5) Improvement of the public transportation**

- To introduce the bus lane and bus way
- To introduce the transit mall
- Punctual and smooth operation of the public transportation

#### **(6) Others**

- Appropriate supply of the housing area corresponding to the population growth
- Construction of distribution centers or truck terminals
- Regulation of sprawl of development of housing areas
- Regulation of disorderly development in the green areas
- Effective connection of the outer ring road (Anillo Periferico, now under construction) with the radial roads

### **10.4 Formulation of Transportation Master Plan**

#### **10.4.1 Planning Goal and Policy**

As examined in Section 8.3, the future structure of the study area was imaged to develop towards the following directions:

- ① The central areas of Tegucigalpa and Comayagüela continue to take a role of the center of the study area.
- ② The central area of Tegucigalpa is planned to be a historical, cultural, tourist, recreational and relaxation area in the future.
- ③ Sub-core districts are fostered in order to accommodate the business functions concentrated in the above area.
- ④ The residential areas expand towards the western and southern areas outside Anillo Periferico.
- ⑤ The built-up areas expand rapidly along Boulevard Morazan, Boulevard Suyapa, Boulevard Miraflores, Boulevard Santa Fe and Boulevard Comunidad Europea near the area of the Toncontin airport.

Under this development direction, the following goals are to be set in order to solve the above-mentioned issues;

#### **<<Goals>>**

- To maintain a high level service of transportation
- To strengthen the public transportation network

In order to achieve the above goals, the following planning policy was adopted;

**<<Policy>>**

- To mitigate the traffic congestion through the increment of the transportation capacity in the study area
- To promote the orderly urban development based on the future land use plan
- To save resources through smooth traffic movement
- To preserve the comfortable urban living environment by securing an efficient traffic system
- To introduce the efficient public transportation for the convenience of the bus users.

**10.4.2 Formulation of the Transportation Master Plan**

**1) Strategies**

Considering the above-mentioned existing problems, issues to be solved, applicable countermeasures, etc.; the following strategy was set up for formulation of a transportation master plan;

**(1) To strengthen the intra-urban transportation axes**

The study area is divided into three parts by rivers, therefore, the transportation capacity is limited to the capacity of the bridges crossing these rivers. Among these circumstances the two following intra-urban transportation axes should be strengthened by constructing new bridges in order to secure smooth movement between each part separated by rivers;

- The north-south transportation axis connecting the central area of Tegucigalpa with the south part of the study area which includes the airport
- The west-east transportation axis connecting the Santa Fe and Boulevard Morazán

**(2) To strengthen the radial roads**

The following radial roads become much important in connecting the CBD area with the sub-core districts, newly developed residential area, bus terminals, etc.:

- Centro - Southeast
- Centro - Southwest
- Centro - West
- Centro - Governmental area

**(3) To strengthen ring roads**

There are two types of ring roads: one type is the ring road to eliminate the through-traffic in the CBD, the other type is to connect the sub-core districts to each other. The following roads are important for achieving an efficient traffic system:

- Inner ring road surrounding the center of Tegucigalpa (to be newly constructed)
- Middle ring road
- Outer ring road



#### (4) Access roads

The new residential areas will expand towards outside of Anillo Periferico. Therefore, the access roads to the Anillo Periferico from these residential areas should be strengthened.

Under these strategies, there are two principal countermeasures which are critical in tackling issues for transportation problems; one is to restrain the traffic demand, the other is to increase the transportation capacity. The former can be attained by introducing various kinds of the regulations (e.g., zone system, etc.) and by strengthening the public transportation. On the other hand, the latter can be attained by constructing new roads, expanding road width and to introducing a railway system. Therefore, the following countermeasures were examined to make a transportation master plan, considering the existing transportation conditions and the future traffic demand;

##### (1) Traffic demand

- Introduction of the zone system to the CBD

##### (2) Transportation network

- Construction of new roads and bridges
- Improvement of roads
- Introduction of bus exclusive lanes
- Introduction of bus ways
- Introduction of a railway system

The above countermeasures were examined for establishing a favorable transportation network on the basis of the four following basic conditions;

- (1) To strengthen the transportation axes
- (2) To mitigate the traffic congestion
- (3) To establish the realistic plan
- (4) To utilize the existing transportation facilities as much as possible

As effective measures to decrease the severe congestion on roads, the introduction of a railway system was examined, however, from the viewpoint of a realistic plan, the introduction of the railway system in the study area was abandoned. The reason is that it is difficult from the financial viewpoint to operate a railway project in a city with a population of less than one million. Actually, according to the rough cost estimation, it takes about 20 million dollars per kilometer to introduce a railway project. It is extremely expensive compared with the construction of an expressway (about 3 million dollars per kilometer). Considering the difficulty to charge a rate higher than the existing bus fare level from the railway passengers, it is not recommended to introduce a railway projects. Concurrently, only the road network plan can be considered in the following section.

## 2) Formulation of Road Network Plan

Under the future framework made on the basis of the above concept and structure, the future traffic demand (the future OD table) was forecast (see Chapter 8 for more detail). With this future OD table, the traffic assignment was performed on the existing road network as shown in Fig. 9.4.2

(no project is implemented during the master plan period). The result of this assignment can be summarized as follows;

- (1) Congestion in the CBD area of Tegucigalpa and Comayagüela
- (2) Insufficiency of the west-east road capacity, especially, Avenida Cabañas-Calle 9 in the central area of Comayagüela- Puente Juan Ramón Molina - Subida a Estadio Nacional- Boulevard Morazán.
- (3) Insufficiency of the north-south transportation axis, especially, Boulevard Comunida Europea-(the Toncontin Airport)-Carretera Reservación
- (4) Insufficiency of the radial road capacity, Boulevard Suyapa-Boulevard Miraflores.
- (5) Congestion of some section of Boulevard Fuerzas Armadas
- (6) Insufficiency of access road to core places from the new residential areas developing outside of Anillo Periférico

In order to solve the above critical problems, many necessary projects were examined from the engineering, economic, and environmental viewpoints. Among projects examined, the following were abandoned;

(1) New radial road construction project

The assignment of future traffic volume on the existing roads shows the insufficiency of the capacity of radial roads. However, through a thorough reconnaissance field survey, the study team judged it not possible to construct any new major radial road, because there is no land to pass a new radial road, especially, near the CBD. Even if it is possible to promote the construction of this radial road, much time and money will be wasted.

(2) Widening of the roads width within the central area of Tegucigalpa

Even now, traffic volume in the central area of Tegucigalpa already exceeds the road capacity. The best way of mitigating the congestion within the center of Tegucigalpa is to widen the road. However, the authority of the municipality has promoted to preserve not only the historical buildings (including the central prison) but also residences. Therefore, the study team has not adopted road widening projects in the center of Tegucigalpa.

