10) Anillo Rural

This road extends between Circunvalar and Carretera A La Playa for a distance of 9.0 km.

(1) Existing road conditions and planned route

This will be an outer circular road for the sub-center planned in the north-west of Barranquilla. No road currently exists along the proposed alignment. The required quantities for excavation and embankment will be comparatively high as the topography is generally a rolling ferrain. There are a number of swamps between Carretera A La Playa and Autopista Al Mar, therefore, adequate measures should be taken at the time of construction. Additionally, adequate provisions should be made for the discharge of ground water and for the construction of base course as the area's soil has a high silt content.

(2) Road plan

The design speed will be 40 kph and the cross-section will be two lanes with a total width of 6.5 m. 1.5 m shoulders and 3.0 m sidewalks will be provided on each side of the road.

11) Carretera Metropolitana

This section extends between Malambo and Puerto Colombia for a distance of 22.3 km.

(1) Existing road conditions and planned route

This road will be the second circunvalar around the Metropolitan Region, connecting Malambo, Galapa, Juan Mina and Puerto Colombia, and all towns located in the suburbs of Barranquilla. No road currently exists for this proposed route. The plan envisages this to be of a rural type road passing entirely through uncultivated fields. The route will cross a number of middle and small-size rivers between Malambo and Juan Mina although the land itself is relatively flat with an elevation varying between 50 m and 70 m. Between Juan Mina and Puerto Colombia, the road must cross hillsides with an elevation exceeding 100 m. Accordingly, the planned route will have frequent bends and undulations depending on the topography of the area. As a result of this, the earthwork volume for this particular road will be the largest of all the roads being planned. The soil conditions are such that sandy sediment dominates the Malambo side while silt soils dominate the Puerto Colombia side. Nevertheless, no problems are expected with the construction of major structures such as earthworks and bridges, etc. provided that proper care is taken in the design stage.

(2) Road plan

The design speed will be 60 kph and the cross-section will be two 3.25 m lanes. 2.5 m shoulders and 1.0 m wide slope protection shoulders will be provided on each side of the

road. All bridges on this road will be pre-stressed concrete bridges.

12) Transversal Rural

This section extends between Anillo Rural and Carretera a la Playa for a distance of 4.0 km.

(1) Existing road conditions and planned route

The existing road conditions for this route are almost the same as for Anillo Rural except that it is located at the center of the sub-center planned to be built in the north-west of Barranquilla. The road will, therefore, be planned as an urban type road in order to prepare for the future urbanisation of the area.

(2) Road plan

The design speed will be 40 kph and the cross-section will be two lanes with a total width of 6.5 m. 1.5 m shoulders and 3.0 m sidewalks will be provided on each side of the road.

11–3–2 Road and Street Improvement Plan

1) Calle 30

The section extends between Circunvalar and Cra. 46 for a distance of 6.0 km.

(1) Existing street conditions and planned route

An industrial complex consisting of a number of plants and warehouses is situated between the Circunvalar and Cra. 21. The existing street has 4 through traffic lanes with a 4.0 m wide mdeian. Although there are 2.5 m wide shoulders on both sides, there are no sidewalks as this is a rural type road. Adequate space is provided between the right-of-way and the buildings along the road. The road changes to an urban type street between Cra. 21 and Cra. 38 where the median narrows to 2.0 m and the shoulder width narrows to 1.5 m on the average. The width of the sidewalks varies from 3.9 m to 7.0 m and the lane width also varies for each direcion. Along this section of the street are many furniture manufacturers and wholesalers, garment wholesalers and shops relating to these businesses. Most buildings have one storey except for a few two storey buildings. All buildings are old and poorly maintained.

Between Cra. 38 and Cra. 40, the street lacks a median and shoulders. Although the width of the sidewalks varies substantially, the average width is 3.0 m. After passing Cra. 38, the street enters the Centro District where middle class retail shops are located side by side. Between Cra. 40 and Cra. 43, the street further narrows to 2 through traffic lanes. In fact,

as a large number of street vendors occupy the street, it practically becomes a single through traffic lane. Buildings along the street are old two storey buildings that the poorly maintained. Between Cra. 43 and Cra. 44, the street widens to four through traffic lanes with no median and no sidewalks.

The area between the street and Caño Ahuyama is occupied by street vendors. Most of the buildings lining the opposite side of the canal belong to wholesalers of food products, and are genrally two or three storey structures, old and poorly maintained. The street further widens to 6 through traffic lanes with a 4.0 m wide median between Cra. 44 and Cra. 46. The average width of the shoulders is 0.75 m and the sidewalks are 1.9–3.0 m wide. The street capacity is largely reduced at this section due to the disorderly parking of large buses.

According to the plan, important control points for this street are the San Rafael Church and the San Roque Church on the western side of the street. The street runs at the foot of the gentle eastern slope of the Barranquilla hill and almost parallel to it. The vertical alignment of the street is almost flat.

(2) Improvement plan

This street will be six-3.25 m wide through traffic lanes with a 3.0 m wide median. 0.75 m shoulders and 3.0 m wide sidewalks will be provided on each side of the street. It will be divided into two sections according to the Improvement Plan, i.e. (i) 2.9 km between the Circunvalar and Cra. 22 and (ii) 3.1 km between Cra. 22 and Cra. 46.

2) Circunvalar

This section extends between Calle 30 and Via 40 for a distance of 19.3 km.

(1) Existing road conditions and planned route

This is a circular road running around the periphery of the Barranquilla urban area. It is of a rural type with 2 through traffic lanes except at interchange sections. The lane width is 3.5 m each and shoulders with an average width of 2.5 m are provided. The road is also provided with a complete drainage system and lighting facilities. Since it has only recently been opened, the roadside is not yet urbanised. As it passes west of the Barranquilla hill, the topography charactised by many undulations, it has several high embankments or cut sections. The area's soil has a high sand content from volcanic ash and shows weak resistance to wind or rain. As a result of this and despite its recent completion, the slopes of the road have been eroded and some have already started to crumble.

(2) Improvement plan

Improvements are planned to give the road four-3.25 m through traffic lanes with a 3.0 m wide median. 2.5 m shoulders will be provided. As the roadside will be urbanised according to the Future Land Use Plan, 4.0 m wide sidewalks will also be provided on both sides of the road.

The Improvement Plan divides this road into four sections, as shown below.

Section I	:	Calle 30 – Calle 45D	4.4 km
Section II	:	Calle 45D – Calle 47	3.4 km
Section III	:	Calle 47 – Cra. 38	4.5 km
Section IV	:	Cra. 38 – Via 40	7.0 km

3) Via 40

This section extends between Calle 82 and the Circunvalar for a distance of 3.5 km.

(1) Existing street conditions and planned route

Via 40 is a semi-arterial street, 8.5 km in length connecting Cra. 46 in the Centro District and the Circunvalar. While the 5.0 km section adjacent to the Centro District consists of 6 through traffic lanes with a median, the rest of the street is not yet developed Improvements will, therefore, be carried out for this 3.5 km stretch where it runs through an industrial zone.

(2) Improvement plan

The total improvement section will result in a four through traffic lanes with a 1.0 m wide median. 1.5 m wide shoulders and 4.0 m wide sidewalks will be provided on each side.

4) Cra. 21B, 22

This section extends between the Riverside Bypass and Calle 58 for a distance of 3.9 km.

(1) Existing street conditions and planned route

This route consists of two streets; the 1.8 km Cra. 21B between the Riverside Bypass and Calle 30 and the 2.1 km Cra. 22 between Calle 30 and Calle 58. Both sides of the entire route are occupied by upper middle to low income residential housing. Since the average width of the streets is approximately 8 m, it should be widened at the time of improvement work.

(2) Improvement plan

Improvement work for Cra. 21B and Cra. 22 will be carried out independently. The im-

proved cross-section of the route will be 4 through traffic lanes totalling a width of 13.0 m without a median. 0.75 m wide shoulders and 4.0 m wide sidewalks will be provided on each side of the street.

5) Avenida la Arenosa

This section extends between Calle 47 and Via 40 for a distance of 5.7 km.

(1) Existing road conditions and planned route

Calle 58 and 58D are part of this road. The road will form an inner circular road as it joins the Riverside Bypass, Cra. 21B and Cra. 22. Although it would be preferable to plan the route from Calle 53D to Calle 57, the provision of a semi-arterial street may pose environmental problems to the two large hospitals located along Calle 57. The planned route has accordingly been shifted to Calle 58 where it will pass through four lower middle class residential blocks at the intersection with Calle 53D.

(2) Improvement plan

The route will be divided into three sections according to the Improvement Plan, i.e. (i) a 1.4 km section between Via 40 and Cra. 54, (ii) a 3.1 km section between Cra. 54 and Cra. 21B and (iii) a 1.2 kilometers section between Cra. 21B and Calle 47. The cross-section will be 4 through traffic lanes with a 1.0 m wide median. 0.75 m wide shoulders and 4.0 m wide sidewalks will be provided on each side of the road.

6) Camino A Caracoli I

This section extends between Autopista Al Aeropuerto and Calle 18 in Soledad for a distance of 0.35 km.

(1) Existing road conditions and planned route

This route will be combined with a new route between Calle 45D and Autopista Al Autopista, Al Aeropuerto (Camia A Caracoli I) in order to form a single route. In view of the purpose in road planning, the route has been divided into a new construction section and an imrprovement section. The roadside area is residential with mostly old single storey houses.

(2) Improvement plan

The existing road will be extended and will become 4 through traffic lanes without a median to match the cross-section of Camino A Caracoli I. The width of the lanes will be 3.25 m each. 0.75 m wide shoulders and 4.0 m wide sidewalks will be provided on both sides of the road.

7) Via Soledad 2000

This section extends between Calle 45 and Autopista Al Aeropuerto for a distance of 3.5 km.

(1) Existing road conditions and planned route

This route will mostly pass through uncultivated fields except for the section in Soledad 2000, a newly developed housing complex in the south of Barranquilla, and the residential area surrounding Soledad 2000. The existing 8.0 m wide road is paved with concrete with 3.3 wide sidewalks for the section near Autopista Al Aeropuerto. Paving of the road around the Soledad 2000 housing complex is incomplete and the width of the sidewalks is as narrow as 1.5 m. Rolling topography is seen in the section between Soledad 2000 and Calle 45.

(2) Improvement plan

The horizontal alignment of the improved road will be almost identical to that of the existing road. The cross-section will be 2 through traffic lanes with a total width of 6.5 m. 0.75 m wide shoulders and 4.0 m wide sidewalks will be provided on each side of the road.

8) Puente Pumarejo Access Road

This section extends between the Riverside Bypass and Calle 17 for a distance of 1.0 km.

(1) Existing road conditions and planned route

This road starts from Puente Pumarejo and connects with Calle 19 at the intersection with Calle 17. The existing road is of a rural type with a width of 7.2 m and 3.6 m wide shoulders. The plan envisages the improvement of the intersection with Calle 17 by widening the road between the intersection with Calle 17 and the Riverside Bypass. The construction of the Riverside Bypass has also been proposed in this study. The roadside areas are currently vacant and the road is constructed on a low embankment.

(2) Improvement plan

The planned section of this road will involve four-3.25 m through traffic lanes with a 3.0 m wide median. 2.5 m wide shoulders and 3.0 m wide sidewalks will be provided on each side of the road.

9) Calle 45D

This section extends between the Circunvalar and Cra. 21.

(1) Existing street conditions and planned route

Combined with the extension street of Calle 45D between the Circunvalar and Via Caracoli, as proposed in this study, this street will form a single axis route connecting the southern sub-center and the northern part of the city. The improved section will be divided into two segments, a 3.9 km segment between the Circunvalar and Calle 47 and a 1.45 km segment between Calle 47 and Cra. 21. The street side areas consist of low class residential areas for both sections and the conditions are particularly bad for areas around the Circunvalar. The existing street has 2 through traffic lanes paved with asphalt concrete without sidewalks. Current street maintenance is poor.

(2) Improvement plan

The section between the Circunvalar and Calle 47 will be built as four through traffic lanes without a median, totalling 13.0 m in width. In addition, 0.75 m wide shoulders and 3.0 m wide sidewalks will be provided on each side of the street.

10) Cra. 26 – Calle 76D

This section extends between Calle 70C and the Circunvalar for a distance of 4.2 km.

(1) Existing street conditions and planned route

This route consists of two streets, part of Cra. 26, and Calle 76D. The Cra. 26 part of this route starts from the intersection with Calle 70C, which runs along the western cliff edge of the Barranquilla hill, descends the cliff, merges with Calle 76D and reaches the Circunvalar intersection at the El Pueblo entrance. The existing Calle 76D has two asphalt-concrete paved through traffic lanes, 8.0 m in width and does not have any other street facilities such as sidewalks. Since it descends a steep cliff, its vertical grade is as high as 8%.This street's Improvement Plan, therefore, will include the partial improvement of its horizontal alignment in order that the grade can be reduced by extending the length of the street. The access road to El Pueble is a 6.2 m wide concrete paved street and the conditin of its surface is good. The intersection with the Circunvalar will be changed into a channelised intersection with traffic signal control.

(2) Improvement plan

The street will have 2 through traffic lanes, 6.5 m total. 0.5 m wide shoulders and 3.0 m wide sidewalks will be provided on each side of the street.

11) Cra. 38 (Occidento)

This section extends between Calle 74 and the Circunvalar for a Distance of 5.0 km.

(1) Existing street conditions and planned route

Cra. 38 currently starts from the entrance to the Zona France which is located on the riverbank of Rio Magdalena. It runs south of the Centro District, meeting with the Circunvalar where it connects to a rural road leading to Juan Mina. While it is a 4 through traffic lanes street inside Barranquilla, its horizontal alignment meanders in some sections between Calle 74 and the Circunvalar when it descends the western cliff of the Barranquilla hill. At this hill area, its cross-section includes 2 through traffic lanes with a total width of 8.4 m. It is a rural type road and the sideroad have not yet been urbanised. The center line of the road should be moved towards the northern side when widening work is carried out, since a part of the road is adjacent to the landslide zone.

(2) Improvement plan

The Improvement Plan for this section involves upgrading the road into four-3.25 m through traffic lanes with a median. 1.5 m wide shoulders and 3.0 m wide sidewalks will be provided on each side of the street.

12) Cra. 38

This section extends between the Riverside Bypass and Calle 30 for a distance of 1.3 km.

(1) Existing street conditions and planned route

This section is also part of Calle 30. Currently the 300 m section between the Zona Franca and the warehouse district has 2 through traffic lanes, totalling 8.4 m in width with 4.0 m wide sidewalks. The 1.4 km section from the warehouse district to Calle 30 has 2 through traffic lanes with a total width of 9.6 m and 4.0 m wide sidewalks. It includes a bridge over Caño Ahuyama.

(2) Improvement plan

The entire improvement section will be made into four-3.25 m through traffic lanes with a 3.0 m wide median. 2.5 m wide shoulders and 3.0 m wide sidewalks will be provided on both sides of the road.

13) Cra. 50 – Cra. 54

This section extends between Via 40 and Calle 58 for a distance of 2.1 km.

(1) Existing street conditions and planned route

This street runs almost parallel to Cra. 46 which is an important city street. The existing street starts from Calle 37 and has a narrow width of 5.0 m and sidewalks with a width of 1.5 m. A number of small and middle size machine shops are located along the road.

These shops use remodelled houses in the residential area of the old quarter of the city. The bridge crossing the Arroyo of Calle 47 has 4 through traffic lanes with a 2.0 m wide median. Excepting for this bridge, however, and upto Calle 54 the street has a narrow width of 6,5 – 8,0 m with about 2.0 m wide sidewalks. Streetside houses are not maintained very well. At the intersection with Calle 53, the street merges with Cra. 54, which has 4 through traffic lanes with a 5.0 m wide median and 6.0 m wide sidewalks. The width of the lanes is 3.0 m, however, which is narrow in view of the street's status as a semi-arterial street.

(2) Improvement plan

The section of the street passing through the customs district between Via 40 and Calle 37, which is part of Cra. 50, will be used especially for a different purpose in accordance with the Renewal Plan for the Centro District. Therefore, the horizontal alignment of this section of the road will be moved southward to connect with Via 40. The design cross-section of the street will be four-3.25 m wide through traffic lanes with a 3.0 m wide median. 0.75 m wide shoulders and 4.0 m wide sidewalks will be provided on each side of the road.

14) Cra. 54 – Cra. 51B

This section extends between Calle 58 and Calle 85 for a distance of 3.2 km.

(1) Existing street conditions and planned route

This route will be connected to the Cra. 50–Cra. 54 route, forming part of the east-west axis of Barranquilla. The streetside consists of high income residential areas. After passing Calle 96, the route gradually ascends westward. The existing cross-section shows 2 through traffic lanes with a total width of 8.0 m with 4.0 m wide sidewalks for the section between Calle 80 and Calle 93. Between Calle 93 and the Circunvalar, the total lane width is 8 m with 2.0 m wide shoulders.

(2) Improvement plan

This street will be made into four-3.25 m through traffic lanes with a 3.0 m wide median. 0.75 m wide shoulders and 4.0 m wide sidewalks will be constructed on each side of the street. As the interchange between Cra. 46 and the Circunvalar is located nearby, the overpass method will be used at the intersection between this road and the Circunvalar, to avoid creating unnecessary danger.

15) Cra. 60 – Cra. 64

This section extends between Calle 58 and the Circunvalar, and continues for an additional 2.0 km for a total distance of 7.8 km.

(1) Existing street conditions and planned route

Cra. 60 runs through upper middle income and high income residential areas and has a through traffic lane width of 8.0 m with 3.0 m wide sidewalks. Although the area around the intersection between Cra. 64 and the Circunvalar is uncultivated fields, the development of residential land has been partially started on the western slope of the Barranquilla hill.

(2) Improvement plan

This street will have 2 through traffic lanes with a total width of 6.5 m. 0.75 m wide shoulders and 3.0 m wide sidewalks will be provided on each side of the street.

16) Carretera Oriental

This section extends between Aeropuerto and Malambo for a distance of 3.0 km.

(1) Existing road conditions and planned route

This Oriental Road starts from the interchange between Calle 30 and the Circunvalar and heads towards Medellin. It is a rural type road with a total through traffic lane width of 10.4 m, including the shoulders. A 4.0 m median divides the lane for the section between the interchange and Aeropuerto. In addition, an average 2.5 m wide slope protection is provided on both sides of the road. After passing the airport, the cross-section changes to 2 through traffic lanes with a total width of 6.0 m with 2.3 m wide shoulders on each side. Since Carretera Metropolitan, which is proposed for construction under the present study, will join Carretara Oriental to form a greater circular road for the Barranquilla Metropolitan Region, the respective section of the Driental Road should be widened accordingly.

(2) Improvement plan

The road will be improved to 4 through traffic lanes with a total width of 13.0 m. 2.5 m wide shoulders will be provided on each side of the road and slope protection will be added to these shoulders.

11–3–3 Collector and Local Streets

1) Collector Streets

Apart from the major roads and streets designed by the Barranquilla Metropolitan Road

Network Plan, collector street networks will be established in the Centro District and Barranquilla, based on the Renewal Plan for the Centro District and the Bus Route Circulation System.

The cross-section of these collector streets will consist of through traffic lanes with a total width of 6.5 m, 0.75 m wide shoulders and 3.0 m wide sidewalks.

The following table lists the collectror streets in the Centro District and Barranquillita (Table 11–3–1).

Table 11–3–1 List of Collector Streets in Centro District and Barranquillita

Centro District

Street Name	Length (m)	Section
Cra. 40	470	Calle 40 – Calle 45
Cra. 45	1,660	Calle 30 – Calle 54
Calle 37	1,600	Cra. 33 – Cra. 50
Calle 38	700	Cra. 38 – Cra. 50
Calle 44	1,400	Cra. 33 – Cra. 50

Barranquillita District

Street Name	Length (m)	Section
Calle 4	913	Cra. 46 – New Street
Calle 6	1,373	Cra. 46 – New Street
Calle 7	998	Cra. 46 – New Street
Cra. 43	906	Riverside Bypass – Calle 30
Cra. 45	910	Riverside Bypass – Calle 30
Via la Loma	1,650	Barranquillita Residentail Area
New Street	926	Riverside Bypass – Calle 17

2) Street Planning Policies for the Sub-Centers

Street planning for the sub-centers to be built in the south and the north-west of Barranquilla should be carried out in accordance with the following policies.

a. Arterial and semi-arterial roads and streets in the Barranquilla road network should not be directly led into the sub-centers. Collector streets from the sub-centers will be used to connect with these roads and streets.

b. Collectro streets will play the role of major streets inside the sub-center districts and local streets will play the role of local road services inside the sub-centers.

c. The cross-section of collectro streets will be four-3.25 m wide through traffic lanes. 1.5 m wide shoulders and 3.0 m wide sidewalks will be provided on each side.

d. The cross-section of local streets in the business area will be four-3.0 m wide through traffic lanes. 0.75 m wide shoulders and 3.0 m wide sidewalks will be provided on each side. The streets in the surrounding residential areas will consist of 2 through traffic lanes with 0.5 m wide shoulders and 3.0 m wide sidewalks on each side.

Drainage facilities will be provided for all streets inside the sub-centers.

11–3–4 Main Cross Section Elements of Roads and Streets

1) Pavement

Paving is planned for arterial and semi-arterial streets in order to cope with heavy traffic use. Structurally adequate paving keeps the surface of the roads and streets in good condition for the smooth motoring of vehicles and requires less frequent maintenance. Long-lasting, nonskid type paving is planned for use, as this will be effective for all weather conditions. The Short Term Plan is, therefore, to repave existing major streets with cement concrete and later on, to cover all surfaces with asphalt concrete pursuant to the Long-Term Plan.

2) Lane Width

A 3.0 m traffic lane width is the minimum width used for all streets in this study as it is considered to be the ideal width with regard to traffic capacity and proper vehicle operation. However, it is desirable that the through traffic lanes on arterial and semi-arterial streets be planned at 3.25 m and those on collectors at 3.0 m. The auxiliary lanes at intersections and interchanges, added to facilitate traffic movement, will also be 3.0 m wide.

3) Shoulders

A shoulder is the portion of the street that runs parallel to the through traffic lane in order to accommodate stopped vehicles, for example, in an emergency. In business and shopping areas, it can be used to temporarily park vehicles.

All traffic lanes are in use during daily peak hours and where shoulders are unavailable, stopped vehicles disrupt the traffic not only on the occupied lane but on all lanes running in the same direction. In addition, shoulders provide space for such drainage facilities as gutters and catch basins.

The right side shoulder width should be sufficient for a stopped vehicle to clear the edge of the through traffic lane, i.e. 2.5 m. However, it is difficult to acquire the space necessary to widen streets. The shoulder width for roads in suburban iindustrial areas has, therefore, been determined at 2.5 m. For 6 lane major streets and/or residential areas the shoulder width has been determined at 0.75 m, and for collector streets at 0.5 m.

Left side shoulders are desirable on all divided streets and, therefore, efforts should be made to provide a paved strip of 0.25 m in width for pavement structural support.

4) Curbs

Curbs are used extensively on all types of streets for the purpose of controlling drainage, deterring vehicles from leaving the street in hazardous places, protecting pedestrians, delineating the edge of the pavement, presenting a more finished appearance and assisting in the orderly development of the sides of streets. The curb planned is mountable and is designed together with a gutter in order to form a curb and gutter section.

5) Medians

It is desirable to have a median on all arterial raods and streets that have four or more lanes. A median is defined as the portion of a divided road and/or street that separates the through traffic lanes for traffic travelling in opposite directions. The main functions of a median are to provide freedom from interference by opposing traffic, a recovery area for out-of-control vehicles and to provide a place for vehicles wishing to turn left at intersections.

The median width in a 4-lane road is calculated from the outside edge of the passing lane on one side to the outside edge of the passing lane on the other with a minimum width of 1.5 m. In a two-lane road, the width is measured from the outside edge of the lane on one side to the outside edge of the lane on the other side.

6) Sidewalks

A sidewalk separates the road from homes and business and is usually part of road facilities for urban roads. Its function is to provide space for pedestrian movement and a green belt.

Sidewalks in residential areas may vary from 3.0 m to 6.0 m. On hazardous sections of streets or roads, a "W" beam guardrail may be used along the edge of the sidewalk to separate the

sidewalk and the through traffic lane in order to protect pedestrians.

11–4 Street Drainage System

The plans for installing a drainage system in the streets of Barranquilla are divided into two categories: a) the construction/improvement of drainage facilities and b) the Arroyo countermeasure.

11–4–1 Gutters

None of the existing streets inside Barranquilla have been constructed with a drainage system. Gutters are planned to be installed along both sides of the streets for drainage. Gutter sections will be provided on the shoulder side of mountable curbs to form the principal drainage system of the streets. The inlet will be provided in either the gutter or the curb, or both. Gutters will be 50–75 cm wide, with a cross slope of 5% to increase the hydraulic capacity of the gutter section. Water collected by the gutter will flow into un underground storn drain pipe.

11–4–2 Arroyo Countermeasure

Overall, the drainage system of Barranquilla is extremely inadequate. Most of the city roads and streets have not been constructed with a drainage systems. As a result, rain run-off collects and flows through certain streets into the Magdalena River. This type of drainage system is generally called an arroyo in Colombia. When it rains, the arroyo water severaly obstructs traffic by temporarily halting all pedestrian and vehicle movement.

1) Basic Considerations

The Arroyo problem is one of the most important issues for the city, and an Arroyo study should be conducted independently from this Comprehensive Urban Transport Study. The study should include drastic action needed to carry out major changes required to mitigate the amount of economical loss caused by traffic stoppage and the socio-environmental effects of implementing and Arroyo countermeasure plan.

In this study, the Arroyo countermeasure plan is limited to critical points and sections along the routes of arterial and semi-arterial streets and in the Centro District enclosed by Cras 38 and 54 and Calle 45.

2) Planning Method

A system of collecting and analyzing data concerning rainfall in key areas of the city, the conditions and gradients of the Arroyo routes, the catchment areas, land conditions and run-off constants, etc. should be established. The method of analysis is quite similar to that for road surface drainage systems.

