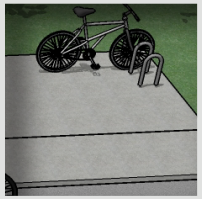
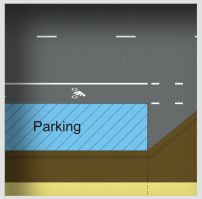
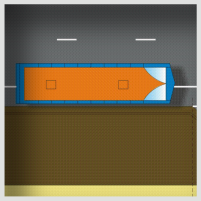
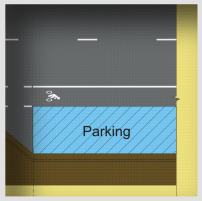
Florida Department of Transportation
Districts One and Seven

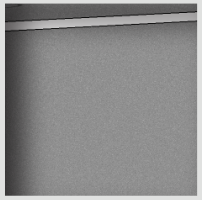
Transit Facility Handbook

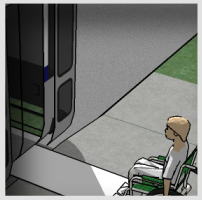


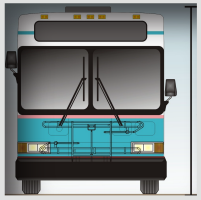












October 11, 2007

Prepared by:

Gannett Fleming, Inc.
Tindale-Oliver & Associates, Inc.
USF Center for Urban
Transportation Research

Florida Department of Transportation Districts One and Seven
TRANSIT FACILITY HANDBOOK
October 2007

FLORIDA DOT CO-PROJECT MANAGERS CONTACT INFORMATION

Jan Parham
Project Coordinator
District One Modal Development/Transit
District One, Department of Transportation
P. O. Box 1249, Bartow, Florida 33831
Office: 863 519 2390
E-Mail: jan.parham@dot.state.fl.us

Elba I. Lopez
Public Transit/Intermodal Administrator
District Seven - Modal Planning and Development Dept.
11201 N. McKinley Drive, MS-7-500
Tampa, Florida 33612-6403
Office: 813-975-6403
E-Mail: elba.lopez@dot.state.fl.us

OVERVIEW

The Florida DOT Districts One and Seven Transit Facility Handbook was a collaborative effort to provide comprehensive guidance for planning and design of transit facilities and activities for the 17 Florida counties contained with within these two FDOT Districts in southwest-central Florida.

This handbook was developed with the technical assistance of Gannett Fleming, Inc., Tindale-Oliver & Associates, Inc., and the University of South Florida Center for Urban Transportation Research. Through the utilization of several workshops and a project steering committee, the handbook was based upon extensive research of transit guidelines developed by transit agencies, field-knowledge of the transit agencies within the FDOT Districts, and input from FDOT District and Central Office staff.

The handbook, which was released in October 2007, synthesizes current research perspectives, practices and experiences; and, will be of interest to public officials, transit agencies, engineers, planners, designers, and developers.

Although the Handbook focused mainly on the issues related to facilities for bus services, the underlying philosophy is that transit facilities and infrastructure should be viewed in a holistic manner to optimize user safety, comfort, and accessibility. It is expected that the guidelines provided in the Handbook when interpreted and adapted to site specific conditions will achieve the following objectives:

- Enhance the experience of transit patrons
- Improve the roadway/transit design interaction
- Enhance transit safety and security
- Support the integration of transit facilities with land uses

- Accommodate neighborhood needs in the design of transit stops
- Encourage transit-oriented development

The Transit Facility Handbook is organized around 11 sections:

- Introduction
- Streetside Factors
- Curbside Factors
- Transit Vehicles
- Bus Rapid Transit
- Park-and-Ride Facilities
- Transit-Oriented Development
- Education Awareness Programs
- Institutional Issues
- References
- Glossary

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Glossary

Glossary of Terms and Abbreviations

- **ABA:** Architectural Barriers Act.
- **Accessibility:** The extent to which facilities are barrier-free and usable by people with disabilities, including those using wheelchairs.
- **Active Transit Signal Priority:** A signal prioritization method where active detection of the transit vehicle triggers signal phase adjustment which favors transit (Also see, *Bus Preferential Treatment*, *Transit Signal Priority (TSP), Passive Transit Signal Priority*).
- **Activity Center:** Refers to a concentration of business, commercial and other uses that draw a large number of people from the region on a daily/regular/periodic basis.
- **ADA:** Americans with Disabilities Act of 1990- FS 335.065(1) (a).
- **Adaptive Traffic Control System (ATCS):** Traffic signal systems that respond in real time to changes in traffic patterns.
- **American Association of State Highway and Transportation Officials (AASHTO):** AASHTO is a nonprofit, nonpartisan association representing highway and transportation departments in the 50 states, the District of Columbia, and Puerto Rico. It represents all five transportation modes: air, highways, public transportation, rail, and water.
- **APTA:** American Public Transportation Association.
- **Articulated Bus:** Transit vehicle more than 40-feet in length (generally up to 60 feet), made up of two or more sections that can bend to maneuver around corners.
- **Bicycle Lane:** A portion of a roadway that has been designated by striping, signing, and pavement markings for preferential use by bicyclists. (AASHTO)
- **Bicycle Route (Bike Route):** A system of bikeways designated by the jurisdiction having authority with appropriate directional and informational route markers, with or without specific bicycle route numbers. Bicycle routes should establish a continuous routing but may be a combination of any and all types of bikeways. (AASHTO)
- **Bus Bay (Pullout):** A dedicated stopping area for buses outside of the travel lane.
- **Bus Lane:** A street or highway lane intended primarily for buses, either all day or during specified periods, but sometimes also used by carpools meeting requirements set out in traffic laws. (APTA)
- **Bus Pad** (also known as landing pad): Typically refers to a minimum 5-foot wide (measured parallel to vehicle roadway) and 8-foot long (measured from face of the curb or vehicle roadway edge) flat, stable, non-slippery concrete surface for passenger boarding and alighting, sufficient to handle wheelchair accessibility (Also see, *Shelter Pad, Stop Area*).

- **Bus Preferential Treatment (BPT):** Hi- and low-tech methods of providing buses with a time advantage over single occupancy vehicles (Also see, *Transit Signal Priority (TSP), Active Transit Signal Priority, Passive Transit Signal Priority*).

- **Bus Rapid Transit (BRT):** A transit system maintaining the basic infrastructure of traditional bus systems, that provide a higher quality of service than a traditional bus system through innovations such as running ways, fare collection, signal priority, and vehicle design. (Federal Transit Administration) BRT systems mostly will have a dedicated right-of-way.

- **Bus Shelter:** A facility that provides seating and protection from the weather for waiting passengers.

- **Bus Stop:** A designated location from which passengers board or alight a bus, usually designated by a sign.

- **Bus Turnaround:** Roadway system which allows buses to return to the street they are serving, generally in the opposite direction of travel.

- **Central Business District (CBD):** The downtown retail trade and commercial area of a city or an area having high land values, traffic flow, and concentration of retail business offices, entertainment, lodging, and services. (APTA)

- **Comprehensive Circulation Plan:** A plan for transit-oriented areas to facilitate the interaction between single occupancy vehicles, transit, pedestrians, and bicycles.

- **Crime Prevention through Environmental Design (CPTED):** A multi-disciplinary planning and design approach to use environmental factors to prevent criminal activities.

- **Detectable Warning Surface:** A standardized surface feature built in or applied to walking surfaces or other elements to warn of hazards on a circulation path (ADA/ABA Accessibility Guidelines) (Also see, *Americans with Disabilities Act*).

- **Far-side Bus Stop:** A bus stop that is located immediately following an intersection as indicated by the direction of travel (Also see, *Mid-block Bus Stop, Near-side Bus Stop*).

- **FBC:** Florida Building Code, maintained by the Department of Community Affairs.

- **Federal Highway Administration (FHWA):** A branch of the US Department of Transportation that administers the federal-aid Highway Program, providing financial assistance to states to construct and improve highways, urban and rural roads, and bridges. The FHWA also administers the Federal Lands Highway Program, including survey, design, and construction of forest highway system roads, parkways and park roads, Indian reservation roads, defense access roads, and other Federal lands roads.

