

CHAPTER 6

RECOMMENDED PROCEDURE FOR THE DEVELOPMENT
OF PUBLICO CAR TERMINALS IN PUERTO RICO

A. INTRODUCTION

As previously indicated in Chapter 1, Puerto Rico's publico-car service is a unique paratransit system whose problems and solutions can not necessarily be undertaken entirely utilizing established public transit planning and operations management procedures. The need to provide exclusive offstreet publico-car terminal facilities for many of Puerto Rico's cities and towns is apparent in light of the existing traffic congestion and parking problems.

During the past few years, publico-car terminal construction in Puerto Rico has become what can be termed a "hot item", a high-visibility project that tends to be in fashion with the local government officials and politicians. The general positive side is that these terminals are able to provide a local solution for local traffic, transit service, and inner city development. The UMTA programs that help develop and fund these projects have provided the much needed funding source to many money-tight communities.

On the negative side, the improper concept of building a publico-car terminal for the sake of it and not because of the actual need (almost all of the municipalities need a terminal facility) can result in a poorly located and/or unutilized (or under-utilized) facility, a waste of much needed funds, and, in many case, a setback in public transit service in some localities.

B. GENERAL PROCESS

Before considering the development of a centralized publico-car terminal facility or multiple, integrated terminal facilities, a **Feasibility Study for Terminal Need and Location** should definitely be conducted. This study should be conducted prior to choosing the terminal site (or sites) or alternate improvement action and prior to the initiation of the solicitation of federal/local funds for implementation.

Prior to the Feasibility Study, the local entity should have the proposed study included in the State Unified Work Program with the subsequent terminal included in the State Transportation Improvement Program. For the major metropolitan and/or urbanized areas, this is usually done under UMTA Sections 5 & 9, Technical assistance Programs. For terminal projects under UMTA Section 18, Transit Assistance Program for Non-urbanized Areas, a request must be submitted for a Feasibility Study for Terminal Need and Location, based on the availability of funds from the Rural Transit Assistance Program (RTAP).

Basically, the Feasibility Study Process should cover, as a minimum, the following aspects:

- (1) Identification and quantification of the transportation problems within the city or town, including, as a minimum, the type and number of public transit vehicles serving the area, vehicle and passenger volumes, traffic volumes, critical corridors and intersections, and the parking characteristics,
- (2) The determination of the needed terminal capacity, based upon the actual number of publico-cars and their operations within the city/town, especially their parking accumulation characteristics,
- (3) The evaluation of potential terminal sites or alternate actions optimizing existing terminal use,
- (4) The assignment of the publico-car routes (and local buses, if available) to the terminal,
- (5) The determination of traffic and parking impacts and the required changes to traffic patterns and parking controls and regulations,
- (6) The conceptual design for the terminal facility including vehicle and passenger movements within and around the facility,
- (7) Justify direct and reasonable costs related to the terminal,
- (8) Potential impacts on businesses, parking and traffic congestion, historical sites and districts and environmentally sensitive sectors (the latter should be coordinated with the State Historic Preservation Officer [SHPO] as per Executive Order 12372 and other pertinent regulations),
- (9) Citizen and private sector participation including publico-car operators, public transit users, local businessmen, residents, etc.,
- (10) The project and land use consultation process through the Planning Board and Permits and Regulations Administration,
- (11) Land acquisition and/or family and/or business relocation.

Following the preparation of the Feasibility Study, the results and potential sites should be presented at Public Hearings. The comments and results of the hearings should be incorporated in the final selection process.

Once having made the terminal site selection and assured the local funding source, the application for UMTA funding can be made via the Department of Transportation and Public Works. This application would include the Feasibility Study and all of the necessary documentations, and cost and time estimates.

Upon approval of the project and funds, the design and construction of the terminal would be undertaken. It is highly recommended that any necessary changes to the existing transportation system related to the terminal (or terminal system), such as changes to traffic patterns and parking regulations, should be planned as soon as the project is in the design phase. This would permit approval of any necessary changes to local city/town ordinances before the end of the construction. In addition, it would be necessary to establish the proper coordination between the various government agencies involved in the project.

The municipal ordinance should include, as a minimum,

- (1) The publico-car routes that are to be assigned to the terminal and the streets to be used to and from the terminal,
- (2) Designation of areas where publico-car passenger discharge and boarding are and are not allowed along the city/town streets,
- (3) Traffic controls such as street directional flows, stops, signals, etc.,
- (4) Parking controls, especially for those areas from which the publico-cars are being relocated,
- (5) Fines/penalties for violations of publico-car restricted areas (for both private motorists and publico-car operators),

Ample publicity is necessary before the inauguration of the terminal facility. Television, radio, and newspapers should be utilized to the fullest to properly disseminate the information. Particular attention should be given to changes to the circulation patterns or parking regulations.

The involvement of the publico-car operators throughout the entire process (Feasibility Study, design and implementation) is absolutely recommended. It should be remembered that these operators are (1) the ones who will have to use the facility (and reap its benefits or suffer its shortcomings), (2) the persons most familiar with the general transit service in the area, and (3) those who intimately know about their route operations and vehicle characteristics.

A recent example of poor municipal/publico-car operator coordination in the design and implementation of a terminal is the Río Piedras East Terminal. It is also a good case of planning and design inconsistency. In this case, the initial coordination during the planning stage was carried out in a highly successful manner. However, after selecting a architectural design firm for the final implementation, communications broke down. The design firm prepared the plans for a terminal which was distinct from that which was presented throughout the entire planning/presentation phase. The differences not only included internal circulation and the boarding area layout (which were enhancements) but to the access configuration and some design aspects detrimental to publico-car operations (i.e., low headroom affecting operations of larger bus-vans, lack of sufficient drop-off area, etc.) . When the publico-car operators realized that the final constructed terminal was not as previously presented and that the new terminal design and access/circulation was never presented to them, they threatened to boycott the terminal until several changes were made. The municipal government had then to provide the necessary changes to the terminal to the satisfaction of the operators.

In the case of Caguas, the publico-car operators were involved throughout the entire process (including the internal distribution of the terminal berths) and had various recommendations included in the terminal designs. In Bayamón and Mayaguez the operators were involved but to a lesser degree (mainly the planning phase).

C. FEASIBILITY STUDY FOR TERMINAL NEED AND LOCATION

This section presents a more detailed description of the recommended Feasibility Study process. The items presented herein are deemed essential in determining the existing public transit service and traffic conditions in the designated study area. The following is an outline of the process:

- (1) Inventory description of current public transit service.
- (2) Identification of local transit and traffic problems.
- (3) Establishment or identification of local transportation related goals.

- (4) Inventory and evaluation of potential sites.
- (5) Recommended site selection.

1. Inventory of Existing Public Transit Service

This process involves the inventory of the existing publico-car and bus and taxi transit (if applicable) service in the particular study area. The subtasks include:

- a. **Inventory of Routes** by type of service, number of vehicles, type of vehicles, route length, service area, fare structure, and terminal location and capacity (number of reserved spaces). Some of this information is obtainable from the Public Service Commission. However, it is highly recommended that the PSC data be complemented with information provided directly from the operators themselves.
- b. **Passenger and Vehicle Volumes** - In order to assess the existing publico-car service, it is necessary to obtain information concerning daily vehicle and passenger volumes. This requires a field survey which would include the establishment of a cordon around the town's central business district and the recording of each public transit vehicle and its occupancy at each access site along the cordon. A count period of at least 12 continuous hours (normally from 6 AM to 6 PM) is recommended. This will yield a generally accurate count of the vehicles and passengers, by route, entering and exiting the CBD. The data would be used to determine route frequencies, occupancy, volumes, general travel and terminal times, and route vehicle accumulation within the CBD. It is not recommended that the vehicle and passenger volumes be obtained by just multiplying the number of vehicles by the number of trips indicated by the operators or the number of trips by the average seating capacity of the route to obtain passenger volumes. This will tend to produce significantly different numbers as actually exist.
- c. **Vehicle Accumulation** - This data can be obtained from the field survey previously described and would be used to determine the actual terminal capacity needs.