The volume of Arroyo water flow at critical points and sections is influenced by the amount of precipitation in the catchment areas located at higher elevations.

Rainfall data on key areas of the central district are not available at present. The Instituto Colombiano de Hidrologia y Adecuacion de Tierras (HIMAT) has been recording daily rainfall at the Barranquilla airport, but this data alone is not sufficient for analyzing and estimating the probability of rainfall intensity in the key areas. Therefore, the rainfall intensity given in the report (see Chapter 4) completed by the University C.U.C. students was used.

3) Facilities

After estimating the volume of Arroyo water flow, the following countermeasures were considered:

(1) Construct water inlet holes at the edges of sidewalk curbs to conduct the road surface water into box culverts constructed under the sidewalks.

(2) Collect the road surface water using lined ditches that cross the road. The ditches are to be covered with grating.

(3) Combination of (1) and (2) above.

The collected Arroyo water is led under the street via box culverts, using the siphon method. Both the inlets and outlets are connected to manholes to facilitate the maintenance work.

4) Implementation

The following two alternatives concerning a timetable for the implementation of the countermeasures can be considered:

(1) Construction of the drainage facilities, not later than 5 years.

(2) Inclusion of the drainage facilities in future street improvement and/or construction plans.

Fig. 11–4–1 shows the proposed network of arroyo drainage facilities, and Fig. 11–4–2, Fig. 11–4–3 show typical drainage facilities.

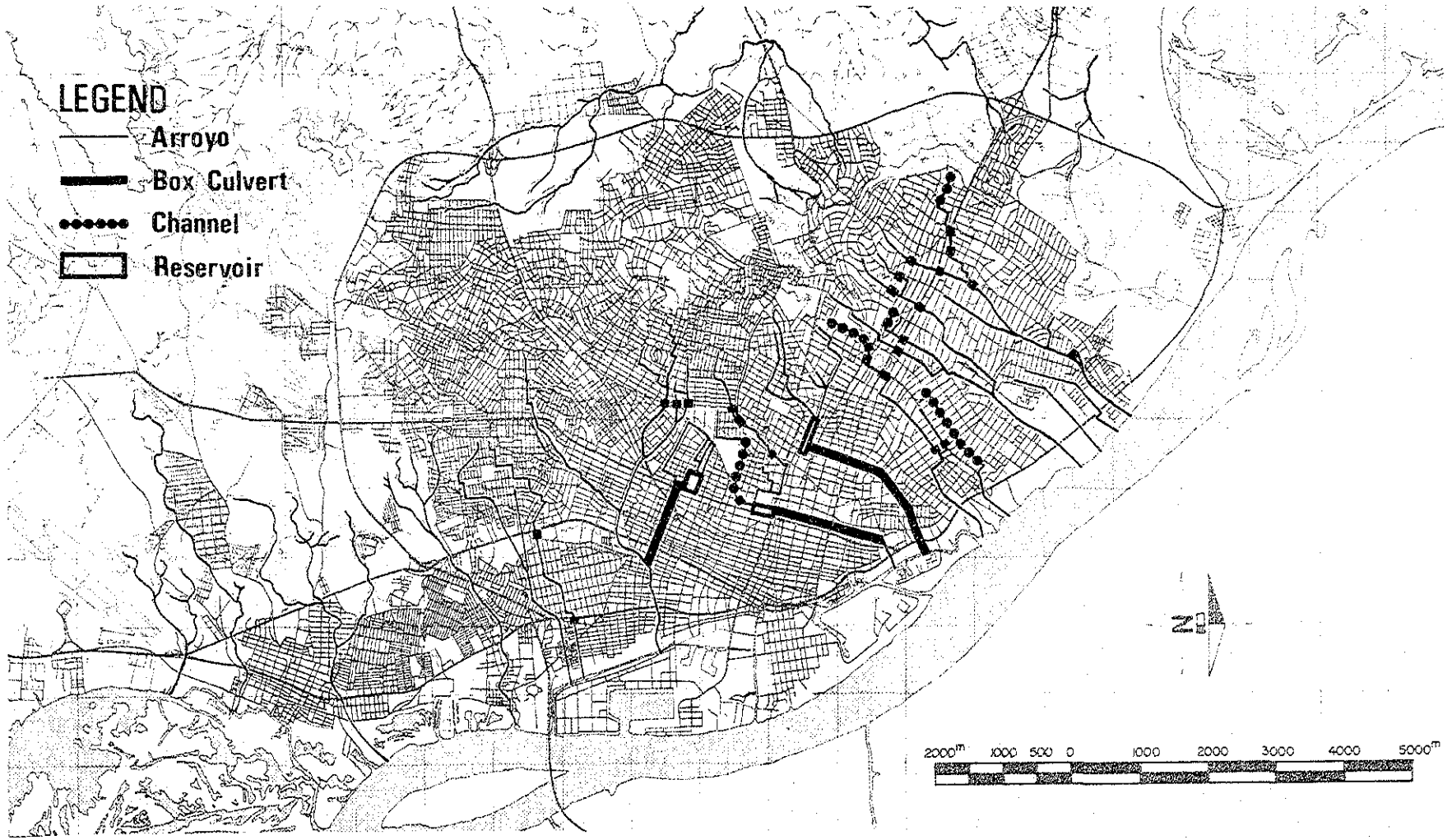


Fig. 11–4–1 The Future Plan of Arroyo Routes

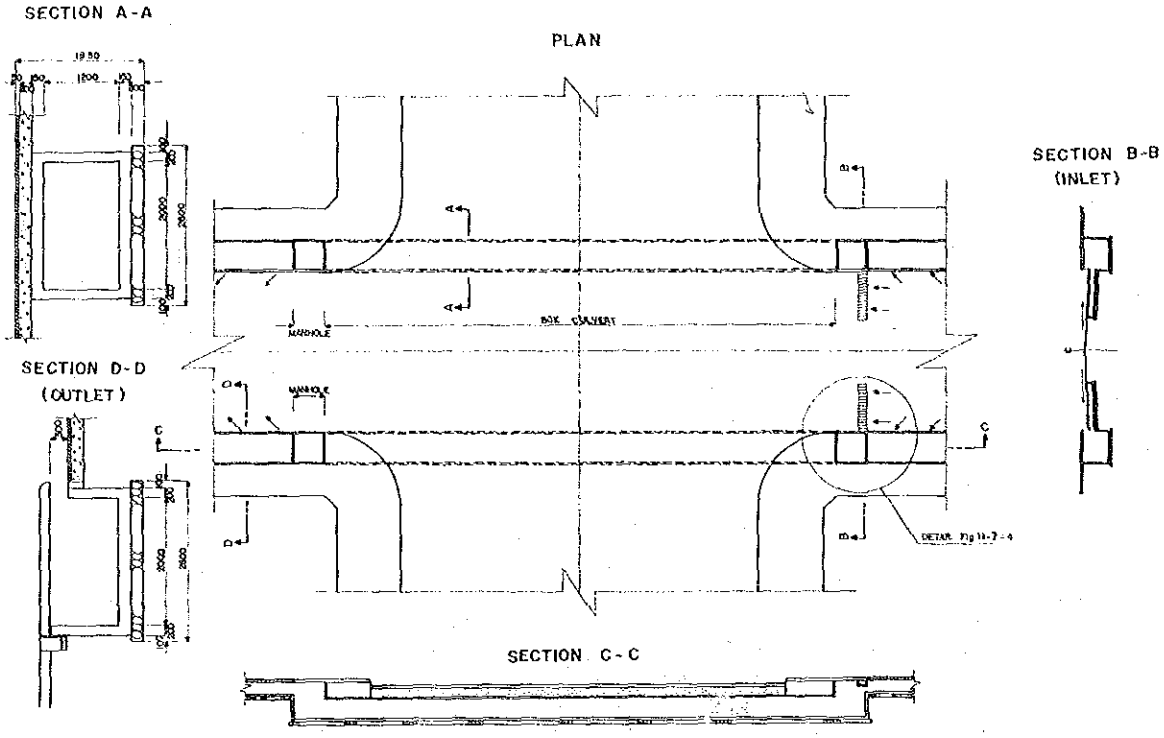


Fig. 11–4–2 The Arroyo Counterplan for the Critical Point

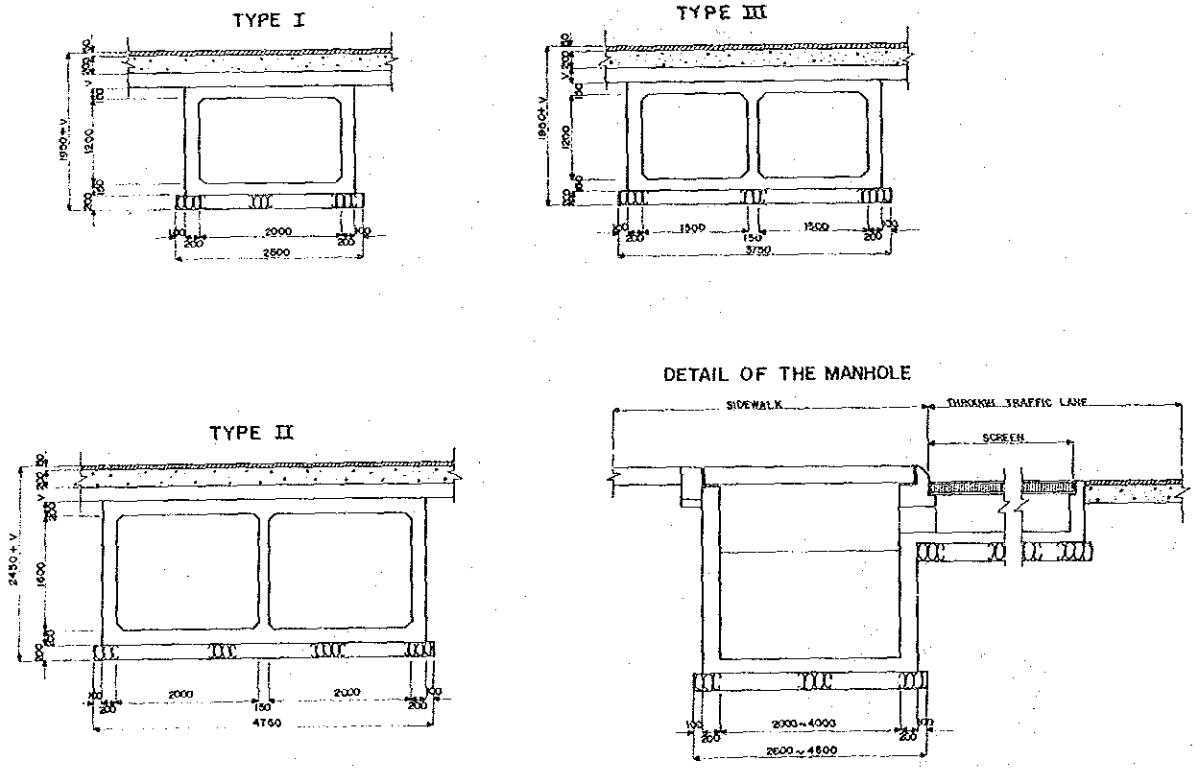


Fig. 11–4–3 Detail of the Culvert Box and Manhole

11–5 Estimation of Road Project Cost

All the costs required for road construction and improvement were estimated on the basis of the price conditions as of Aug. 1984 in Colombia, particularly in Barranquilla.

The total project cost is obtained by estimating the cost for each component as grouped in Fig. 11–5–1, i.e., the construction cost, land acquisition cost and compensation cost for the other properties affected by the project.

Construction cost is composed of direct construction cost, overhead, contingency, and engineering cost for survey, desing, supervision, etc.

The direct construction cost was estimated by three cost items, material, equipment costs, labor cost, and tax for the purpose of classifying the foreign and local currency portions and to convert it to an economic cost. All project costs are estimated for each road project identified in Cahpter 15.

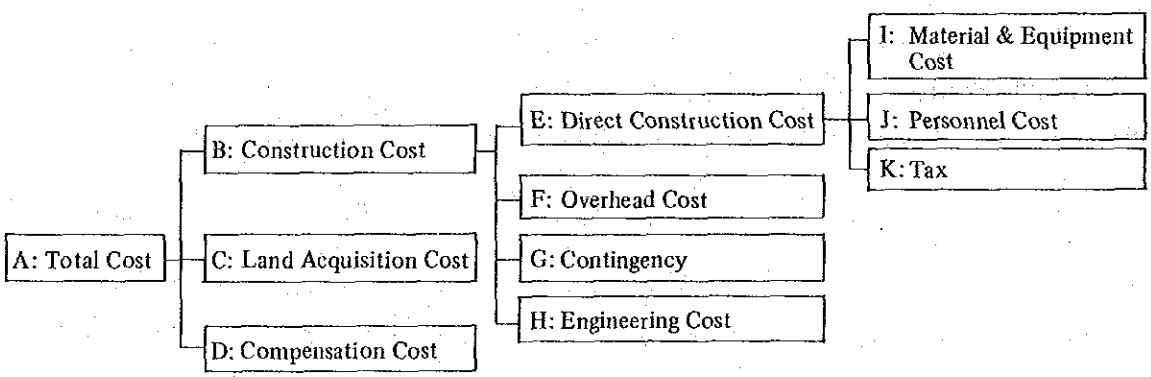


Fig. 11–5–1 Composition of Project Cost

11–5–1 Construction Cost

1) Construction Material Cost

Most of the construction materials are locally available in Colombia except for high-tensile steel, guardrail, paint for marking and reflectors, etc. Local Prices for materials were obtained from the information by CAMACOL partly supplemented by the contractors in Barranquilla. These costs include the transport costs to the construction site.

As for the small structural products required in big quantities for drainage facilities etc., it is assumed that a pre-cast concrete produced in Barranquilla will be used for better quality control and reduction of production cost.

2) Machinery Cost

Machinery cost is estimated on the basis of the information and estimation method proposed by Colombia Construction Industries Association (ACIC). Machinery cost can be subdivided into the depreciation cost (rental fee) and operation cost. The depreciaion cost is obtained from the depreciable value multiplied by a certain factor which is determined by taking into account the depreciation rate, interest rate, tax, insurance and charges for custody, etd. by type of machine. All construction machinery are assumed to be imported.

The operation cost is the total of consumed elements cost such as fuel, lubricants, filter, etc., the maintenance and repair cost, and the administration cost including labor cost for the operators and assistants.

3) Labor Cost

Labor cost is estimated by applying the unit labor cost which is used when the Municipality of Barranquilla gives an order construction work.

The unit prices per day (8 hours working) are 1,300 pesos for supervisor, 1,095 pesos for foreman, 900 pesos for skilled laborer and 765 pesos for unskilled laborer. These include the social allowances legislatively mandated to be paid such as social insurances, etc.

4) Tax

All taxes included in the machinery cost and the material cost are extimated separately. According to the road plan "Carretera Bogota – La Dorada" (Oct. 1984, INGETEC S.A.) by MOPT, the average taxation rate for the imported materials is 23.75% and the value added tax for the domestic materials is 10%.

5) Unit Construction Cost

Unit construction cost is obtained by work items such as excavation, embankment, cement concrete pavement etc. as shown in Table 11–5–1.

For the estimation of the construction cost of street widening it is assumed that the existing concrete pavement would be used as the base for the asphalt concrete pavement.

Hence, for the portion to be widened, asphalt concrete will be overlayed after bringing it to the same condition as the existing portion paved with concrete.

Table 11–5–1 Unit Construction Cost in Barranquilla 1984

Work Item	Unit	Cost (pesos)	Cost Compositon (%)		
			Equipment & Material	Labour Cost	Tax
Demolition	m^2	1,370	43.9	42.4	13.7
Cement Concrete Repavement	m^2	3,762	65.0	23.9	11.1
Asphalt Concrete Repavement	m^2	2,229	46.2	31.5	22.3
Cement Concrete New Pavement	m^2	2,391	77.2	13.2	9.6
Asphalt Concrete New Repavement	m^2	1,396	74.1	10.1	16.8
Sheet Asphalt	m^2	470	86.2	1.8	12.0
Median	m^2	2,658	73.4	18.8	7.8
Sidewalk	m^2	494	73.9	17.9	8.2
Curbs (6 lines)	ml	1,227	80.9	11.1	9.0
Marking T1 (4 line + Median)	km	2,169,440	75.4	0.9	23.7
Marking T2 (4 line)	km	1,027,080	75.4	0.9	23.7
Marking T3 (2 line)	km	1,684,720	75.4	0.9	23.7
Marking T4	km	542,360	75.4	0.9	23.7
Guardrail	ml	6,379	87.5	2.6	9.9
Drainage	ml	14,450	80.0	8.8	9.2
Bridge Construction	m^2	55,000	64.3	26.7	9.0
Pedestrian Overpass	m^2	28,052	75.0	15.0	10.0
Manual Filling	m^3	309	0.9	99.0	0.1
Embankment	m^3	150	68.1	10.9	21.0
Excavation (h = 0–3 m)	m^3	312	15.8	64.2	20.0
Excavation (h = 3 m)	m^3	389	20.9	65.6	13.9
Filling & Compacting (including material cost)	m^3	1,023	84.6	1.6	13.8

6) Indirect Cost

Using the direct cost, which is obtained from the unit construction cost multiplied by each construction quantiy, the indirect cost is estimated as follows.

a. Overhead Cost : 30% of the direct cost.

b. Contingency : 10% of the total of the direct cost and overhead.

c. Engineering Cost : 12% of the total of the direct cost, overhead and contingency cost.

As a result, the total construction cost will be 1.6 times the direct cost.

11–5–2 Land Acquisition and Compensation Cost

Land acquisition cost is estimated as the required land area multiplied by the unit price. The required land area is calculated from the length of widening multiplied by the difference in the right of way from width before and after-widening, however, the area within right of way of the crossing streets should be excluded. Accordingly, the required land area is estimated to be 90% of the area, i.e. the length of widening multiplied by the difference in the rights of ways. Refer to Fig 11–5–2.

The unit land price is obtained from the information of CAMACOL and Agente de Lonja.

As for the estimation of the compensation cost in the masterplan stage, each affected property cannot be assessed individually, therefore, the estimation method is as follows.

$$\begin{pmatrix}\text{Compensation}\\ \text{Cost}\end{pmatrix} = \begin{pmatrix}\text{Floor Area of}\\ \text{Affected Houses}\end{pmatrix} \times \begin{pmatrix}\text{Unit Construction}\\ \text{Cost}\end{pmatrix} \times \begin{pmatrix}\text{Residual Value}\\ \text{Rate}\end{pmatrix}$$

As stated above, the widening scheme covers nearly 90% of the length of the project.

It is also assumed that nearly 70% of the area to be taken for the widening falls within buildings already in existence. The balance will be obtained from spaces between buildings or from unoccupied land within the buildings' setback.

This reduction rate is applied to the average residential area in Barranquilla, but cannot be used for Centro. It is also assumed that the frontage of an average house is 8 m and the floor area is 120 m^2.

It is also assumed that the frontage of an average house is 8 m and the floor area is 120 .The compensation cost depends on the type of widening. If both sides of the existing road are widened, the compensation cost will be almost double that of one-side widening. Therefore, the way of sidening was carefully considered for each project.

The unit construction cost was estimated by calculating the average of the information from CAMACOL and from a large contractor in Barranquilla. As a result, the unit construction cost is as follows.

– Low income group house	11,500 pesos/m^2
– Middle income group house	20,200
– High income grup house	31,600
– Commercial buildings	38,600
– Factories, Warehouses	19,800

The residential value rate was assumed to be 80% for the newly developed area (0 to 15 years), 50% for the medium area (16 to 30 years) and 30% for the old area (more than 30 years). However, for the old area where the reconstruction is proceeding, 50% was taken.

11–5–3 Estimation Results

The estimated cost of the road projects is shown in Table 11–5–2. Total project cost is

28,265 million pesos at 1984 prices, of which about 80% is for the construction cost, and 20% for land acquisition and compensation costs.

94% of the total project cost will be spent for the construction, the balance, or 6% will be used for land acquisition and compensation. In the case of widening, only 70% of the total project cost will be used for the construction. The balance, or 30% will be spent for land acquisition and compensation.

As shown in Fig. 11–5–2, the land acquisition costs is less than 10% in most cases, however, the compensation cost differs considerably by project. The projects where the compensation cost is more than 50% of the total cost, are Ave. La Arenosa (I10, I16), Cra 50-Cra. 51 (I21), Calle 30 (I01), etc. Fig. 11–5–3 also shows the composition of road project cost.

The foreign currency portion of the project cost is estimated as indicated in Table 11-5-3.

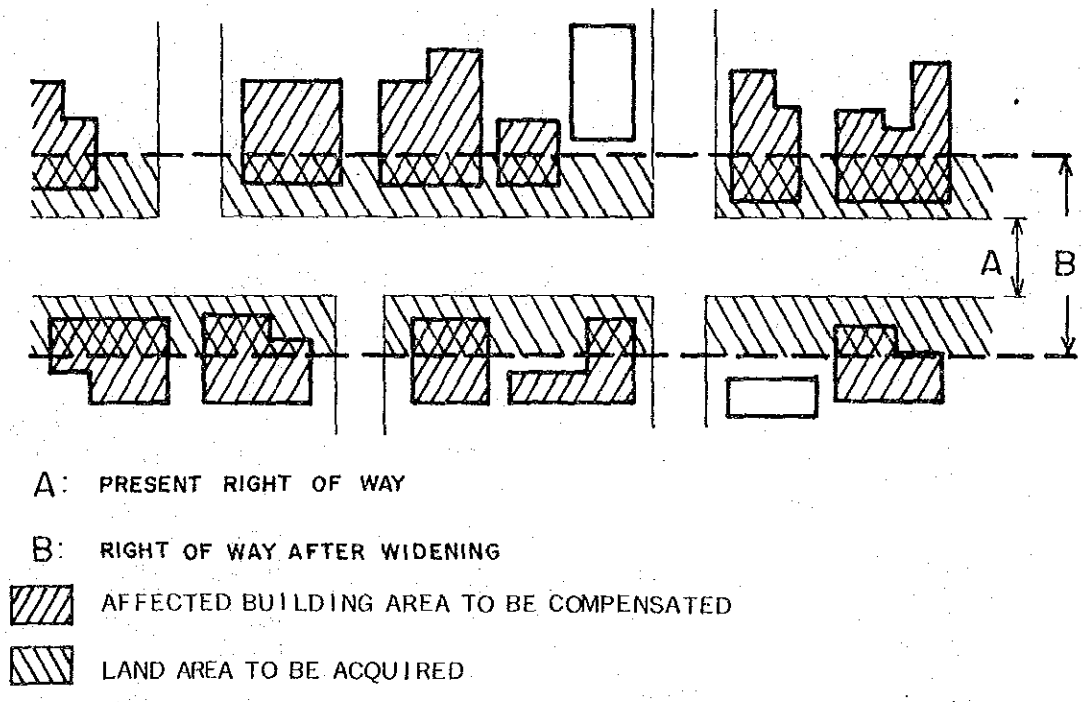


Fig. 11–5–2 Land and Building to be Compensated

It is assumed that all the machinery costs, 30% of material costs, 30% of engineering costs involve a foreign currency poriton. Other costs such as labor, land acquisition, compensation costs are considered local currency costs.

In general, road projects have foreign currency components of more than 50% of the total cost, but in this study the foreign costs are 44.55 since the projects require a large amount of land acquisition and compensation costs for the road improvement.

Table 11-5-2 Road Projects

No.	Cod.	Project	Length (km)	No. of Lanes		No. of Bridges	Cost (million pesos)		
				Before	After		Construction	Right of way	Total
1	C01	Bypass I	4.5	–	4	3	1,921.2	258.0	2,179.2
2	C02	Bypass II	3.0	–	4	2	1,525.2	161.1	1,686.3
3	C03	Cra. 46	1.0	–	4	1	296.8	16.5	313.3
4	C04	Calle 17	1.3	–	4	1	397.5	93.6	491.1
5	C05	Vía Caracolf I	5.05	–	4	–	560.6	59.3	619.9
6	C06	Transversal I	2.0	–	2	–	158.8	14.0	172.8
7	C07	Av. Las Moras	1.5	–	2	–	123.2	10.5	133.7
8	C08	Transveral II	1.4	–	2	–	11.1	2.8	11.39
9	C09	Vía Central de Abastos	4.7	–	2	–	386.1	23.6	409.7
10	C10	Calle 45D Ext.	1.2	–	4	–	92.1	12.1	104.2
11	C11	Calle 45 Ext.	6.0	–	4	–	1,616.1	17.7	1,633.8
12	C12	Carretera Metropolitana	22.3	–	2	–	3,739.1	46.7	3,785.9
13	C13	Anillo Rural	9.0	–	2	–	1,273.6	81.0	1,354.6
14	C14	Transveral Rural	4.0	–	2	–	569.2	39.2	608.4
15	I01	Calle 30 I	3.1	4	6	–	398.8	977.8	1,376.6
16	I02	Calle 30 II	2.9	4	6	–	301.1	–	301.1
17	I03	Circunvalar I	4.4	2	4	1*	670.3	–	670.3
18	I04	Circunvalar II	3.4	2	4	–	454.9	–	454.9
19	I05	Circunvalar III	4.5	2	4	1*	660.9	–	660.9
20	I06	Circunvalar IV	7.0	2	4	–	1,099.8	–	1,099.8
21	I07	Vía 40	3.5	2	4	–	414.5	–	414.5
22	I08	Cra. 22 I	1.8	2	4	–	234.8	174.6	409.4
23	I09	Cra. 22 II	2.1	2	4	–	273.4	159.1	432.5
24	I10	Ave. La Arenosa I	3.1	2	4	–	437.7	586.7	1.024.4
25	I11	Ave. La Arenosa II	1.4	2	4	–	169.0	174.6	343.6
26	I12	Vía Caracolf	0.25	2	4	–	83.0	67.9	150.9
27	I13	Vía Soledad 2000	3.5	2	2	–	237.5	80.0	317.5
28	I14	Acceso Puente Pumarejo	1.0	2	4	–	128.9	8.0	136.9
29	I15	CAlle 45D I	3.9	2	4	1	586.7	675.9	1,262.6
30	I16	Avenida La Arenosa III	1.2	2	4	–	177.8	696.4	874.2
31	I17	Calle 45D II	1.45	2	2	–	364.8	140.1	504.9
32	I18	Cra. 26-Calle 76D	4.2	2	2	1	306.8	–	306.8
33	I19	Cra. 38	1.3	2	4	–	170.2	20.3	190.5
34	I20	Cra. 38 Occidente	5.0	2	4	–	972.9	55.0	1,027.9
35	I21	Cra. 50-Cra. 54	2.1	2	4	–	404.2	890.0	1,294.2
36	I22	Cra. 54-Cra. 51B	3.2	2	4	–	229.2	–	229.2
37	I23	Cra. 60-Cra. 64	7.8	2	2	1	706.6	25.0	731.6
38	I24	Carretera Oriental	6.0	2	4	–	258.1	–	258.1
39	I25	Cra. 46 Abajo	1.0	4	6	–	132.6	52.3	184.9
Total			146.65	–	–	12	22,645.1	5,619.8	28,264.9

* Including interchange intersection.