- **Federal Transit Administration (FTA):** FTA is the agency of the U.S. Department of Transportation which administers the federal program of financial assistance to public transit. (APTA)

- **Fixed Route:** Transit service provided on a repetitive, scheduled basis along a specific route with vehicles stopping to pick up and discharge passengers at bus stops.

- **Florida Department of Transportation (FDOT):** A department of the State of Florida overseeing transportation systems in the state.

- **Florida Intrastate Highway System (FIHS):** A system of existing and future limited-access and controlled facilities that have the capacity to provide high-speed and high-volume traffic movements in an efficient and safe manner. (FDOT)

- **Grade:** The slope (ratio of change in elevation to change in distance) of a roadway, bicycle or pedestrian facility typically given in percent. For example, a 2% grade represents 2-feet of elevation change over a 100-foot distance.

- **Grade Separation:** A vertical separation between intersecting roads, bicycle and pedestrian facilities or railroad corridors. One facility travels over the other via an overpass or other structure.

- **Headway:** It refers to the frequency of transit service or amount of time between transit vehicles operating on the same route.

- **High-occupancy Vehicle (HOV) Lane:** Any preferential lane designated for exclusive use by high-occupancy vehicles for all or part of the day -- including a designated lane on a freeway, other highway, street, or independent roadway on separate right-of-way. (MUTCD)

- **Intelligent Transportation System (ITS):** ITS replaces the term Intelligent Vehicle Highway System. ITS is a surveillance system designed to monitor traffic flows on major freeways and to inform motorists of problem areas. ITS applications include: the integration of traffic control and transportation management systems; highway advisory radio systems; vehicle detectors; closed-circuit television; Global Positioning Systems (GPS) and route guidance.

- **Intermodal:** A transportation system connecting two or more different modes of transportation.

- **Intermodal Facility:** A building or site specifically designed to accommodate two or more transportation modes. Typically to enable seamless mode transfer.

- **Joint Development:** A partnership between developers and government agencies to improve a station area in a way that is beneficial to both parties.

- **Landing Pad:** Typically refers to a minimum 5-foot wide (measured parallel to roadway) and 8-foot long (measured from face of the curb or roadway edge) flat, stable, non-slippery surface for wheelchair accessibility (Also See, *Shelter Pad, Stop Area*).

- **Location Efficiency:** The convenience of location made possible by transportation options and nearby amenities.

- **Mid-block Bus Stop:** A bus stop that is located between intersections (Also see, *Far-side Bus Stop, Near-side Bus Stop*).

- **Manual on Uniform Traffic Control Devices (MUTCD):** It defines the standards used by road managers nationwide to install and maintain traffic control devices on all streets and highways. The MUTCD is published by the Federal Highway Administration (FHWA) under 23 Code of Federal Regulations (CFR), Part 655, Subpart F. (FHWA)

- **NCHRP:** National Cooperation Highway Research Program

- **Near-side Bus Stop:** A bus stop that is located immediately before an intersection as indicated by the direction of travel (Also see, *Far-side Bus Stop, Mid-block Bus Stop*).

- **Park-and-Ride (P&R) Lots:** P&R lots are designed to intercept automobiles at outlying locations along transitway corridors (e.g. bus routes).

- **Passive Transit Signal Priority:** A signal prioritization method under which standard traffic signal parameters are adjusted based on historical traffic pattern to ensure average operations of the traffic signal favors the average operation of transit *(*Also See, *Transit Signal Priority).*

- **Queue Bypass Lanes:** Bus-only lanes or right turn lanes that enable buses to pass through congested intersections with reduced delay.

- **Queue Jump Operations:** A combination of transit signal priority and queue bypass lanes to allow buses to "jump" ahead of traffic queues by transmitting signals directly to an exclusive bus priority signal.

- **Right-Of-Way (ROW):** A general term denoting land, property or interest therein, usually in a strip acquired for or devoted to transportation purposes (AASHTO).

- **Shared Use Path:** A bikeway physically separated from motorized vehicular traffic by an open space or barrier and either within the highway right-of-way or within an independent right-of-way. Shared use paths may also be used by pedestrians, skaters, wheelchair users, joggers and other non-motorized users.

- **Sidewalk:** The portion of a highway, road, or street intended for pedestrians (FHWA).

- **Sight Distance:** The length of roadway or path visible to a driver, bicyclist, or pedestrian; the distance a person can see along an unobstructed line of sight. (FHWA)

- **Shelter Pad:** A designated area at the bus stops to support installation of a shelter including a bus landing pad (Also See, *Bus Pad, Landing Pad, Stop Area*).

- **Special-use Lane:** A lane restricted for special uses only (Also See, *HOV Lane*).

- **Strategic Intermodal System (SIS):** A transportation system comprised of facilities and services of statewide and interregional significance, including appropriate components of all modes. (FDOT)
- **Speed:** *Design speed* is a selected speed used to determine the various geometric design features of the roadway. *Operating speed* is the speed at which drivers are observed operating their vehicles. *Posted speed* is the maximum speed limit posted on a section of roadway using a regulatory sign. Speed limits can not be posted in excess of legislatively mandated speed limits.
- **Stop Area:** Refers to the immediate surrounding near a transit stop (Also See, *Bus Pad, Landing Pad, Shelter Pad*).
- **TCRP:** Transit Cooperative Research Program.
- **Transit Generator:** A location that generates a higher than average number of transit passengers.
- **Transit-Oriented Development (TOD):** Typically high density mixed-use communities within walking distance of transit stations.
- **Transit Signal Priority (TSP):** Technique of altering the sequence or timing of traffic signal phases to provide preferential treatment to transit vehicles (Also See, *Active Transit Signal Priority, Passive Transit Signal Priority*).
- **Traffic Calming:** It involves strategic physical changes to streets to reduce vehicle speeds and decrease the cars' dominance. (Florida Pedestrian Facilities Planning and Design Handbook)
- **TRB:** Transportation Research Board.
- **Temporary Traffic Control (TTC) Plan:** A TTC plan is a set of specific plan sheets, references to standard (typical) layouts, and/or notes on roadway plans describing how traffic will be controlled through a work zone. (Florida Greenbook)
- **Transit Overlay Zone:** Zone that is "overlaid" onto existing zones to allow for increased density and a pedestrian friendly environment around a transit facility.
- **Transportation Design for Livable Communities (TDLC):** Adopted policy of the Florida Department of Transportation to consider TDLC features on the State Highway System when such features are desired, appropriate and feasible. This involves providing a balance between mobility and livability.
- **Transit Ways:** Running-ways dedicated exclusively to the operation of transit vehicles.
- **University Transportation Center (UTC):** Centers within universities dedicated to the study of transportation issues and funded by Federal Highway Administration.

1. Introduction

The goal of this handbook is to provide comprehensive guidance for planning and design of transit facilities, activities, and services in the Florida Department of Transportation's (FDOT) Districts One and Seven. FDOT's District One includes Charlotte, Collier, De Soto, Glades, Hardee, Hendry, Highlands, Lee, Manatee, Okeechobee, Polk, and Sarasota Counties. FDOT's District Seven includes Citrus, Hernando, Hillsborough, Pasco, and Pinellas Counties.


Figure 1.1: A Bus Shelter

Image source: Gannett Fleming, Inc.

This handbook is informed by an extensive research of transit guidelines developed by other agencies and the field-knowledge of transit agencies operating in FDOT's Districts One and Seven. Two workshops were held in June and October 2005 to prepare a detailed outline for the document. The workshops were attended by experts in the subject area that included staff from Districts One and Seven's offices and transit agencies, researchers, and consultants. A Technical Advisory Committee (TAC) was constituted to provide input on design issues, share field experiences, and review the draft documents. A mock document was developed in June 2006 and was reviewed by the TAC. The recommendations were combined with research findings for developing this handbook.

The handbook synthesizes current research perspectives, practices and experiences; and will be of interest to public officials, transit agencies, engineers, planners, and designers. Furthermore, the handbook will aid developers, individuals, and agencies that are actively involved in the planning, funding, and implementation of transit facilities. Although this handbook mainly addresses the issues related to facilities for bus services, the underlying philosophy is that transit facilities and infrastructure should be viewed in a holistic manner to optimize user safety, comfort, and accessibility. It should be noted that the design criteria and standards established by FDOT, other road agencies, and state and local authorities supersede the guidelines mentioned in this handbook.

The handbook uses the following styles to highlight important subjects and material:

- ♿ This symbol indicates accessibility related guidance except if the entire section is focused on accessibility issues.