- d. **Traffic Counts and Related Data** - Data concerning traffic and parking within the study area should be recorded. It is recommended that traffic counts be made at several major intersections, especially those near the potential terminal sites. This field survey, coupled with other traffic data from other sources (DTPW, PR Highway Authority, municipal, etc.) can be used to measure the possible impacts. In addition, classification counts can be used to determine the percentage of publico-car traffic along the major streets. Parking data can be limited to parking space inventory, although a general parking survey of the area would be more desirable.

2. Identification and Quantification of the Transportation Problems

This phase can be easily derived, in part, from the information obtained in the preceding phase. The types of problems that can be and generally are stated include, among others,

- . Traffic congestion, caused in part by the curbside publico-car terminals
- . Lack of adequate parking
- . Inadequate and/or uncoordinated public transit service
- . Poor accessibility
- . Uncomfortable and unsafe terminal facilities (exposed to the natural elements)
- . Congestion of sidewalks

It is very simple to state these problems but it is another thing to identify and quantify them. For example, traffic congestion is the principal problem cited in all of the feasibility studies or the project justifications. However, it is necessary to quantify this congestion through the analyses of the intersections and street segments showing the proportion of public transit vehicles in the traffic stream. Sometimes traffic congestion can be caused by situations in which public transit vehicles are not involved. Examples of this can be the lack of signalized intersections, uncontrolled parking violations, cargo zones, local accesses, high pedestrian volumes at certain crossings, etc.

The goals and objectives for implementing a terminal should be assessed and not only just stated. For example the stated goals may include the improvement of public transportation in the municipality and city, for the benefit of users and operators and as part of the city's development strategy. The objectives, on the other hand, would include, among others, direct benefits to the users (accessibility, convenience of use, ease of transfers, safety, rapid service), to the operators (increased ridership, decreased operating and maintenance costs, increased revenues) and benefits to the city as a whole (reduction in traffic congestion, parking availability, reduced dependence upon private auto use, increase of persons to the CBD's commercial area, etc.).

Another aspect that should be considered in this phase is how all of the transportation problems can be integrated and, hopefully, resolved within the context of the CBD's development. The implementation of a publico-car terminal should not be a single item that will be expected to resolve, by itself, the city's or town's traffic and transit service problems. The terminal (or terminals) should compose part of an overall traffic and public transit improvement plan. This type of plan should consider all of the basic elements, such as urban and transportation development goals and specific objectives, roadway improvements, traffic and parking controls, land use controls, among others.

3. Determination of the Needed Terminal Capacity

This factor is one of the most critical within the planning and design phases. The design of the terminal must be oriented toward a realistic number of needed spaces. The number of required spaces will significantly influence the size and cost of the facility.

There are two basic methodologies that can be applied to determine the capacity requirements. The first is the use of the cordon data as previously presented to determine the number of vehicles per route accumulated within the CBD. This method tends to provide a very slightly higher number of vehicles supposedly at the curbside terminals. However, it does provide a very reliable estimate of the number of vehicles that would be within the terminal environment.

The second method would be to post an observer at each curbside terminal (or small group of adjacent terminals) to record the actual number of vehicles within the immediate area. While the apparent advantage to this method would be a more exact number of vehicles at the existing terminal, the disadvantages are (1) it is much more time consuming, (2) much more expensive considering the higher number of man-hours that would have to be assigned, and (3) it does not readily take into account those vehicles that are parked elsewhere other than their terminal due to the high concentration of both private and public transit vehicles at and near the terminals.

The possibility of subestimating the capacity needs would thus tend to be much higher than the first method.

It is important to note that the capacity determined by either of the methods should be considered as a minimum. This is based on the perception that the counts may represent a lower activity than in reality.

4. Terminal Location, Site and Planning Evaluation Parameters

This section presents a series of evaluation parameters which should be made an integral part of the terminal feasibility study. Many of these parameters have been derived from previous terminal studies.

a. Site Location

Inner city merchants are generally in favor of terminals located as close as possible to their businesses since the terminals attract numerous persons; persons who are considered potential customers. The siting of a terminal at a site uncomfortably distant, in terms of pedestrian accessibility, from the established commercial areas, generally would be expected to have a significantly adverse impact on business in the area. This factor is supported, in part, by the results of the business survey conducted as part of this study in the three cities. It was found that those businessmen who most complained about the location of the terminals tended to be the ones furthest from the terminals.

From the user's point of view, the terminal should be located in an area where the majority of the users are close to their destinations or transfer points. Siting the terminal at a point uncomfortably distant from the traditional sites (curbside) can result in a general displeasure from the transit users and a lack of cooperation from the operators.

b. Lot Configuration, Size and Topography

Three important physical parameters in the evaluation of terminal sites are the configuration, size, and topographic aspects of the lot(s). Terminal design can vary from a simple asphalt covered lot with little or no amenities to an elaborate multimodal, multi-storied terminal complex with an abundance of amenities.

The size, configuration and topography of the lot(s), to a significant degree, will tend to determine the size of the terminal and other design factors such as how many spaces can be allocated for passenger boarding operations, how many levels of vehicle holding areas must be provided, pedestrian and vehicular access, internal pedestrian and vehicular circulation, and the structural and aesthetic limitations.

One might easily assume that the number of spaces required as capacity (as determined from the previous phases) should determine the lot size. However, the most critical determining factor is the passenger boarding area requirement. This factor is covered in a later section.

With respect to the size of a terminal facility, the number of levels for holding areas and passenger service will depend primarily upon the actual needs and demand as determined by the feasibility analysis and, in addition, upon the physical limitations of the terminal site.

c. Allocation of Routes

In considering the relocation of the terminals, consideration must be made of the existing number and types of publico-car vehicles and the routes or general areas they serve. When evaluating possible terminal locations, it is necessary to consider the publico-car corridor(s) that the terminal(s) will service. In addition, consideration must be taken into account of the idiosyncracies of the operators themselves. One important aspect is that practically all of the operators within each service corridor operate along common roadways; common in the sense that all of the routes along one segment or another compete directly. Along these roadways, all passengers are considered to be available for all the routes. These operator characteristics are evident in the existing curbside terminal patterns in almost all of Puerto Rico's major towns and cities in which routes serving similar areas tend to keep as close as possible to other routes serving some of the same areas in order to minimize an uneven (and for many, an unprofitable) distribution or competition for passengers.

There are two basic options for the distribution or allocation of routes to a terminal or terminals. The first of these options is the concentration of all the routes within one terminal. The second option would be the distribution of the routes amongst two or more terminals located in areas corresponding to the publico route coverage areas. The first option can be readily applied to small and medium sized towns. The second option, however, is usually more appropriate to the large towns and cities.

The distribution amongst two or more terminals facilitates the reduction of traffic volumes within the innermost sectors of the CBD and concentrates the routes in a more efficient manner according to the corridors served.

The disadvantage of this latter system is that it does not facilitate easy transfers from one corridor to another. In addition, the implementation and operational costs for two or more smaller and separate terminals tend to be much higher than that for a single terminal. One method to overcome the problem of integration of service amongst two or more terminals is the establishment of a shuttle bus system. This type of system, which is currently

being planned for Caguas and Mayaguez, would provide connecting service between the terminals and the main central commercial area, as well as other peripheral service. The shuttle bus services would be designed in order not to conflict with existing publico-car (or bus) routes.

The three study cities (Bayamón, Caguas and Mayaguez) have a route allocation based upon the second option. In Bayamón's case, it was originally proposed that all of the city's routes would be transferred, eventually, to the Kuilan Terminal. However, due to the service pattern present at that time, it was decided to relocate only those routes, located along Calle Parque (PR-167), the Market Plaza, the Town Plaza and Dr. Veve Street (and adjacent local streets). The routes serving the north, northwestern, and southeastern corridor remained at their terminals for future relocation. Subsequently, the southeastern routes (with terminals located along Barbosa Street) were relocated to the new Guardarrama Terminal.

In Caguas, the allocation of the routes was based upon a preplanned three terminal system, each with routes serving a specific corridor. The main CTC would handle all of the routes parked around the Town Plaza while the South Terminal would serve several of the rural routes serving the southern area of the Municipality of Caguas and the West Terminal serving several routes operating along the Agua Buenas Corridor.