To establish a suitable transportation network corresponding to the various traffic demands, the following consideration is necessary;

(1) Central area of Tegucigalpa

The traffic volume is already over the road capacity in this area, however, according to the municipality, this area is planned to be reserved as a historical, cultural, tourist and recreational area. Therefore, it is not possible to construct the new road or expand the road width within this area. As a result, the improvement of the traffic situation in this area should be made by the traffic control system or construction of surrounding road around this area. The following alternatives were considered;

- Introduction of exclusive bus way
- Construction of inner ring road around this area

## **(2) Central area of Comayagüela**

Calle 9 in this area is the most important section connecting Boulevard Santa Fé with Boulevard Morazán, which composes the main east-west transportation axis. However, the traffic flow of this Calle is awfully bad because of the limited capacity of the intersection of Subida al Estadio Nacional and the circular road of the National Stadium. On the other hand, there are Avenidas 1, 2, 4 and 6, which compose the important north-south transportation axis connecting with Boulevard Comunidad Europea. Although the Avenida 6 has four lanes, this Avenida is not utilized efficiently because of the presence of many street vendors. The following alternatives were examined;

- Strength of the west-east transportation axis
- Efficient utilization of the Avenida 6
- Introduction of bus exclusive way
- Strength of the north-south transportation axle

## **(3) Connection of sub-core districts**

The existing administrative functions and business offices are expected to transfer outside the CBD area to the areas along Boulevard Morazán, Boulevard Suyapa, Boulevard Santa Fe, and near Toncontin Airport and Casa Presidencial. These areas will function as sub-core districts of economic activities in the future. Therefore, the connection among these sub-core districts and the connection of the central area of Tegucigalpa with these sub-core districts should be strengthen. The following links are required to be strengthened;

- Strength of the north-south transportation axes
- Strength of the west-east transportation axes
- Utilization of ring roads

## **(4) Connection of the Anillo Periferico with the major radial roads**

Considering the expansion of the residential area outside of Anillo Periferico, the efficient connection of the radial roads with Anillo Periferico should be planned to secure the access to the CBD and sub-core districts from the newly developed residential area. In the future the connecting road or access road for the southeastern part of the residential area is required to be construct or improved.

Future transportation master plan is shown in Fig. 10.4.1.

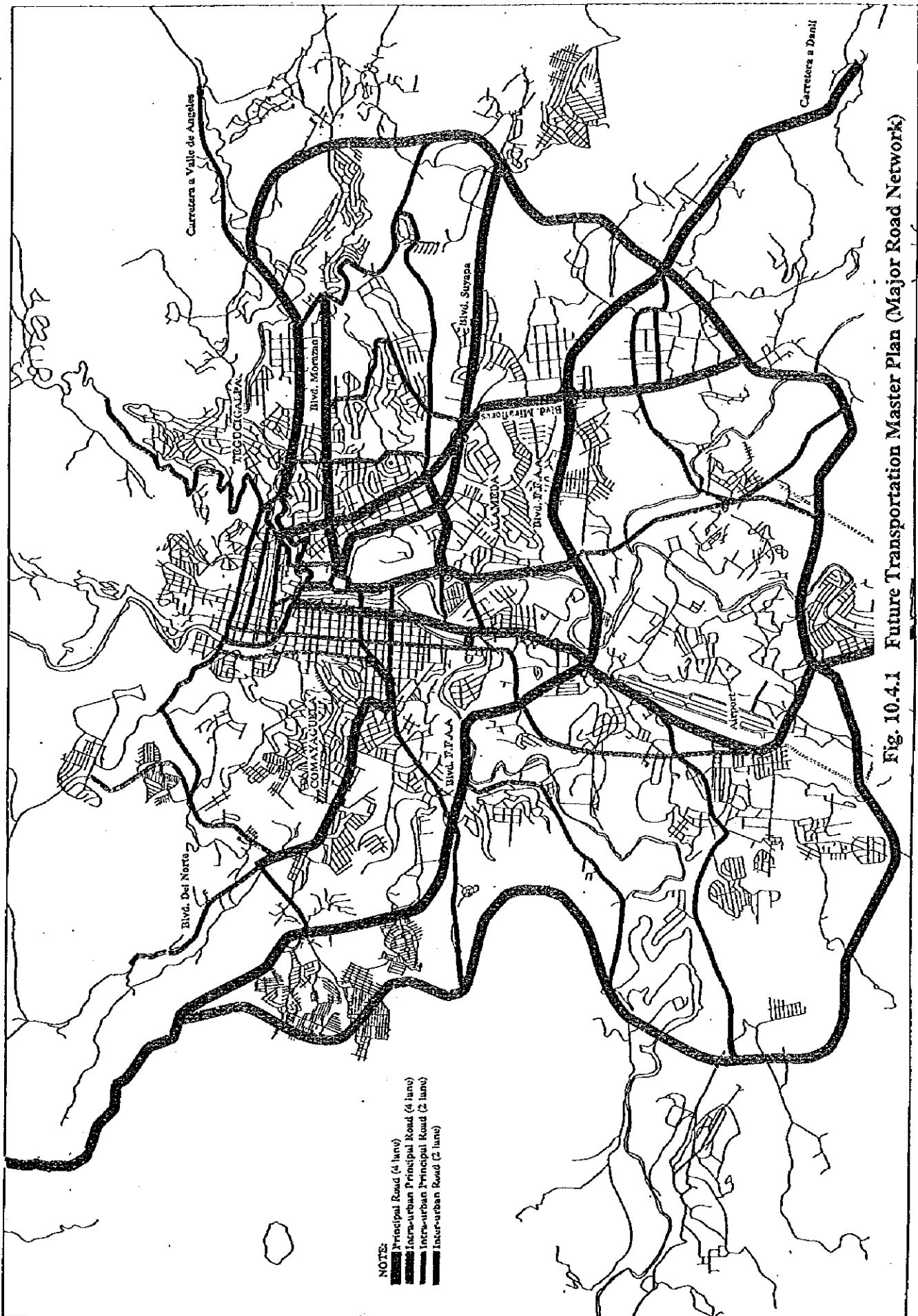


Fig. 10.4.1 Future Transportation Master Plan (Major Road Network)

- NOTES:
- ▬ Principal Road (4 lane)
  - ▬ Inter-urban Principal Road (4 lane)
  - ▬ Inter-urban Principal Road (2 lane)
  - ▬ Inter-urban Road (2 lane)

## 10.5 Selection of Master Plan Projects

### 10.5.1 Alternatives of Master Plan Projects

Various projects to relieve the traffic congestion were planned considering the road engineering and financial aspects besides the urgent projects mentioned above. These projects were categorized into the following three, judging from the critical impacts on the traffic situation;

- (1) To introduce regulation for prohibiting the vehicle inflow into the central area of Tegucigalpa (Regulation)
- (2) To construct a toll road connecting the central area of Tegucigalpa with Anillo Periférico using the river basin of the Choluteca River (Toll road)
- (3) To implement other projects, considering the realization of the linear multi-nuclei urban structural pattern (Other projects)

The alternative master plan projects were made by the combination of the above three categories. As a result, the four alternatives were made as shown in Table 10.5.1.