Web-link: Underlined text in a sky blue color indicates an active web-link in the PDF version of the document.

1.1. Roadway

1.1.1 State Roads

The FDOT is responsible for construction, maintenance, and traffic operations along state roads. State roads typically provide connectivity to the attraction side of a trip since major commercial areas are often located along or near state roads. Traffic patterns and transit demand along the state roads can be different from other types of roads. This handbook provides guidelines for a wide spectrum of issues related to transit facilities along state roads.

1.1.2 Non-state Roads

Non-state roads include county and local roads. Typically, county roads are managed by county governments. These roads often act as arterial streets; however, in many rural areas, they also serve as collector streets that provide access to abutting properties. From a transit operation and facility design perspective, county roads pose unique challenges due to a range of alignment variations and land uses of abutting properties.

Local roads are mostly under the jurisdiction of local governments and constitute a high proportion of roadway mileage in the State of Florida. A major part of rural areas consists of two-lane local roads.

1.2. Purpose

The purpose of this handbook is as follows:

- To identify techniques for the design, access, and safety of transit facilities along state and non-state roads;
- To present transit facility guidelines in a technical but user-friendly manner.

This handbook is not intended to provide guidance on specific transit operations issues.

1.3. Objectives

It is expected that the guidelines provided in this handbook when interpreted and adapted to site specific conditions will achieve the following objectives:

- Enhance the experience of transit patrons;
- Improve the roadway/transit design interaction;
- Enhance transit safety and security (on vehicles and at stops);
- Support the integration of transit infrastructure with land use;
- Accommodate neighborhood needs in the design of transit stops (design should coordinate with neighborhoods); and
- Encourage transit-oriented development (TOD).

1.4. Construction Guidelines

Transit facilities are typically built and maintained by transit agencies, local governments, private developers, or non-governmental agencies. Construction procedures to build transit facilities along state roads must comply with FDOT standards in addition to standards established by other state and local agencies. All applicable offices within the FDOT and local or county governments shall be contacted to identify site-specific construction procedures and specifications. Agencies responsible for the following areas should be contacted during the planning process:

- Utilities;
- Electricity supply and maintenance;
- Traffic impacts;
- Drainage;
- Environmental planning; and
- Historic preservation.

In addition to the above, adjacent property owners should also be contacted especially if construction could, temporarily or permanently, affect residents' sight view, access to property, etc.

1.5. Intended Usage

This handbook is expected to serve as a common source of reference for various agencies and individuals designing transit facilities in FDOT Districts One and Seven. Specifically, this handbook is expected to assist the following agencies:

1.5.1 Florida Department of Transportation (FDOT) Districts One and Seven

- Providing local governments and transit agencies with design guidelines;
- Coordinating work between FDOT Districts One and Seven;
- Streamlining administrative and technical processes;
- Pursuing funding;
- Preventing litigation;
- Addressing safety issues;
- Integrating into the FDOT process during construction and resurfacing;
- Encouraging consistency in approach, methods and, administrative procedures related to design of transit facilities; and
- Ensuring early coordination and consideration of transit facilities on all FDOT projects.

1.5.2 Transit Agencies

- Coordinating work with FDOT and other agencies;
- Planning access improvements to transit facilities;
- Integrating with transit development plans; and
- Providing and/or supplementing guidelines

1.5.3 Local Governments

- Providing guidance to local governments on potential requirements for development along transit corridors;
- Incorporating guidelines in local plans; and
- Providing an easy reference for non-technical staff regarding transit facilities.

1.5.4 Consultants/Engineers

- Providing guidelines to follow;
- Establishing and maintaining quality of services and products; and
- Fostering efficient and effective communication with agencies.

2. Streetside Factors

Careful consideration of streetside factors in planning transit services, facilities and related infrastructure can significantly improve the efficiency of transit services. This chapter provides standards and guidelines related to a wide array of issues associated with roadways on which transit services operate.

2.1. Traffic Control Devices

A significant amount of delay to transit vehicles in urban areas is caused by traffic congestion. This congestion results in longer travel times for passengers, and over a period of time, requires transit agencies to add more buses in order to maintain frequent headways which ultimately results in higher agency operating costs. Such inefficiencies can be minimized by effectively using control devices that are employed to ensure safe, efficient, and orderly movement of users of motorized and non-motorized modes of transportation. Traffic control devices such as signs, signals, and markings should be easy to understand and simple to follow. Transit agencies should coordinate with other agencies to maximize the benefits for transit users and services.

2.1.1 Traffic Signals

Delays incurred by buses at signalized intersections typically account for 10 – 20% of bus running times. Transit signal priority, a proven traffic operations method, provides various techniques to optimize transit operations.

Table 2.1: Signal Coordination

Benefits
· Reduces stops at signals
· Reduces bus delays
· Influences vehicle speed
· Reduces crash risk
· Reduces emissions, wear and tear of buses
Limiting Factors
· Limited capacity of roadways
· Complicated intersections
· Short signal spacing
· Heavy turn volumes
· Traffic incidents
· Maintenance and monitoring related requirements
· No advantage to a “late runner” bus

➘ **Passive Transit Signal Priority (TSP) / Signal Coordination**

What it is: A method by which the sequence (begin and end) of the green phase of a signal along a corridor is established to allow for the uninterrupted flow of transit vehicles.

How it works: The slower speed of the bus and its dwell time is taken into account. The goal of signal coordination efforts is to get the maximum number of transit vehicles through a corridor with the fewest stops at the signalized intersections in the safest and most efficient manner.

Where it is used: Typically it is employed along heavily traveled arterial streets with frequent presence of traffic signals.

Benefits: It can significantly improve transit service by reducing delays and increasing service reliability (Table 2.1).

Limiting factors: It provides only limited advantage in heavily traveled corridors with irregular signal spacing as signal timings are developed off-line, reflecting historically observed average traffic conditions.

Refer to:

FHWA Manual on Uniform Traffic Control Devices

FDOT Operations – Traffic Engineering Manual (TEM)

➘ Active Transit Signal Priority (TSP)

Active TSP is a "Field to Vehicle" Intelligent Transportation Systems (ITS) application that provides wireless communication interface between field equipment and vehicles on the road. Such applications are increasingly being adopted under the Federal Intelligent Vehicle Initiative (IVI), which promotes Intelligent Vehicle Systems (IVS) technologies. Active Transit Signal Priority Strategies include signal progression, adaptive traffic signals, and signal preemption.

♦ Adaptive Traffic Control System (ATCS) TSP

This is a traffic operations strategy, which takes into account trade-offs between transit and non-transit delay. This method allows real-time changes in all three critical components of traffic signal timing - cycle length, phase split, and offset. More conventional systems rely on multiple, fixed, and time-of-day timing schemes. The implementation of this method can be challenging as it requires considerable initial investment as well as continuous monitoring and changes.

♦ Signal Preemption

What it is: A method to interrupt pre-set signal times so that transit vehicles are provided with the maximum opportunity to have a green signal when they reach an intersection.

How it works: The transit vehicle is fitted with an electrical device(s) such that a traffic control signal responds uniquely to the approaching transit vehicle.

Where it is used: Typically along corridors with frequent signals and very high transit ridership. However, a number of factors have prevented widespread use of signal preemption methods. It is widely recognized as the least favored method to improve the transit travel times due to lack of standards to determine need of signal preemption and inability to prevent inordinate delays to non-transit vehicles traveling along the cross-streets. Furthermore, in situations where a near-side stop is located, prediction of exact arrival times can be particularly difficult due to uncertainties associated with passenger boarding and alightings.

During the operation of signal preemption, buses must yield to emergency vehicles at all times in accordance with standard traffic regulations. FDOT's Plans Preparation Manual (PPM) allows pre-emption systems for mass transit vehicles. Such projects should be referred to the District Traffic Operations Engineer and/or traffic signal maintaining agency for review and approval prior to finalization of the plans. Signal preemption is implemented mainly to increase the safety of transit vehicles near moveable span bridges and railroad crossings as opposed to traditional usage for higher service reliability. Signal preemption at intersections near fire stations, hospitals, other emergency facilities, and schools should be avoided.

Transit agencies must contact the traffic operations department for authorization to own and operate signal preemption devices. Additionally, before implementing signal preemption, an educational campaign should be carried out throughout the affected area.