At Mayaguez the difference between the planned and final allocation was significant. The original concept was to relocate the majority of the routes located at terminals around the Town Plaza and points north and east to the main terminal. The other routes, including those of the Market Plaza, would be eventually transferred to smaller terminals in the southern (Market Plaza) and northeastern (Balboa) sectors of the CBD. The actual implementation was the relocation to the MTC of the interurban routes at and near the Town Plaza but not the other intraurban and rural routes. This action has resulted, in part, to the significant underutilization of the MTC.

5. City Planning and Operational Parameters

When considering relocating publico-cars to a central terminal facility or series of mutually supporting facilities, there are several major impact parameters that deal with the city's (or CBD) planning and operational factors such as:

- a) The possible impact upon existing land use
- b) The impact upon CBD planning
- c) Pedestrian (user) accessibility
- d) Vehicular accessibility, and
- e) The impact on CBD traffic.

a. Impact Upon Existing Land Use

The construction of a major terminal facility can change the character of a neighborhood. It is important to assess the probable impact of the facility upon the affected areas to determine the facility's compatibility with the existing land use. The experience in towns and cities where publico terminals have been constructed has been one where the land uses around the terminal tend to be developed for commercial use.

In Bayamón both terminals were constructed on public property with adjacent established public and commercial land uses. The Kuilan Terminal has had a beneficial impact upon the Río Hondo Mall, although according to several local businessmen, the commercial activity in the northeastern and eastern sectors of the CBD has been adversely affected by the relocation of the curbside terminals to both the Kuilan and Guardarrama Terminals.

The Caguas Transportation Terminal has helped to revitalize the section of Acosta Street between Ruiz Belvis Street and Route PR-189. The CTC, in combination with large, high trip generating public facilities such as the government center, judicial center, market plaza, other private institutions and new business generally oriented towards the publico users, have helped reconstruct what used to be an almost entirely abandoned sector. The municipal government has contributed by the restoration of several nearby buildings including ones housing a cultural center and a theatre.

The Mayaguez Transportation Terminal, on the other hand, has not stimulated a significant amount of commercial activity in the surrounding area, which remains predominantly residential. To stress the point even further, the MTC has not even been able to support any commercial establishment (i.e., a cafeteria) within its service area.

b. Impact on CBD Planning

The evaluation of alternate terminal sites must seriously consider the terminal's (or terminals') integration within the scope of the future development of the CBD. A properly integrated terminal system can significantly help to enhance the CBD's commercial generating powers and improve traffic and pedestrian flows, among other factors. The terminal would also help promote more established businesses to the CBD.

c. Passenger Accessibility

As mentioned in one of the previous sections, terminals are sensitive to location. Generally, the majority of the publico-car users are more or less satisfied with the service provided. One of the reasons and a major positive factor for this is that curbside terminals are readily accessible; they are

literally at the door steps of the town's principal commercial establishments and governmental institutions. The evaluation process for alternate terminal site selection must consider the factor of walking distance to and from the major activity centers in relation with existing sidewalk conditions, since, instead of being dispersed along various streets, pedestrian/publico-user flow will tend to be concentrated along specific pedestrian corridors and for possibly longer distances.

The provision of efficient pedestrian accessibility, possible physical improvements such as pedestrian malls, sidewalk widenings, and shuttle bus systems should be included in the evaluation process.

d. Route Transfer Patterns

In order to analyze the transfer situation in relation to the alternate terminal site evaluation, it is necessary to determine where and how these transfers are realized. In general, the main areas for route transfers are found at the Town Plaza, Market Plaza, or any streets where there is a large concentration of publico-car terminals. In conclusion, the evaluation of alternate terminal sites must include consideration of the present passenger transfer patterns and resulting situation such as traffic congestion. Distances between routes and terminals should be kept at least acceptably comparable to the existing conditions.

e. Vehicle Accessibility

The terminal site must be readily accessible to the public transit vehicles. With the establishment of a terminal, it may be possible that many of the existing streets which currently experience considerable publico-car volumes will not be used by the publico-cars. The streets leading to and from the terminal should provide adequate capacity to handle a much more concentrated load of traffic. Thus, the site should have adequate street access capacity and controls in order to minimize congestion. A good evaluation method is the use of street capacity analysis techniques to compare before and after traffic volumes and the impact caused by additional accesses.

The primary related aspect of terminal location planning which should be considered here is the impact on public transit service. The terminal site should occupy an area which is close enough to the activity centers but in an area so as to minimize traffic congestion and to help improve publico-car service. Publico-car service tends to be hampered by the congestion usually encountered on the principal approaches to the existing curbside terminals. Thus, with these vehicles tied up, the levels of service of the routes are adversely affected. Passengers outside of the study area often have to wait long periods of time for vehicles along their routes. If the terminal is located on a site where access is good, congestion is reduced and route operations improved,

then it can be expected that the route frequencies of service will be positively impacted through the reduction of headway times.

f. Impact on Internal CBD Traffic and Parking Conditions

In evaluating any potential terminal site, it is necessary to assess the impact upon the surrounding streets and the general street system in terms of increased or decreased volumes. The evaluation should also stress possible changes and/or physical aspects of the street system in order to provide adequate accessibility and improved traffic flow. One aspect that should be considered in evaluating the changes in traffic volumes is whether the subsequent increase in traffic is due to diverted traffic (traffic that used to utilize other routes prior to the relocation of the public-cars) or to new generated traffic due to the access improvements or to other CBD developments.

6. Environmental Parameters

a. Land Requirements

The land required for a terminal facility should be limited to that which is absolutely necessary for the proper design and operations. Land within central urban areas in Puerto Rico tend to be prime resources with only a very limited amount of unused, abandoned, or vacant tracts remaining.

Ideally, the planning agency should strive to utilize unused or underutilized land for a terminal facility. Efforts should be made to possibly maximize the use of smaller tracts or improve the existing curbside terminal system. However, if the necessity of a terminal facility is overwhelming, serious consideration must be given to the possible acquisition of the needed land along with the acquisition of commercial, residential or other use properties.

In the cases of Bayamón, Caguas and Mayaguez, large tracts of public lands were used. In all three cases, availability of those lands was definitely fortuitous. However, this situation was the exception and not the rule.

In several other cases such as in Ponce, Río Piedras, Trujillo Alto and many others, the municipal planners had unsuccessfully sought adequate land that would not have had to involve very expensive land acquisition and which would have had minimized business and residential acquisitions and relocation. However, the larger and often vacant land locations tended to be outside of the main public-car terminal areas. The relocation of the terminals to an area significantly distant from the existing terminals would have adversely impacted service and jeopardized cooperation between the municipal government and the operators.

Experience has shown that the location of a terminal on a large tract of land in order to limit costs and other acquisitions but significantly distant from the traditional central area has resulted in the complete disutilization of the facility.

The Mayaguez Terminal was located on a large tract of urban land that was used by the municipal Public Works Department. Although, the site is very large, its location has seriously hampered its optimal use. Very few of the publico-car routes have relocated to the terminal (none of the local urban/rural routes have relocated).

In a large urban area such as Mayaguez (and Caguas and Bayamón, as well), this situation could be remedied by providing supporting services such as a shuttle bus system.

Other land related considerations that must be made during the evaluation process include the minimization of the adverse impacts such as residence and/or business displacements and land use incompatibility. The possible (and highly undesirable) location within a designated floodprone area should be avoided. Trade-offs between various impacts should not be discarded.

b. Other Impacts

In Puerto Rico, virtually all types of construction of major public facilities, especially those involving local and federal funds, require the preparation of an environmental impact analysis process. This process, for which procedures are documented by the Urban Mass Transportation Administration and the Puerto Rico Environmental Quality Board, involves the evaluation of the ecological and community impacts including the possible positive or adverse impacts on air, water, and noise, the restriction or elimination of special social service, the use of or impact upon natural resources, and impacts upon community cohesion, schools, churches, etc. Another important factor that must be considered is the possible historical aspect of the site. Many of the CBD sites can include either historically significant structures or archaeological material. In order to avoid or mitigate any adverse impact upon the site, coordination with the State Historic Preservation Officer should be established early in the location analyses.