**Table 10.5.1 Alternatives of Master Plan Projects**

Alternatives	Alternative-1	Alternative-2	Alternative-3	Alternative-4
Regulation	Implement	Implement	Not Implement	Not Implement
Toll Road	Construct	Not Construct	Construct	Not Construct
Other Projects	Implement	Implement	Implement	Implement

Alternative 3 and Alternative 4 are shown in Fig. 10.5.1 (1) and 10.5.1 (2), respectively. These projects can be summarized as follows;

#### Improvement of Intersection (Urgent Project)

**Project-1 Configuration Improvement and Traffic Signal Installation Project at intersection of Subida al Estadio Nacional and the circular road of the National Stadium**

This intersection is the worst bottleneck of the west-east traffic flow. Since the ascending right-turn curve in front of the stadium from Subida al Estadio is too sharp, it is difficult to manage the large volume of traffic. By improving such an unfavorable configuration, this intersection capacity is expected to increase. In addition, it is recommended that traffic signals be installed, because many vehicles are passing through this intersection.

**Project-2 Configuration Improvement Project at Intersection of Avenida Cabañas and Boulevard Santa Fé**

Traffic flow on the lanes of Boulevard Santa Fé to Colonia Santa Fé direction from Comayagüela are obstructed by vehicles trying to turn left from Comayagüela to Calle Nickson. This situation will be improved by installing a sufficient left-turn lane.

**Project-3 Configuration Improvement Project at Intersection in front of Instituto Hondureño de Seguridad Social on Boulevard Comunidad Europea**

The configuration of this intersection is a little complicated, therefore, vehicles trying to turn left to Calle Golan from the CBD are always queuing randomly on the lanes of Comunidad Europea to the airport direction. If this complicated configuration is changed into a simple " + " shape intersection, the traffic flow would become much smoother.

**Project-4 Traffic Signal Installation Project at Intersection of Boulevard José Cecilio del Valle and Calle Golan**

At this intersection the sight distance is very bad for the drivers going to Boulevard José Cecilio del Valle from Calle Golan. Therefore, these vehicles coming from Calle Golan are forced to wait inside the lanes of Boulevard José Cecilio del Valle for vehicles running on Boulevard José Cecilio del Valle to pass by. This causes the traffic congestion at this intersection. This situation will be improved simply by installing the traffic signal.

**Project-5 Approach Road Construction Project at Grade Separation of Boulevard Miraflores and Boulevard Fuerzas Armadas**

At this grade separation there is no approach road to Colonia Kennedy direction on Boulevard Miraflores from Danli direction on Boulevard Fuerzas Armadas. Therefore, these vehicles coming from Danli are forced to turn right once to the central area of Tegucigalpa on Boulevard Miraflores, then turn back to Colonia Kennedy direction after making a U-turn somewhere on Boulevard Miraflores. The construction of an approach road to Colonia Kennedy direction will exclude this unnecessary U-turn traffic movement from Boulevard Miraflores.

Construction of Inner Ring Road

**Project-6 Construction Project of the Inner Ring Road surrounding the Central Area of Tegucigalpa**

As mentioned before, no road widening projects are allowed by the conservation policy of the central area of Tegucigalpa. Therefore, by constructing the inner ring road surrounding the central area, the congestion within the central area can be mitigated significantly, by eliminating the by the through-traffic. This project is divided into two sections, that is, Project-6-1 (Northern ring section) and Project-6-2 (Southern ring section), considering the priority of the project implementation.

Road Strengthening Project between West and East Transportation Axle

**Project-7 Road Improvement of Estadio Nacional – Boulevard Morazán to the intersection of Juan Manuel Galves**

This road section has only two lanes while other sections of Boulevard Morazán have four. Therefore, through increasing the capacity by widening this section to four lanes, the traffic flow between west and east will become much smoother.

**Project-8 Road Improvement of Calle Nickson – Calle 12 of the central area of Comayagüela – a new bridge the south of Puente de Juan Ramon Malino up to Boulevard José Cecilio de Valle.**