♦ **Signal progression TSP**

What it is: A “Field to Vehicle” ITS application.

How it works: As a bus approaches an intersection, special devices on the buses send signals to detectors installed at traffic-signal controlled intersections, which automatically give the bus priority by extending a green light, shortening a red light, or providing a queue jump (Figure 2.1).

Where it is used: This method is typically used along congested arterials with frequent signals.

Benefits: Signal priority ensures schedule adherence and improves travel times along busy arterial routes. These time savings, although small at each intersection, significantly reduce travel time over the course of an entire bus route.

Limiting factors: Recent research indicates that benefits to a transit service may come at the expense of overall traffic, especially along busy roadways. Thus, the need for signal priority should be carefully analyzed under all circumstances. This strategy, however, provides flexibility by allowing the bus driver to decide when signal progression is required. A bus driver may choose not to use the signal progression option if the bus is empty or is near the end of a route with an out-of service period to follow.

Figure 2.1: Signal Progression Transit Signal Priority

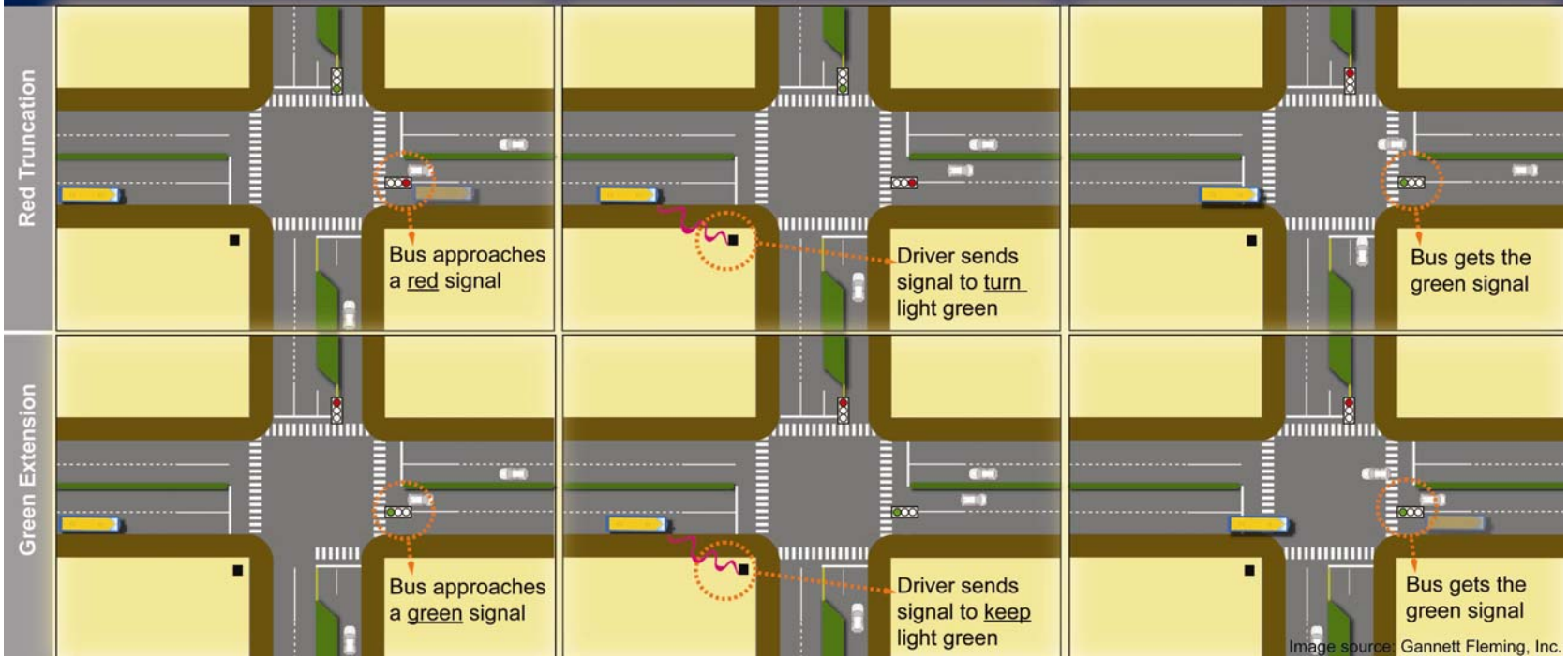
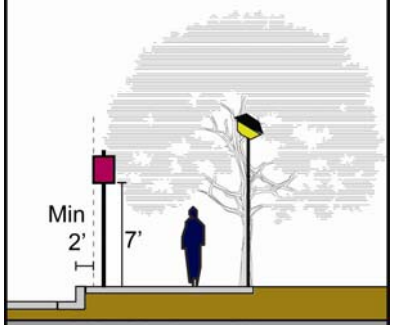
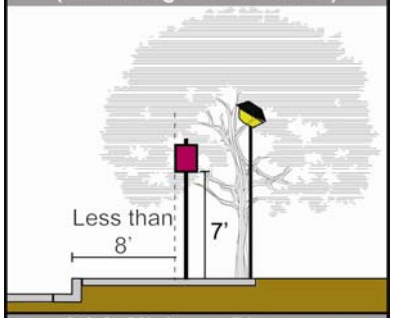


Figure 2.2: Sign Placement

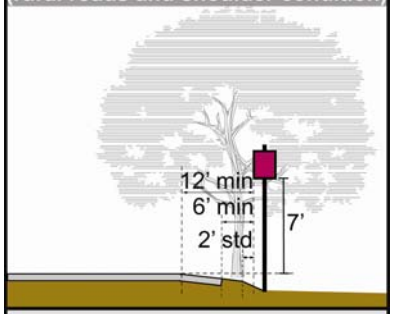
2.2.1: Minimum Distance (curb and gutter condition)



2.2.2: Maximum Distance (curb and gutter condition)



2.2.3: Minimum Distance (rural roads and shoulder condition)



Notes:
1. For bus pad placement refer to Figure 3.1 and Figure 3.3.
2. Refer to FDOT Design Standards and PPM.

Image source: Gannett Fleming, Inc.

2.1.2 Street Signage

Bus stop signs help direct passengers and drivers to the bus stop, and publicize transit services. Bus stop signs are approved signs indicating the operators and routes that serve the stop. All signs must be in compliance with Manual on Uniform Traffic Control Devices (MUTCD). The following should be considered while designing and placing bus stop signs.

- The sign must be securely mounted at an angle perpendicular to the street. Existing signposts can be used depending on the policies of the sign maintaining agency and the transit agencies' design specifications.
- The bus stop sign should neither block jurisdictional signs nor be blocked by other signs, trees or buildings.
- The sign must be easily visible to the approaching bus driver. For curb and gutter sections, the FDOT Design Standards require a minimum 2 foot distance from the face of the curb to the bus stop sign (Figures 2.2.1-2). For typical rural shoulder sections, the minimum distance is 12 feet from the edge of the traveled way and 6 feet from edge of the shoulder (Figure 2.2.3). The minimum distance will vary according to the design speed of the road.
- To comply with Americans with Disability Act requirements, signage should include the following:

♿ Signs shall provide a minimum 7-foot vertical clearance from the paved surface (sidewalk or roadway pavement). If the vertical clearance is less than 7 feet, a barrier to warn people with visual impairment should be provided.

♿ Wherever required or applicable, signs should include the international symbol of accessibility (wheelchair logo).

♿ Where the circulation path is different, signage complying with the items listed above along with all other applicable clauses should be provided to indicate direction and to identify accessible route and entrance(s).

♿ The Access Board has developed the guidance in section 409.5 of its Revised Draft Guidelines for signs on public right-of-way. This guidance has not been formally adopted in federal rulemaking but is considered best practice at this time.

Figure 2.3: Pavement Markings

A clear "BUS ONLY" marking warns drivers of the exclusiveness of the lane for buses.

- Local authorities can prohibit stopping, standing, or parking at bus stops. In such cases, signs indicating no parking areas consistent with the MUTCD should be installed.
- If a bus stop sign is relocated or removed during roadway construction projects, the temporary traffic plan should include the provision of temporary bus stop signs and the location should be coordinated with the transit agency

2.1.3 Pavement Markings

Pavement markings are necessary to help ensure roadway safety by providing orderly and predictable movement of all traffic. Pavement markings help guide transit vehicle flow and provide information to the transit vehicle driver. Major marking types include pavement and curb markings, object markers, delineators, colored pavements, barricades, channelizing devices, and islands (Figure 2.3). All pavement markings must be compliant with MUTCD standards.