7. Terminal System Integration

One of the most important factors to be considered when evaluating alternative public transit terminal locations or other transit related actions is the optimal integration of all the transit modes serving the study area in a manner which improves the overall transit system without a detrimental impact upon any particular mode, transit route, or the general public. The

integration of modes includes not only the provision of terminal facilities, but also the route operations within an area.

This aspect is of particular importance in the larger urban areas where the more expansive CBD's tend to separate the publico-car routes and their terminals to serve specific corridors. As previously mentioned, there is a need to clearly identify transfer in order to determine the location and the routes to serve the terminal. As in the situations found in Bayamón, Caguas and Mayaguez, the existing and proposed terminals in each city have been developed as a planned terminal system of two to three terminals, each serving a particular number of publicos, routes, sectors and corridors. In the case of Caguas and Mayaguez, plans for municipally owned and operated shuttle bus systems are being developed to complement the terminal systems in those two cities.

Besides a shuttle bus system, another possible method to facilitate transfers is to permit publico-cars assigned to one terminal to take passengers to another terminal during peak rush hours (or any given period). This system is currently extensively employed in Caguas, particularly by the publico-cars serving the Aguas Buenas (PR-156) corridor (Aguas Buenas, Valle Tolima, Cañaboncito, and Hormiga). During their early morning runs, the majority of the operators of these routes travel to the CTC to unload transferring passengers. This characteristic is also noted, although to a more limited degree, in the operations of the southern rural routes (San Salvador, Borinquen, Guavate and Beatriz).

Because of the relatively short distances between the three main publico-car terminal groups (Kuilan and Guardarrama Terminals and the area adjacent to the MBA terminal), the type of operation as described for Caguas occurs more infrequently in Bayamón. The Guardarrama Terminal tends to receive more transferring passengers from publico-car routes that operate along the PR-2 East Corridor in addition to the Metropolitan Bus Authority, and are stationed at the Kuilan Terminal (especially the Centro Médico, Río Piedras, and Santurce routes).

The Mayaguez Terminal has a much lower incidence of this type of operation. Very few of the local urban and rural routes (except for some of the "Urbano" Route vehicles) tend to go out of their way to take transferring passengers. This is due, in part, to the location of the Terminal and the traffic congestion prevalent along the approach streets.

Service integration with other modes of public transit (buses and taxis) is an essential planning criteria for any major city terminal. This integration may include the provision of bus and taxi terminal facilities within the design of the main terminal or the provision of stops at or near the main pedestrian accesses.

The Caguas Transportation Center includes a special bus terminal to serve all of the various local and intercity bus routes serving the Caguas Area. The buses are able to board and/or discharge their passengers directly within an extremely short walking distance from the publico-car area.

Local Caguas taxi services (three organizations) have been provided with several off-street areas adjacent to the CTC and, in some cases, with offices in the CTC. Several spaces with communications facilities have been assigned to the taxi organizations (through municipal ordinance) at the Town Plaza.

Bayamón is served by both private bus lines and the Metropolitan Bus Authority. The layout of the terminal system permits direct bus service to all three of Bayamón's terminal groups, thus maximizing transfer opportunities. Taxi services are provided along an exclusive taxi lane fronting the Kuilan Terminal along Parque Street.

Mayaguez does not have any bus services but the Terminal does include reserved spaces for two taxi organizations.

D. TERMINAL DESIGN PARAMETERS AND REQUIREMENTS

1. Introduction

The planning and design of public transit facilities involve architectural, structural, mechanical, electrical, and transit operations considerations. The planning and design of publico-car transportation terminal facilities in Puerto Rico is a relatively new field. Although the first terminal was inaugurated in Caguas in April 1980, followed by Bayamón in 1981 and Mayaguez in 1983, as well as, various others recently inaugurated, in planning or in design, no definite design guidelines had been presented up until the preparation of an alternate terminal study for Río Piedras ("Río Piedras Publico-Car Terminal Location Alternative Analysis", Final Report, Municipality of San Juan, Consultores Técnicos Asociados, April 1981).

This Study established several basic conceptual design guidelines based upon the typical transit vehicle, passenger and community characteristics, which could be applicable to practically any location and publico-car demands. These concepts deal with passenger access and circulation, publico-car vehicle berths and passenger loading platforms, vehicle holding areas, information systems, communications, security, and internal operations.

The terminal(s) should be considered to function as an integral element of the publico-car system. The main purpose of the terminal would be to serve as a centralized passenger pick up area. Terminal facilities should be used only by public transit vehicles.

It must be pointed out that many of the following parameters do not necessarily significantly influence the terminal site selection analysis. However, they do provide many elements which must be considered during the planning preliminary design phase and will influence the size, operations, and final costs of the terminal or terminals.

2. Passenger Access and Circulation

Passenger circulation requirements should be assessed prior to the site selection, facility design, and location of terminal facility components. Generally, terminal configurations are based on two primary objectives: (1) to provide efficient pedestrian and vehicular circulation, and (2) to provide adequate vehicular capacity. Guidelines for planning a publico-car terminal should include the provision of direct paths, provision for unobstructed walking areas, attainment of smooth and continuous traffic and pedestrian flows, and reduction of conflict-producing situations, such as combined passenger loading/unloading areas.

Access to the terminal itself should be made as convenient as possible and should not include elements which could disorient passengers or form barriers that would retard comfortable access or seriously impede access to the handicapped. A basic and more desirable terminal design would provide for street level access to the passenger loading areas, that is, the passengers would not have to climb stairs or ramps or use escalators or elevators to gain access to the loading areas. Only loading would be permitted at this level with each publico-car route assigned a specific number of spaces. The terminal could consist of a multi-storied structure with the passenger concourse at ground level and excess vehicle holding areas comprising the upper floors.

Internal circulation, particularly within the immediate loading areas, should be provided in such a way as to minimize pedestrian-vehicular conflicts to the greatest extent as possible. Access to the vehicles should be made as direct as possible and should not interfere with the loading or circulation of the individual vehicles.

3. Vehicle Access and Circulation

Vehicle access and circulation within a publico-car terminal are similar to passenger access and circulation. It should be designed in such a way as to minimize conflicts. For large terminals, inbound and outbound vehicle accesses should be separated and a counterclock-wise internal circulation established, ideally.

An important factor which should be seriously considered in terminal design is that of minimum vehicle clearances. The currently used publico-car vehicle types include the relatively large passenger vans with a capacity of up to 17 passengers (see Figure 6-1). The heights of these vehicles can vary up to almost 7 feet. Some of the determining factors for vehicle heights include tire sizes, suspension characteristics, internal headroom, and luggage racks, among others.

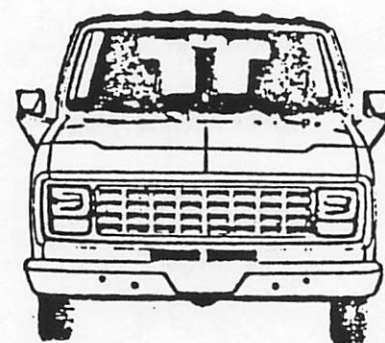
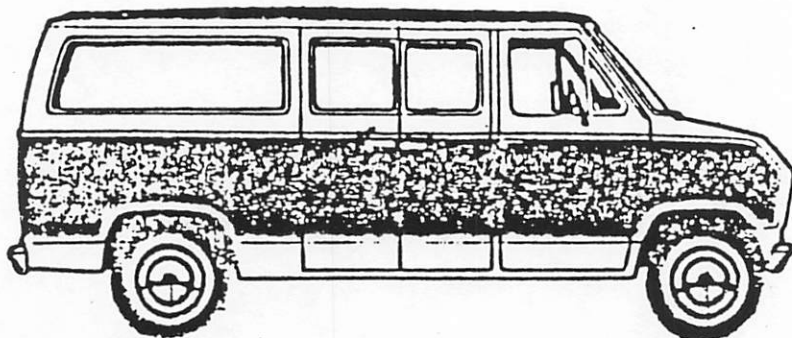
During the past couple of decades, the trend in vehicle type within the publico-car system, particularly within the local urban routes in the larger urban areas, has been towards larger and more efficient vehicles. Sedans have tended to give way to van-type conversions. Most recently, publico-car operators have been introduced to large van-bus conversions which have a much larger capacity (up to 21 passengers) and require large capital investment, high start up costs and large storage facilities. Given the history of publico-car vehicle-types, it could be assumed that these small buses can be considered to be the next generation of publico-car vehicle type. However, by 1988 there were approximately less than one hundred such vehicles in service as publico-cars in all of Puerto Rico. Due to its high costs (between \$25,000 and \$35,000) and higher operating costs, these small buses tend to be cost effective only in the high demand urban routes.