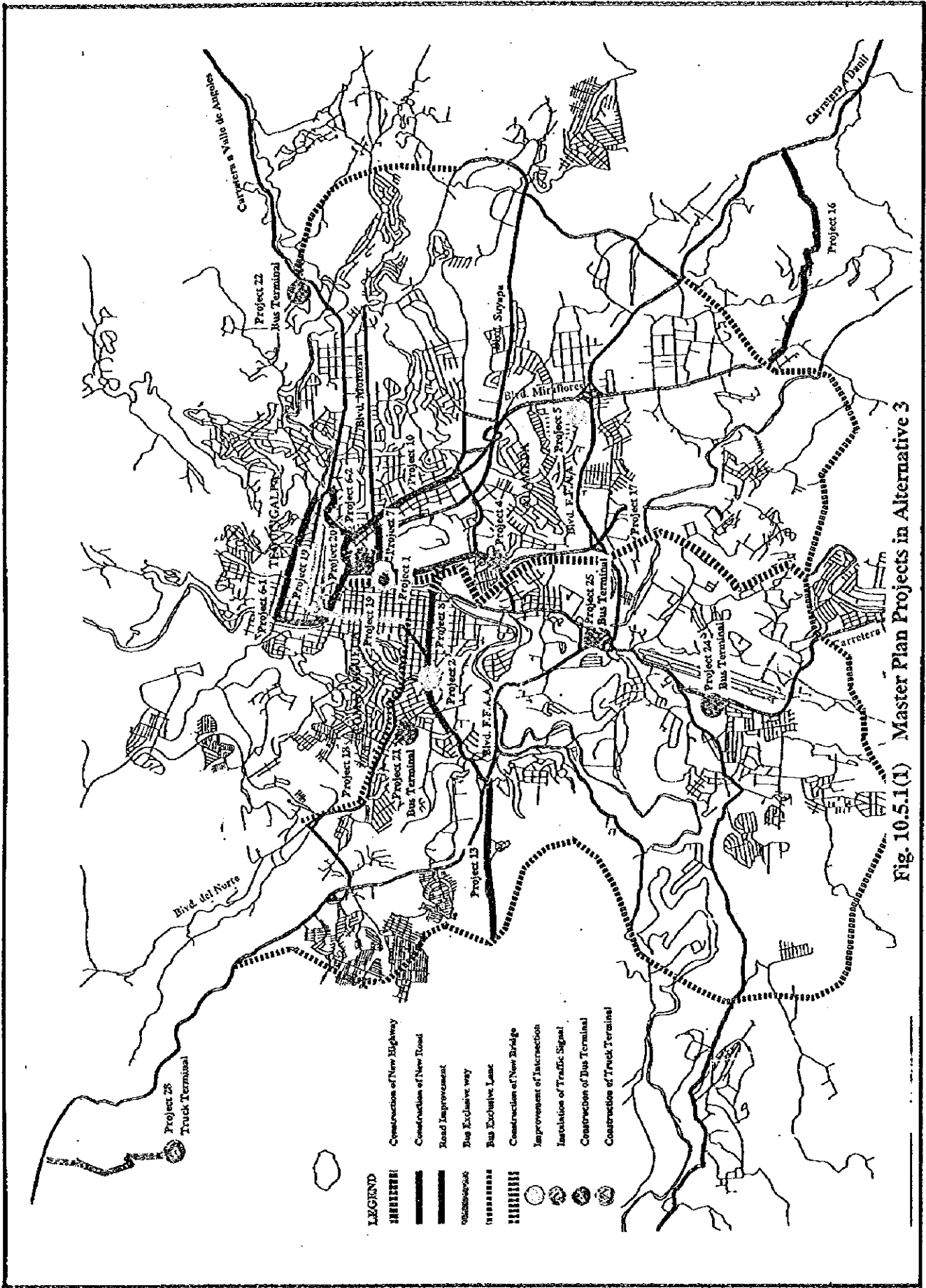


Fig. 10.5.1(1) Master Plan Projects in Alternative 3

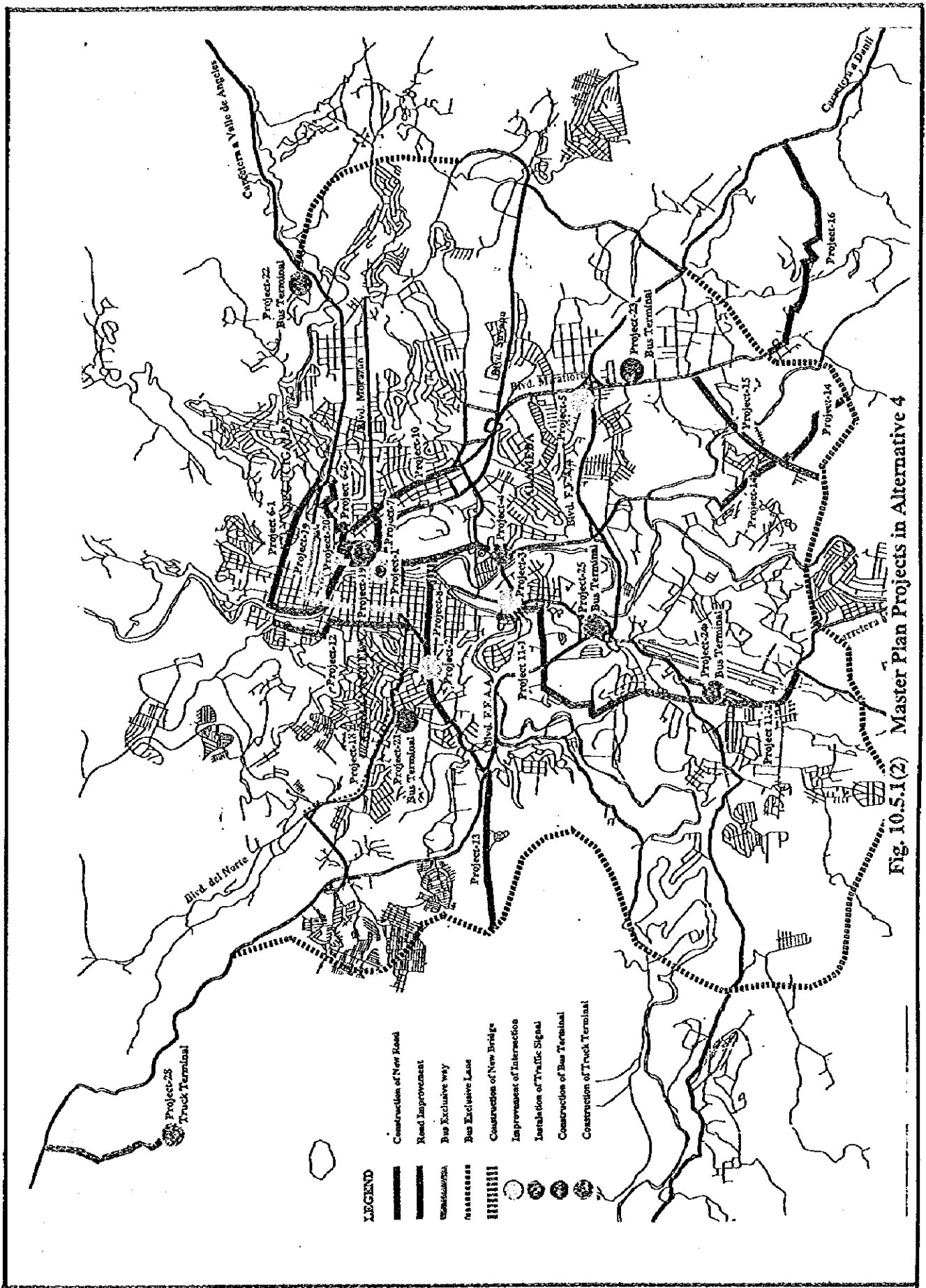


Fig. 10.5.1(2) Master Plan Projects in Alternative 4



At the moment, the road of Calle 9 in the center of Comayagüela – Subida al Estudio Nacional is the only one major west-east road. Therefore, it is always filled with vehicles. The capacity is absolutely short, however, and there is no room to widen the road. Therefore, this project will greatly contribute to smooth the west-east traffic flow.

#### Road Strengthening Projects to north – south transportation Axles

##### **Project-9 Road Improvement of Calle Isla – José Cecilio del Valle**

This projects aims to increase the capacity of the radial roads from the central area of Tegucigalpa to the southern part of the study area. In addition, since this road is expected to accommodate the traffic coming from the west through the new bridge and Calle 12 in Comayagüela, it will serve to mitigate the congestion on Boulevard Comunidad Europea.

##### **Project-10 Road Improvement of Boulevard Juan Manuel Galves**

This is an important road connecting the central area of Tegucigalpa with the rapidly developing built-up area of Miraflores and the biggest residential area of Colonia Kennedy. Since some sections of this road are not in good condition at the moment, this road is not utilized efficiently. By widening the road width of at the necessary sections, much more traffic will come to use this road.

##### **Project-11 Road Improvement of the southern section of Avenida 6 – New bridge –San José – Lomas de Toncontin**

This project aims to mitigate the traffic congestion on Boulevard Comunidad Europea. Since Boulevard Comunidad Europea is forecast to become much more congested in the future, the improvement of this road is very important, especially, traffic heading for the airport from the CBD area. This project is divided into two sections, that is, bridge section (Project-11-1) and road section (Project-11-2), considering the priority of the project implementation.

##### **Project-12 Road Improvement of Avenida 8 in the center of Comayagüela**

Vehicles cannot pass some section of this road because of steep slope. Through improving this section, this Avenida will turn into a major road connecting the central area of Tegucigalpa with the west part of the study area. The north part beyond Avenida 8 also needs improving.

#### Road Project connecting with Anillo Periférico

##### **Project-13 Road Improvement of Anillo Periférico – Colonia La Fuente – Boulevard Fuerzas Armadas**

This is an important road connecting the western part of Anillo Periférico with Boulevard Fuerzas Armadas. Since the western part of the study area outside Anillo Periférico is expected to develop in the future, the importance of this road will increase.

##### **Project-14 Road Construction and Improvement of Colonia San José de la Vega –La Canada – Anillo Periférico**

The construction and improvement of this road can connect the CBD with the southern part of the study area outside Anillo Periférico directly. Therefore, since the southern part of the study area is also expected to develop rapidly hereafter, the construction and improvement of this road will be necessary.