2.2. Street Design

2.2.1 Traffic Volumes

Traffic volumes are intricately correlated with transit services. High traffic volume typically indicates higher household and/or employment densities, which in turn, reflects a potential high-volume market for transit. However, high traffic volume also leads to congestion that negatively affects a transit system's service reliability. Other issues such as collisions involving transit and non-transit vehicles, pedestrian activity, traffic congestion, and transit system performance must be considered when locating transit facilities on high volume roadways. In areas with high pedestrian activities, traffic congestion, and significant number of vehicle-pedestrian conflicts, alternative transit routes should be evaluated.

Figure 2.4: Special-use Lanes

2.4.1: Exclusive Bus Lanes

2.4.2: Buses on HOV Lanes

2.2.2 Special-Use Lanes (SUL)

A bus service can operate on various types of roadways ranging from streets with mixed traffic to exclusive bus-only lanes. A greater degree of separation from non-transit traffic reduces travel times, increases service reliability, and makes a transit trip less stressful. The separation between transit and non-transit vehicles can be achieved using the following two methods:

- **Exclusive bus lanes:** This method should be considered for high-volume congested routes (Figure 2.4.1). Exclusive bus lane experiences around the country shows that they are best implemented as added lanes to an existing roadway. In the absence of required right-of-way, dedication of an existing travel lane for exclusive transit use has also been successful in a few areas. The provision of designated bus lanes also indicates an institutional preference for transit.
- **High-Occupancy Vehicle (HOV) lanes for transit:** This is the most commonly employed method of preferential treatment for bus traffic (Figure 2.4.2). Where capacity permits, buses can successfully operate in HOV lanes. The transit service reliability further increases if HOV lanes are separated by barriers. In areas where buses use HOV lanes, buses of any type can use an HOV lane even without passengers as it helps adherence to schedules.

  The HOV occupancy requirement for non-transit vehicles varies depending on local policies. In theory, occupancy requirements can be raised in order to maintain a desired level of service (LOS) and increase person-moving capacity. However, reduction in occupancy requirements is often done to reduce the negative public perception caused by the “empty lane” syndrome which can negatively impact transit travel times.
- **Queue bypass/queue jumpers**: Short reserved lane segments, known as queue bypass or queue jumpers, are often used to allow buses to bypass congestion points such as at signalized intersections (For detailed explanation refer to Section 5: Bus Rapid Transit).

Refer to:

[AASHTO Guide for Development of Bicycle Facilities]

Figure 2.5: Bicycle Lanes

A bus bay on a designated bicycle route

2.2.3 Bicycle Lanes

Bicyclists are a great potential market for transit services. Individuals will generally bicycle three to four times as far as they will walk and this could extend the catchment area of a bus stop. Therefore, transit services should be compatible with bicycle facilities. When the bus is likely to cross the bike lane (Figure 2.5), dashed lane line pavement markings consistent with the MUTCD should be used.

Please refer to Section 3.2.8 for bicycle rack related recommendations.

2.2.4 Lighting

Street lighting, although not directly under the purview of transit agencies, can play an important role in designing and locating transit facilities. Lighting along streets is typically designed for smoother vehicular movement and may not always meet illumination requirements of a transit stop. The following should be considered to ensure that lighting is suitable for both, vehicular movement and stop area:

Desirable condition:

- Local transit stops should be located within 30 feet of an overhead light source. A minimum distance of 15 feet is recommended between a shelter and light pole (Figure 2.6);
- Lighting fixtures of any height should have minimum glare that could otherwise adversely impact drivers and provide even and uniform illumination over the whole area;
- Lighting fixtures should be oriented so stop area infrastructure such as shelter or amenities do not cast a shadow on the waiting area and the bus driver should be able to see the waiting passengers;
- Lighting at places such as mid-block crossings associated with bus stops, where significant vehicle-pedestrian interactions may occur (explained later in the chapter), should preferably be illuminated for safety considerations; and

Figure 2.6: Lighting Access

Bus shelter getting maximum benefit from an existing light pole. Note there is 15' distance between the pole and the shelter per Florida Administrative Code requirement.

- In rural areas, efforts should be made to maximize the safety and security of bus stops with available or cost feasible lighting. The conditions for lighting at and around transit facilities in rural areas should be reviewed on a location-specific basis. A possible consideration is solar lighting where utility service is not readily available. Please refer to Section 3.2: Stop Infrastructure and Amenities for more details on lighting at transit facilities. Lighting access is also an integral part of Crime Prevention through Environmental Design (CPTED) methods covered under Section 3.3.4.

Desirable condition:

Pedestrian scale lighting helps create pedestrian-friendly environments and agencies should consider it's installation at bus stops that attract significant ridership in the evenings or early mornings. Pedestrian-scale lighting at stops near neighborhood business areas, malls, hospitals, and recreational/sports facilities can be achieved through public-private initiatives by contacting adjacent facility owners. Wherever feasible, solar powered lighting options should also be considered.

2.2.5 Emergency Medical Services (EMS) Access

The free movement of emergency vehicles is very important. To accommodate this free movement the following should be considered while planning and designing transit infrastructure and amenities:

- Bus facilities should not obstruct fire lanes or other similar emergency facilities and equipment. Florida Administrative Code Section 14-20.003.09 requires that bus shelters not be located within 15 feet of a fire hydrant;
- While planning transit facilities near hospitals, fire stations and police stations, respective agencies should be contacted to seek their input;

During the operation of transit signal priority, buses must accommodate emergency vehicles at all times.

2.3. Stop Location

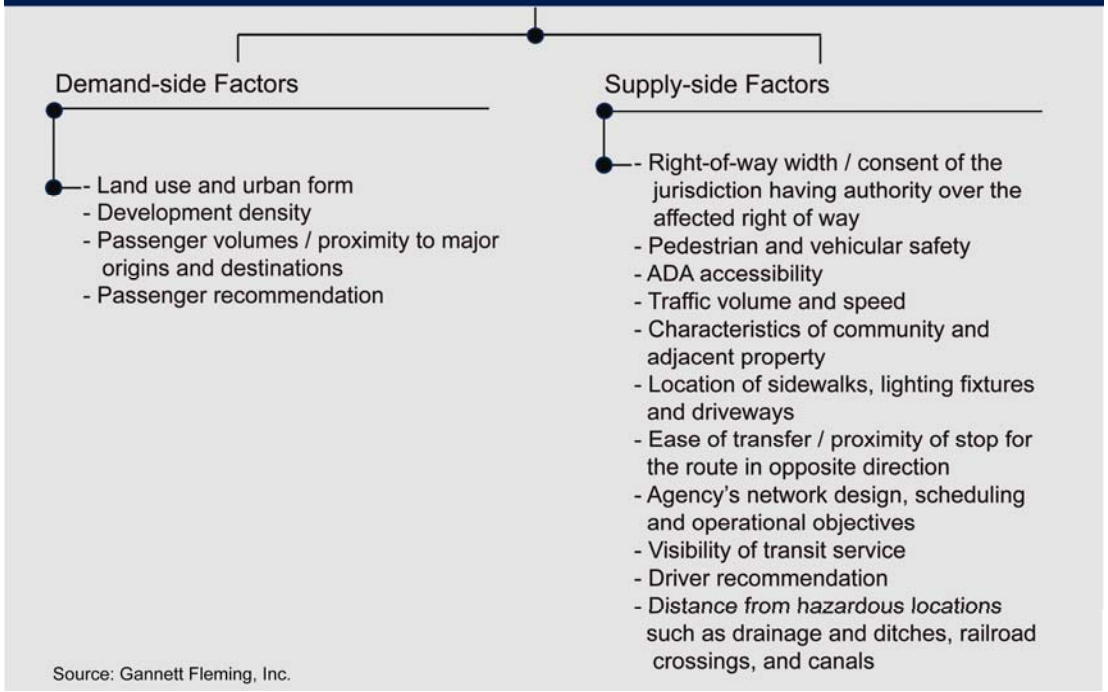
A bus stop is the first point of contact between a passenger and the bus service; therefore, its location and spacing directly affect the accessibility and convenience of use. Stops can be categorized into two types:

- **Scheduled stops:** The bus arrives and departs on a pre-scheduled time. Scheduled stops are a norm in urban areas.
- **Request or flag stop:** The bus does not stop unless signaled by a person to do so. Patrons waiting at a bus stop may request a stop by pressing a button. Similarly, on-board patrons may request stop by pulling cord. Presence of a person waiting at the stop is also sufficient to stop the bus. In certain cases, a request stop is also defined as an unscheduled stop to let off passengers. Depending on roadway safety and traffic considerations, transit agencies may also offer this service during evening routes.