Figure 6-2 shows the typical dimensions of the two styles of small buses which have been recently introduced into several routes in Puerto Rico, especially in Caguas, Bayamón, and Mayaguez. As can be seen, the typical vehicle length is 17 feet 6½ inches, slightly longer than current van-types. The more critical factor or dimension is the vehicle height. The height of the larger bus (Transette) is 8 feet 11½ inches, almost two feet higher than the average passenger van. This height would require a minimum clearance of about 10 feet at critical elevations.

It is recommended that the minimum height clearance design criterion for publico-car terminals be determined by the maximum height (plus a reasonable safety clearance) of the largest publico-car in operations within the study Area (or the largest vehicle expected within the near future).

The Mayaguez and Caguas Terminals and Bayamón's Guardarrama Terminal have no problems in accommodating the larger vans since the terminal designs provide for very high clearances. The Bayamón Kuilan Terminal, however, has a very serious problem which limits the number and types of vehicles to circulate within the terminal.

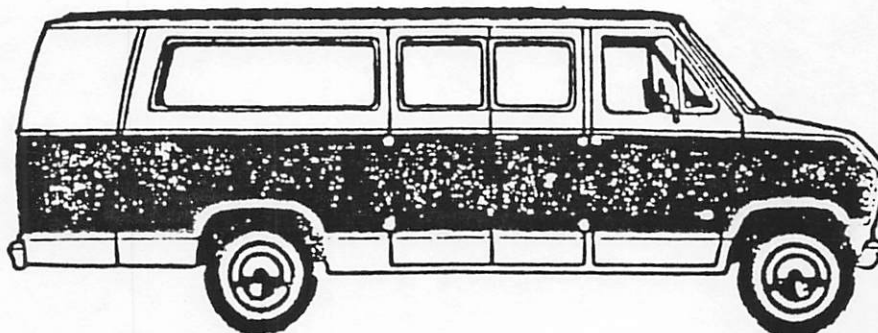
It has been observed that the overhead clearance of the circulation section under the Multi-Services Building does not permit the passage of the newer bus-vans currently in use throughout various urban routes in Puerto Rico. In fact, a few of the current passenger vans had to be modified by removing their luggage racks



TYPE A: 14-15 Passenger Van

Front View

Average Length = 17 Ft. 3 In.
Average height = 6 Ft. 11 In.
Average Width = 5 Ft. 8 In.



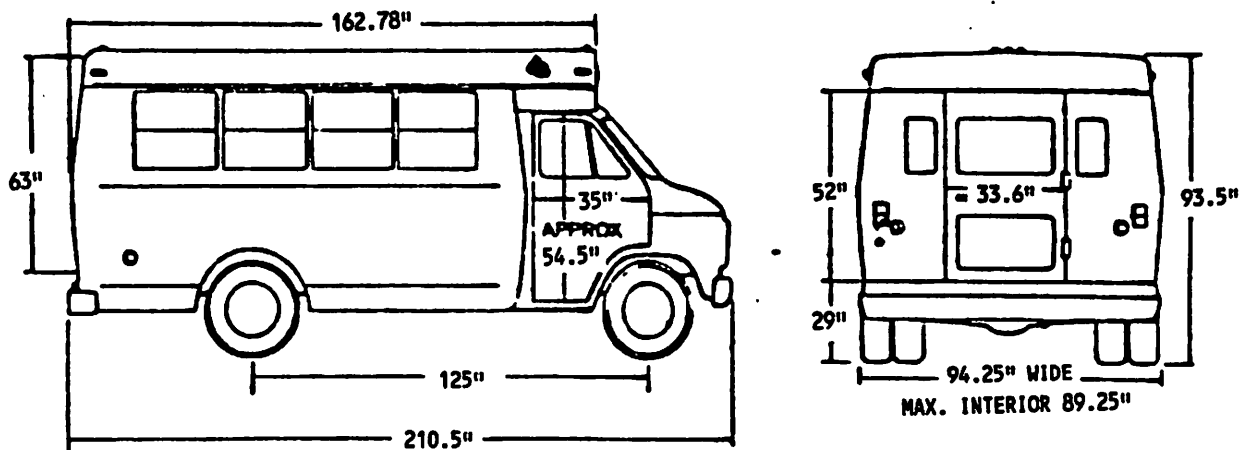
TYPE B: 17 Passenger Van

Average Length = 18 Ft. 11 In.
Average Height = 7 Ft.

FIGURE 6-1

TYPICAL PUBLICO PASSENGER VANS

Busette dimensions



Transette dimensions

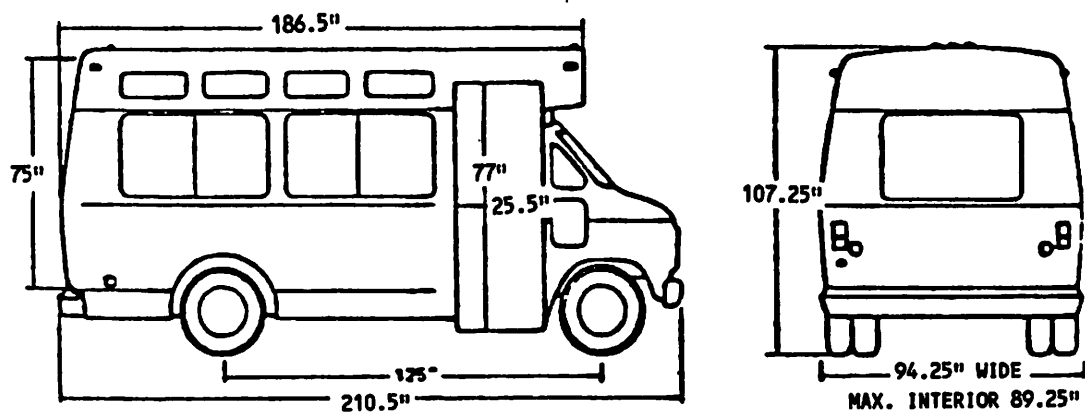


FIGURE 6-2

NEW PASSENGER BUS VANS

and changing the tire size in order to "fit" in the section. This situation is also found at the ramp junctions in the multi-storied holding area. Those operators with the newer, larger vans must accommodate their vehicles in the external area of the lower level (passenger concourse).

4. Loading Berths

a. Design

At the curb-side terminals, the publico-cars basically line up along the curb and open their doors towards the sidewalk. The passenger would then board directly off the sidewalk onto the vehicle. This scheme provides for an easy and rapid loading principle which should be considered in the terminal design.

Because of the relatively large areas and high costs associated with transportation terminals, space must be utilized at its optimum. With this in mind, the publico-car berths should be designed in such a way as to provide the maximum amount of berths possible (based on the needed number of loading spaces per route as determined from the field studies), direct loading ability, the optimum utilization of terminal space, and foremost, safety.

There are three basic terminal service area configurations. The first of these provides for parallel curb service like the on-street terminal system. The second type is the perpendicular (90°) configuration. The third configuration consists of angled berths (less than 90°) similar to major bus terminals.

When considering the typical publico-car system characteristics and the need to provide an efficient and compact terminal facility, the parallel system requires a large amount of space to provide for passenger berths and auxiliary lanes. Second, the parallel system requires various parallel berths. Passenger access to these berths requires crossing one or more vehicle paths, resulting in an unsafe environment. Third, the terminal(s) would be utilized by a large number of individual routes, each requiring a certain amount of curb space. The more open parallel system results in operator and route conflicts and would be difficult to control operationally.

The basic advantage of this system is that it provides a terminal operations similar to that found along the street. The Mayaguez Transportation Center employs the parallel berth layout (see Figure 6-3). This system is also more adaptable for terminals where the majority of the vehicles are sedans and/or "checkers".