**Project-15 Road Construction of Colonia Kennedy – Residential Plaza-Anillo Periférico**  
This is a useful road connecting the southern part of the study area outside Anillo Periférico with Boulevard Miraflores.

**Project-16 Improvement of Anillo Periférico – Colonia Loma de Jacaleapa –Carretera a Oriente**  
This road can take on the role of a bypass by making vehicles from Danli go directly to the Boulevard Miraflores. The traffic volume on the eastern section of Boulevard Fuerzas Armadas will be mitigated.

#### Toll Road Project

**Project-17 Construction of Toll Road**  
Introduction of this toll road would save travel time and increase the capacity of radial roads from the CBD to the southern part of the study area.

#### Bus Ways and Bus Lanes

**Project-18 Introduction of Exclusive Bus Lanes**  
Boulevard Santa Fé is the road where bus routes to the CBD area concentrate most. Therefore, this road is crowded with many buses. The operation of buses will become smoother after introducing the bus lanes from Salida a Olancho to Avenida 6 in the center of Comayagüela.

**Project-19 Introduce of Bus Exclusive Ways**  
Disorderly bus operation is one of the reasons of congestion in the central area of Tegucigalpa and Comayagüela. By designating the bus routes, not only the bus operation but also the flow of the other vehicles will improve. Therefore, the following roads were recommended to be designated as exclusive bus ways;

- Avenida 6 from Calle 9 in the central area of Comayagüela to Puente Carias
- Avenida Miguel de Cervantes from Calle La Concordia to Calle Salvador Mendiente
- Avenida Maximo Jeres from Calle La Concordia to Cine Presidente

#### Community Road

**Project-20 Introduction of Community Road**  
The central area of Tegucigalpa is planned to be a place for tourists and a place of recreation and relaxation for citizens. Considering the convenience of shopping, strolling, etc., the community road is introduced on Avenida Miguel de Cervantes from Puente San Rafael to Plaza Francisco Morazán.

#### Urban Facilities (see in Section 10.7 and 10.8 in more detail)

**Project-21 Construction of an interurban bus terminal**

This bus terminal is to be located in Santa Fé . Bus passengers would use this terminal for and from San Pedro Sula, Comayagüa, Olancho, etc.

**Project-22 Construction of the interurban bus terminal**

This bus terminal is to be constructed at 21 de Octubre for bus passengers to and from Valle de Angeles, San Juancito, etc.

**Project-23 Construction of the interurban bus terminal**

This bus terminal at Mirflores is to be used for bus passengers from and to Danlí, Zamorano, etc.

**Project-24 Construction of the interurban bus terminal**

Located near the airport, bus passengers to and from Choluteca, Nicaragua, El Salvador, etc. would use this bus terminal.

**Project-25 Construction of the bus terminal for changing buses**

This bus terminal is to be used for connection the key route urban buses with ordinary buses, located in Las Brisas.

**Project-26 Construction of the urban buses**

This is to be the terminal bus center to the CBD, located by Calle Isla next to National Stadium.

**Project-27 Construction of parking building**

This parking building is to be used in order to keep cars from entering into the central area of Tegucigalpa. The place near Puente La Hoya just outside the Centro is recommended because the municipality already owns the land.

**Project-28 Construction of truck terminal**

This truck terminal is to be constructed lest large trucks enter the urban area. The place near Laguna el Padregal is recommended for its site.

Fig. 10.5.2 summarized the relationship of these projects and their issues.

### **10.5.2 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.

- Since the central administrative functions and business and commercial activities have already agglomerated in the central area of Tegucigalpa, it is very difficult to obtain the mutual agreement on this regulation from the government and business circles established here.
- If this regulation is introduced, car users to the central area will be forced to park their cars outside the central area. However, it is very difficult to keep parking space outside the central area.

# PROJECTS

- Project-1 Configuration improvement and traffic signal installation project at intersection of Subida al Estadio Nacional and the circular road of the national stadium
- Project-2 Configuration improvement project at intersection of Avenida Cabañas and Boulevard Santa Fé
- Project-3 Configuration improvement project at intersection in front of Instituto Hondureño de Seguridad Social on Boulevard Comunidad Europea
- Project-4 Traffic signal installation project at intersection of Boulevard José Cecilio de Valle and Calle Golán
- Project-5 Ramp construction project at grade separation of Boulevard Miraflores and Boulevard Fuerzas Armadas
- Project-6 Construction of the inner ring road surrounding Tegucigalpa Centro
- Project-7 Road improvement of Estadio Nacional-Boulevard Morazan until the intersection of Juan Manuel Galvez
- Project-8 Road improvement of Calle Nickson - Calle 12 of the central area of Comayagüela - a new bridge in the south of Puente de Juan Ramón Molina up to Boulevard José Cecilio del Valle
- Project-9 Road improvement of Calle Isla - José Cecilio del Valle
- Project-10 Road improvement of Boulevard Juan Manuel Galvez
- Project-11 Road improvement of the southern section of Avenida 6 - San José - Lomas de Toncontinó
- Project-12 Road improvement of Avenida 8 in the center of Comayagüela
- Project-13 Road improvement of Anillo Periférico - Colonia Fuzate - Boulevard Fuerzas Armadas
- Project-14 Road construction and improvement of Colonia San José de la Vega - La Canada - Anillo Periférico
- Project-15 Road construction of Colonia Kennedy - Residential Plaza - Anillo Periférico
- Project-16 Improvement of Anillo Periférico - Colonia Loma de Jacalespa - Carretera a Oriente
- Project-18 Introduction of bus exclusive lane
- Project-19 Introduction of bus exclusive way
- Project-20 Introduction of community road
- Project-21 Construction of interurban bus terminal heading for San Pedro Sula
- Project-22 Construction of interurban bus terminal heading for Valle de Angeles
- Project-23 Construction of interurban bus terminal heading for Danlí
- Project-24 Construction of interurban bus terminal heading for Choluteca
- Project-25 Construction of bus terminal changing buses
- Project-26 Construction of central urban bus terminal
- Project-27 Construction of the parking building
- Project-28 Construction of the truck terminal

# ISSUES

- Tegucigalpa Centro
  - Mitigate Congestion.....
  - Eliminate the rough traffic.....
  - Promote the safety for pedestrian.....
  - Promote the use of public transportation.....
- Comayagüela Centro
  - Mitigate traffic congestion.....
  - Make the efficient use of Avenida 6.....
  - Improve the west-east transportation axes.....
- Road Network
  - Mitigate the congestion on major roads.....
  - Improve some sections of major radial roads.....
  - Improve access road to built-up area from new residential area.....
  - Strengthen the access road to the airport and central administrative area.....
  - Connect major radial roads with the outer ring road.....
- Public Transportation
  - Promote the use of public transportation.....
  - Improve the bus operation.....
  - Rearrange bus terminals.....
- Traffic Management
  - Install traffic signal at necessary intersections.....
  - Improve the configuration at necessary intersection.....
  - Strengthen the control of the on-road parking.....