Table 11–5–3 Road Project Cost by Foregin and Local Currency

(million)

	Foreign Portion (U.S.$)	Local Portion (Pesos)
New Roads Projects	64.5 (52.2%)	6,506.1 (47.8%)
Road Improvement Project	49.9 (37.4%)	9,167.9 (62.6%)
Total	114.4 (44.5%)	15,674.0 (55.5%)

Source: Study Team

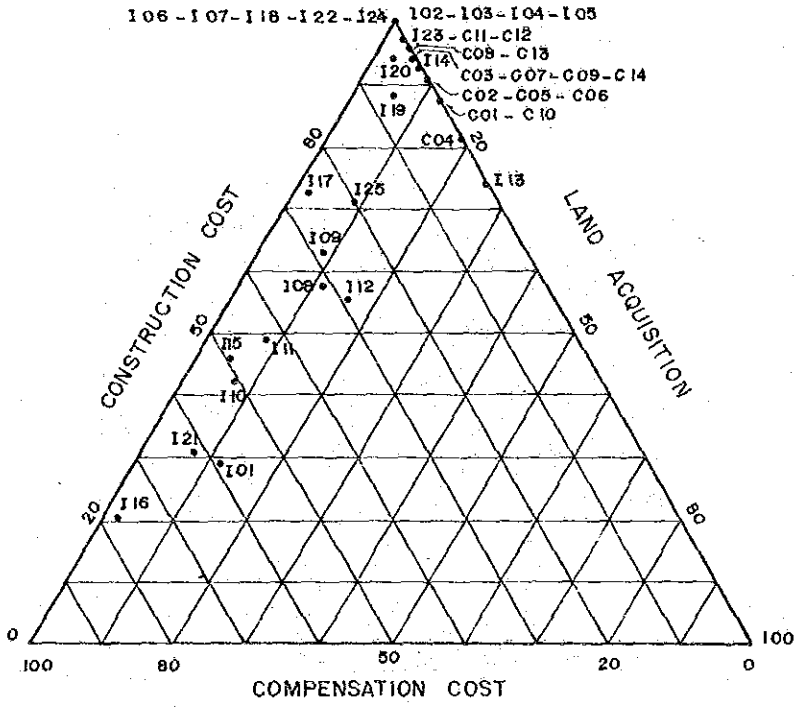


Fig. 11–5–3 Composition of Road Project Cost

11–6 Long-Term Traffic Management Plan

11–6–1 Traffic Signal Control Plan

Future increases in the vehicle traffic volume and the traffic density at intersections are expected in accordance with the expansion of the city's urban area. It will be necessary for a traffic signal control system to eventually shift from a line control system to an area control system for the smooth flow of complex traffic. The gradual introduction of these systems will best achieve the desired results. It seems reasonable to plan the introduction of a traffic signal control system for an area with a 2 km radius surrounded by Cra. 38, Calle 45 and Cra. 46 by 1990 and for an area with a 5 km radius surrounded by Via 40, Calle 76 and Cra. 14 by the year 2000.

In addition, the number of traffic signals should be increased for such arterial roads as Calle 30, Calle 45, Cra. 38 and Cra. 46 which lead to neighbouring citites. A line control system should also be introduced (see Fig. 11–6–1).

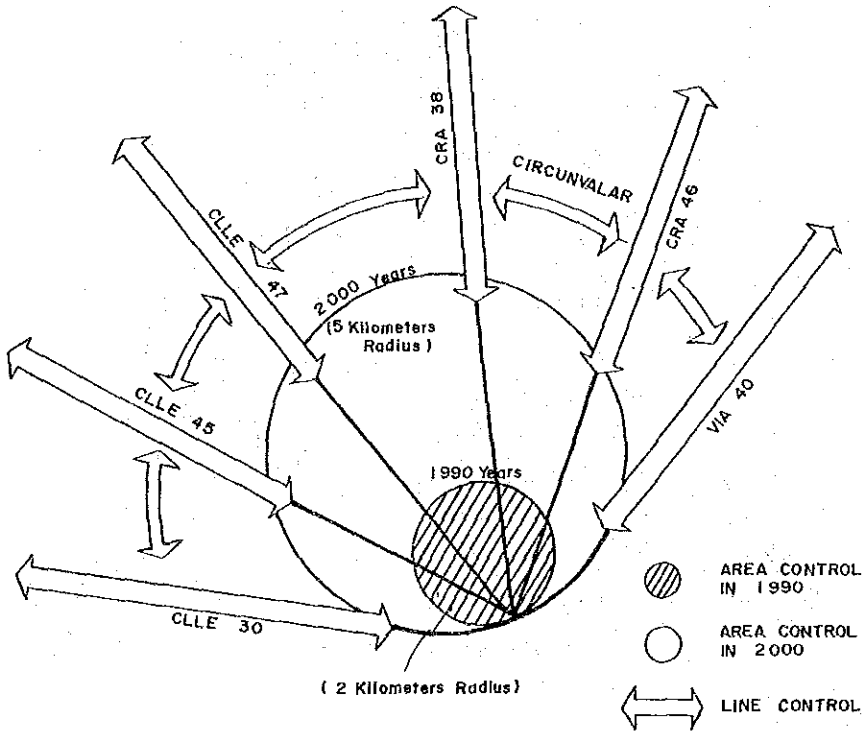


Fig. 11–6–1 Long Term Concept of Signal Control

11-6-2 Traffic Regulation Plan

1) Parking Regulation Plan

While many vehicles illegally park on the streets at present, parking regulations should be strongly enforced to improve the awareness of these regulations. Although no-parking regulations are currently enforced along arterial roads and streets with the purpose of preventing vehicles from parking on congested roads and streets, parking on semi-arterial roads and streets should also be prohibited. Furthermore, with regard to collector and local streets, in principle, new parking regulations should be introduced in order to extend the scope of the parking regulations for those zones where the street ratio is low.

In concrete terms, north Barranquilla, including the Centro District, should be made into a no-street parking area as this area is expected to grow into a large business area in the future. In addition, no-parking regulations should be strictly enforced along the arterial and semi-arterial roads and streets in the north Barranquilla area surrounded by Cra. 38, Via 40 and Calle 76.

2) Traffic Direction Regulation Plan

Traffic congestion in the Centro District is expected to become critical in the future in accordance with the increase in vehicular traffic. It is difficult to secure a smooth flow of traffic under such circumstances as a concentration of large buildings and the shortage of space for street widening, etc.

In addition, traffic congestion caused by the concentration of bus routes is considered to be one of the major current problems and is believed to have reduced the capacities of thr roads. A vehicle circulation system, therefore, based on the introduction of one-way traffic regulations will be effective in increasing the vehicular traffic volume in the Centro District as a supplementary measure to other improvement plans.

One-way streets are rather confined to the Centro District within the area surrounded by Calle 45, Cra. 38, Cra. 46 and Calle 30, where a road network resumbling a grid can be established. The following conditins should be met for the effective introduction of one-way traffic regulations for major streets.

(1) It is important to select one-way streets in pairs. The distance between these streets should be within about 500 m. It is also preferable that these streets have similar OD trip characteristics and road traffic capcities.

(2) The required travelling distances to destinations should not be appreciably increased.

(3) The left-turn traffic volume at particular intersections should not be appreciably increased.

(4) The traffic volume into side streets should not be appreciably increased.

(5) Traffic congestion at the ends of one-way streets or around them should not be allowed to develop into a critical state.

(6) The prvision of one-way streets should not cause much inconvenience to bus transport users.

(7) Weaving traffic lines cutting across each other will not result in a decline in traffic capacities nor will result in more hazardous conditions than the current conditions.

In accordance with the above-mentioned conditions, it would be preferable to adopt the following regular one-way directions for respective streets.

(1) With regard to Calle 45 and Calle 30, they will be used as two-way streets due to the lack of possible substitute streets.

(2) Since the traffic characteristics of the major streets running east to west are quite similar and since thedistances of these streets are within 500 m, the introducion of a one-way traffic system for these major streets will be effective.

(3) The selection of one-way streets should be determined on the basis of critical examination of the resulting supply and demand concerning the road capacities for each pair of street.

11–6–3 Parking Lot Plan

1) Basic Policy

The demand for parking will increase in the future in accordance with the increase in vehicle trips for commuting, shopping, business and other purposes. Traffic congestion will certainly become critical and traffic accidents will also increase if curb parking is uncontrolled. Futhremore, unless an adequate number of parking lots are made available, city activities will be hindered and city functions as a commercial, as well as inductrial, center may well be reduced.A huge amount of parking space will, however, be required if the total parking demand is to be met, limiting the availability and utilisation of urban space. Therefore, a Parking Lot Plan, accompanied by countermeasures to control the parking demand, will be necessary.

2) Scope of the Plan

Based on the results of the Parking Inventory Survey, and as previously described in the section concerning parking problems, traffic congestion in the Centro district and the north Barranquilla district is expected to further increase in the future. As shown by the Land Use Plan for the year 2000, where the expansion of CBD and the increase in the commercial population are predicted, it is evident that these two districts will become the centers of urban activities.

Based on the above-mentioned considerations, the Centro district and the north Barranquilla district have been chosen as subject districts for the Parking Lot Plan.

3) Estimate of the Future Parking Demand

The future parking demand is calculated using the peak time parking rate, given by the relationship between the current number of trips for each zone, and the number of peak time parked vehicles (see Table 11–6–1).

The total parking demand in the Centro district and the north Barranquilla district in the year 2000 will be approximately 19,300 parking spaces. The current parking capacity is 8,240 spaces, excluding curb parking. It will difficult to provide an additional 8,000 parking spaces which would still leave a dificit of 2,000 spaces. It would, therefore, be appropriate to adopt a policy for planning and constructing new buildings to provide parking spaces.

Based on the assumption that curb parking will be prohibited, the obligation to provide parking spaces should be considered. If this measure still does not meet the future demand, the construction of public, as well as private, car parks should be encouraged.

4) Development Need for New Parking Spaces

Table 11–6–1 shows the peak hour parking demand for each zone in the year 2000. The number of parking spaces provided as an obligatory requirement for new buildings is calculated on the basis of one parking space per 150 square meters of flow space. Newly built or rebuilt floor space by 2000 is calculated based on the estimated rebuilding rate in view of the ages of current buildings. With regard to the north district, the figure indicating the floor space in the year 2000 is estimated by using the number of employees estimated at that time.

The developmental need for new parking spaces is calculated as shown in Table 11–6–1,

Table 11–6–1 Peak Hour Parking Demand

(Vehicles)

Zone No.	Total Car Attraction[1] (veh./day)	Peak Hour Parking Rate	Peak Hour Parking Demand (vehicles)	Peak Hour Parking Demand	Existing Parking Spaces				Development Needs of Parking Spaces
					On Street	Off Street	Obligatory Parking Spaces	Total	
1	8,595	0.092	827	830	–	100	268	368	470
2	1,464	0.347	508	510	–	299	137	436	80
3	8,751	0.163	1,426	1,430	–	143	189	332	1,100
4	7,158	0.247	1,768	1,770	–	917	396	1,313	460
5	2,340	0.248	580	580	–	154	127	281	300
6	3,735	0.168	627	630	–	285	157	442	190
7	1,343	0.163	218	220	–	33	79	112	110
8	2,389	0.098	234	230	–	162	124	286	–
9	1,317	0.347	457	460	–	85	335	420	40
10	1,390	0.192[2]	267	270	–	14	269	283	–
11	808	0.192[2]	155	160	–	85	87	172	–
12	2,489	0.228	567	570	–	13	606	619	–
13	2,241	0.167	374	370	–	74	146	220	150
14	1,183	0.072	85	90	–	45	65	110	–
18	1,917	0.097	186	190	–	200	184	384	–
19	1,545	0.250	386	390	–	13	138	151	240
20	1,628	0.192[2]	312	310	600	–	80	680	–
24	2,793	0.192	536	540	500	396	77	973	–
25	2,365	0.192	454	450	600	140	72	812	–
26	2,249	0.192	432	430	300	60	39	399	30
27	12,241	0.192	2,350	2,350	3,000	1,481	807	5,288	–
28	4,264	0.192	817	820	1,300	958	278	2,536	–
29	2,460	0.192	472	470	1,400	476	221	2,097	–
38	2,285	0.192	439	440	400	105	55	560	–
61	6,768	0.192[2]	1,299	1,300	900	137	73	1,110	190
62	13,186	0.192[2]	2,531	2,530	1,500	1,374	297	3,171	–
63	5,081	0.192[2]	976	980	1,100	493	200	1,793	–
Total	104,375	0.192	19,283	19,320	11,600	8,242	5,506	25,348	3,360

Note: 1) Excluding taxis and "Home" purpose trips
2) Average peak hour rate of Central District

based on the comparison between the parking capacity, consisting of newly introduced obligatory parking spaces and existing parking spaces, and the parking demand. However, as far as the north district is concerned, it is planned to gradually prohibit curb parking along arterial and semi-arterial roads and streets by the year 2000.

As the number of newly required parking lots is large in Zones 1, 3, 4, 5, 6 and 19 of the Centro district and Zone 16 of the north commercial district, these roads are designated as urban parking lot development zones and priority will be given to them over other zones for the provision of new parking lots (see Fig. 11–6–2).

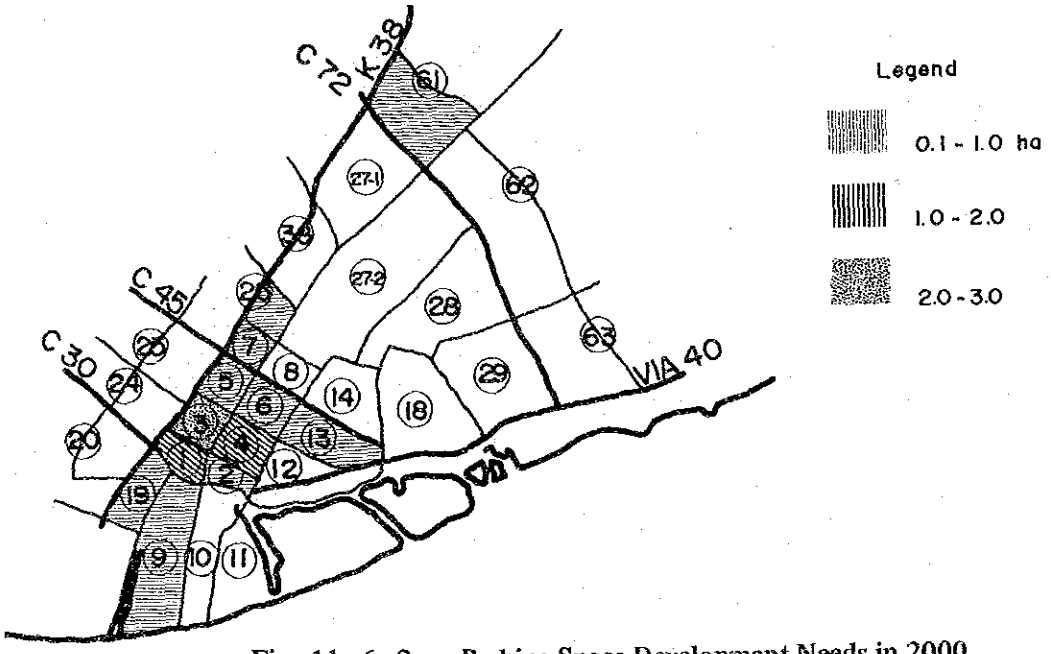


Fig. 11–6–2 Parking Space Development Needs in 2000

The following administrative measures should be considered to promote the provision of parking lots in these above-mentioned urban parking lot development zones.

(1) A policy should be made to make the provision of parking lots obligatory for all buildings to be newly built in the future.

(2) A policy should be made to subsidise private car parks or to give them preferential treatment in taxation (such as reductions or exemptions from income tax, property tax, etc.).

(3) The relaxation of building standards for the construction of private car parks (such as the relaxation of the capacity restrictions, etc.).

(4) The imposition of heavier taxation on unused space.

(5) The preferential development of public car parks.

Chapter 12.

PUBLIC TRANSPORT DEVELOPMENT PLAN

Chapter 12 PUBLIC TRANSPORT DEVELOPMENT PLAN

12–1 Basic Policy

12–1–1 Characteristics of Future Public Transport Demand

1) Substantial Greater Demand

The public transortation demand in the Metropolitan Barranquilla in the year 2000 will be more than 2.5 million person trips which is about 1.89 times that of the 1.3 million person trips today.

The public transport's share of the total transport demand excluding walking trips, in terms of person trips, is about 68% in the year 2000. This is about 3 percentage points less than today.

The trip purpose composition of public transport users in the year 2000 will also be similar with today's.

Table 12–1–1 Trip Purpose Composition of Bus Users

Trip Purpose	2000	1983
To Home	48.7%	46.8%
To Work	17.4	18.3
Private	10.1	11.6
Business	2.6	2.5
To School	13.9	12.5
To Shopping	7.3	8.3

2) Areas Generating and Attracting Bus Passengers are Expanding

The central area of the city, which is zone 001, generates and/or attracts about 12% of the total volume of the passengers, while the 4 km zone generates of attracts 34%. In 1983 these percentage shares mentioned above were 20.8% and 41% respectively.

The zones outside the Circunvalar will generate or attract 20% of the total volume of passengers for public transport demand compared with 5% in 1983.

The shares of the zones in the outer areas are increasing more rapidly than the inner area of the city. (See Fig. 12–1–1 and 12–1–2).

3) Major Flow of Public Transport Passengers

The zone-pairs with more than 50,000 psgr per day are categorized into two groups (See Fig. 12–1–3). The first group is the radial flow which connects 001 zone to other zones, such as 211, 222, 312, 322 and 411. The second group consists of the zone-pairs which are not located in the center of the city such as 111, 112, 112–113, 312–313, 313–323. The zone-paris 112–113

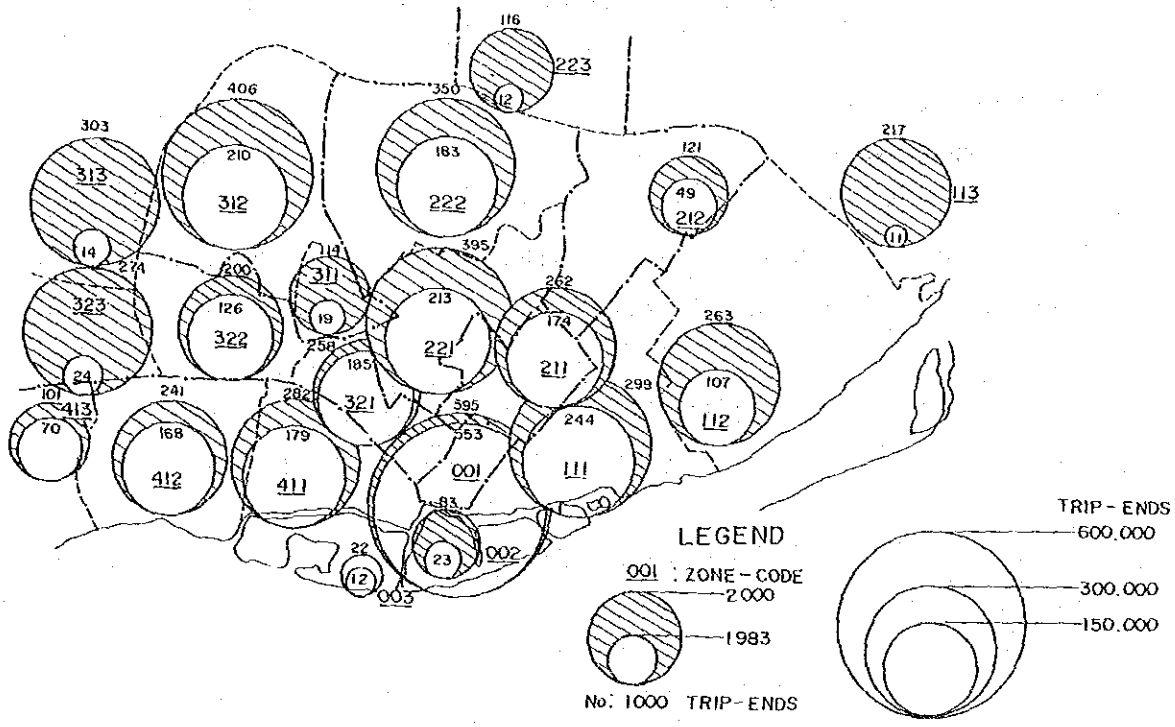


Fig. 12–1–1 Generation and Attraction of Bus Passenger

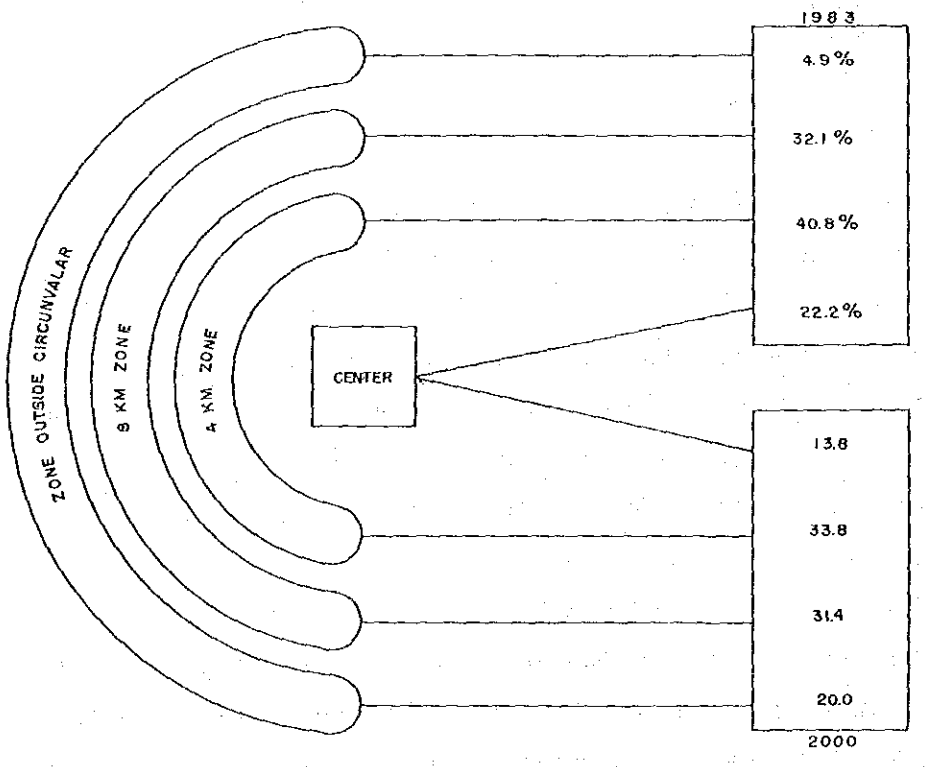


Fig. 12–1–2 Percentage Share of Bus Passenger Trip-End by Zone

and 313–323 involve the radial flow to and from the regional centers which will be located at the northern and southern part of the city according to the land use plan in the year 2000.

This tendency of the radial flow of public transport demand to and from the center of the city will continue in the future. Passenger flows between zones which are not located in the center will also be added.

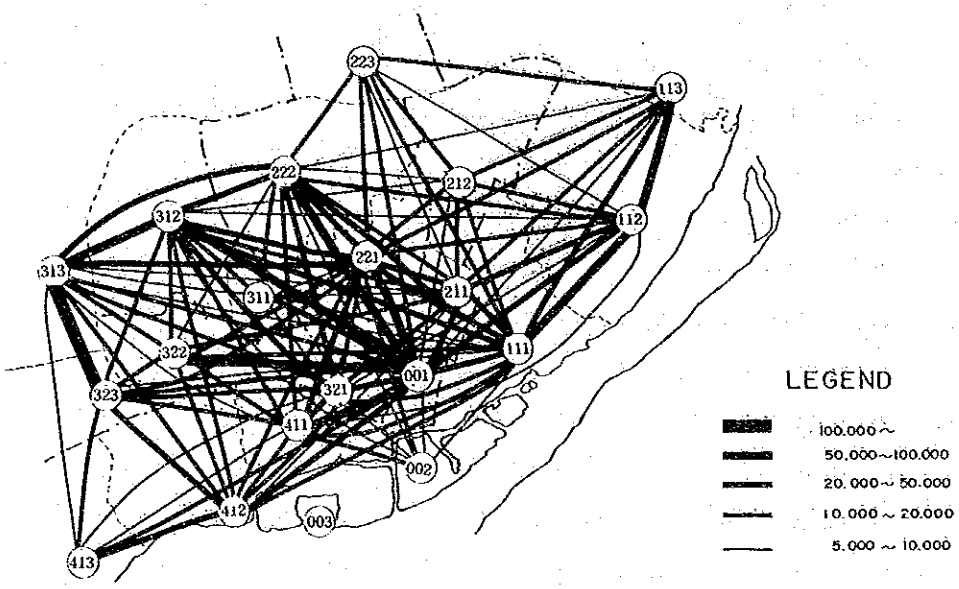


Fig. 12–1–3 Desire Line of Bus Passengers in 2000

4) The Public Transport Flow is Concentrated Along the Radial Roads

The radial roads which have a large traffic demand for public transportation are as follows:

In Northern part of the City

Via 40 – 2,700 bus/day along some parts of the road

Cra. 46 – 3,300

Cra. 38 – 8,900

In South-Western Part of the City

Calle 47 – 7,400 bus/day along some parts of the road

Calle 30 – 7,000

Calle 17 – 8,600

On the other hand, some circumferential roads have large public transportation loads such as:

Calle 72 – 5,900 bus/day along some parts of the road
Calle 76 – 4,100
Calle 71 – 5,900

12–1–2 Basic Policy of Public Transportation Plan

Future city public transportation will be as important as it is today in terms of the passenger's share of the total transport demand, and the increasing demand for public transportation. However, the structure of the demand will be different than it is today because there will be some sectors which have different traffic characteristics as a reflection of the new urban structure. The basic policies of public transportation for the year 2000 are summarized as follows:

(1) The routes served by public transportation should be categorized as major and minor routes similar to the categorization of the roads.