The perpendicular and angled parking schemes, on the other hand, provide vehicle berths which are independent of the spaces. This way, as many berths as required may be assigned to each route providing a large area for direct passenger boarding and making it much easier to control in terms of route allocation and dispatch.

Perpendicular berths (90°) provide maximum berth accommodation providing individual loading platforms for each space and wider internal roadways. The Bayamón Kuilan Terminal employs the perpendicular berth configuration (See Figures 6-4 and 2-8).

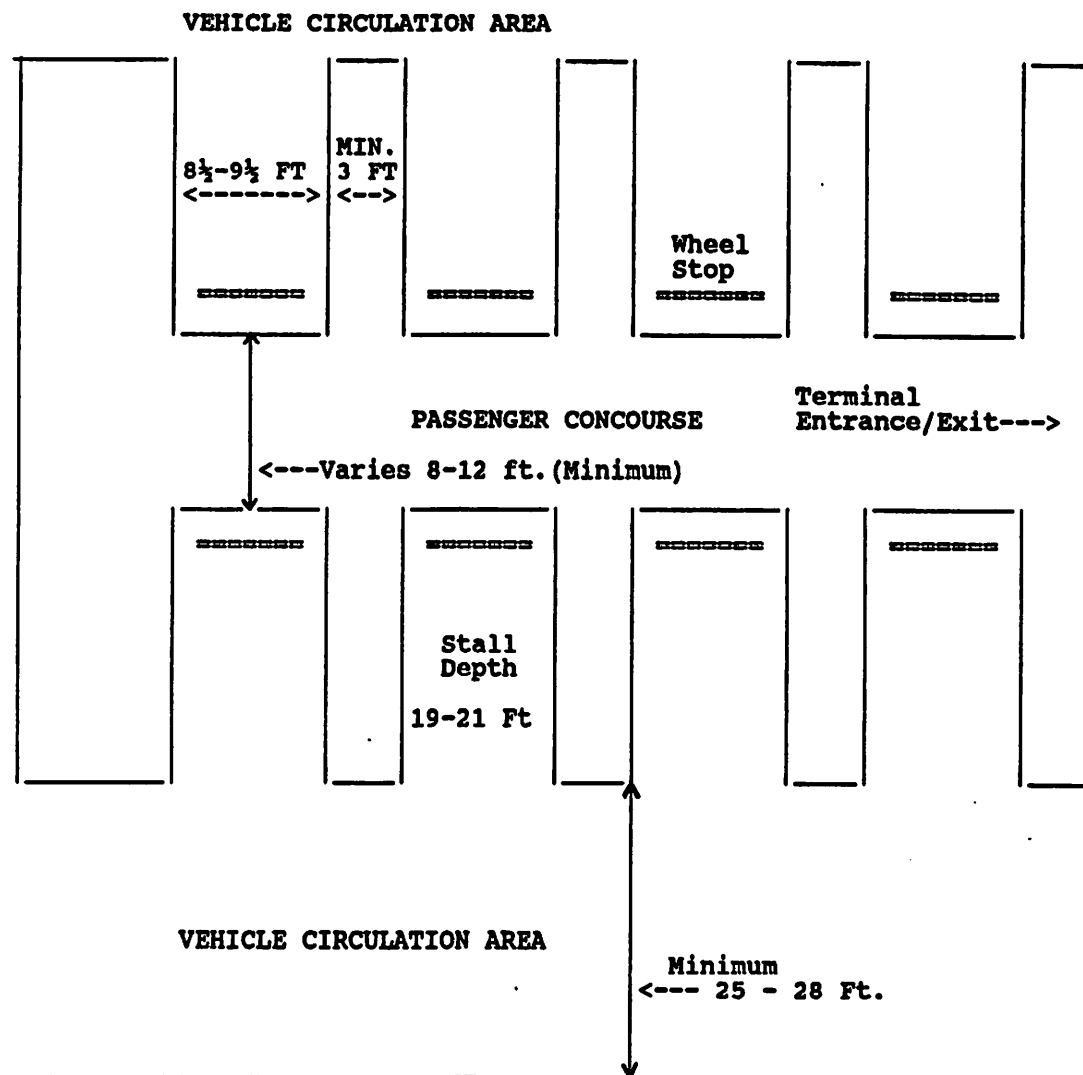
Berth angles between 60 and 45 degrees tend to provide the optimum space utilization particularly with respect to circulation and structural design (see Figure 6-5). The Caguas Transportation Center and the Bayamón Guardarrama Terminal both employ variations of the angled berth system.

Berth dimensions should consist of a minimum berth width of 8.5 ft. and a maximum of 10.0 ft. with the latter preferable to take into account larger and wider vehicles. Berth lengths can range from 20 ft. to 24 ft. in order to effectively accommodate the large publico-cars currently in service and those expected to enter service within the next few years.

An often overlooked aspect in the design of the passenger boarding area is the provision of the extension of the passenger concourse structure for the ease of passenger boarding. This extension can be completely integrated in the perpendicular and angled berths (as shown in Figures 6-4 and 6-5) or raised walkways can be constructed between each vehicle space when the loading berths are angled. The reasoning behind this is that at the existing curbside terminals, the boarding passengers have a 4 to 6 inch advantage in stepping up onto the vehicle. This is critical specifically for the passenger vans where the step height may be 6 inches or more. The raised loading area will permit a more faster, comfortable and safer boarding operations. It should be pointed out that the raised area will also result in a more continuous separation of the pedestrian movements from the vehicle circulation areas. Although sedan publico-cars have a lower step height than vans, a raised boarding area is still advantageous.

The passenger concourse area is a critical element for the proper functioning of any terminal. Because of the very large amount of persons utilizing the urban terminals, the passenger concourse areas should have a minimum width of 8 feet. In addition, ample access areas should be provided at the entrance of the terminal in order to provide efficient passenger distribution.

Drop-off areas can also be considered to be critical areas for design considerations. Publico-cars nearing or entering the terminal carry a large number of passengers whose destination is near the terminal or have to make a transfer at the terminal.



NOTE: Geometric design must accommodate the largest vehicle expected to use the facility; critical dimensions include length, width, height, front and rear overhang, roadway clearance, and minimum turning radii. Sources for this criteria include A Policy on Geometric Design of Highways and Streets, The American Association of State Highway and Transportation Officials, 1984; The Dimension of Parking: Second Edition, Urban Land Institute and National Parking Association, 1983; and Parking Dimensions, Motor Vehicles Manufacturers' Association.

Security Gates should be placed at all vehicular and pedestrian accesses of the terminal.

FIGURE 6-4

SCHEMATIC PERPENDICULAR BERTH CONFIGURATION

There are two basic manners to address drop-off or passenger discharge areas: (1) provide the drop-off area outside of the terminal and, (2) provide it within the terminal. The areas outside of the terminal can be the curb area fronting one or more of the terminal's pedestrian accesses. An ideal situation would be to provide interior drop-off areas for vehicles assigned to the terminal and external drop-off areas for all other routes including buses.

The Bayamón Kuilan Terminal has its passenger drop-off area in the interior sector. It is used primarily by the routes that operate from that terminal. Some passenger discharge occurs along Rossy Street on the south side of the terminal, but technically none is permitted in this area.

The Bayamón Guardarrama Terminal has its drop-off areas on the exterior along the street separating the terminal from the City Hall Building.

The Caguas Transportation Center has various passenger discharge areas, both within and outside the terminal. The principal interior discharge area is the access separating the publico-car and bus terminals which facilitates internal circulation as well. The external discharge areas are located curbside along the east side of Acosta Street, the south side of Goyco Street, and along the east accesses off Cordero Avenue.

The Mayaguez Terminal provides for a passenger drop-off area within the assigned parallel terminal spaces. Other discharge activity occurs throughout the immediate area without any specifically organized operation.

b. Allocation and Requirements

The number of publico-car passenger loading berths required is dependent upon the number of publico-car routes and vehicles serving an area and the type of operations performed. The capacity requirement will depend largely upon the number of routes to be allocated to the terminal and the design of the terminal system. The capacity requirement should be determined through the analysis of route accumulation and frequency of service (headways), among other operational characteristics.