Bus stops are most commonly placed along the curb. In cases where on-street parking is allowed, the bus stop areas are designated no-parking zones or special lane configurations such as bulb outs are employed. In commercial areas, transit agencies can collaborate with private property owners to locate a bus stop as a part of development.

Figure 2.7 lists demand-and supply-side factors that can be utilized as indicators of potential or need of a stop. Demand-side factors reflect a need from the user side but are often difficult to be met due to supply-side constraints.

Figure 2.7: Criteria for Determination of Bus Stop Location



Source: Gannett Fleming, Inc.

2.3.1 Spacing by Roadway Type

The optimum spacing for bus stops is defined as spacing which minimizes the sum of the cost of time to passengers and the operating cost of buses. For agencies, the focus is on revenues, operational costs, service reliability, and passenger satisfaction. Bus stop spacing:

- Is an optimization issue that tries to balance the different needs of passengers and operational requirements;
- Has a major impact on vehicle and system performance as well as on service quality and accessibility;
- Is correlated with the density of development, which proxies demand. Exceptions can be made to cater to the special mobility needs of a small segment of population;
- Shall be within one-quarter mile radius or walkable distance according to a planning rule-of-thumb. The determination of what can be considered a walkable distance should depend on local land use, urban form, topography, and travel time; and
- Is large in rural areas with less-frequent transit service and stops, and are located around local activity centers.

Table 2.2 summarizes stop spacing guidelines provided by the Transit Cooperation Research Program (TCRP) and the National Cooperative Highway Research Program (NCHRP). Different agencies opt for different spacing standards and the two examples presented are based on widely used industry practices. Often bus stops are added on an as-requested basis along existing bus routes - a practice that can lead to operational inefficiencies and negatively impact service reliability. To address this, a periodic re-examination of stop spacing is recommended.

Table 2.2: Bus Stop Spacing

	TCRP Report 19 Range (typical spacing)*	NCHRP Report 69 Range*
High-density residential areas, CBDs, and major employment centers	300 -1000 (600)	440-528
High-density residential and employment areas	500 -1000 (750)	660-880
Suburban residential areas (4 to 22 units/acre)	600 -2500 (1000)	1056-2640
Rural areas	650 -2640 (1250)	1320-2640

*Dimensions in feet

2.3.2 Considerations for Impediments/Hazards

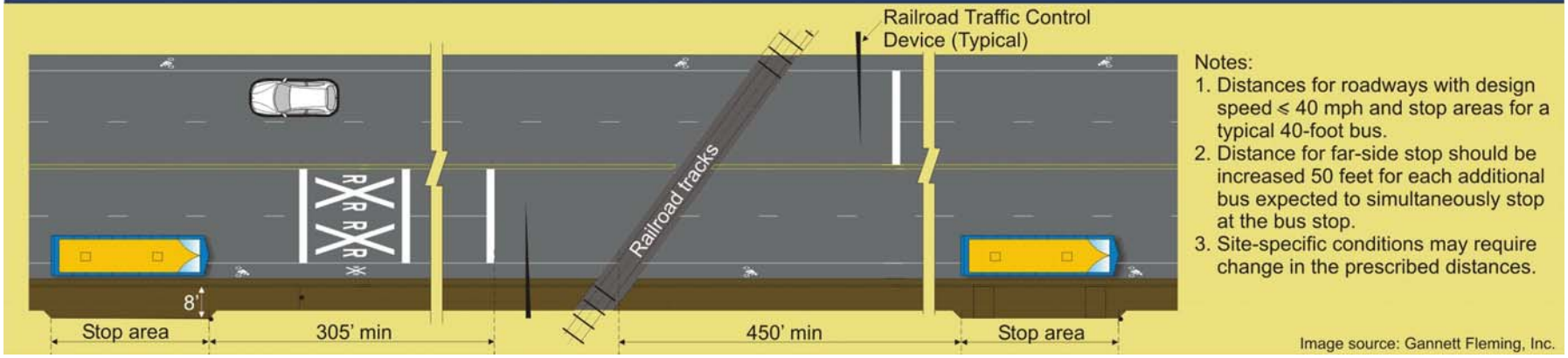
Maintaining the recommended stop spacing is often difficult due to the presence of impediments or hazardous objects and activities. At the same time, it is important that transit facilities do not become hazards for pedestrians, bicyclists, and non-transit vehicles. The following discussion addresses impediments such as drainage and ditches, railroad crossings, driveways, and canals that limit potential locations for bus stops. Requirements related to minimum distances for transit facilities, sight distances, and horizontal clearances are also included.

➘ Railroad Crossings

Per Florida Statute 316.1945 (I), a minimum distance of 50 feet should be maintained between bus stops and the nearest railroad crossing. The minimum distance value is calculated based on appropriate stopping sight distance to railroad crossings. The minimum distance should be modified based on site-specific conditions.

- **Bus routes parallel to railway tracks:** Bus stops should be placed outside of the clear zone of the railroad (minimum 8 feet) or be protected by crash walls.
- **Bus routes perpendicular to railway tracks:** Near-side bus stops are recommended and should be located such that railroad-warning signs are not obstructed by a stationary bus. Supplemental left side signs should be provided at all near side bus stop locations.

Figure 2.8: Stop in Relation to Railroad Crossing



Refer to:

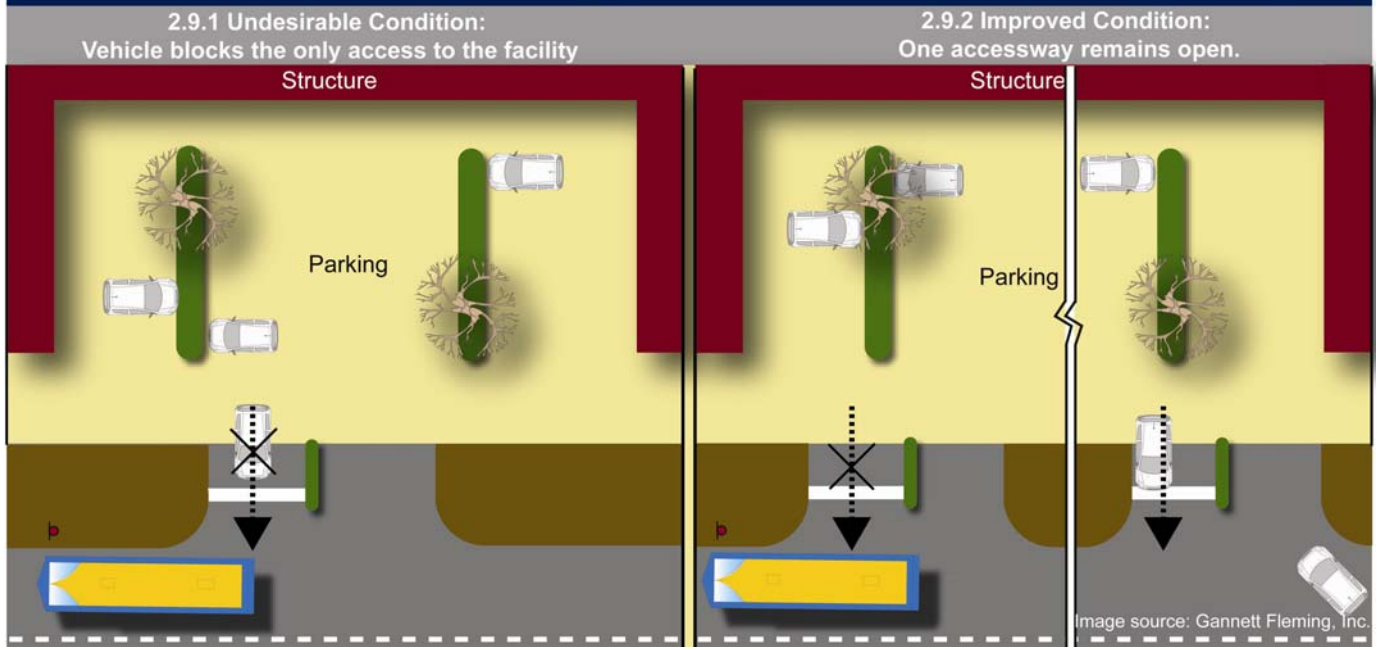
FDOT Driveway Handbook

➘ Driveway/Access Cuts

Driveways upstream of bus stops are critical, as a bus at a stop location will reduce the sight distance of a right-turning vehicle. For a proposed stop location, all driveways within 250 feet should be identified. This distance should be increased depending on the posted speed of the facility and the number of buses that are expected to stop at the same time.