(2) An improvement of the bus service routes based on the route categorization mentioned above will be necessary. This improvement will give better service to the passengers who presently require more than two bus trips to arrive at their destination.

(3) Major bus routes should have exclusive bus lanes. This space can then be used as the right-of-way for the rail transit system when it is introduced.

(4) The basic transportation policy to be used in the central area of the city dealing with the coexistance of buses and private cars is for the buses and cars to use different roads.

(5) Bus passenger facilities, such as bus bays, exclusive bus lanes, etc., will be introduced to help realize smooth and safe passenger service, and to minimize traffic interruptions near the bus stops along the arterial roads.

(6) As part of the introduction of bus passenger facilities, two kinds of bus terminals, inter-department and intermunicipal, will be constructed to coincide with the development of Barranquilla.

12–2 Future Public Transportation System

12–2–1 Basic Network of Public Transportation

1) Necessity of Basic Network

The basic network of the public transportation is defined as the principal service network to be offered by certain public transport systems in the future.

The aims to formulate this network are as follows:

(1) To identify the network pattern which will incorporate the necessary route pattern characteristics of future demand and to provide the solution for the present problems of the routes.

(2) To ensure the continuity and flexibility of this network policy. The routes which are identified in this study might have multiple applications in different bus routes, such as the present integrated route (explained in the supplementary paper which appears in Appendix J). Although the actual route may have a variety of option, the principle of the route will be kept.

(3) To allow the introduction of different transportation means into portions of the network. In the future, it may be feasible to introduce the rail transit system. The rail transit system can then occupy one of the major bus routes without any radical changes in the public transport network.

2) Components of Basic Network

The present bus routes have been categorized into 4 types:

(1) Linear type

(2) Radial type

(3) Circular type

(4) Through type

According to the applications submitted to INTRA by the bus companies, the type of routes preferred by the bus companies are identified (See Appendix J).

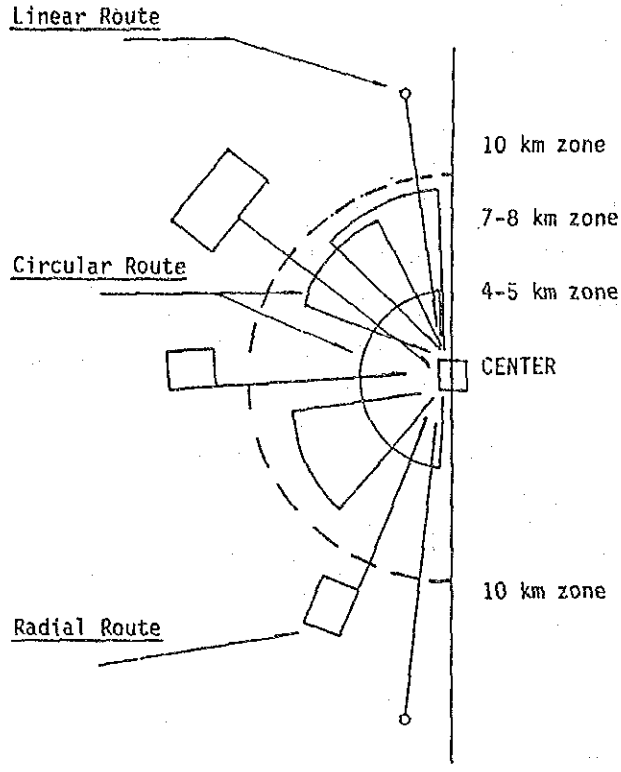
8 of 11 routes proposed by the bus companies aim to serve newly developed areas. The length of this kind of route is longer than the existing one. Of the other 3 which aim to serve existing urban areas, 2 are circular routes. At present, this kind of circular route does not exist but will prove to be an important route in the future.

Based on the observations of the new route applications of bus companies, the tendencies of future routes to be considered are as follows:

(1) The length of linear routes will be increased.

(2) The length of radial routes will be increased and will serve the areas outside Circunvalar.

(3) The circular routes will have wider service areas than today's. These tendencies are summarized in Fig. 12–2–1.



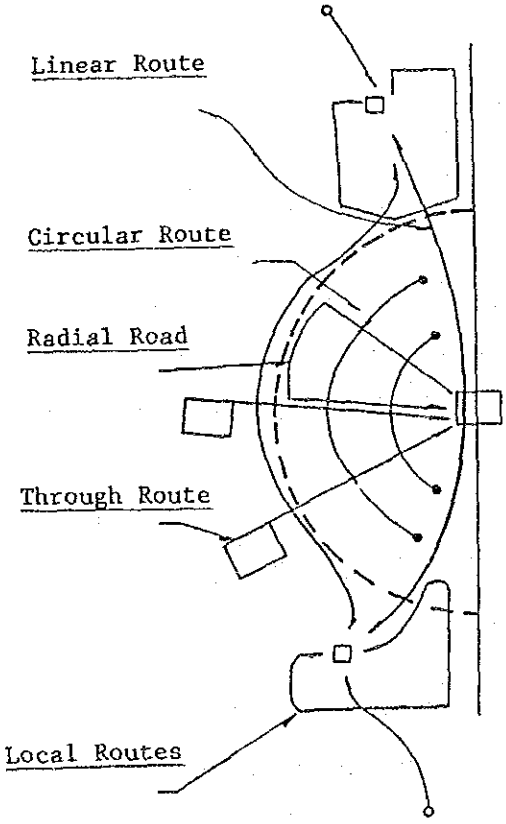
Note : Linear Route: Service area of the routes will extend from the 10 km zone at present to just outside the future urban area approximately 12 km from central area.

Circular Route: There will exist two kinds of circulation routes. One group has their service area within the 4-5 km zone from the center and covering all sectors from North to South. The other group has their service area in a 7-8 km zone, covering individual sectors.

Radial Route: Service areas of these routes are those located inside the circunvalar which have been developed recently.

Through Route: Combination of linear and radial routes.

Fig. 12–2–1 Tendency of the Route Charges in the Applications to INTRA from Bus Companies



Note : Linear Route: Connecting the Center and Sub-centers. If there is enough demand along this route, buses will be replaced by the MASS-TRANSIT system.

Circular Route: Placed along second and/or third inner circumferential roads. Another kind of this route will serve the area between the center and circunvalación.

Radial Route: Service areas of these routes will be those located outside the circunvalar which will be developed in future.

Through Route: This function will be covered by linear routes and circulation routes.

Local Route: Operating from sub-center to service area around the sub-center which will be developed in the future.

Fig. 12–2–2 Concept of Future Basic Network

Based on the characteristics of present routes and the tendencies for future change, the major characteristics of the future basic network are summarized in the following Fig. 12–2–2.

12–3 Urban Bus System in the Year 2000

12–3–1 Bus Route Network

Public transportation network is studied in the previous section as a basic reference for reviewing the bus route network. According to this, the establishment of main public transportation corridors is recommended for the future, and bus routes will be established in accordance with this. The names of main corridors and bus routes are shown in Table 12–3–1.

Table 12–3–1 Corridor and Bus Route

Corridor	Name of Bus Route
City Center – Sub Center	Major Route
City Center – Outside of Circunvalar	Radial Route
Inner City Circular	Circular Route
Outside of City Center	Through Route/Inter Sub Center Route

There are no clear-cut guidelines for route establishment, for instance existing bus routes follow arterial and non-arterial streets very haphazardly. Under the assumption that in the future all streets will be categorized according to their characteristics and that the method of approving bus routes will be improved, basic guidelines for future route establishment are proposed here. However, routes discussed here are representative routes, and each may, in fact, require several bus routes for actual service.

1) Aspect from the Relationship between Bus Service Areas and Streets

Clarification of the relationship between the sector to be served by a bus route and the street which leads to such a sector. In other words, sectors (sector 100–400) which are bordered by major radial streets (Via 40, Cras. 46 and 38, Calles 45, 47, 30 and 17) should be served by such radial roads that pass through or by the sectors (See Fig. 12–3–1), and sectors bordered by major circumferential streets should be served by such circumferential streets that pass by the sectors (See Fig. 12–3–2). This leads to the following routing guideline:

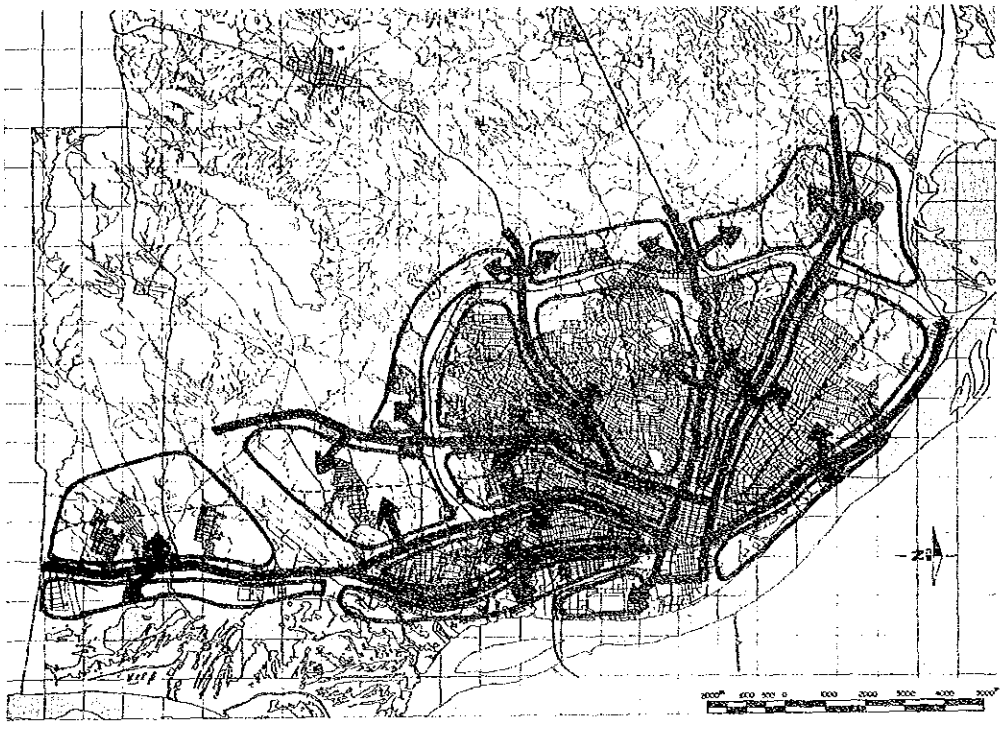


Fig. 12–3–1 Bus Service Area from Major Radial Route

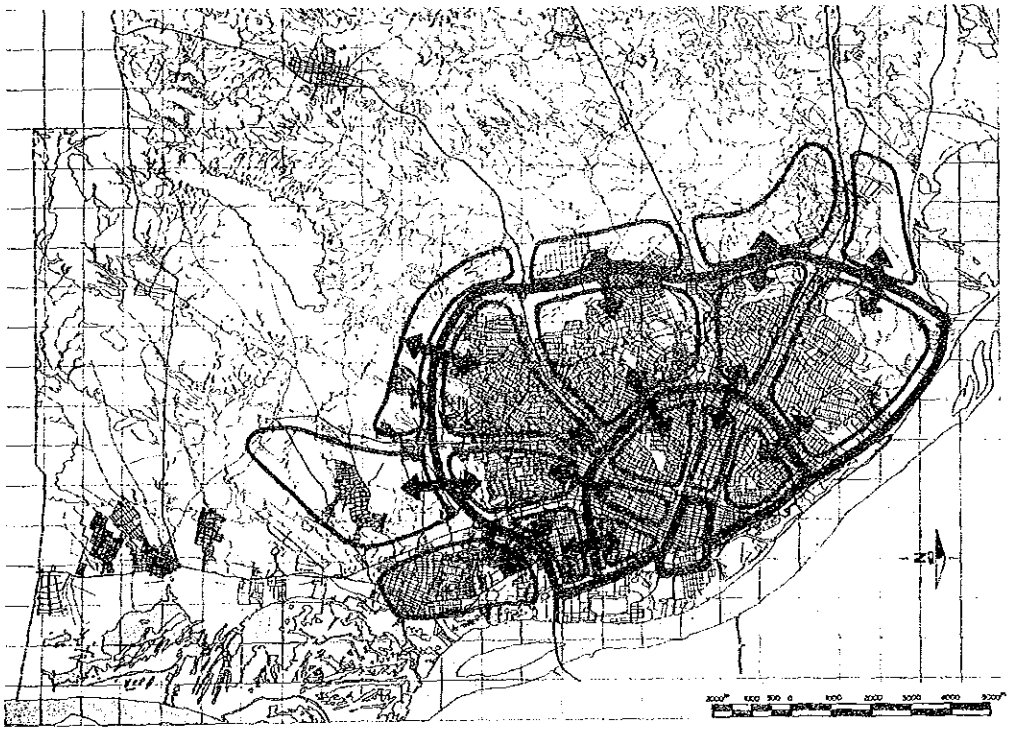


Fig. 12–3–2 Bus Service Area from Circumferencial Route

The main service area (which will consist of several Barrios, with the exception of Centro and the sub-centers) of a bus route will lie withing the above-mentioned service sector. Therefore, if the relationship between service sector and major street mentioned above is rigidly adhered to, bus routes should follow major streets (arterial and semi-arterials in actual routing) in areas other than the service areas belonging to the respective bus routes.

2) Aspect from the Compatibility with Urban Structure and Demand Structure

We have mentioned in 12–1 above that the metropolitan area of Barranquilla will have two sub-centers and that public transportation demand centering around these two sub-centers and Centro will be extremely large. To meet the increase in transportation demand, a road scheme called "Mixed Pattern" (wherein the linkage between Centro and the sub-centers will be strengthened by partially improving existing radial roads, and an inner-circumferential road will be constructed about 2.5 km from Centro in order to decentralize entry into Centro) will be adopted.

When these demand-size and road-side conditions are combined with bus route characteristics, the following guidelines are arrived to:

(1) "Major Bus Routes" linking Centro with the sub-centers shall follow Cra. 46 and Calle 45, both of which connect directly to the two districts.
(2) "Radial Bus Routes" linking Centro with residential areas developing along the outer side of the Circunvalar Road shall follow major radial roads from Centro to the Circunvalar Road and then enter local streets within the service areas of the respective bus routes.
(3) "Inner-city Circular Routes" linking Centro with old urban districts shall follow major radial roads and the inner-circumferential street and then enter local streets within the respective service areas.
(4) "Through Routes" linking several service areas located outside of the Centro District shall follow major radial roads.
(5) "The Inter Sub-center Route" linking the two sub-centers without passing through Centro shall follow the Circunvalar Road.

Based on the above guidelines, 17 bus routes as listed below (Table 12–3–2) will be required in the year 2000. These routes are chosen with reference to route classification by service area characteristics and to the future spread of the Barranquilla urban area. As mentioned

earlier, the number of service routes under actual conditions will not necessarily be 17 (See Fig. 12–3–3).

Table 12–3–2 Proposed Bus Routes

Code No. of Route	Characteristics of Route	Major Sercice Sector	Length of Route
R–1	Major	North Sub-center	16.3 km
R–2	Major	South Sub-center	15.4
R–3	Major	Sector 413	17.4
R–4	Radial	Sector 100	13.5
R–5	Radial	Sector 200	9.0
R–6	Radial	Sector 220/310	13.4
R–7	Radial	Sector 400	13.2
R–8	Inner City Circular	Sector 100/210	15.9
R–9	"	All Sector	18.5
R–10	"	Sector 220	17.0
R–11	"	Sector 220/310	19.6
R–12	"	Sector 200/300	18.8
R–13	"	Sector 320/400	16.9
R–14	"	Sector 200/300/400	15.8
R–15	"	Sector 100	10.5
R–16	Inter Sub-center	North-South Sub-center	18.2
R–17	Through	Section 100–320	18.4

12–3–2 Demand Forecast by Bus Route

1) Objective

It is possible to find out which district requires better bus service by estimating the number of bus passengers, which means checking the effectiveness of a route through conducting passenger counts and analyzing the regional distribution of demand. The unlinked trip OD table concerning transfer passengers, prepared for this purpose, is also used as data for traffic volume studies.

2) Methodology

Passenger forecasts for the proposed bus routes are made by distributing to the respective bus routes the forecasted volume of public transportation demand indicated by the results of a general traffic demand forecast, which includes pedestrians and cars (See Fig. 12–3–4). The following information is necessary for this forecast:

- OD Table of public transportation passengers.
- Service areas by bus route, explained using the same zones as those used in the above-mentioned OD table.

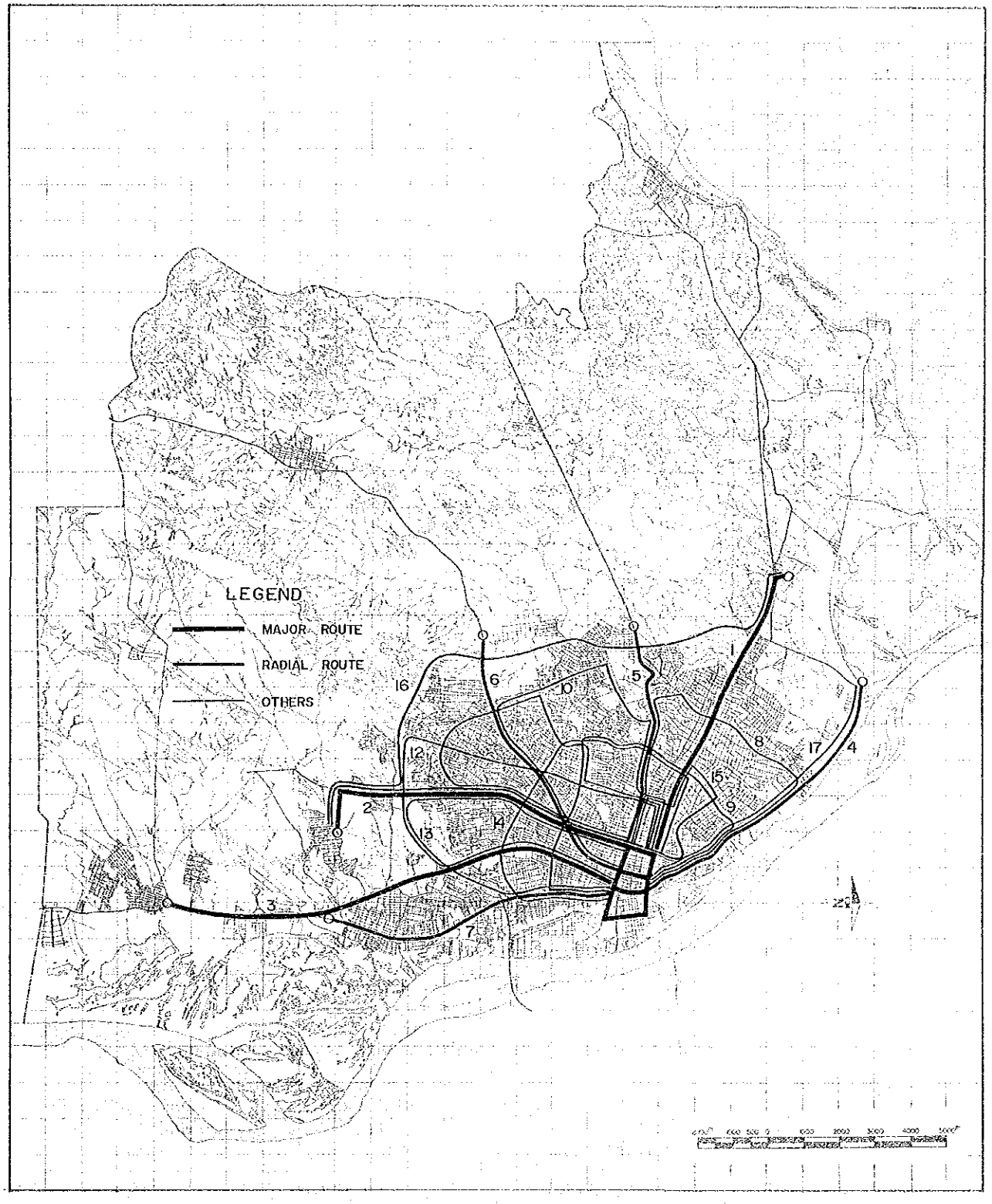


Fig. 12–3–3 Future Bus Route Network

– For zone pairs requiring bus transfers, the two zone pairs of origin to transfer point and transfer point to destination have been applied.

Within zone pairs with competing routes, it is assumed that demand allocated to each route is equal.

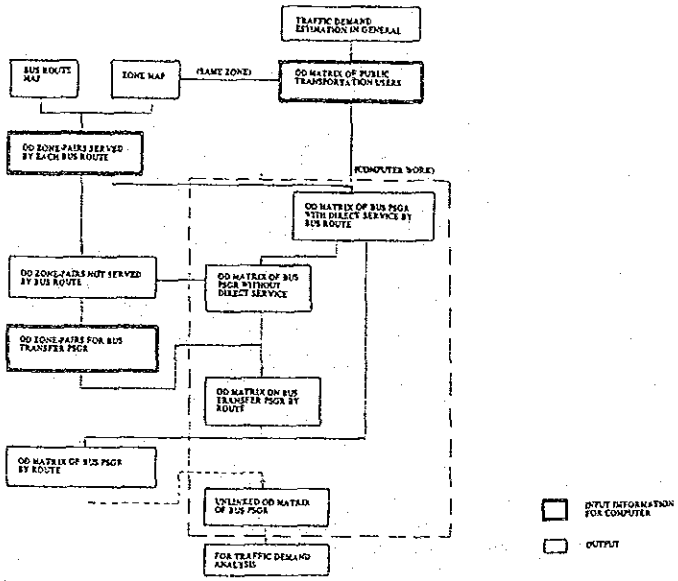


Fig. 12–3–4 Estimation Procedure of Number of Passenger by Bus Route

3) Results and Evaluation

The number of bus passengers in the year 2000 is forecasted to total 2,870,000 persons for the 17 routes. However, since transfer passengers are counted twice, the figure is reduced to about 2,586,000 persons when the overlap is eliminated. Transfer passengers will represent about 20% of all bus passengers in the year 2000 compared to the current 30%, which means that the planned bus route network will be superior to the present one (See Table 12–3–3).

Table 12–3–3 Total Number of Bus Passengers Estimated

	No. of Psgr. of Bus *1 (A) (Psgr./day)	No. of Bus Users *2 (B) (Psgr./day)	Double Trip Psgr' % to Total Psgr. (%)
2000	2,870,000	2,586,000	19.8
1983	1,593,000	1,323,000	33.9

*1 : Including double trip psgr. (Unlinked trip basis)
*2 : Not including double trip psgr. (Linked trip basis)

The total income of all bus systems in the year 2000 is estimated (based on the forecasted number of bus passengers and the proposed number and types of bus routes), to amount to about 32 million pesos on 1983 prices, while expenditure is forecasted to amount to 27 million pesos. The benefit/cost ratio is 1.14, so that bus service operation under the proposed route network is expected to be viable.

The future bus traffic along major streets is as follows:

Via 40 : 12,300 bus/day
Cra. 46 : 10,800
Cra. 38 : 10,700
Calle 45 : 14,100
Calle 30 : 9,100
Calle 17 : 15,600 (See Fig. 12–3–5)

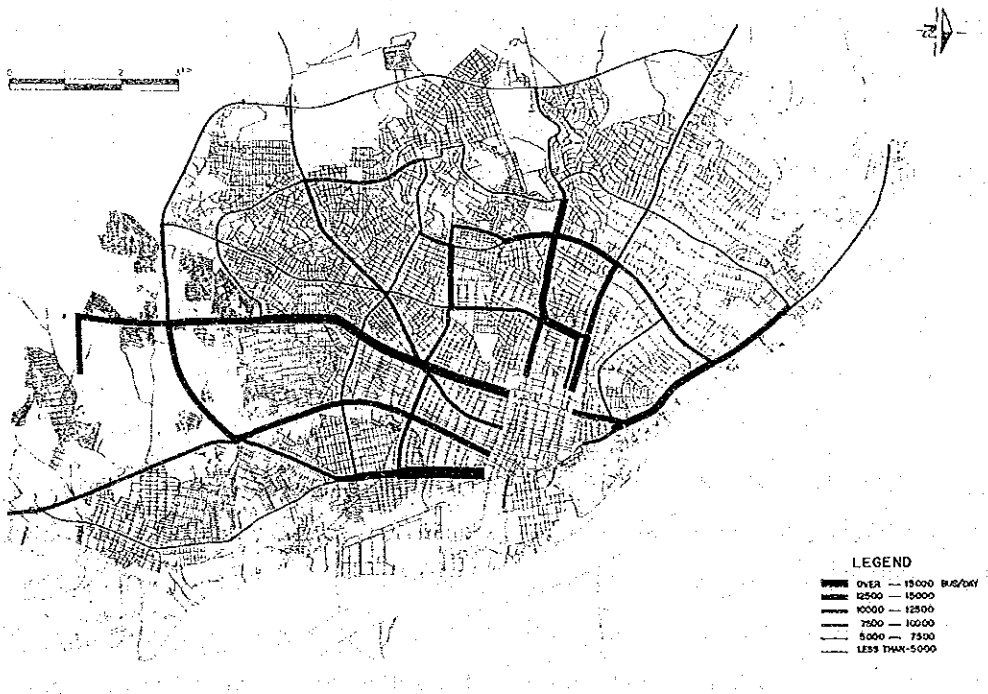


Fig. 12–3–5 Bus Traffic Pattern, 2000

4) Implementation Measures of New Bus Route System

The new bus route system proposed for the long-term plan involves two new bus network patterns: the one in Centro, which is called Circular system, and the other outside Centro, which proposes 17 new routes. This new system cannot be realized at once but will be realized route by route through an issuance work of operation licenses to new route applications.