The extensive field data obtained during the Feasibility Study should provide the necessary parameters to determine the allocation of passenger loading berths per route within a major terminal facility or facilities.

The service volume of terminals is generally limited by the ability of the loading area (berths) to pickup passengers. Each publico-car requires a certain amount of service time at the terminal which varies with the number of boarding passengers. Volumes may be increased where vehicles can overtake or leave each other in entering or leaving loading areas.

In order to analytically determine the minimum number of loading spaces required for each route, a special empirical relationship can be adopted. The relationship is derived from The Highway Capacity Manual, 1985 (Special Report 209, Transportation Research Board). Although the formula use was developed for bus transit on the mainland, it is readily applicable to the publico-car system since the determining factors such as passenger volumes, vehicle frequency or headway, and peak hour vehicle volumes are readily available from the extensive data collected that should be obtained during the required Feasibility Study.

The following formula from the Manual can be used to determine the effective number of berths (N) required to serve J number of passengers per hour (assuming, as in the case of publico-cars, loading conditions govern):

$$N = \frac{J (bB + C)}{(3600) (B)}$$

Where

N = Number of effective berths per route at a terminal

J = Boarding passengers per hour per route

B = Boarding passengers per publico-car in peak 10 minute period

C = Clearance time between successive publico-cars (per route) in seconds (in this case C is assumed to be the average headway during the peak hour)

b = Boarding service time per passenger, in seconds (for purposes of analysis, this value can be assumed to be 3,600 seconds/J)

Note: All fractions should be rounded upwards.

This formula should be used only to establish a minimum number of boarding spaces required for operations. Each authorized route should be allocated at least one boarding area (especially for routes having less than five authorized vehicles). Additional boarding spaces can be determined based upon judgement determined by on the individual route's operations, the estimated

space turnover time (in order to reduce the time wherein a route space or spaces remain empty, and the general configuration of the proposed terminal.

This empirical approach will provide a quantity of required leading spaces for the existing conditions. However, public transit service in an area could most likely increase due to higher demand (directly related to population growth), increase in new routes, and the possible extension or reconfiguration of existing routes. In order to address any possible future growth, it is recommended that the design of the terminal facility include approximately 10 percent extra spaces, both in the passenger loading area and in the holding area.

5. Design of the Terminal Environment

The quality of the terminal environment is a design objective equal in importance to those of passenger flow and capacity. The perception of the terminal in terms of such human attributes as comfort, security, orientation, and scale will be reflected in passenger acceptance and use. The terminals should be well lighted, simple to negotiate, well ventilated, and supportive of other passenger needs.

Terminal lighting design should consider minimum illumination levels, maximum brightness ratios, maximum discomfort glare rating reflectance, and provisions for emergencies. The terminal design should incorporate natural lighting as much as possible. This not only promotes a more natural environment but also helps save energy.

Both Bayamón terminals provide for very good lighting although The Kuilan Terminal greatly sacrifices coverage protection for over half of the passenger boarding areas. High overhead clearance, large open sections along the side and an open area in the west sector of the building provide the Guardarrama Terminal with more than adequate lighting, in spite of the excessive number of levels.

The Caguas Transportation Center combines low structures, two levels, generally unrestricted (uncovered) sides high overhead clearance, and a large open area in the south bay of the boarding area to provide exceptionally natural illumination.

Ventilation is necessary to help expel emissions and provide comfortability in consideration of Puerto Rico's constant high daytime temperatures. The principal emission generated within the terminal is carbon dioxide (CO₂). To help dispel these emissions, ventilation nearer the ground is required. A good method of obtaining ventilation through design is to limit first floor/passenger concourse structures and side walls to a minimum, thus permitting fresh air to circulate freely and, at the same time, avoid the implementation of costly mechanical ventilation systems.

The Bayamón, Caguas, and Mayaguez terminals all employ good ventilation characteristics. Many of the smaller terminals throughout the Island do not have serious problems with ventilation. However, larger terminals, like that in Ponce and the one being constructed in Río Piedras, may suffer from inadequate ventilation due to the much higher degree of closure of the side boundaries at the boarding areas. This situation usually results in somewhat higher interior temperatures and/or humidity.

The goals for terminal acoustics are to maintain noise levels in vehicles and terminals within acceptable limits and to limit the noise impact of the terminals on the surrounding community. The noise level criteria ranges from 67 decibels (exterior) as per Federal Highway Administration standards to 60 decibels as per the Environmental Quality Board (PR) with respect to residential areas near a traffic noise source. Noise control is achieved by the acoustical design of the terminal and the use of noise absorbing materials. If necessary, noise barriers can be constructed to mitigate the generated noise.

Noise levels within the study terminals (except for the Mayaguez Terminal) tend to be high due to the constant vehicular and pedestrian activities. The noise levels can be considered to be a function of the number of vehicles operating within the terminal, especially during peak rush hours.

Fire control is accomplished by (a) using materials that are fire resistant and produce only limited amounts of dense or toxic smoke in the terminal, vehicles, and equipment; (b) furnishing adequate fire alarm and detectors, system standpipes and hoses, and portable fire extinguishers; and (c) providing means for passenger escape and entry for fire-fighting equipment. Fire hazards should be eliminated and provisions made to isolate and confine danger areas.

Information and directional signs for passengers are essential to the operations of a public transit terminal. Passenger orientation is the principal criterion for the effectiveness of an information system. The design should provide a continuous path of graphic directions between the transit vehicles and the street. Messages should be simple to understand and provided at frequent intervals.

Principles and guidelines for a passenger information system are (a) to use a single style of lettering, standard signs, and simple words; (b) to avoid confusion by eliminating advertising in the vicinity of information graphics; (c) locate information signs at critical decision points; (d) to provide map space near the accesses and on platforms; (e) to minimize the number of independent messages at each point; (f) to maintain continuity, consistency, and sight distance; and (g) to furnish direct information that does not require translation into other terms or units.

The information systems in the study terminals tend to be limited to the identification of the route boarding spaces. None of the terminals has a centralized information map or guide signs indicating the locations of the routes. The Kuilan Terminal (Bayamón) has what can be deemed the more confusing system, or lack of system, due to the small signs indicating the route spaces (complicated by their placement parallel to the curbs) and the great quantity of commercial signs and related activity. The other three study terminals have larger route signs easily visible to the public transit users.

The terminal facility design must include provisions for passenger protection from harassment and violence, the surveillance against potential criminal acts, and the means for apprehension of persons involved in vandalism and other illegal acts.

The existing terminals have had in the past provided police (municipal and/or state) vigilance and, as in the case of the Caguas Terminal, a municipal police station was provided (it has been subsequently replaced). Coordination between the municipal administrators and the local police forces has been established, although, according to many users and publico-car operators, more vigilance should be implemented.

Ample sanitary facilities, water fountains, telephones, and benches should be provided for the comfort and benefit of passengers and operators alike. In addition, internal communication facilities (i.e. public address system, CB antennas, etc.) should be provided within the design phase of the terminal. The passenger loading areas should be covered in order to provide protection from the physical elements.

The Study Terminals have been provided with internal communication facilities, although, at the present time, only Caguas' is working most of the time.

All of the study Terminals, except for only the Kuilan Terminal, have boarding areas completely protected from the natural elements. A few years back, a partial roof area was added to the exposed boarding and discharge area in the Kuilan Terminal. However, its design (and extent of coverage) has limited its effectiveness.

The provision of concessions within a terminal is a matter related to management policy. The benefits of providing commercial outlets for sale of newspapers, candy, and other short-order items are an added convenience for the transit patrons, income for the administrating agency, and the vitality of the area due to the life and color brought into the terminal by advertising and concessions. On the other hand, if improperly planned and deployed, these facilities can consume valuable space, interfere with the traffic flow, contribute to the untidiness of terminals and vehicles,

require additional maintenance and cleanup crews, and promote vandalism and loitering.

Bayamón's Kuilan Terminal has a high concentration of small business throughout the main terminal building (not including the Multi-Services Building). These businesses provide some use to the terminal visitors, but the locations and operations of these businesses tend to interfere with the publico-car operations, resulting in internal congestion, unsafe conflicts between vehicles and pedestrians, and an unaesthetic situation.