Fig. 10.5.2 Relationship of Issues and Projects in Master Plan

- For reasons of personnel security, car users in the higher income classes are not likely to convert to public transport.
- Whatever measures of regulation are adopted, each measure will have its own fault (Example: Let us assume that the only cars are permitted to enter the central area on the designated day if the last number of the license plate is odd. In this case if the citizen have two cars and one has the odd number and the other has the even number, they can enter the central area every day. This causes inequality.)

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 the 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 the various aspects. From the transportation aspect, the congestion of Alternative 4 decreases much more than Alternative 3 as shown Fig. 10.5.3 (1) and 10.5.3 (2). Alternative 3 remains the some congestion section on the road network such as Calle 12 in the central area of Comayagüela, Boulevard Comunidad Europea, and Boulevard Fuerzas Armadas. In Alternative 4 road sections with present congestion rates of 1.0 or over will completely disappear.

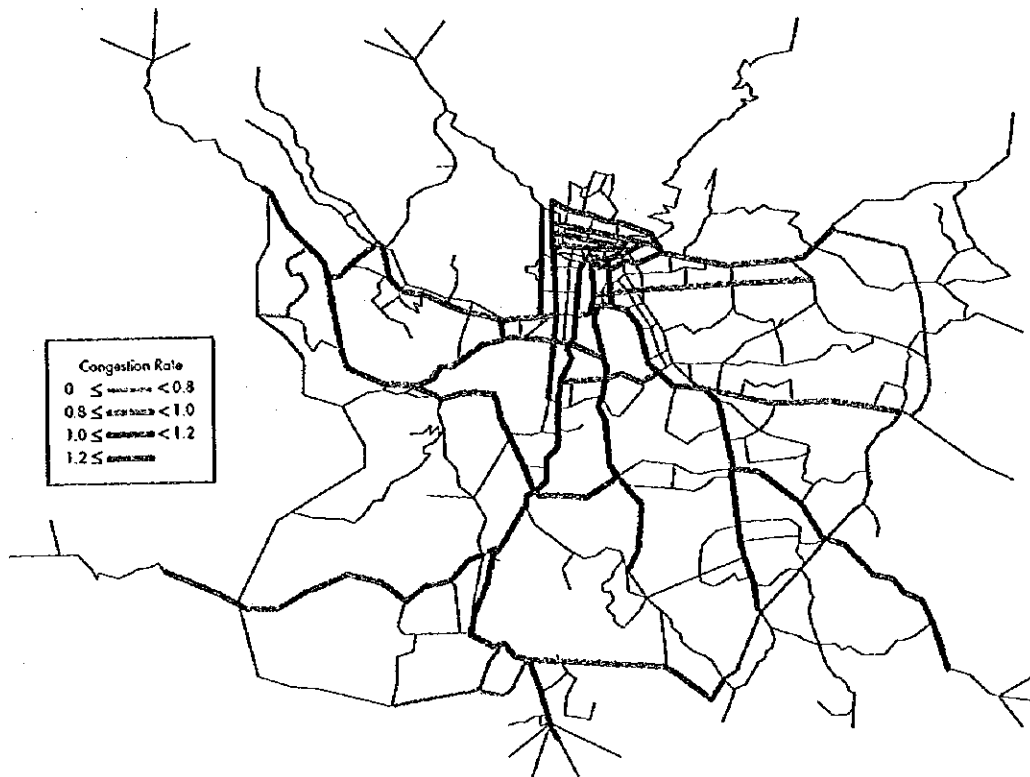
The economic evaluation is indicated in Table 10.5.2 together with the indicators related to the traffic. The rate of return (IRR) in this table was calculated with the project cost and the project benefit. The project benefit consists of the saving of the total vehicle time and the saving of the total vehicle distance. The estimation of the benefit and the calculation of IRR are explained in Chapter 13 in more detail.

**Table 10.5.2 Comparison of Alternative 3 with Alternative 4**

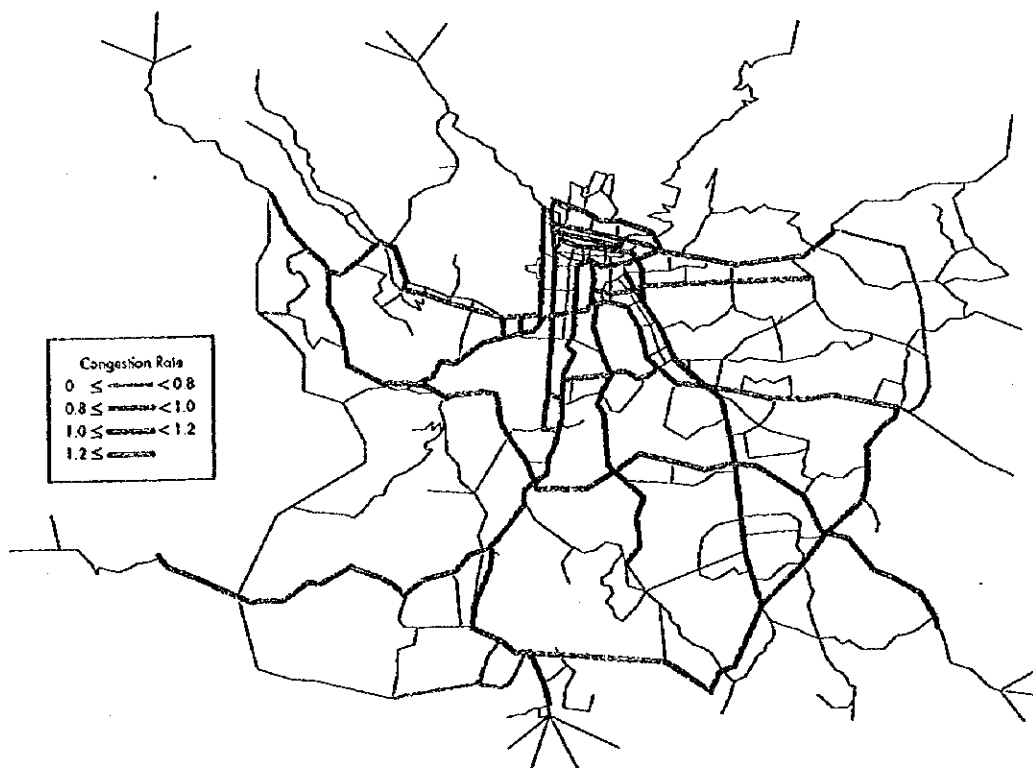
Alternatives	Without Project	Alternative 3	Alternative 4
Construction Cost (1,000 Lps.)	-	1,866,137	871,393
Saving of Total Vehicle Travel Time (vehicles-hour/day)	-	19,739	23,538
Saving of Total Vehicle Travel Distance (vehicles-km/day)	-	- 122,221	-63,530
Average Trip Length (km/trip)	7.46	7.60	7.55
Average Congestion Rate (volume/capacity)	0.94	0.85	0.78
Average Travel Speed (km/h)	29.0	32.1	32.4
Internal Rate of Return (%)	-	0 %	25.33 %
Consideration of Environment	-	Negative Impact is large.	Negative impact is small.

The following findings can be understood from the above table.

- The construction cost of Alternative 3 is higher than Alternative 4 (2.5 times), which makes the fund procurement much more difficult.