As mentioned before, the urban bus routes in Barranquilla are approved by the municipality based on the applications proposed by bus companies. At present there are 11 applications for new routes and modification of the existing routes. When the licenses for those applications are issued, the proposed new route pattern should be considered.

The municipality of Barranquilla has a plan to eliminate the bus route from Paseo Bolivar avenue (Cra. 34) to mitigate the traffic congestion in this street. The route rearrangement due to the elimination of bus route from Paseo Bolivar will be a good opportunity to introduce the proposed Circular system in Centro.

12–4 Public Transportation System in the Central District

12–4–1 General

The Central District of Barranquilla city, which functions as the core of the Costa region, is forecasted to attract about 17% of all traffic in the year 2000, and its generation and attraction of traffic is forecasted to 2.0 times compared to 1983.

The tendency for public transportation demand to concentrate in Centro will decrease considerably by the year 2000 (attraction rate will decline to 20% compared to the current 40%). This is because the generation and attraction of public transportation demand in the two subcenters to be created to the north and south of the existing urban area, will work to lessen the concentration, in the Central District. However, the actual volume of traffic will still remain the greatest.

On the other hand, some of the economic functions of the Central District are being lost due to a lack of adequate social infrastructure. In order to prevent this tendency and to allow the District to remain the center of Barranquilla and the Costa region in the future as well, the Central District Renewal Plan is drawn up.

Taking the opportunity of the implementation of the Central District Renewal Plan, a system wherein both public transportation facilities and private cars can equally enjoy a high level of convenience should be introduced into the Central District so that future functions of the District can be maintained.

12–4–2 Traffic Capacity of the Centro District

A study is made on how long existing traffic facilities – esepcailly roads – of the Centro District can continue to meet the demand of increasing traffic. This study is made by comparing the total length of streets in Centro and the total number of vehicles present in Centro.

1) Total Street Length

Centro, as viewed in this study, is the district bordered by Calle 45, Cras. 46 and 38 and Auyama Canal. There are 38 minor and major street sections in Centro. Main streets running north-south are Calles 45, 38, 34 and 30, and those running east-west are Cras. 38, 40, 43, 44, 45 and 46. The total length of streets running north-south is 39.3 lane-km and those running east-west is 33.0 lane-km. Refer to Table 12–4–1 (Lane-km is the total extension of a road multiplied by the number of lanes in that road and indicates the amount of space available for vehicles to travel.).

There are at present quite a number of on-street parking spaces in the Central District. When these are taken into consideration, the total street length declines to 53.5 lane-km.

Table 12–4–1 Total Lane-km of Streets in Centro

(lane-km)

Direction	Classification of Street	No. of Street	Total Lane-km
North-South	Principal	4	14.0
	Others	18	25.3
Subtotal		22	39.3
East-West	Principal	6	25.4
	Others	10	7.8
Subtotal		16	33.2
Total		38	72.6

2) Total Number of Vehicles Moving in Centro

The maximum number of vehicles in Centro in an instantaneous time is assumed to

correspond to the number of person-trips generated in or attracted to the District during peak hours. Calculations are made under the following conditions:

(1) The current number of buses in Centro is calculated by using the OD Table which includes number of passengers who transfer bus route in Centro (which is called the bus passenger OD Table on unlinked person trip basis). The future number of buses is calculated from the OD Table of the year 2000 and the number of passengers from sterring buses. The number of transferring passengers is estimated from the distribution of bus passengers over the proposed routes.

(2) The average number of bus passengers is given as 42.5 persons/bus, and the average occupancy ratio per bus during peak hours is given as 150%.

(3) The average length of time from the arrival of a bus to its departure from Centro including time in Centro during peak hours is estimated at 15 minutes.

(4) The number of non-bus vehicles is also calculated using OD Tables (present and future) for passengers of such vehicles.

(5) The average number of passengers during peak hours for the above is given as 1.57 person/vehicles.

The number of buses moving in Centro during the peak hour is estimated as 440 units and the total number of vehicles are 5,400 units in 2000 (See Table 12–4–2).

Table 12–4–2 Number of Vehicles to be Found in Centro during Peak Hour

	Bus (Units)	Car (Units)	Total
1983	564	2,794	3,358
1990	419	3,715	4,134
2000	438	4,979	5,417

3) Comparison of Road Facilities and Number of Vehicles

By comparing the amount of road space occupied by vehicles present in Centro in an instantaneous time with the amount of available road space, it is possible to find out when the existing facilities will no longer satisfy demand, in other words when road improvements or bus countermeasures will become necessary.

Average vehicle interval is used here as an indicator of road space occupied by vehicles because it reflects the density of vehicles on a road and, compared to other density indicators, is easily recognized by the people experienced to drive cars. Refer to Table 12–4–3.

Calculations are made based on the following assumptions:

(1) The length of a bus is 10 m (or 10 lane-m).

(2) The length of a car or other non-bus vehicle is 5 m.

(3) Average vehicle intervals are calculated as follows:

$$A.V.I = \frac{T.L. - (B \times 10 + NB \times 5)}{T.V - 1}$$

wherein, A.V.I.: Average Vehicle Interval
B : Number of Buses
NB : Number of Non-bus Vehicles
T.V.: Total Number of Vehicles
T.L.: Total Length of Road in Lane-m

Table 12–4–3 Analysis of Limitation on Traffic Capacity in Centro

			In Case of Elimination of Bus from Centro	
	Case A (m)	Case B (m)	Case A' (m)	Case B' (m)
1983	15.8	10.1	20.0	14.2
1990	12.0	7.4	14.5	9.4
2000	8.0	4.4	9.8	5.9

Case A and A' : Total Lane-km of Street in Centro : 72.5 Lane-km
Case B and B' : Length of Parking spaces deducted from Total Lane-km: 53.5 Lane-km.

As a result, the average vehicle interval in Centro is found to be about 10 m at present (when space taken up by curb-parking is subtracted from the total street length) and will be 7.4 m in 1990 and 4.4 m in the year 2000. As mentioned below, the volume-capacity ratio of major streets in Centro will reach 1.0 when the average vehicle intervals reach 8 m. Hence, this is used as the standard in making evaluations.

Based on the above standard, the following conclusions are arrived at:

(1) If on-street parking is not controlled in the future, smooth driving on streets in Centro

will be difficult by the year 1990. If on-street parking is controlled, however, vehicle flow in Centro can be ensured at least up to the year 1990.

(2) Even with on-street parking control, streets in Centro will be filled near capacity in the year 2000. Therefore, the countermeasure of either reducing vehicle inflow or expanding road facilities must be taken. It may be of interest to note that if the inflow of buses into central district is completely eliminated, vehicle flow can be ensured even in the year 2000.

12–4–3 Alternatives for the Coexistance of Buses and Cars

As mentioned above, traffic in Centro will be paralyzed around 1990 if existing traffic conditions are not altered, and by the year 2000 existing facilities alone will not be enough to satisfy the expected demand.

As discussed in Chapters 11 and 14, the countermeasure of regulating on-street-parking in Centro under a short-term plan and in the area north of Centro as well as in Centro itself under a long-term plan is proposed. Therefore, countermeasures other than on-street-parking control will be discussed herein.

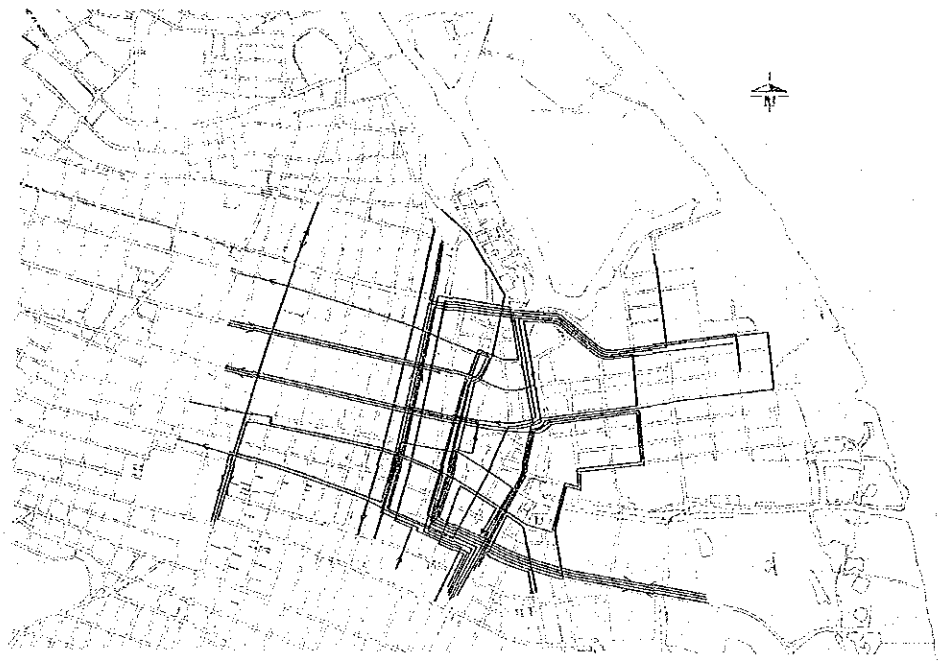


Fig. 12–4–1 Existing Bus Routes in City Center

One of the factors causing traffic problems in the central district is its disorganized network of bus routes. Although bus operators may claim that they are serving areas where demand is greatest, from a traffic organization standpoint the streets in Centro are being used as bus routes in a haphazard manner (See Fig. 12--4--1).

In order to solve this problem, five alternatives which satisfy either of the following two conditions are examined:

(1) Buses will be banned from Centro in order to reduce traffic demand in Centro. This will be accomplished by having all existing urban bus routes converge on an urban bus terminal to be constructed outside Centro for this purpose.

(2) Bus routes within Centro will be reorganized, and spaces for buses and for cars will be separated.

a. Alternative 1 : Urban Bus Terminal Construction

If the following assumptions are made, a terminal to which urban buses will converge will require at least 10 hectares of land: In Centro at present there are 18* bus routes and 13,500 services per day. This will increase to 15,500 services per day in the future. Based on this estimation, 125 embarkation platforms and 63 disembarkation platforms will be required. Consequently, about 11 hectares of land will be necessary for the terminal (*The actual number is 61, but these are combined into 18 integrated routes for the purpose of analysis).

b. Alternative 1-1

The district bordered by CAlle 48 and 53 and Cra. 43 and 45 is the only district within the urban area where at least 10 hectares of land can be obtained. If the urban bus terminal is constructed in this district, bus access to the terminal and local service route linking the terminal with the commercial/business district (provided by, for example, minibuses) are envisioned to be as shown in Fig. 12--4--2.

(2) Alternative 1-2

The only area where at least 10 hectares of unused land is available near the central district is Barranquillita. A local service route linking the terminal with the commercial/business district is also proposed.

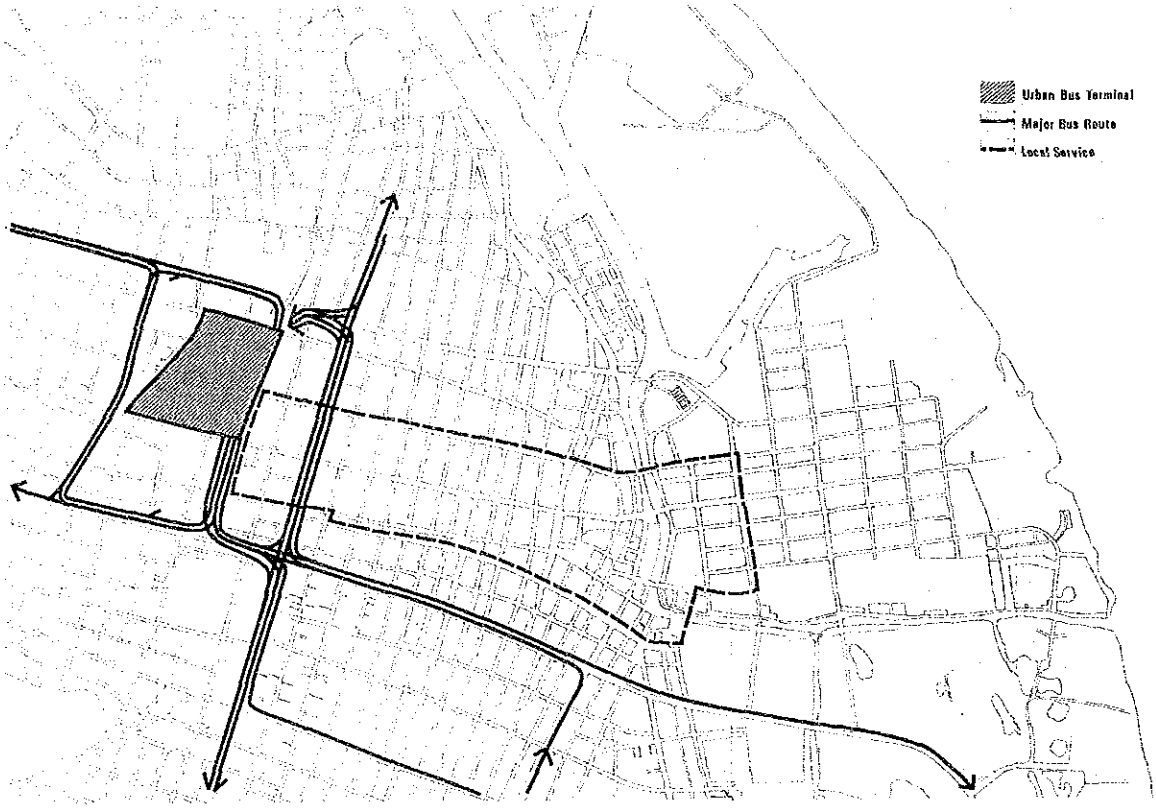


Fig. 12–4–2 (1) Bus Route Improvement Plan

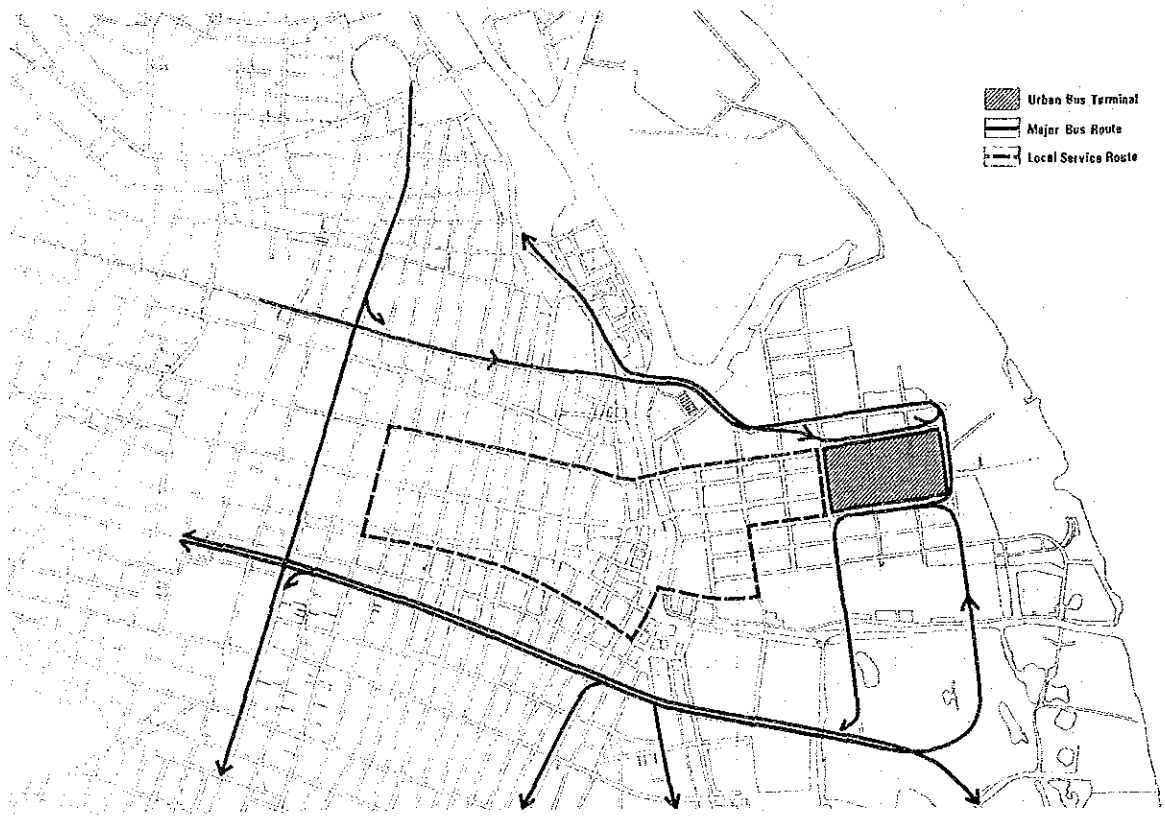


Fig. 12–4–2 (2) Bus Route Improvement Plan

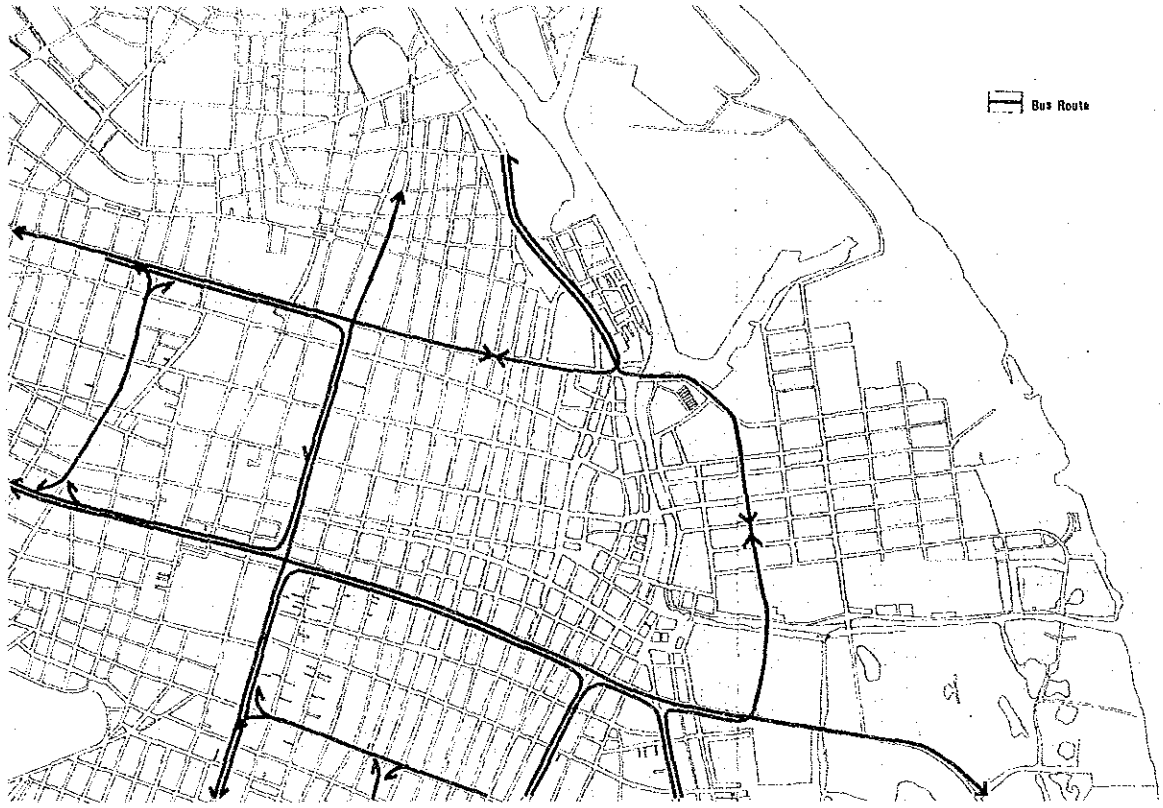


Fig. 12–4–2 (3) Bus Route Improvement Plan

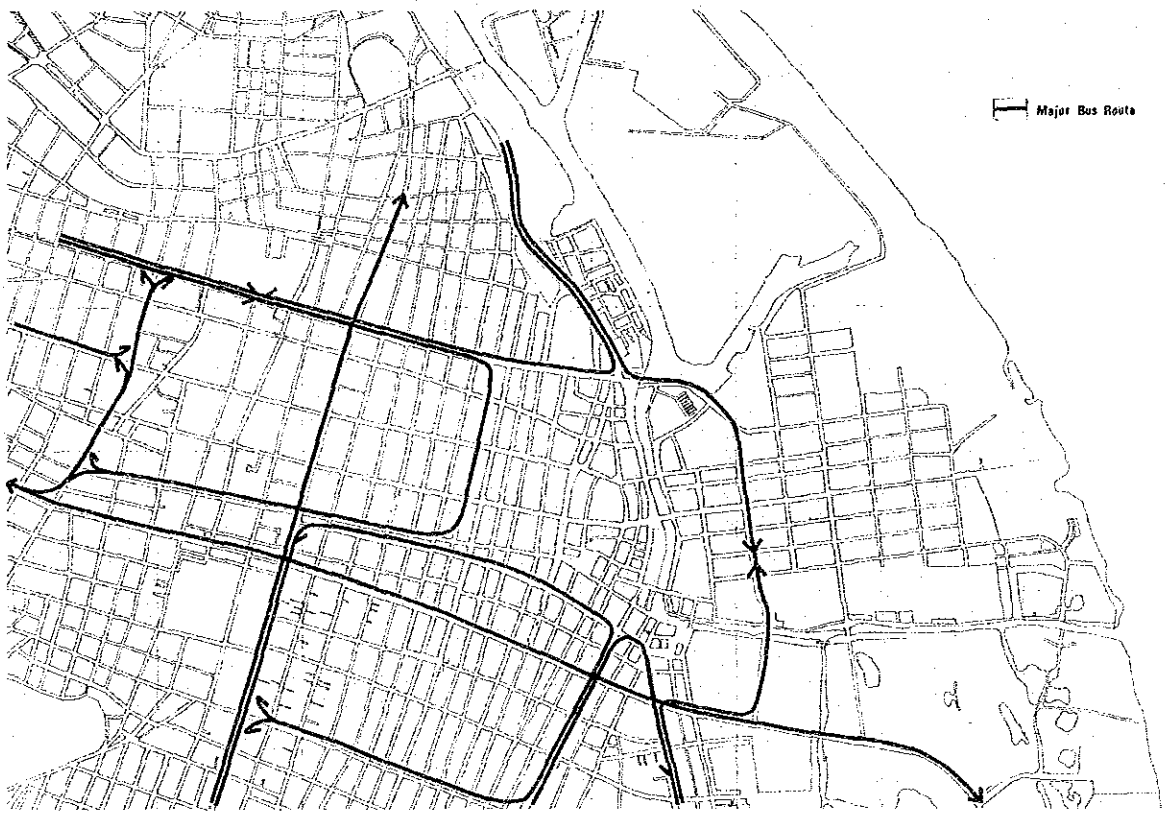


Fig. 12–4–2 (4) Bus Route Improvement Plan

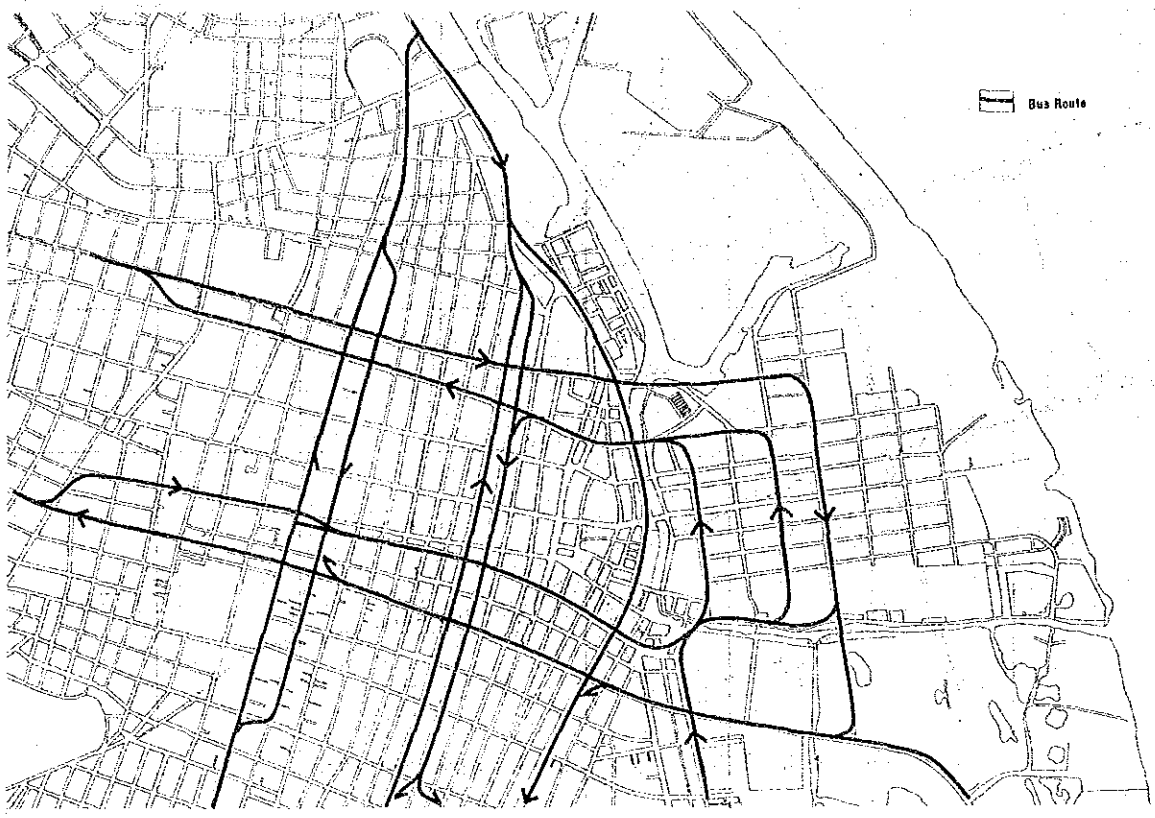


Fig. 12-4-2 (5) Bus Route Improvement Plan

b. Alternative 2: Route Control

Depending to what extent buses will be allowed into Centro and the routes that the buses will follow, the following three route control alternatives are proposed.