The Guardarrama Terminal, on the other hand, has a very limited amount of small businesses which conforms more properly with the function of the terminal.

The Caguas Transportation Terminal also has a limited number of businesses. Their location does not interfere with the normal terminal operations nor detracts from the overall aesthetics.

The Mayaguez Terminal does not have any commercial uses within the facility.

For the proper and efficient function of the terminal, an administrative office should be established and incorporated as part of the overall design and operations scheme. The office would be directed by an appointed administrator who would be responsible for the management, maintenance and operations of the terminal (or terminals). The office would also serve as a central passenger information center.

All of the Study Terminals have an administrator and corresponding office including at least one office worker (secretary). In addition, maintenance personnel are assigned to each terminal.

A drivers' lounge or rest area should be provided within the terminal (where merited due to a significantly large number of publico-car operators).

E. PUBLICO-CAR TERMINAL COSTS

The cost of constructing a publico-car terminal is a very important factor to be considered. Although the current major urban terminals and several still in construction or in the planning stages tend to be similar, their costs can vary significantly. Some of the principal variable cost items include the following:

- (1) Planning and Feasibility Study Costs
- (2) Preliminary Designs and Funding Applications
- (3) Land Acquisition (including Residential/Business Relocations)

- (4) Final Terminal Design Plans
- (5) Construction including Supervision and Inspection during Construction
- (6) Administration and Maintenance Costs

1. Planning and Feasibility Study Costs

These costs are those related to the planning process including the Feasibility Study and final terminal site selection, but prior to solicitation of funds. At the present time, the majority of the planning work is carried out by the local jurisdiction with the assistance of local consultants. The cost for this phase (including the consultant's fees for the Feasibility Study) more often than not comes from UMTA funds (up to 80%) such as those as provided through Sections 5 and 9, Capital and Operating Grants; Section 3, Discretionary Grants; and Section 18, Rural Transit Assistance Program, and local (up to 20%) from municipal and/or State sources. These monies will have been assigned through the Unified Work Program of the Department of Transportation and Public Works, as approved by the Metropolitan Planning Organization (MPO) or DTPW (depending upon the urban area in question).

Normally, the municipal government includes part of the planning costs from its normal planning work funding source. These costs are difficult to preassess; although, the typical procedure is to assign personnel (and their related costs) to a predicted time frame. The Feasibility Study, on the other hand, is usually contracted out to a consultant or consulting firm. The cost for a Feasibility Study could range from \$10,000 to approximately \$50,000, depending upon the size of the urban study areas and the extent of the public transit service.

2. Preliminary Design and Funding Applications

After determining the most appropriate and feasible terminal site, the municipal planners can undertake two concurrent tasks: (1) the preparation of a Preliminary Design for the selected site and (2) the preparation of application for UMTA funding.

The preliminary design is usually prepared by a architectural and/or engineering consulting firm whose fees are paid by the local agency. The main purpose for the preliminary design is to provide a more refined terminal design (as compared to the schematic layouts prepared during the Feasibility Study) to determine the preliminary construction costs. These costs, in turn, are used for the Funding Application. These costs are also used to include the proposed project in the Transportation Improvement Program (DTPW) and for funds allocation.

The funding application is prepared by the local agency either by its personnel or by a consultant. The application process also includes the preparation of the necessary environmental documents.

The preliminary project costs would include, as a minimum, the following items:

- (1) Land Acquisition Costs
- (2) Design (Planning/engineering, working drawings, specifications, site survey, etc.)
- (3) Project Supervision
- (4) Construction Cost
- (5) Project Administration
- (6) Contingency Costs (10% - 20% of total cost)

3. Land Acquisition

Land within the central urban areas tend to be expensive. Vacant land is scarce; whereas, renewable land is limited. As such, the terminal location may require the acquisition of land and/or structures currently utilized for other purposes. The design and construction of a terminal may incorporate existing structures. As the case of many of the CBD'S wherein there are numerous historic structures either currently in use but modified to meet current needs or in a state of disrepair, the integration of these structures can include their partial restoration. This action would have to include a close coordination with the SHPO.

In the case of the study terminals, the local agencies (municipalities) were benefited by the availability of sufficient land either previously purchased or belonging to another public agency which made transfer or interagency purchasing more easily. For example, the Caguas Transportation Center was built on a large tract of land that had previously belonged to the Urban Housing Corporation. The land was earmarked for more urban/residential development, but was subsequently designated for the terminal. The Bayamón terminals were both built on public property; the Kuilan Terminal was built on land previously owned by the Energy Authority, and the Guardarrama Terminal occupies municipal land. The Mayaguez Terminal was constructed on municipal land used by the municipal public works department.

Although these terminals were the first three major facilities built in Puerto Rico, the availability of low-cost lands has been one of the areas of major concern for local planners. Land acquisition has been necessary for an ever increasing amount of municipalities. The necessary land acquisition has also resulted in related residential/commercial displacements, thus increasing overall costs. For example, recent construction of terminals in the municipalities of Canovanas and Trujillo Alto have had high land acquisition and relocation costs due to the non-availability of vacant land.

Acquisition costs can vary significantly dependent on such variables as site topography, types of properties and structures, land use, etc.

Ideally, land acquisition costs should not exceed the estimated construction cost by more than 50 percent. This planning norm has been utilized as a "rule of thumb" by the local planning and review agencies to evaluate and assign costs to each terminal project. However, there can occur situations where the overall cost of acquisition and relocation can exceed the norm due to various factors (i.e., a large business, numerous residences or business, etc.). The evaluation of the costs must then weigh the expected benefits of the proposed project in comparison with the costs. In other words, is it worth the cost? Will the project benefits such as reduction in traffic congestion, acceleration in CBD development, improvement of the local environment, and others, justify the costs?

The land acquisition costs would be based upon land appraisals approved by the local agencies. Relocation costs would be based upon a more detailed evaluation of the relocation requirements for the project. The restoration of historical buildings as an integral part of the terminal depends upon the recommendations from the SHPO.

4. Final Terminal Design Plans

These costs are those associated with the preparation of the final construction plans by an A/E consultant. These costs are normally based upon a percentage range of the estimated construction cost (between 5% and 10%).

5. Construction, Supervision, and Inspection Costs

These costs cover all related construction and incidental costs including project administration and supervision.

6. Administration and Maintenance Costs

Once the construction of the terminal is complete, it is necessary to operate and maintain the terminal. These costs must be covered by allocations from local municipal funds. The administration/maintenance costs include the salaries of the terminal administrator, a secretary and maintenance personnel plus maintenance materials and periodic painting and overall cleaning.

7. Comments Concerning Construction Costs

Ever since the construction of the first terminal at Caguas, planners at all levels have been concerned about terminal project costs. There has been some thought that a public-car terminal should not cost much more than a typical public parking garage whose costs can range between \$6,000 and \$10,000 per space.

However, it must be realized that a publico-car terminal is not a parking garage but rather a central public transit center for passenger boardings, discharge and transfers. As such the design of the terminal must include a higher degree of costs associated with such factors as higher level clearances, passenger concourse and platforms, information systems, more efficient access, more lighting, wall and sidewalk finishings, etc. The ratio of cost per space for a publico-car terminal may range between \$7,000 and \$15,000 per space approximately.

On the other hand, one major determining factor is the limitation of available funds from both local and federal sources. Those UMTA funds allocated to Puerto Rico are further allocated for various public transit services. The bulk of the funds (70% - 90%) goes to the Metropolitan Bus Authority while the rest is allocated amongst the urban areas and the smaller towns and rural areas (through Section 18, UMT Act). This creates a competitive situation complicated by the need to justly distribute the funds. The planners should make all efforts to provide the most cost efficient and justifiable facility as possible. The DTPW should also beef up its project review personnel and increase its emphasis on the evaluation of the terminal with respect to need, benefits, and function.

In addition, all terminal plans should be subjected to an intense review by local DTPW engineers or independent engineers to determine, among others, the structural viability, access controls and circulation, impact upon publico-car operations, and cost effectiveness. It is also recommended that periodic inspection visits by UMTA personnel or its local representatives in Puerto Rico be made during the construction of the terminal facility.