**Fig. 10.5.3 (1) Road Congestion in Alternative 3**



**Fig. 10.5.3 (2) Road Congestion in Alternative 4**

- IRR of 25.33 % shows that Alternative 4 is feasible, however, and that Alternative 3 is not feasible.
- The toll road project is included in Alternative 3. However, if 10 Lempiras is charged for the user of this toll road, the number of user would be very few (about 850 vehicles). Therefore, this toll road project is not feasible from the financial viewpoint.
- Since the toll road is planned to be constructed in the Choluteca River basin, an environmental problem exists.
- Since another road would be improved or constructed from the south of Avenida 6 in Comayagüela to the airport, the traffic volume up to 2010 between the north and the south can be accommodated even without this toll road.

From the results of the evaluation, it was determined that construction of the toll road not be recommended. As a result, Alternative 4 was adopted as the desirable Master Plan.

### 10.6 Implementation Schedule of the Master Plan

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 west-east transportation axis, together with projects to mitigate the congestion in the central area of Tegucigalpa
- Mid term : Projects packages to introduce bus lanes and bus ways and for improvement of roads to accommodate the vehicles displaced by the introduction of the bus lanes and bus ways
- Long Term : Projects to strengthen the radial roads connecting Anillo Periférico

Table 10.6.1 shows the comparison of "Short Term", "Mid Term" and "Long Term". The internal rate of return (IRR) shows that the projects planned in every term are sufficiently feasible. Especially, the value of IRR of the short term indicates the highest value of 25.19 %. In Table 10.6.1 listed projects are categorized by the above criteria. The location of projects is shown in Fig. 10.6.1 (1) for the short term, in Fig. 10.6.1 (2) for the mid term and in Fig. 10.6.1 (3) for the long term, respectively.

**Table 10.6.1 Comparison of Master Plan Projects by Term**

Project Term	Short Term	Mid Term	Long Term
Construction Cost (US\$1000)	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
Consideration of Environment	Negative Impact is small.	Negative Impact is small.	Negative impact is small.

**Table 10.6.2 Master Plan Projects**

Term	Category	Prjt. No.	Project Description	Project Length(m)	Total Cost (US\$1,000)
Urgent	Improvement of Intersection	1	Configuration Improvement and Traffic Signal Installation at Intersection of Subida al Estadio Nacional 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 Armada	-	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 of Comayaguela	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 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
		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 Anillo Periferico - 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 Terminal	28	Construction of Truck Terminal in Laguna el Pedregal	-	7,780