(1) Alternative 2-1

Buses will be limited to major streets along the outer edges of Centro. Buses approaching Centro from the southern sector will tern back on a major street running along the southern edge of Centro, in other words, Cra. 38. The same goes for buses approaching Centro form the other three directions.

(2) Alternative 2-2

Buses will be allowed further into Centro compared to Alternative 2-1. Buses from the southern sector will turn back on Cra. 40, those from the western sectors will turn back on Calle 40. All other bus movements are the same as under Alternative 2-1.

(3) Alternative 2-3

The extent to which buses are allowed into Centro is determined on the basis of the maximum distance that can be walked in Centro. At the same time, buses from all four directions will make a full turn around Centro before turning back. For example, buses from the southern sector will make a detour to the northern edge of Centro before turning back to the southern sector. This is because it allows passengers to make transfers in Centro more easily. These transfers are extremely numerous at present and are expected to remain as such in the future although slightly reduced.

The alternatives are evaluated from the following standpoints:

(1) Bus passenger service aspect includes following factors such as linkage between terminal and commercial/business district, walking distance, and transfer of passengers.

(2) Traffic aspect includes following factors such as volume of bus traffic at terminal entrance/exit, and volume of bus traffic along bus routes in central districts.

(3) Availability of land for constructing traffic facilities are also important elements in the evaluation.

Alternative 1 is difficult to implement because bus traffic at and around the terminal entrance and exit will exceed 10,000 buses per day. It is difficult to obtain sufficient land to build a terminal in the urban area. Although land is available in Barranquillita it will necessitate

that passengers travel back to Centro by local bus service after already passing through Centro on the way to the terminal, thus causing a problem in traffic flow.

Alternatives 2-1 and 2-2 are effective for reducing bus traffic in the urban area but are difficult to implement because the distance that must be walked to reach the commercial/business district is greater than the maximum distance of 350 m that bus passengers can walk, and also because passengers must walk about 1 km across the commercial/business district to transfer buses.

Alternative 2-3 requires traffic control on major roads used as circular bus routes and at intersections where two or more bus routes cross each other. On the whole, however, this alternative offers the best possibility for improving the public transportation system in Centro (See Table 12–4–4).

Table 12–4–4 Evaluation of Alternatives on Bus Route Improvement in the Central District

View Points of Alternatives Evaluation	Passenger Service	Traffic in the Center (See Appendix J)	Availability of Facility Necessary Conditions
1-1 Introduction of terminal in the urban area.	– Need connection service between terminal and the major commercial area.	– Bus traffic at the entrance and exit of the terminal are over 10,000 buses.	– Difficult to provide the site with over 10 has. in the urban area.
1-2 Introduction of terminal at Barranquillita.	– Need connection service tween terminal and major commercial areas. – Terminal is located after pass through major commercial areas.	– Same problem as above.	– Relatively easier to provide site than alternative 1-1.
2-1 Limitation of bus service routes at roads surrounding	– –Walking distance of passengers in the area is large. – Inconvenient for passengers to transfer bus route.	– Bus traffic in the roads designated is not large.	– Improvement of intersections with traffic control at those points along the roads used for bus routes.
2-2 Limitation of bus service routes at roads inside the central area.	– Smaller walking distance than alternative 2-1. – Same problems as 2-1 for passengers who need to transfer bus routes.	– Same as above.	– Same countermeasures accompanied with implementation of the plan.
2-3 Limitation of bus service routes at road pairs surrounding the center with circular system through above-mentioned road pairs.	– Almost all bus routes are located within maximum walking distance.	– Bus traffic in the roads are than those of alternatives 2-1 and 2-2 but smaller than alternatives 1-1 and 1-2.	– Similar countermeasures will be required.

12–4–4 Outline of the Bus Circular System

1) Purpose of the System

This system is intended to secure the future convenience for both buses and private vehicles in the centro district. Specific streets in the centro district will be used exclusively for bus routes while other streets will be used only by private vehicles. The achievement of the following purposes is intended by the introductin of this system.

(1) The smooth flow of bus traffic in the centro district.

(2) The distribution of bus routes within some 350 m from any area in the centro district in order to improve passenger services.

(3) The distribution of bus routes for the convenience of transfer passengers in the centro district.

(4) The provision of base points (combined bus stops which are called Gran Paradas) for the convenience of those passengers who intend to travel on foot from the bus routes to destinations in the centro district. These base points will provide safe and convenient places of transfer for transfer passengers and will also help to achieve smooth bus traffic on the streets by concentrating the embarking and disembarking of buses at these Gran Paradas. Furthermore, they will temporarily reduce the volume of bus traffic on the streets.

2) Scope of the System

This system will be one of the infrastructures for the smooth operation of urban functions in the center of the Barranquilla urban area and it will be necessary, therefore, that this system regards the entire future CBD area as the area of service. From this point of view, the subject area of the system will be the entire Central District, including Centro and Barranquillita.

The following streets will be used to introduce the system. Plan 2000, however, presupposes that the improvement work for Cra. 46 and Calle 17 has been completed and that the intermunicipal bus terminal will have been developed in Barranquillita (See Fig. 12–4–3 and Table 12–4–5).

Table 12–4–5 Streets for the Bus Circular System

Calle 45/Calle 44	Cra. 38/Cra. 40
Calle 38/Calle 37	Cra. 45/Cra. 46
Calle 30/Calle 9 (extension of Calle 17)	
Calle 7/Calle 6	

The selection of these streets was made due to the following reasons.

(1) Calle 37/Calle 38 are included in order to serve the areas which are located outside the 350 m radius (maximum walking distance for bus passengers) from the circumferential streets of Centro, i.e. Calle 45, Calle 30, Cra. 38 and Cra. 46.

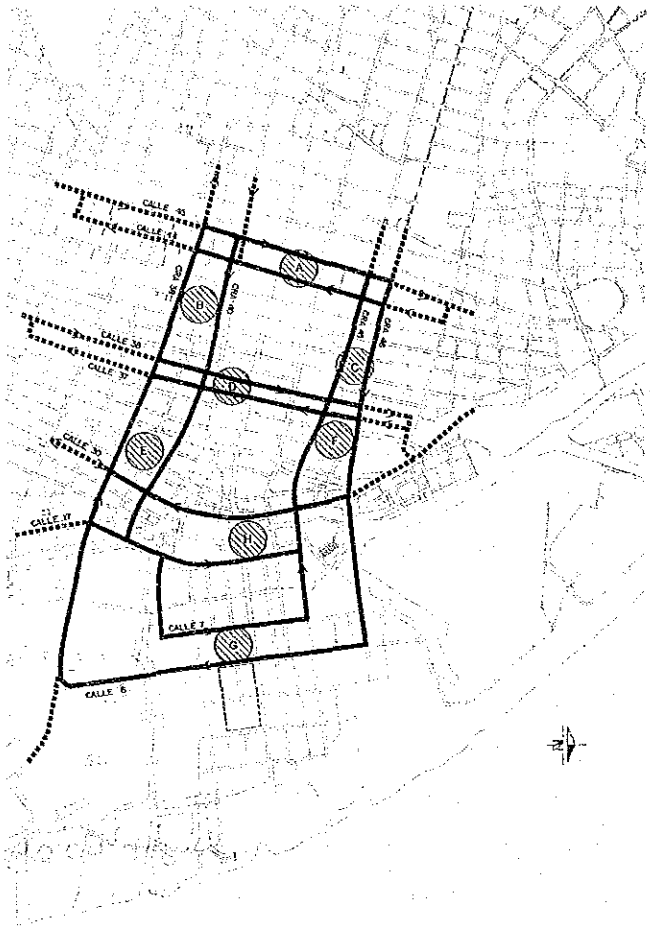


Fig. 12–4–3 Bus Circular System in Central District

(2) Cra. 38, Cra. 40, Cra. 45 and Cra. 46 which run east to west should be made into major connecting streets between Centro and Barranquillita.

(3) Calle 17 is included in the system to supplement Calle 30 which serves the area where wholesale market for fresh food for Barranquilla is located.

(4) Calle 6 and Calle 7 are included to connect with the Inter Municipal Bus Terminal that will be located in Barranquillita.

The streets in the circular system will be distributed in paris. Buses will each use one of these two streets for opposite directions to achieve a smooth flow of traffic and to provide convenience for transfer passengers.

3) Rerouting Plan

17 bus routes* are proposed as city bus routes for the year 2000. Coupled with the improvement of bus routes outside the Central District, rerouting inside the Central District will also be indispensable for the rationalisation of all bus routes.

The principles of bus rerouting in the Central District are as follows.

(1) To provide bus services that will connect locations in the Central District in a minimum of time and to reduce idling time inside the Central District.

(2) To make bus routes circulating outside the Central District pass through the relatively straight routes inside the Central District and veceversa.

(3) Those bus routes serving different zones will be distributed in order that they will mutually cross one another at one of the streets inside the circular system (See Appendix 2) in consideration of the provision of services for transfer passengers in the Central District.

(4) At least one bus route from each zone should lead to Barranquillita in order to provide a bus service between each district of the city and the intermunicipal bus terminal to be located in Barranquillita.

As a result, a traffic volume of over 1,000 buses during the peak hour, serving 10 different bus route, will be generated for a pair of streets, Cra. 45 and Cra. 46, Cra. 38 and Cra. 40

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* The number of representative routes is 17, summarized from the numerous bus routes used for actual services in view of route characteristics and service areas.

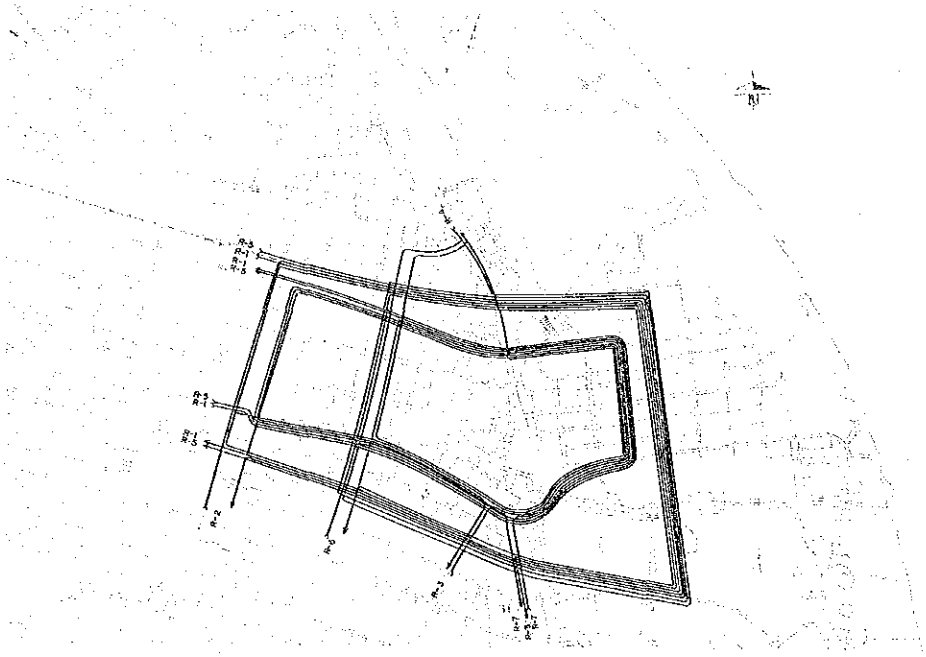

Fig. 12–4–4 (1) Rerouted Bus Route

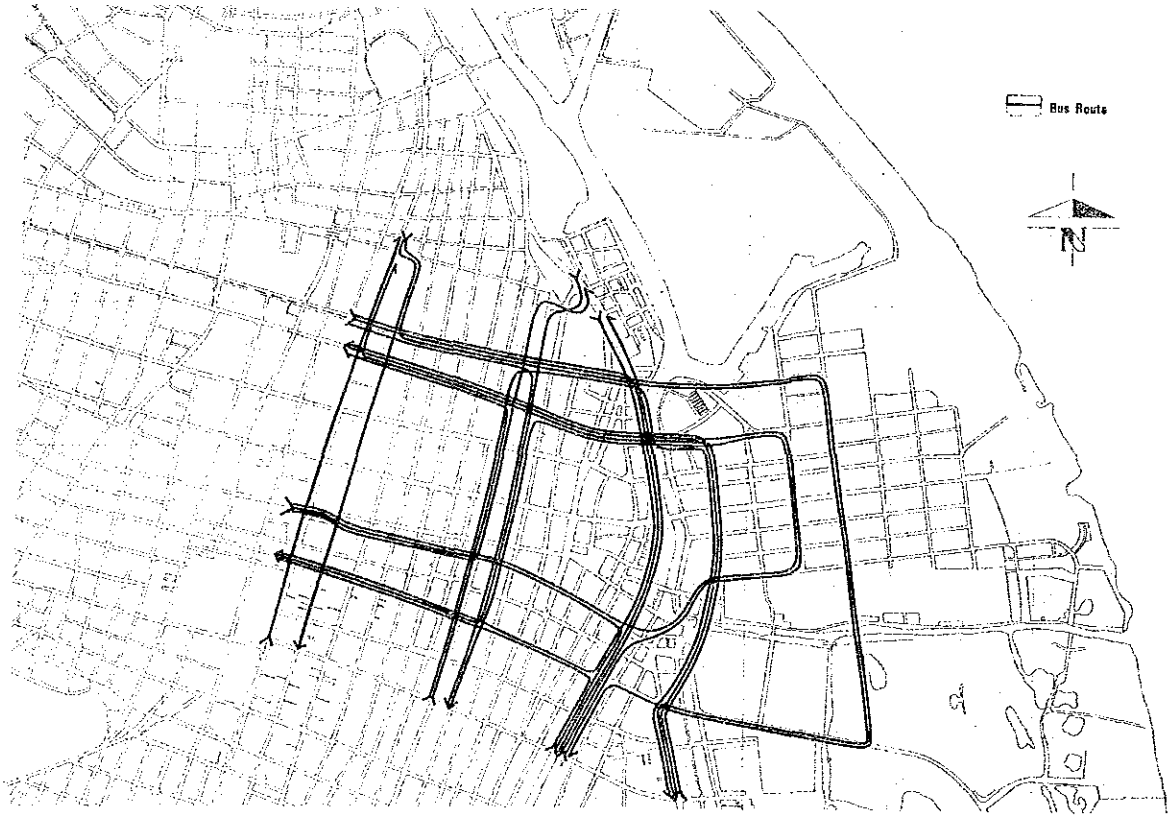

Fig. 12–4–4 (2) Rerouted Bus Route

will also have a bus traffic volume of over 800 buses/hour serving 9 routes (See Fig. 12–4–4 (1) and (2) and Fig. 12–4–5).

The volume of the bus traffic inside the Bus Circular System estimated here cannot be accommodated by the existing road capacity. Therefore, the possibility of the above-mentioned volume of bus traffic passing various intersections is examined, based on the assumption that the proposed widening of the streets given in the street plan for the Central District has been completed.

Based on the examination of 25 major intersections with 52 directions that are located inside the Circular System, 8 direcions show a volume capacity ratio of more than 1.0, with the 3 directions below showing a ratio of over 1.1.

(1) Intersection of Calle 45 and Cra. 38 south of Calle 45.
(2) Intersection of Calle 37 and Cra. 45 east of Cra. 38.
(3) Intersection of Calle 37 and Cra. 46 west of Calle 37.

To secure a smooth flow of bus traffic, the introduction of countermeasures will be necessary for the above intersections.

12–4–5 Gran Paradas

Gran Paradas* are supplementary facilities for the smooth functioning of the Bus Circular bined together to make large bus stops (Gran Paradas) with adequate space in order to contribute to the improvement of passenger services and to a reduction of traffic congestion. The general functions of Gran Paradas are as follows.

(1) To provide bus stops for passengers whose journeys originated inside the Centro district and whose destinations are also inside the Centro district within some 350 m distance (possible walking distance).
(2) To provide bus stops for transfer passengers in the Centro district so that these passengers do not have to walk long distances in order to change buses.

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* Gran Parada: The Spanish words for "Bus Stop" are "Parada de Bus". Although gran parada means a large bus stop, "Gran Parada de Bus" would be the more accurate Spanish terminology.

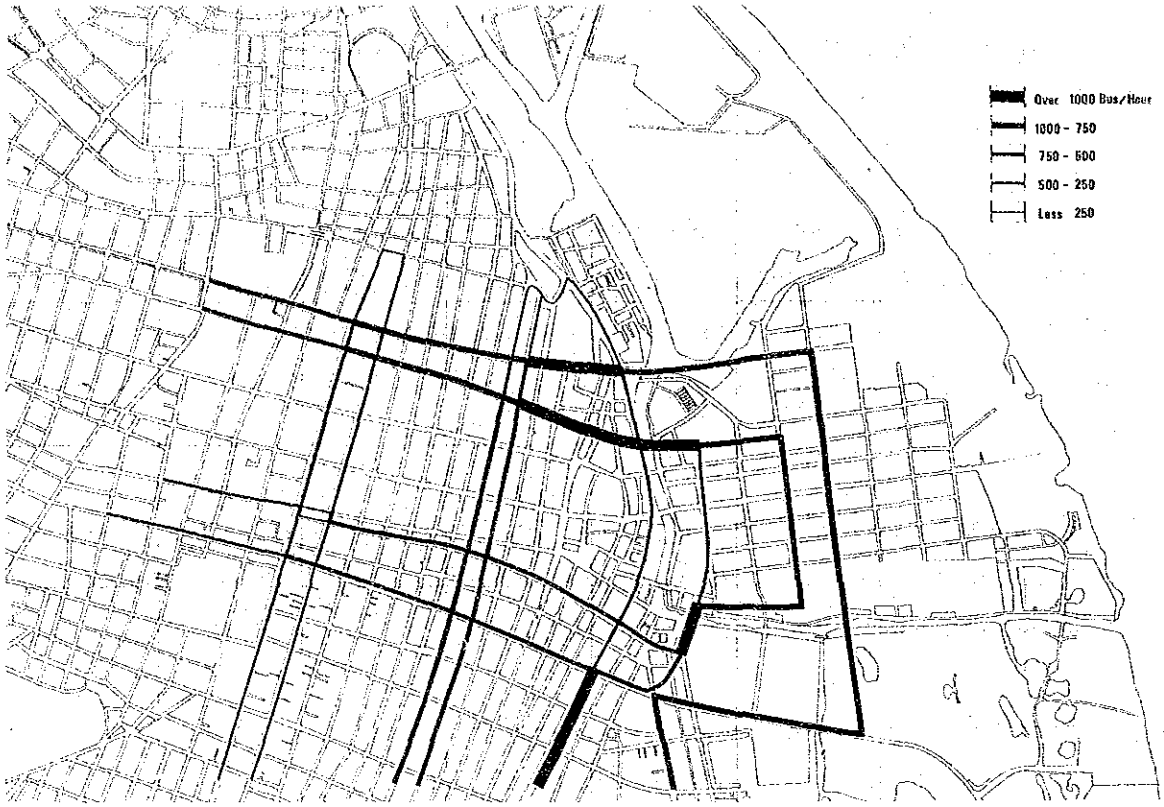


Fig. 12–4–5 Bus Traffic Volume in Peak Hour

(3) To secure a smooth traffic flow on the bus circular routes by withdrawing passenger services on these routes.

1) Distribution of Gran Paradas

The central area, consisting of Centro and Barranquillita, is the direct service area for the Bus Circular System.

Centro has a square area of approximately 1.1 km in the east-west direction by about 900 m in the north-south direction. Therefore, if two Gran Paradas are located on both the northern and southern boundaries, one Gran Parada is located on both the eastern and western boundaries and one Gran Parada is located in the center of the area, all locations within the entire Centro area will be within walking distance of one of these Gran Paradas.

In the case of Barranquillita, one Gran Parada will be located in the center in consideration of the location of the intermunicipal bus terminal and one Gran Parada will be located on the border with the Centro district. Most of western Barranquillita, which is the commercial and business area, will be within walking distance of one of these two Gran Paradas (See Fig. 12–4–3).

2) Demand for Gran Paradas

The demand for Gran Paradas is estimated in terms of the number of passengers, bus routes and the frequency of bus services (See Fig. 12–4–6).

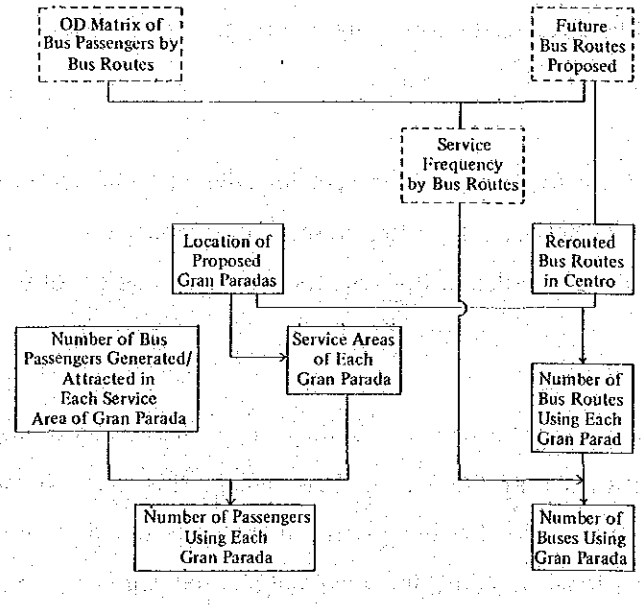


Fig. 12–4–6 Estimation of Number of Bus Passengers by Gran Parada

The number of passengers using a specific Gran Parada is considered to be the number of bus passengers generated in and attracted to the zone where this particular Gran Parada is located. The total number of passengers using the 8 Gran Paradas will be approximately 960,000, with the busiest Gran Parada E having 245,000 passengers and the least busy gran parada having 49,000 passengers (See Table 12–4–6).

Table 12–4–6 Utilization of Gran Parada

Gran Parada	No. of Bus psgr	No. of Bus Route	No. of Service Frequency of Bus (SF/Hour)
A	54,000	3	400 ~ 530
B	111,000	8	1,200 ~ 1,340
C	118,000	8	1,500 ~ 1,650
D	141,000	6	1,200 ~ 1,230
E	245,000	9	1,400 ~ 1,430
F	176,000	10	1,500 ~ 1,560
G	68,000	9	1,400 ~ 1,620
H	49,000	3	700 ~ 710
Total	963,000	56	9,300 ~ 10,070

The Centro district will be served by 16 bus routes. Gran Parada F will have the largest number of bus routes of 10 with 1,560 buses/hour while Gran Parada A and H will have 3 bus routes, the smallest number of routes, with 500–700 buses/hours (See Table 12–4–6).

3) Plan for Gran Paradas

Consideration will be given to the following two types of Gran Paradas.

(1) Bus Terminal Method

All bus routes in the central area will, in principle, use a pair of streets as a circular route. Part or all of the area between these two streets will be considered as Gran Parada. In this case, a platform will be installed in this area for getting on and off of buses.

(2) Bus Bay Method

Two relatively long bus bays will be installed along these pairs of streets and will face each other on both sides of the area in between. In this plan, the street bus bays are intended as substitutions for the bus platforms in the terminal method. This method is proposed as a transitional step until the Terminal Method can be implemented.

Although the provision of 8 Gran Paradas has been proposed along the bus circular routes, the plan should be carried out as part of urban renewal work. The plan for the year 2000 anticipated that all these 8 gran paradas will be constructed employing the Bus Terminal Method.

Of these 8 Gran Paradas, Gran Parada G in Barranquillita, Gran Parada H alongside of the canal and Gran Parada F in particular should employ the Terminal Method as they are all located in the preferential development area. In addition, Gran Parada E is also expected to employ the Terminal Method at a relatively early date as it is adjacent to an area that is already heavily congested by traffic. For other locations, the Bus Bay Method will suffice at the initial stage.

a. Design Policy

Buses are the most important means of transportation used by more than half of all passengers in Barranquilla city.

Future demand forecasts (the number of passengers to utilize some loading facility in centro district per day) is about one million around the year 2000, including transfer passengers. At the same time, the facility area will be very large. The future aspects of bus service are to provide a safe and pleasant facilities for passengers waiting for or changing buses, and to control bus operation to meet the demand.

The Gran Paradas are also proposed as a kind of open space facility. It will act as buffer zone against fire in dense areas, and it is very significant from the stand point of urban planning.

b. Planning Capacity

The basic planning condition of Gran Parada facilities is the number of bus berths, which is calculated based on the number of buses (service frequency) in peak hour. The number of bus berths calculated for each Gran Parada, based on the turnover ratio, are listed in Table 12–4–6 and Table 12–4–7.

Table 12–4–7 Bus Service Frequency in Peak Hour by Parada

(unit of Bus/Hour)

No. of Route	Gran Parada															
	A		B		C		D		E		F		G		H	
1	–		104	104	104	104	–		104	104	104	104	104	104	–	
2	61	61	61	61	61	61	–		61	61	(61	61)	61	61	–	
3	130	130	130	130	130	130	–		130	130	(130	130)	130	130	–	
4	–		–		–		32	32	32	32	–		32	32	–	
5	–		81	81	(81	81)	–		81	81	81	81	81	81	–	
6	–		–		–		77	77	77	77	77	77	77	77	–	
7	–		–		–		45	45	45	45	45	45	45	45	–	
8	–		108	108	–		108	108	–		–		–		–	
9	–		–		176	176	–		–		176	176	176	176	–	
10	–		–		152	152	152	152	–		–		–		–	
11	–		–		104	104	–		–		104	104	104	104	–	
12	–		132	132	–		–		132	132	–		–		–	
13	–		–		–		201	201	–		201	201	–		201	201
14	–		–		99	99	–		–		(99	99)	–		99	99
15	–		54	54	–		–		54	54	–		–		54	54
16	–		–		–		–		–		–		–		–	
17	73	73	–		–		–		–		–		–		–	
Grand Total	264	264	670	670	826	826	615	615	716	716	782	782	810	810	354	354

Note: As each Gran Parada is faced with two streets, the Gran Paradas serve for buses with different directions.