- Bus stops should not block driveways. If a bus stop is either too close to a driveway or blocking it, at least one entrance and exit should remain open at all times (Figure 2.9).
- It is recommended that a bus stop be located downstream of traffic movement from a driveway.
- Bus stop infrastructure and amenities should not block view of traffic entering or exiting the driveway;
- Consult roadway authorities and property owners when there is a possibility of a transit vehicle blocking the only access route to the property;
- Under all circumstances stops where a vehicle blocks an accessway should not be layover points or transfer locations.
- Pedestrian impacts of stop placement should be carefully considered. Frequently, pedestrians walking past a bus stop will go around the bus stop and that may take them out of the sight line of non-transit vehicle drivers.

Figure 2.9: Stops in Relation to Accessways



Refer to:

FDOT Plans Preparation Manual Chapter 4.2: Hazard Standards

➘ Canals and Drop-off Hazards

Drop-off hazards are defined as steep or abrupt downward slopes. It is desirable that all bus stops in urban areas be located at least 20 feet from canals (Figure 2.10) and 6 feet from a drop-off location. Where conditions do not permit this, site-specific engineering judgment should be employed and the following should be considered:

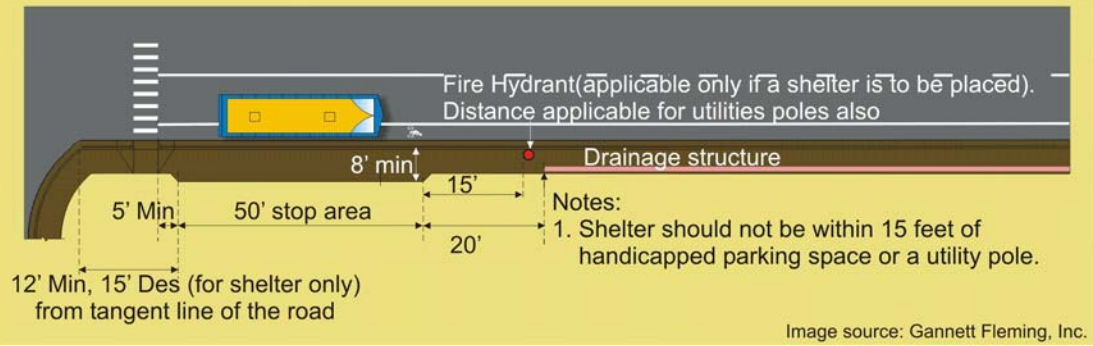
- Stop infrastructure or amenities should not obstruct the flow of the canal;
- Special design and safety considerations should be given to stops that are likely to be used by children, elderly, and people with disabilities; and
- Depending on clear zone requirements, standard bus stop design and accessibility measures such as guard and hand rails immediately adjacent to canal or drop-off locations should be implemented.

➘ Site Dimensions

While locating a bus stop, appropriate distances should be maintained from other infrastructure and services (Figure 2.10) and the following should be considered:

- A minimum distance of 5 feet should be kept between a bus stop and the edge of a crosswalk or end of a radius, whichever is farther from the intersection;
- Florida Administrative Code Section 14-20.003 requires that a minimum 15 foot distance be maintained between a bus stop and an on-street parking space for people with disabilities;
- If a shelter is to be placed, a minimum 15 feet distance from a fire hydrant and 12 feet from the intersection point of curve/tangent should be maintained. Site conditions or other regulations may require more distance.
- It is desirable that a shelter be placed at a 15 foot distance from a pole. Under all circumstances, a minimum distance of 8 feet should be maintained.

Figure 2.10: Site Dimensions



➘ Horizontal Clearances and Sight Distances

- The Federal Highway Administration (FHWA) defines horizontal clearance as the lateral offset distance from the edge of the traveled way, shoulder or other designated point to a vertical roadside element. These dimensional values are not calculated, and are not intended to constitute a clear zone. They are intended to provide a roadside environment that is not likely to have an adverse affect on motorists' using the roadway. These lateral offsets provide clearance for mirrors on trucks and buses that are in the extreme right lane of a facility and for opening curbside doors of parked vehicles, as two examples.
- Sight distance on the other hand, is the length of a roadway visible to a driver and is required to ensure that a driver can see that the road is clear and avoid conflicts with other vehicles and objects.
- Sight distance is critical to drivers in making decisions such as to stop, slow down, turn, or merge into traffic.
- Sight distance on rural roadways is often critically important because of unsignalized intersections and dense vegetation that pose unique challenges.
- Rural roadways also have higher travel speeds and curves or terrain that may restrict sight lines. Higher vehicle speeds also limit a driver's ability to react quickly.
- Horizontal clearance and sight distances are also important for pedestrian safety. If a roadway facility has unique sight distance related issues, the roadway design engineer of the respective facility should be contacted before locating a transit facility.
- Under all conditions, transit facilities, landscaping, and signage should meet the applicable sight distance requirements. Facilities on state roads must comply with the FDOT Design Standards and for non-state roads, the sight distance requirements for street connections of the applicable jurisdiction apply.

➘ Placement of Stops in Relation to Street Intersections

The following should be considered for bus stop placement:

- ♦ A skewed intersection should be carefully analyzed;
- ♦ For all stop areas, a minimum 5 foot distance from the edge of the crosswalk and, if a shelter is to be placed, a minimum 12 foot distance from the intersection point of curve/tangent should be maintained (Refer to Figure 2.10);
- ♦ Traffic pattern, volume and controls;
- ♦ Restricted turning lanes;
- ♦ Turning movement of transit and non-transit vehicles;
- ♦ Curb clearance needs;
- ♦ Clear zone and horizontal clearance requirements;
- ♦ Pedestrian, bike, and vehicular safety; and
- ♿ Access for people with disabilities.

Advantages and disadvantages of different stop locations shown in Figure 2.11 are discussed in Table 2.3. The final decision on bus stop locations should be based on ease of operation, transfer situations, space availability, and traffic volumes. Table 2.4 provides recommended stop locations for various conditions.