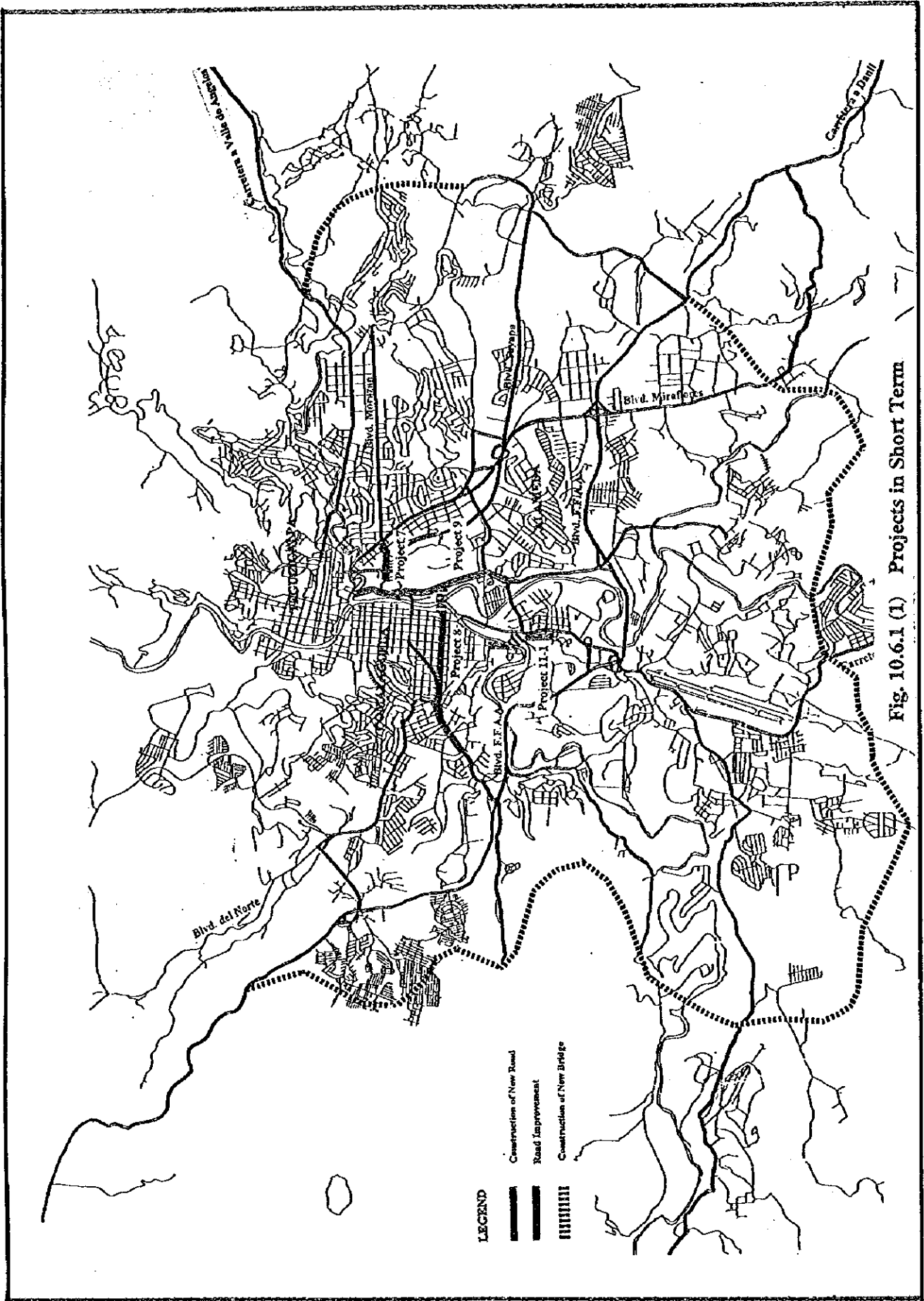


Fig. 10.6.1 (1) Projects in Short Term

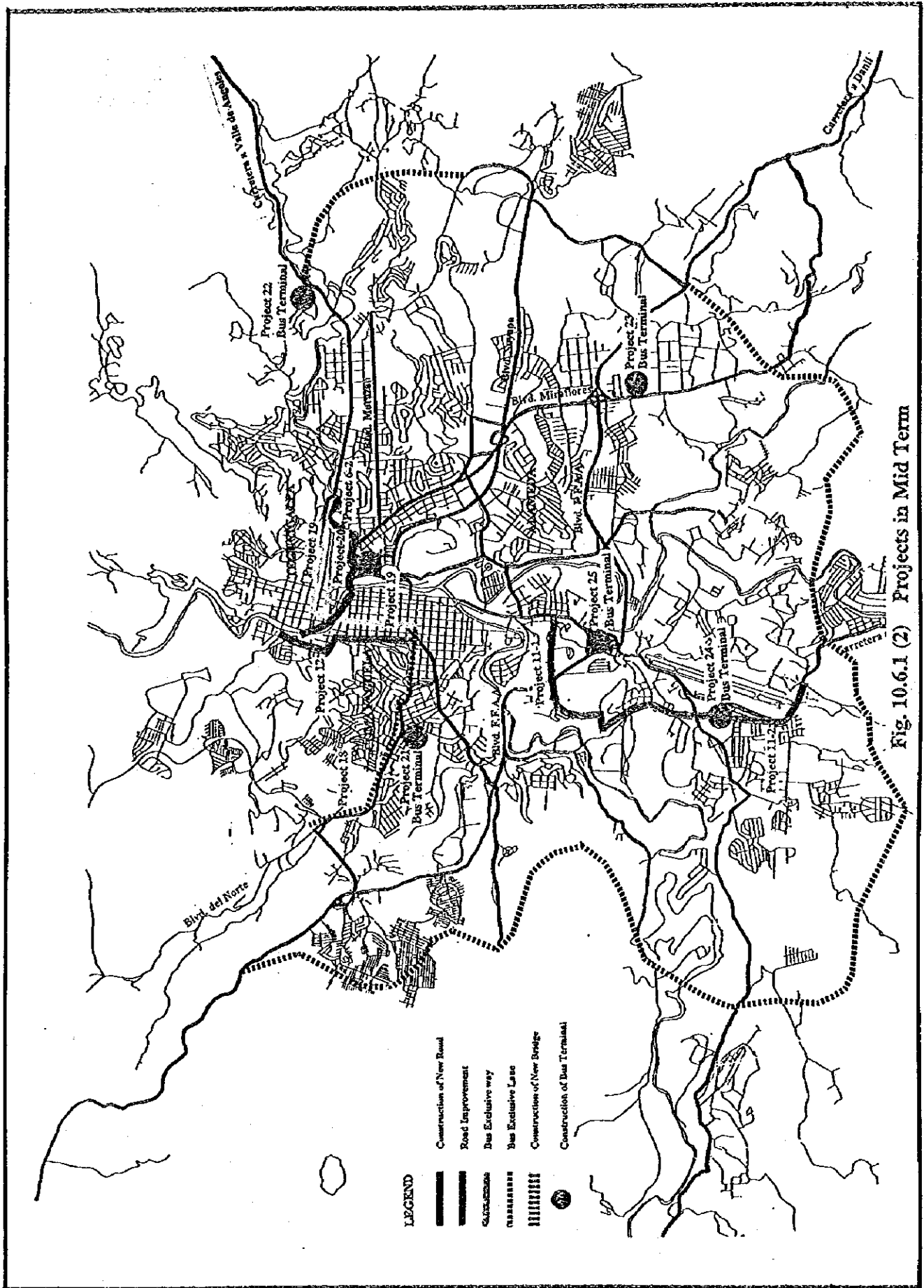


Fig. 10.6.1 (2) Projects in Mid Term

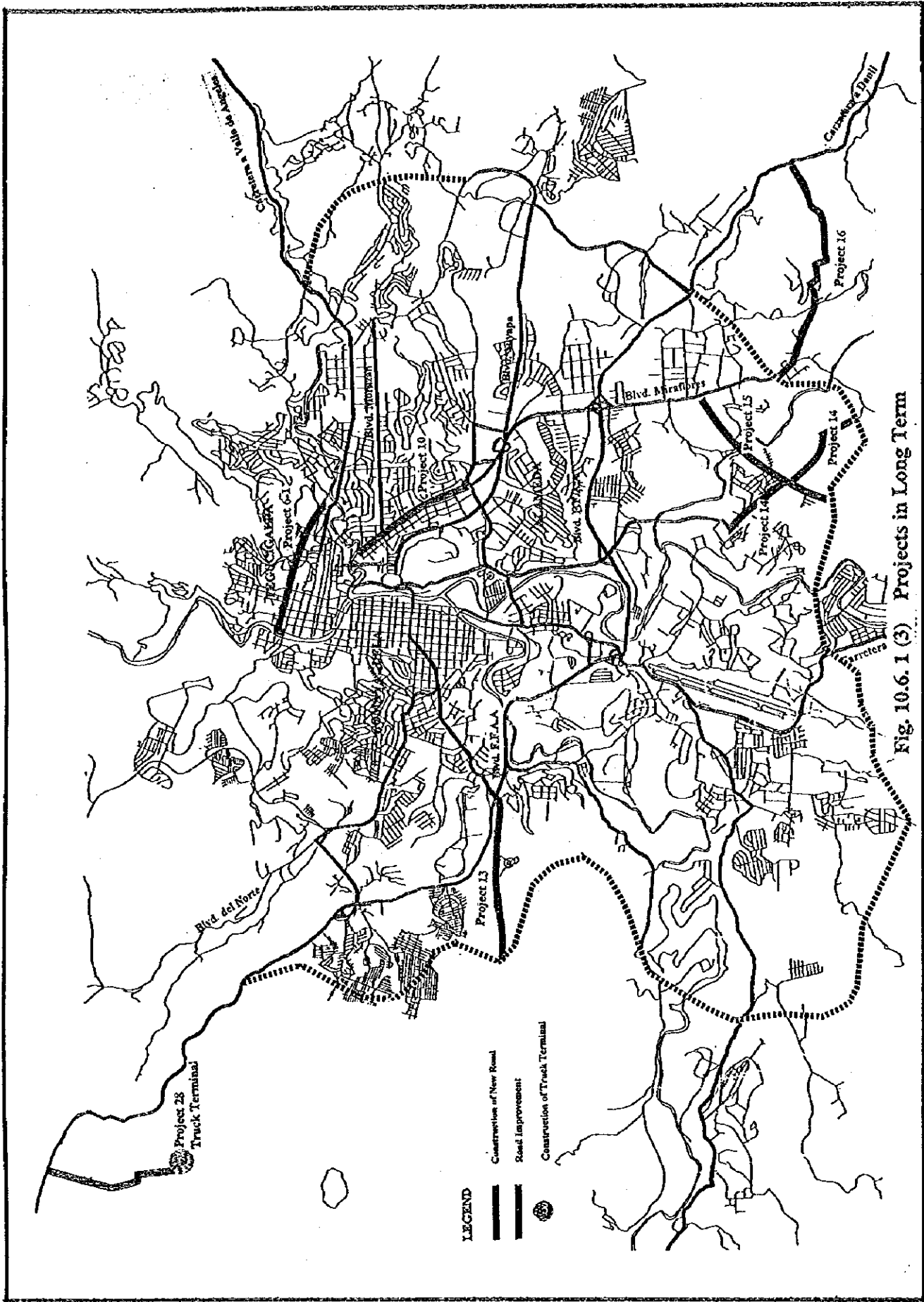


Fig. 10.6. 1 (3) Projects in Long Term