Generally the trunover time in Gran Parada is 2–3 minutes per bus. It is proposed 2 minutes per bus on condition that bus flow is very smooth in the planned Gran Parada. The number of berths required is shown in Fig. 12–4–7 with the model plan.

c. Planning Criteria and Model Plan

The Model Plan of each Gran Parada that has been design based on the "Design Criteria" is as follows:

(1) Necessary area for the Gran Paradas Lot.
(2) Type of Gran Parada
(3) Bus approach and bus circulation in the Gran Parada
(4) Parking pattern
(5) Platform pattern

Those design criteria are explained more in detail from the model plan of the 8 Gran Paradas, which is shown in Fig. 12–4–7 (1) and (2).

i) Necessary Area for the Gran Paradas Lot

The existing condition of the candidate site of the 8 Gran Paradas, is either some old buildings which is not tall, or some vacant lot.

The Gran Paradas A and H, will use only half of the block, but the other Gran Paradas will need one or two blocks. The necessary area has to follow some planning conditions and criteria to be adjusted to the existing conditions. In case the required area is larger than the existing one it will be necessary to readjust the design of the Gran Parada Model.

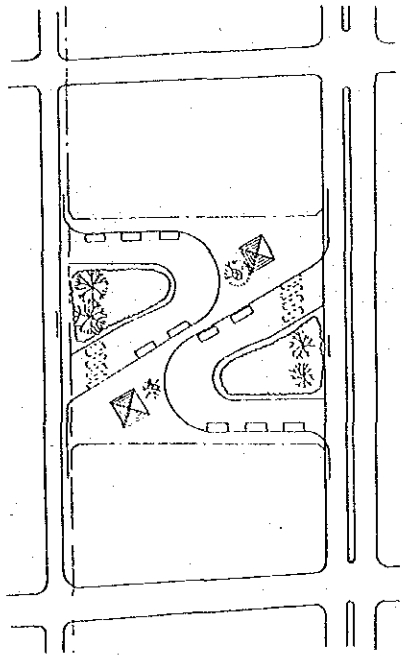
ii) Type of Gran Parada

Type of bus terminal for the Gran Paradas is classsified as below:

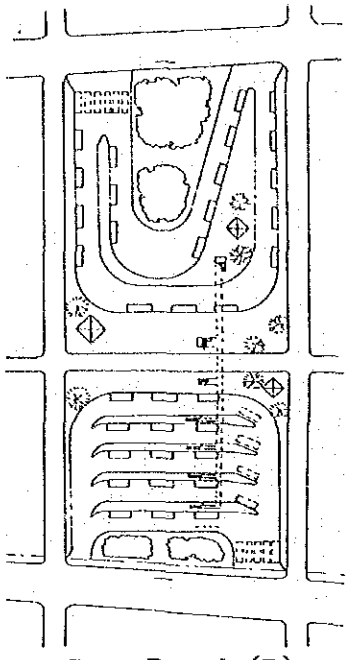
– Classification by bus route – city bus terminal
– Classification by bus operation – drive-through by terminal.
– Classification by management and passenger facility – loading zones only.

iii) Bus Approach and Bus Circulation in the Gran Parada

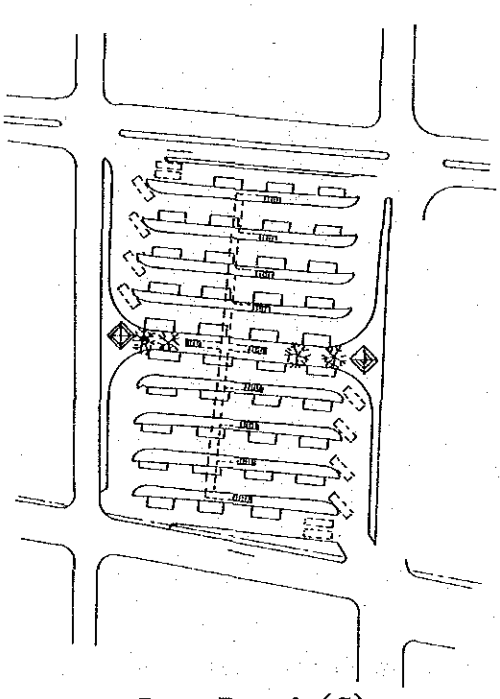
Bus approaches to a block which is surrounded by public road are many. However, there are mainly three patterns which differ through the utilization of surrounding road (See Fig. 12–4–8). In those three (3) patterns, the key points of evaluation are as follows.



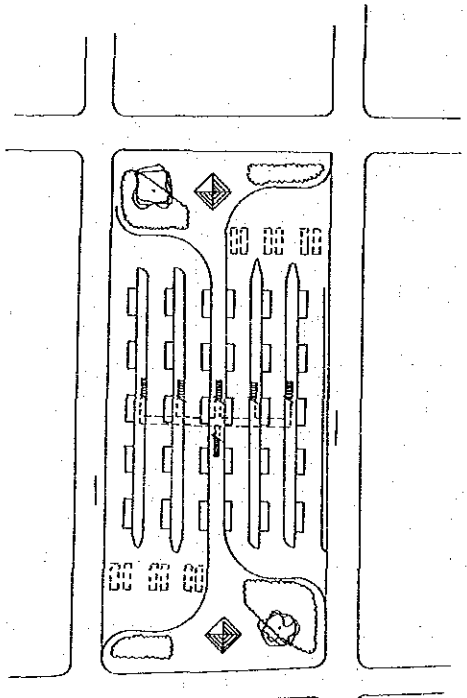
Gran Parada (A)



Gran Parada(B)



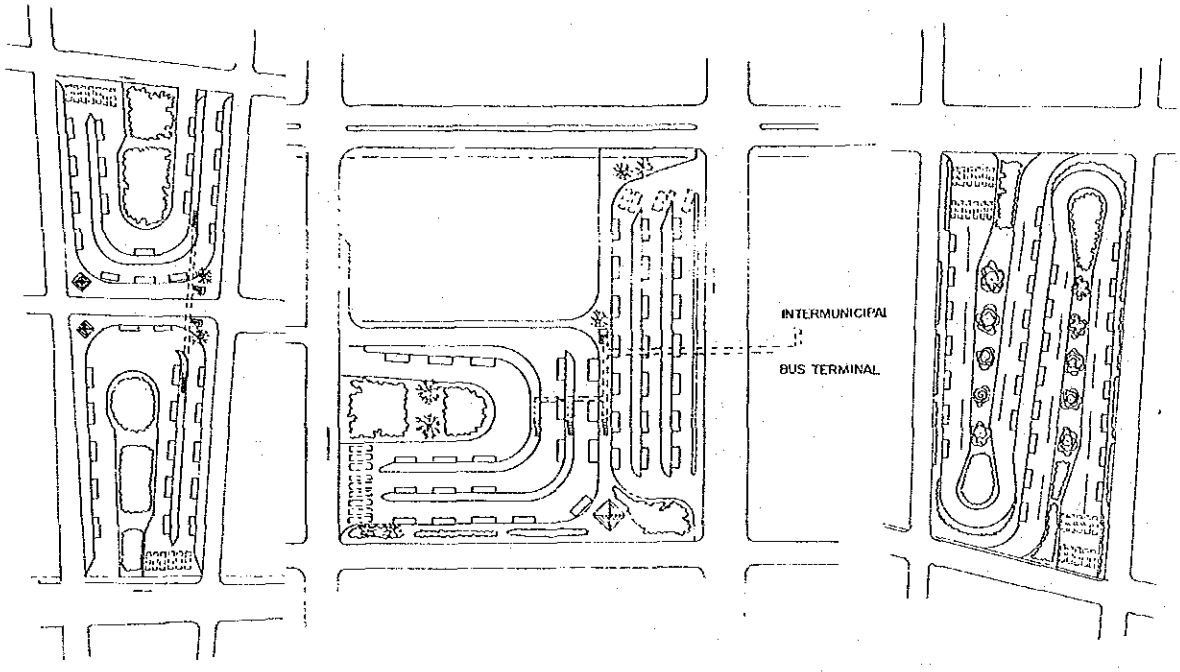
Gran Parada(C)



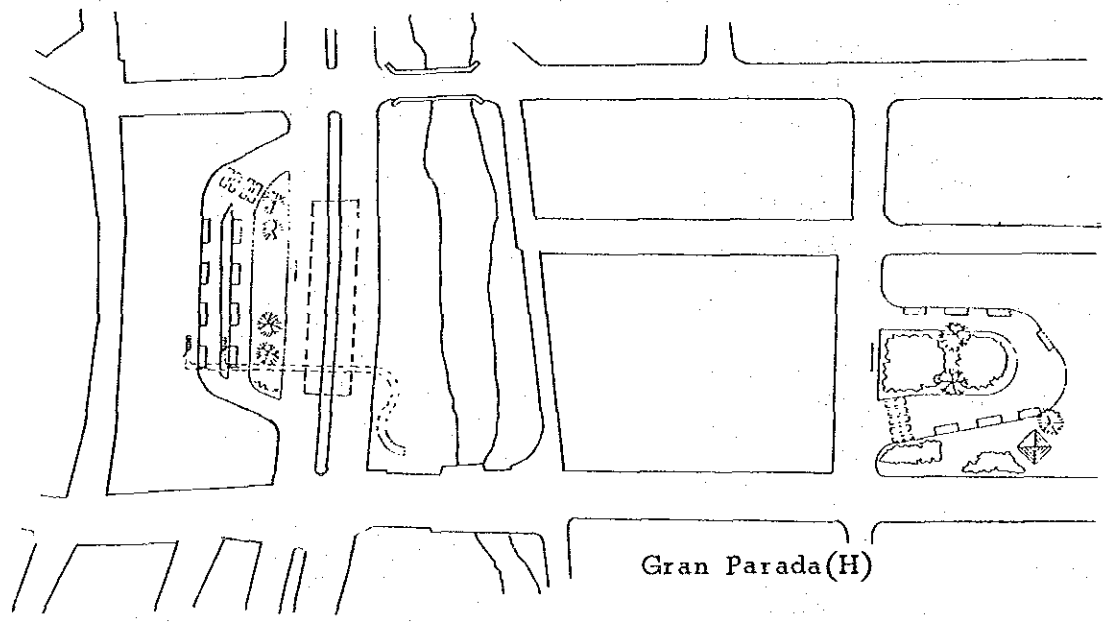
Gran Parada(D)

	Item	A	B	C	D
1.	Occupied Area	6,800	12,800	7,800	8,300
2.	Number of Buses	18	51	50	42
3.	Number of Berths	10	35	38	30
4.	Number of Waiting Space	8	16	12	12

Fig. 12–4–7 (1) Model Plan for Gran Parada



Gran Parada(E) Gran Parada(G) Gran Parada(F)



Item		E	F	G	H
1.	Occupied Area	10,800	11,700	13,000	9,100
2.	Number of Buses	48	52	55	24
3.	Number of Berths	35	30	41	15
4.	Number of Waitng Space	13	22	14	9

Fig. 12-4-7 (2) Model Plan for Gran Parada

– In the central district the gran paradas are proposed so as to eliminate the traffic disturbances caused by buses occupying the public road.

– Using the road without bus route, it will lead to adverse effect in the traffic movement and in the accessibility to passengers.

– It is better for a bus circulation and flow to be simplified. For the above reasons, pattern (B) will be the basic one for planning the Gran Paradas.

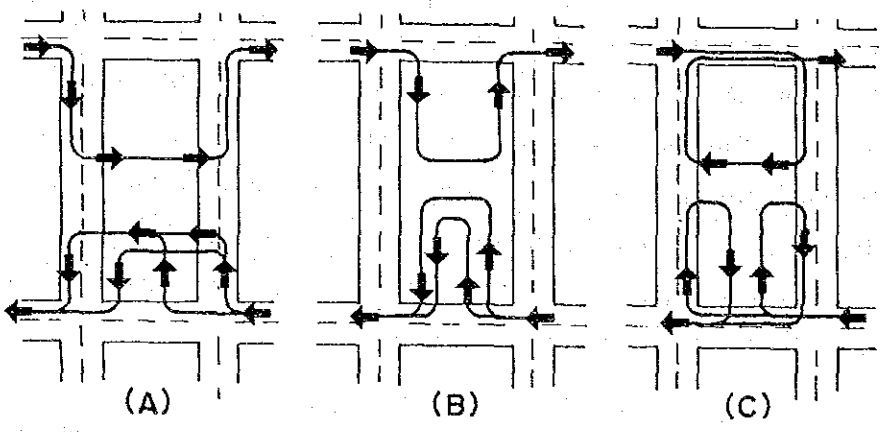


Fig. 12–4–8 Bus Approach and Circulation in Gran Parada

iv) Parking Pattern

There are three different types of parking patterns, parallel parking, diagonal parking and front parking. The parallel parking is a very comfortable way for the bus arrival and departure. The bus movement is in line with the smooth traffic. In case of a long arrival and departure parked, a platform will be necessary as well as an additional through lane. The clear distance between two berths is 15 m, and the width of the road should be 7.5 m normally and 3.5 m in the additional lane (See Fig. 12–4–9). Based on this pattern all the Gran Paradas should follow this kind of structure, because of the easy operation.

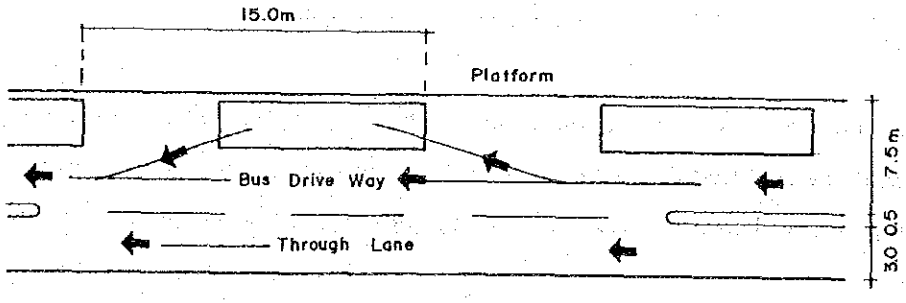


Fig. 12–4–9 Parking Platform Pattern

v) Platform Pattern

There are several platform patterns. but in this plan it is proposed to use single straight lane straight line pattern. If additional space is needed, a parallel lane can be considered.

4) Construction Program and Cost

a. Size of Land Required

Gran Parada proposed by this Plan will be constructed at 8 locations in the Centro and Barranquillita districts. The land area for each facility will be a minimum of 6,800 m^2, a maximum of12,800 m^2, and an average of 7,500 m^2. Except for Grand Paradas A and G, these land areas will occupy a full Manzana (city block). Candidate sites are selected so as to avoid medium and high-rise buildings, which are difficult to be removed, with most of the buildings having 2 floors or less. The ratio of total floor area to land area still remains at the low level of about 80%, except for Grand Parada D, where it is about 200%. The land area required and the total building floor area of the candidate sites are as shown in Table 12–4–8.

Table 12–4–8 Land Area Required for Gran Parada

(Unit: m^2)

Item	Name of Grand Parada								
	A	B	C	D	E	F	G	H	Total
Land area	6,200	11,292	7,092	7,332	9,990	9,854	10,200	7,700	60,483
Floor area	7,000	9,353	2,663	13,997	8,100	6,606	7,000	3,000	57,719

Source: Land registration book of Barranquilla city

b. Land Acquisition Policy

It is generally extremely difficult to acquire a full block of land in the central district of a city, where land usage is high and a multiple number of land owners are involved. This may, however, be a good time for acquiring land in the central district of Barranquilla, where building density still remains low at present and the current development level is sinking. The significance of land acquisition, the promoting organization, and coordination with related development projects are given below. These will establish the policy of land acquisition.

(1) The Grand Parada construction is one of the most important development projects, in view of the fact that the facility seeks to provide safe passenger embarkation/disembarkation points and to ameliorate traffic congestion in the district, where a majority of buses, the sole major public transportation facility in Barranquilla city, converge and where the number of passengers is expected to exceed 900,000 a day in the future.

(2) Open spaces of about one hectare each (including the road encircling the Gran Parada) will be provided every 300 m or so of radius in the central district of Barranquilla, where open spaces are few. These open spaces will act as buffer zones against fire in dense areas, and are very significant from the standpoint of urban planning.

(3) The organization to promote land acquisition will be established within a public agency of the city, in veiw of the significance of this project mentioned in (1) and (2).

(4) Measures for land acquisition will be implemented carefully but forcefully from the public point of view.

(5) The planned land will be frozen in order to facilitate land acquisition in the future.

(6) When buying the land, consideration will be given to offering services to the existing land owners such as transfer to other redeveloped areas in the Centro District. For this purpose, redevelopment plans in other districts will be implemented at the same time.

c. Planning and Implementation Time

The planned scale of each Grand Parada is based on conditions forecasted for the year 2000. The decision on when to implement the plan should take into consideration both the geographic conditions of each Grand Parada and the related development projects. Thus, the implementation time is broadly classified into the following three phases as shown below in Table 12–4–9.

Table 12–4–9 Implementation Schedule of Gran Parada

Project Name	89	90	91	92	93	94	95	96	97	98	99	2000
Gran Parada E.												
Gran Parada F, G, H												
Gran Parada A, B, C, D												

Legend: --- Land acquisition period
— Engineering service
— Construction

d. Construction Cost of Gran Parada

i) Precondition of estimation

Facilities of each Gran Parada are almost composed of drive way, loading platform, sidewalk, pedestrian and green belt.

These facilities are integrated as an extension of road and include some work item associ-

ated with the road. Therefore, all costs have been estimated in the same way as road construction cost (See 11–5).

ii) Construction Cost

The preliminary plan for each Gran Parada is shown in Fig. 12–4–9. Direct construction has been estimated by summing up the labour cost, machinery cost and materials cost of each work item, calculated by multiplying the unit cost by the quantity.

The result of construction cost of each Gran Parada is shown in Table 12–4–10 (1) and (2), and detailed them in Appendix J.

Table 12–4–10 (1) Construction Cost of Each Gran Parada

(thousand pesos)

Item \ Gran Parada	A	B	C	D
1) Site preparation	27,400	16,835	4,793	25,195
2) Road and parking	4,815	11,242	9,562	8,358
3) Platform and sidewalk	1,980	3,700	1,793	2,119
4) Pedestrian bridge	0	9,920	11,738	6,420
5) Utilities	1,588	3,191	3,018	2,656
6) Planting	876	1,042	144	559
7) Others	10,077	5,986	7,114	6,132
Subtotal	46,736	51,916	38,163	51,439
8) Overhead (15%)	7,011	7,787	5,724	7,716
9) Contingency (10%)	5,375	5,970	4,389	5,915
10) Engineering fee (12%)	7,095	7,881	5,793	7,808
Total	66,217	73,558	54,069	72,878

Table 12–4–10 (2) Construction Cost of Each Gran Parada

(thousand pesos)

Item \ Gran Parada	E	F	G	H
1) Site preparation	14,580	11,891	12,600	5,400
2) Road and parking	11,232	11,307	12,227	4,890
3) Platform	2,119	1,459	2,820	2,038
4) Pedestrian	5,673	0	7,824	3,272
5) Utilities	2,832	3,382	3,091	2,084
6) Planting	1,212	1,884	912	2,076
7) Others	6,887	5,791	6,309	7,639
Subtotal	44,536	35,713	45,783	27,398
8) Overhead (15%)	6,680	5,357	6,868	4,110
9) Contingency (10%)	5,122	4,107	5,265	3,151
10) Engineering fee (12%)	6,761	5,421	6,950	4,159
Total	63,099	50,598	64,866	38,818

12–5 Bus Related Facility

Bus related facilities that will assist the functioning of the bus circular system will be discussed in this section. The interdepartmental and intermunicipal bus terminals and bus inspection center will be proposed.

12–5–1 Interdepartmental Bus Terminal

1) Introduction

The introduction of this bus terminal is one of the measures intended to give better service to passengers on buses, even those that are not urban buses.

There has been a project to construct a bus terminal for ten years, ever since CFT prepared a master bus terminal plan for major cities. Unfortunately, the project in Barranquilla has not been implemented.

The mayor of the city recently declared his intention to eliminate bus traffic from Calle 34, because it is a simbolic road for the city. Along this road are located almost all the interdepartmental bus companies (See Fig. 12–3–3). Due to these circumstances the interdepartmental bus terminal is to be implemented in the near future.

2) Necessity of the Terminal

The interdepartmental bus services from Barranquilla are introduced in Chapter 7.

There are 11 bus companies with 21 routes engaged in these services. They have their offices along Calle 34 each with space for only 2 or 3 buses. There is no passenger space or bus operation space.

The bus passengers and street vendors serving these bus passengers are crowded on the street in from of the bus companies (See Appendix J). The buses must park on the roadside around their offices which causes traffic problems in the center of the city.

Consequently, the relocation of the interdepartmental bus terminal is necessary from the point of view of both, bus passenger service and road traffic control.

3) Area required

The area required of the interdepartmental bus terminal depends on the future service frequency of interdepartmental buses in Barranquilla.

At present there are about 510 bus services per day between the major cities in Atlántico

department and Barranquilla, and they are expected to increase about 3.3! annually. From this trend, it is estimated that the terminal will need 28 platforms with about 3.3 hectares of area.

After 25 years, the necessary area will be about 4.7 hectares; the area required after 1988 should be considered as part of the expansion area of the plan (See Table 12–5–1).

Table 12–5–1 Area of the Interdepartmental Bus Terminal in 1988

	Area Unit: 1000 m²	Note
Operation Area	15.7	Including Platform and Parking Space
Administrative Area	2.5	Bus Companies' Offices Ticketing Offices
Passenger Service	2.1	Parcels handling space
Other Complementary Services	1.9	Cafeteria, Toilet, etc.
Urban Transportation Service Area	5.5	
Green Zone	1.6	About 10% of Subtotal
Total	29.2	

4) Selection of the site

The streets which have interdepartmental and/or intermunicipal bus routes are Calle 47, Carretera a Santa Marta and Calle 30 (See Fig. 12–5–1).

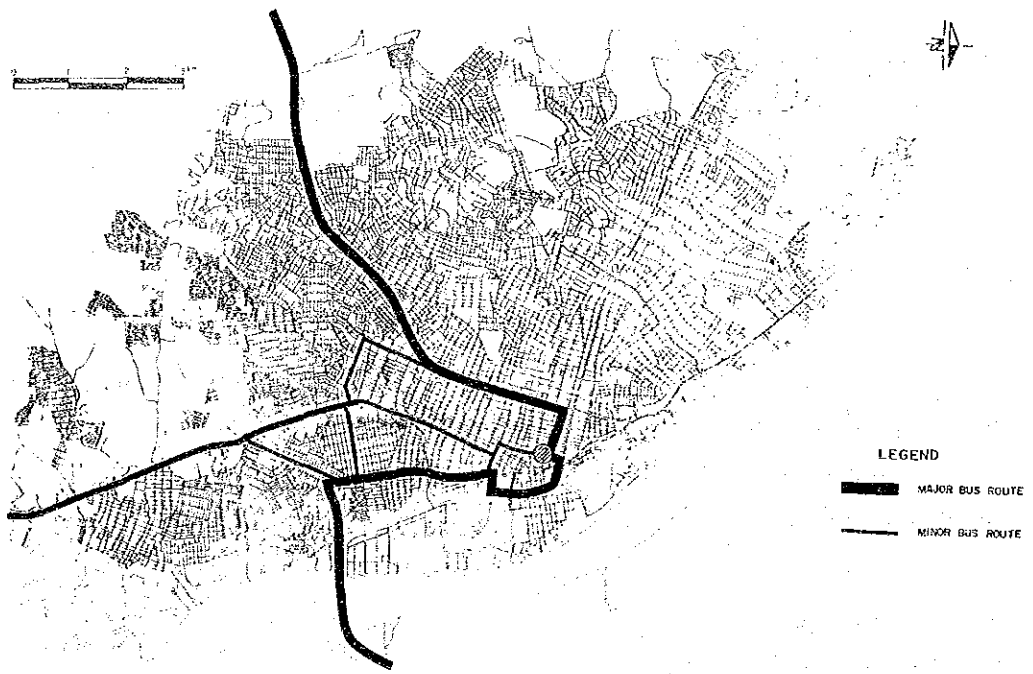


Fig. 12–5–1 Interdepartmental Bus Routes in Barranquilla

Table 12–5–2 Evaluation of Selected Sites

No.	Area (ha.)	Actual Land Use and Topography	Location km from the center	Major roads near the site	Land Use around the site	Infrastructure water	Infrastructure drainage	Infrastructure road	Possibility of expansion	Development project around site
A-14, 16	35.0	- Warehouse	8 km	Calle 30		Yes	Yes	Yes	Yes	Regional Center behind the site
A-18	5.0	- Vacant - Arroyo	10 km	Calle 30		Yes	Yes	Yes	Yes	Industrial Area
C-2	20.0	- Hilly and Arroyo	7 km	Circunvalar	Residential	No	No	Yes	Yes	Residential
C-5	18.0	- Vacant	10 km	Calle 45	Residential	No	No	Yes	Yes	Regional Center behind the site
C-6		- Vacant	11 km	Calle 45	Near Gran-Abastos	No	No	Yes	Yes	—
C-7	22.0	- Vacant - Gas Pipe	11 km	Calle 45	Near Gran-Abastos	No	No	Yes	Yes	Near Gran-Abastos
D-1	12.7	- Vacant	6 km	—	Residential	No	No	No	Yes	Mousing
D-2	22.0	- Vacant	6 km	Circunvalar	Residential	No	No	Yes	Yes	Park
D-3	16.0	- Vacant - Arroyo	8 km	Circunvalar	Residential	No	No	Yes	Yes	Commercial Residential
D-4	12.0	- Vacant	9 km	—	—	No	No	No	Yes	Beside Regional Center
D-5	80.0	- Vacant	10 km	—	Residential	No	No	Yes	Yes	In and around Regional Center

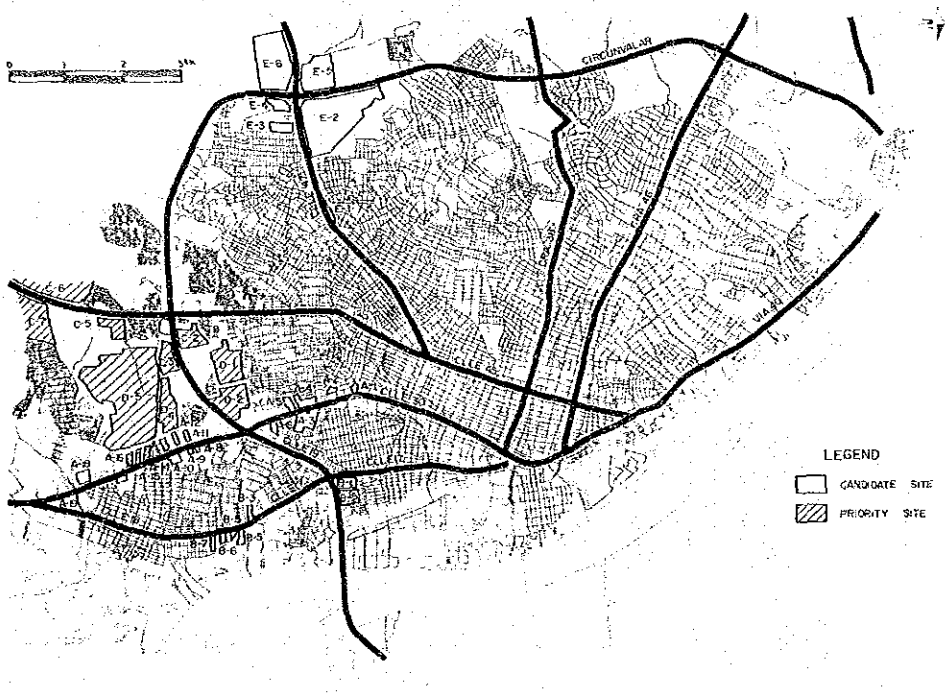


Fig. 12–5–2 Candidate Sites for Interdepartmental Bus Terminal

Table 12–5–3 Result of Field Investigation of Candidate Site

Selected Site	Topographic Condition: Difference between the level of road and site	Land	Surface Condition	Necessary Civil Work	Amount
No.1	+ 5 m	Sand	Small trees ditches	Surface cleaning Land work (5 m)	47,000 m² 23,500 m³
No.2	0 m	Sand	Small trees	Surface cleaning Land work (1 m)	47,000 m² 47,000 m³
No.3	+ 1 m	Sand	Small trees	Surface cleaning Land work (0.75 m)	47,000 m² 35,250 m³
No.4	+ 1 m	Sand	Relatively big trees	Surface cleaning Land work (0.5 m)	47,000 m² 23,500 m³
No.5	0 m	Similar to alternative No. 2			
No.6	Doesn't require civil work				

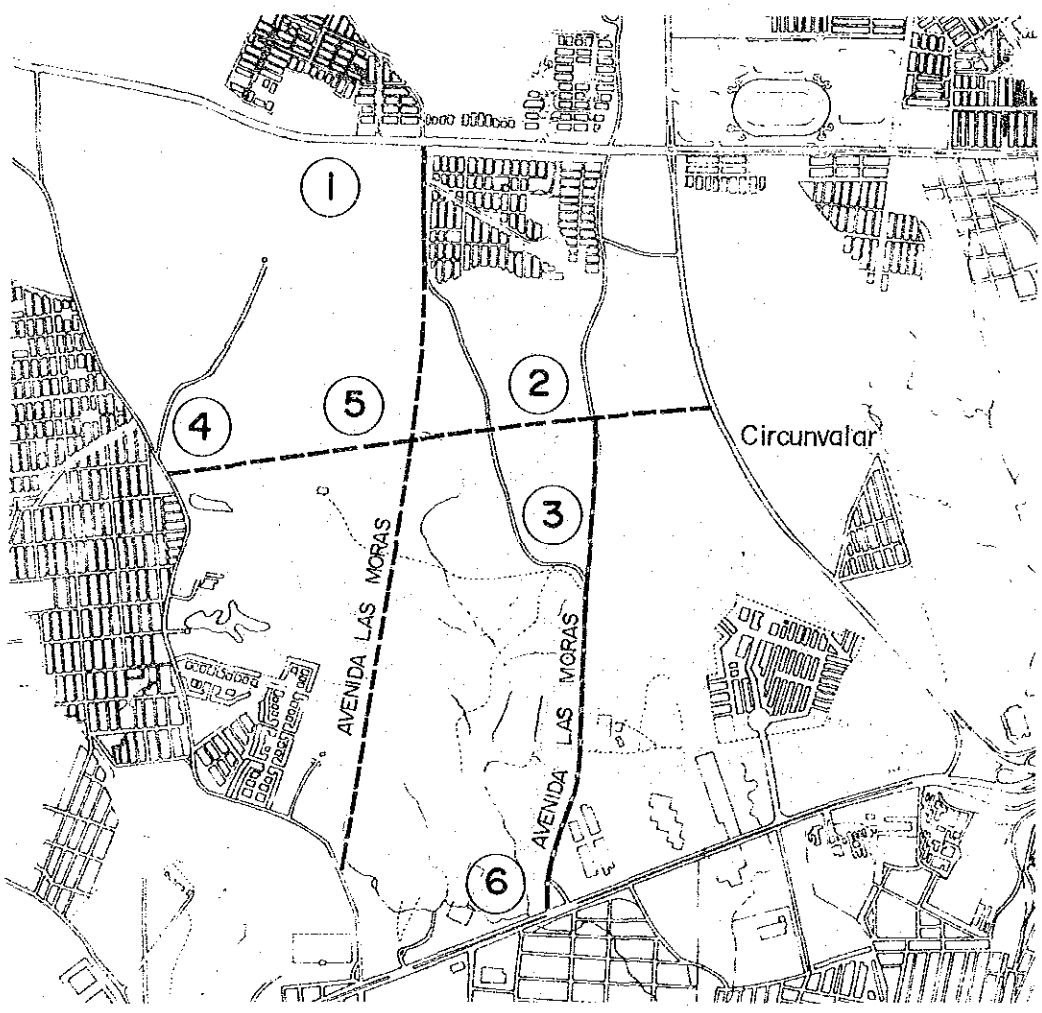


Fig. 12–5–3 Candidate Sites of Interdepartmental Terminal in Site D-5

From the point of view of the location of the existing bus routes, the interdepartmental bus terminal should be located along the Circunvalar between Calle 30 and Calle 45.

Vacant tracts of land that can be utilized for the terminal were identified based on the present land use of Barranquilla (See Fig. 12–5–2, Table 12–5–2).

6 locations were selected as candidate areas for the terminal, after field investigations were conducted.

The site coded "D-5" was selected as the location for the terminal from the point of view of future development of the area. D-5 contains 5 candidate site. After a field investigation and evaluation of these sites, No. 4 was selected because of favorable land conditions and the fact that the site is located in an area where the south subcenter will be developed in the future.

5) Basic Plan

a. Terminal Types

The proposed interdepartmental bus terminal is located in the suburbs of the city just as in Bogota.

It should be accessible directly by local transit, taxi and automobile. It differs from other terminal types in that it includes long haul service in excess of several hundred km and provides for a much greater number of bus movements.

Land costs normally will dictate vertical expansion capability in denser city areas, so it is necessary to get the full land in the near future.

More elaborate "package express" facilities are provided in the interdepartmental terminal and a greater amount of concession and rental space should be provided to defray higher terminal constructin and operating costs.

b. Function

The interdepartmental bus terminal should have the following functions:

(1) Platforms for embarkment and disembarkment

(2) Waiting space

(3) Bus operation space

(4) Administrative space

(5) Space for urban transportation, such as buses, taxis, and so on.

(6) Green space

(7) Space for future expansion

A model plan of the terminal has been designed based on these function and the flow diagram in Fig. 12–5–4.

6) Construction Cost

Bus center construction consists of civil engineering work and architectural work. Civil work will be on approach roads, passenger platforms, sidewalks, bridges, road apprurtenant works, and utilities facilities. Architectural work will be for the construction of the center building which will have passenger service facilities and administration functions, covered walkways, a filling station and a small maintenance shop.

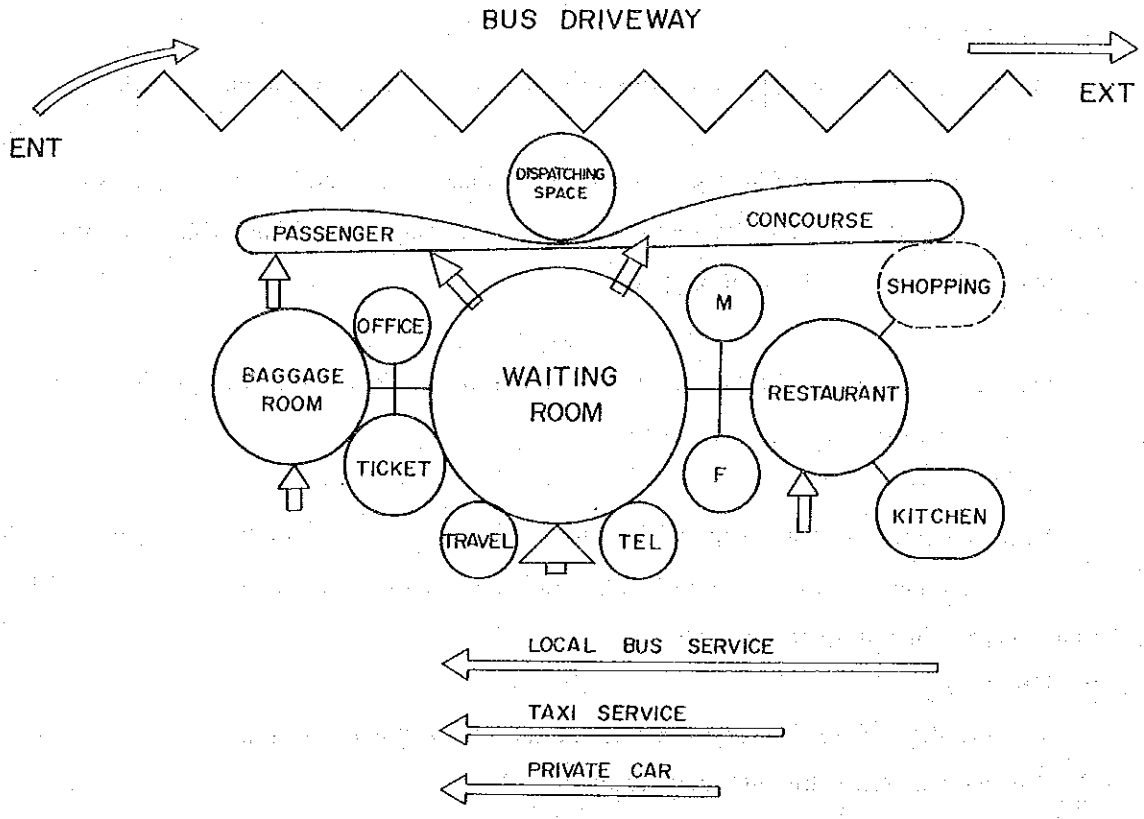


Fig. 12–5–4 Flow Diagram of Bus Center

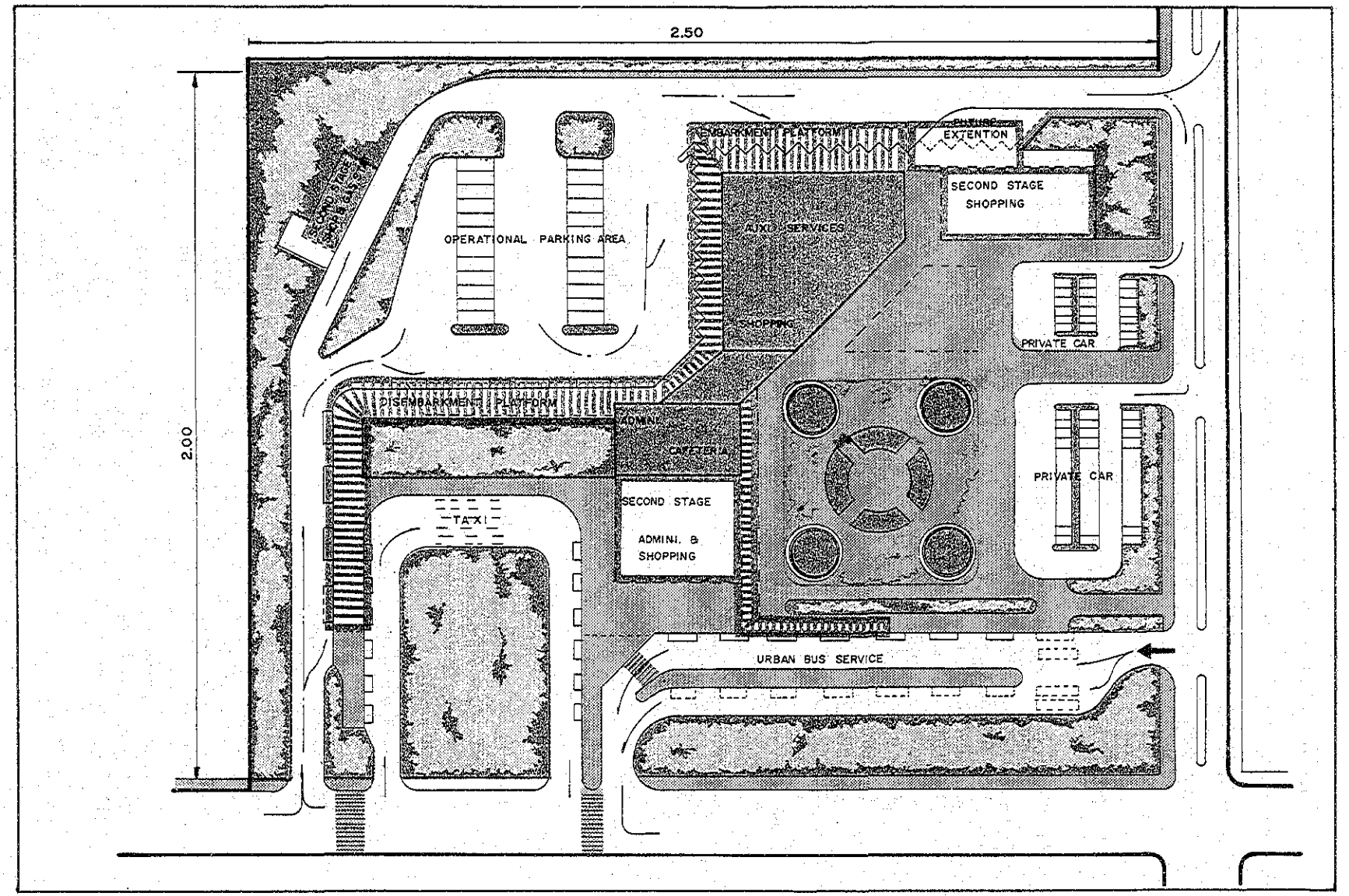


Fig. 12–5–5 Interdepartmental Bus Terminal

Estimation of the architectural cost is by the usual simplified method. On the other hand, the civil engineering cost has been estimated in the same way as the gran parada construction cost. The resulting construction cost for Interdepartmental Bus Terminal is shown in Table 12–5–4 and Table 12–5–5.

Table 12–5–4 Construction Cost of Interdepartmental Terminal (1st Stage)

(thousand pesos)

Item	F.P.	L.P.	Amount
1) Site preparation	0	0	0
2) Road and parking	20,708	12,737	33,444
3) Platform and sidewalk	4,987	2,657	7,645
4) Pedestrian bridge	0	0	0
5) Utilities	6,733	6,302	13,035
6) Planting	2,062	12,284	14,346
7) Buildings	18,761	43,776	62,537
8) Building service	5,617	4,277	9,894
9) Others	6,288	6,087	12,375
Subtotal	65,156	88,120	153,276
10) Overhead (15%)	9,773	13,218	22,991
11) Contingency (10%)	7,493	10,134	17,628
12) Engineering (12%)	9,891	13,377	23,267
Total	92,314	124,848	217,162

Table 12–5–5 Construction Cost of Interdepartmental Terminal (2nd Stage)

(thousand pesos)

Item	F.P.	L.P.	Amount
1) Site preparation	0	0	0
2) Road and parking	5	1	7
3) Platform and sidewalk	441	235	676
4) Pedestrian bridge	0	0	0
5) Utilities	0	0	0
6) Planting	103	1,045	1,148
7) Buildings	13,700	31,966	45,665
8) Building service	8,552	6,512	1,506
Subtotal	22,802	39,759	62,561
9) Overhead (10%)	3,420	5,964	9,384
10) Contingency (10%)	2,622	4,572	7,194
11) Engineering (12%)	3,461	6,035	9,497
Total	32,305	56,331	88,636

12–5–2 Intermunicipal Bus Terminal

1) Existing Condition and Future Aspects

Intermunicipal bus companies do not have special terminal facilities in Barranquilla. The open space in front of the Qguila beer factory and Calle 38 near the Central market is currently used as a makeshift terminal (See Fig. 12–5–6).

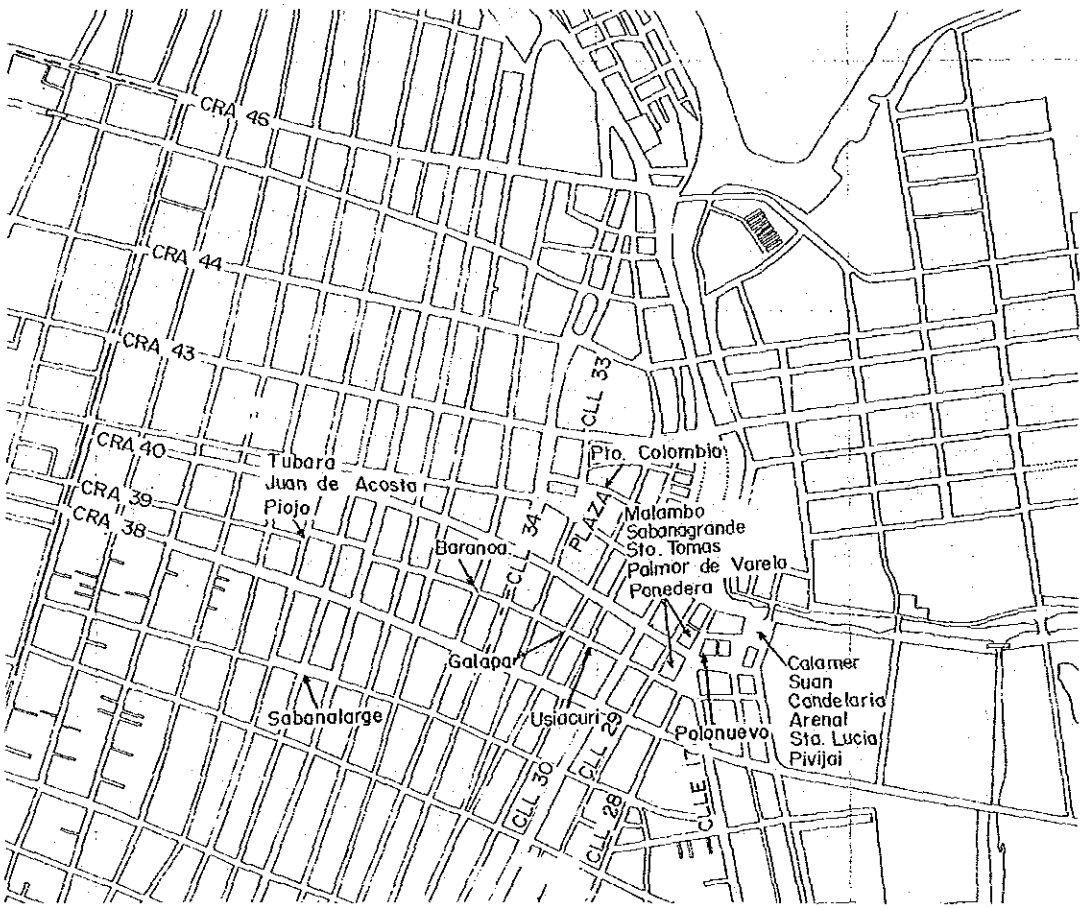


Fig. 12–5–6 Distribution of Intermunicipal Bus Companies

There are 9 intermunicipal bus companies in Barranquilla operating 31 routes and providing 600 services per day.

The characteristics of intermunicipal bus passengers are similar to those of urban bus passengers, so that the intermunicipal bus terminal should be located near Centro.

When selecting the site of the terminal, it is necessary to ensure coordination with the central district renewal project. The area of land required for the terminal is estimated to be about 2.5 hectares based on a prediction of the number of intermunicipal bus passengers. Barran-

quillita is the only area to have such a large open space. The area bordered by Calle 4 and Calle 6, which includes large public land and which is moreover mostly vacant, is selected as the site for the terminal. This site has a gran parada in front and the Riverside Bypass behind it; these facilities will facilitate access for bus passengers and buses.

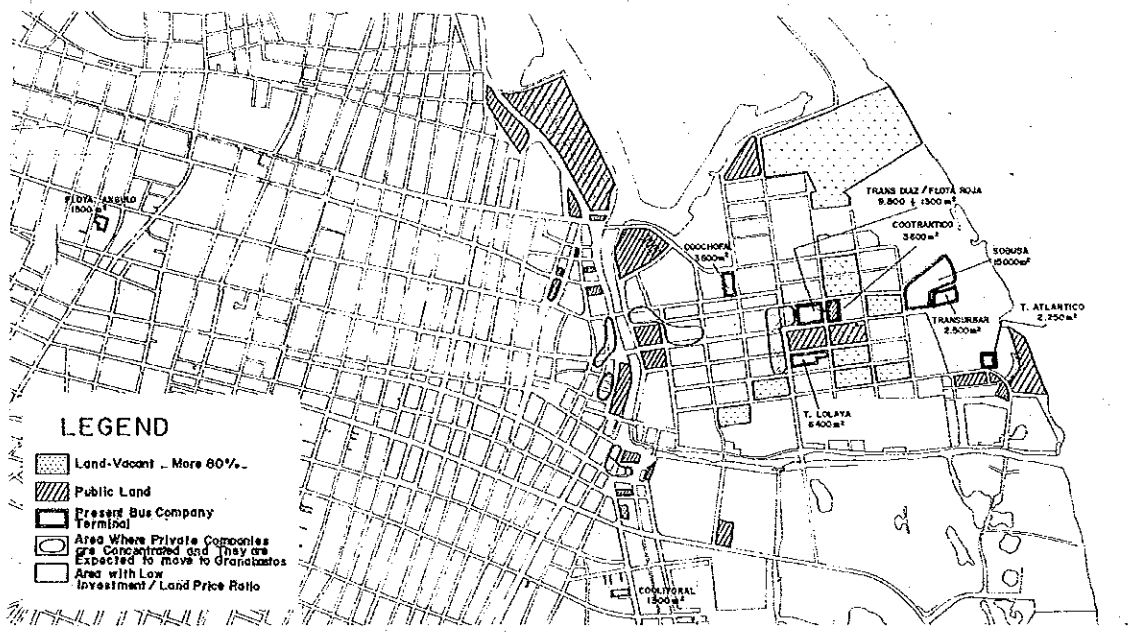


Fig. 12–5–7 Site Condition of Intermunicipal Bus Terminal

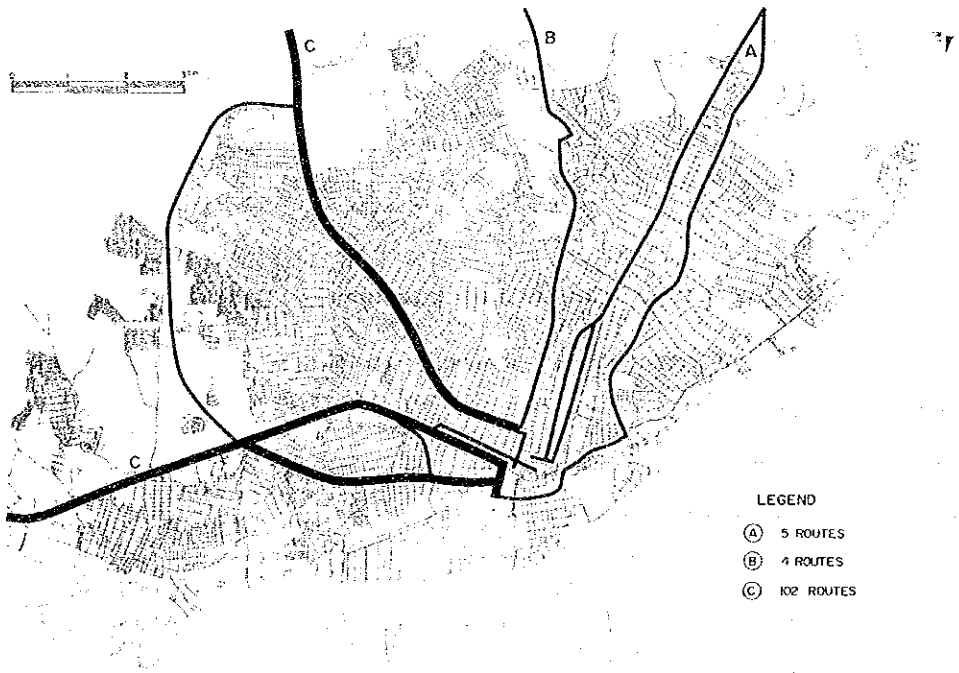


Fig. 12–5–8 Intermunicipal Bus Routes in Barranquilla