Figure 2.11: Stop in Relation to Intersections

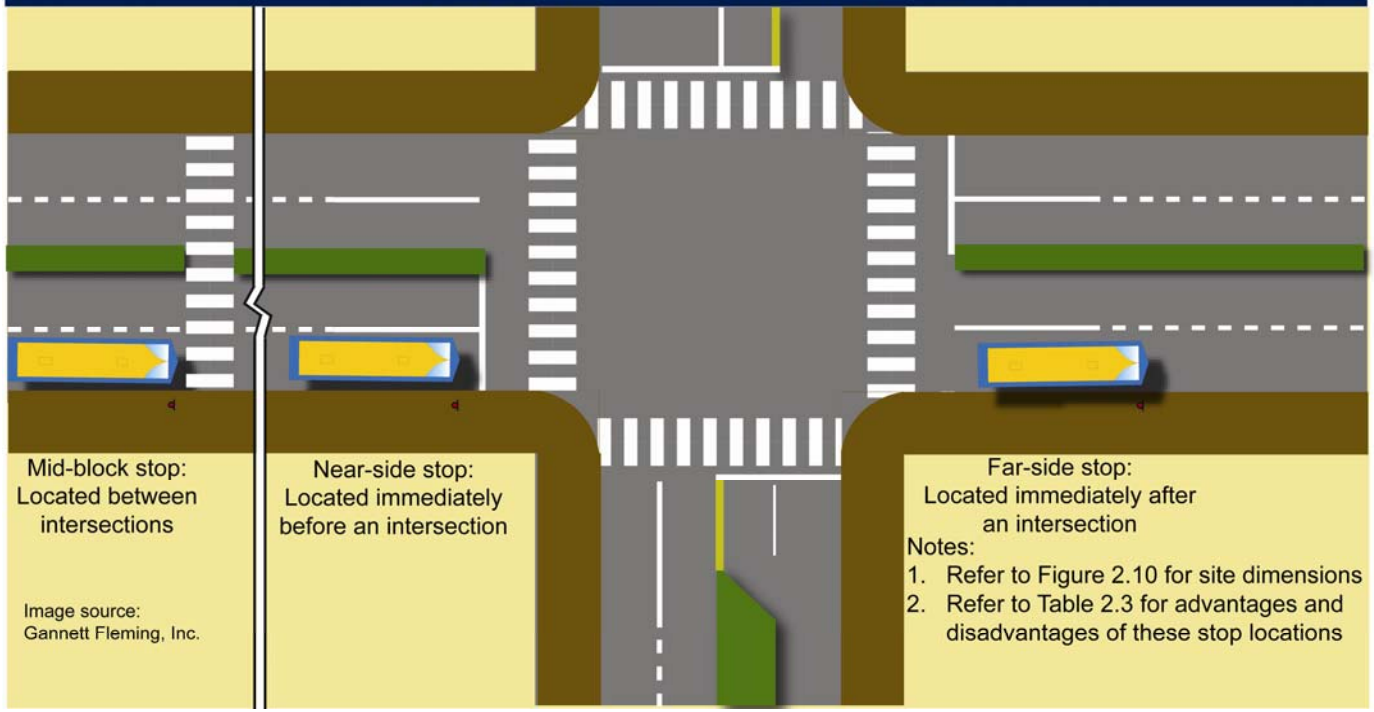


Table 2.3: Advantages and Disadvantages of Stop Locations Types		
Near-side Stop	**Advantage**	**Disadvantage**
Traffic control and operations	- Minimizes interference when traffic is heavy on the far-side of the intersection	- Increases conflicts with right turning vehicles - Sight distance is obstructed for cross-traffic - Through lane may be blocked during peak periods by queuing buses
Safety and comfort	- Permits pedestrians to access buses close to crosswalk	- Buses may block sight of traffic control devices and crossing pedestrians - Increases sight distance problems for crossing pedestrians
Transit operations	- Intersection available to assist in pulling away from the curb - No double stopping as buses can service passengers while stopped at a red light - Provides driver with an opportunity to look for oncoming traffic including other buses with potential passengers	- May cause vehicles making a right turn to wait till passengers board and the signal turns green. During this phase, non-transit vehicle drivers may try to drive around the bus to turn right.
Far-side Stop	**Advantages**	**Disadvantages**
Traffic controls and operations	- Right turns can be accommodated with less conflict - Provides additional right turn capacity by making curb lane available for traffic - Minimizes sight distance problems on approaches to intersection	- Intersections may be blocked during peak periods by queuing buses
Safety and comfort	- Encourages pedestrians to cross behind the bus	- Sight distance may be obstructed for crossing vehicles and pedestrians - May increase number of rear-end accidents since drivers do not expect buses to stop again after stopping at a red light
Transit operations	- Requires shorter deceleration distances for buses - Gaps in traffic flow are created allowing buses to safely re-enter the flow of traffic at signalized intersections	- Stopping on the far side after stopping for a red light interferes with bus operations and all traffic in general.
Mid-block stop	**Advantages**	**Disadvantages**
Traffic controls and operations		- Requires additional distance for no-parking restrictions on roadways with on-street parking
Safety and comfort	- Minimizes sight distance problems for non-transit vehicles and pedestrians - Stop areas experience less pedestrian congestion - Stop can be placed adjacent to a major attractor	- Encourages patrons to make mid-block street crossings - Increases walking distance for patrons crossing at intersections - Not advisable unless required under special circumstances

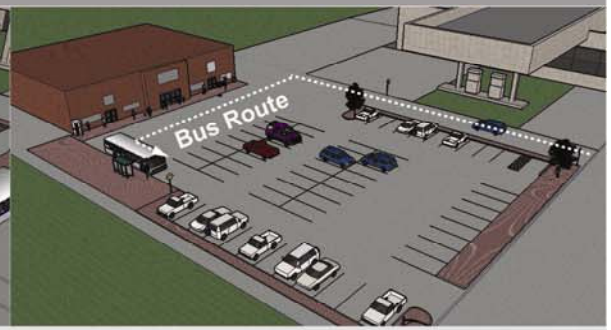
Table 2.4: Recommended Situations For Stop Location Types		
Near-side stop	**Far-side Stop**	**Mid-block stop**
- When traffic is heavier on the far-side than on the approaching side of the intersection - When pedestrian access and landing area conditions on the near-side are better than on the far-side - When street crossings and other pedestrian movements are safer on the near-side than the far-side - When the bus route continues straight through the intersection - When the cross street is a one-way from right to left - When the route causes the bus to turn right from an intersection	- When traffic is heavier on the near-side than on the far-side of the intersection - At intersections where heavy right turn occurs - When pedestrian access and existing landing area conditions on the far-side are better than on the near-side - At intersections where traffic conditions and signal patterns may cause delay - At intersections with transit signal priority treatments - When the cross street is a one-way from left to right - At unsignalized intersections	- When traffic or street/side walk conditions at the intersection are not conducive for a near-side or far-side stop - When a major passenger traffic generator is located in the middle of a block - When the interval between adjacent stops exceeds stop spacing standards for the area - When a mid-block stop is compatible with a corridor or district plan

➘ Connectivity to Activity Centers

Activity centers such as major employment areas and shopping centers provide a suitable opportunity to capture a large number of transit patrons within a concentrated area. However, these centers often attract a significant volume of non-transit traffic which can adversely impact transit travel time. A well-located stop can minimize such issues and increase accessibility.

Transit agencies should coordinate with developers to locate stops within the development such that transit patrons do not have to walk through a parking lot to access transit. If a transit stop cannot be located within the development, pedestrian walkways through the parking lot can be developed to provide safe and direct access to transit stops (Figure 2.12).

Figure 2.12: Stop In Relation to Activity Centers

2.12.1 Condition 1	2.12.2 Condition 2	2.12.3 Condition 3
		
Advantages: 1. Saves travel time as the bus remains on the main thoroughfare 2. Provides higher visibility of transit facilities	Advantages: 1. Enables safer pedestrian movement and reduces potential pedestrian-vehicle conflicts 2. Saves travel time as the bus remains on the main thoroughfare	Advantages: 1. Reduces walking distance 2. Reduces potential pedestrian-vehicle conflicts 3. Convenient for patrons with shopping bags, strollers, and disabilities 4. May be suitable as a transfer point
Disadvantages/limitations: 1. Patrons walk through the parking lot to access transit facility 2. Increases potential pedestrian-vehicle conflicts 3. In case of a mall or retail store, patrons may have to walk through the parking lot with shopping bags 4. Carts collect at the stop	Disadvantages/limitations: 1. Patrons still have to walk through the parking lot 2. Inconvenient in extreme climate conditions 3. Requires the property owner to eliminate a few parking spaces 4. Carts collect at the stop	Disadvantages/limitations: 1. Increases travel time for buses 2. Increased potential transit vehicle-non-transit vehicle conflicts 3. Requires co-ordination with the property owner 4. Transit vehicle may have difficulty merging in the thoroughfare traffic

Source: Gannett Fleming, Inc.

2.4. Stop Design

Design of bus stops can significantly influence the flow characteristics of traffic on the road.

2.4.1 Bus Bays

Bus bays are also referred to as bus turnouts, off-line bus stops or bus pullouts, and they provide a special zone on the side of the main roadway for buses to stop for passenger boarding and alighting. The purpose of the bus bays is to avoid blocking a lane of traffic and to improve passenger safety. Bus bays should be considered under the following circumstances:

- Traffic in the curb lane exceeds 250 vehicles during the peak hour;
- Passenger volume at the stop exceeds 20 boardings per hour;
- Traffic speed is greater than 40 miles per hour;
- Bus volumes are 10 or more per peak hour;
- Recurrent crash patterns;
- Availability of right-of-way and suitable roadway geometrics;
- Buses are expected to layover at the end of a route or at transfer locations;
- Average peak-hour dwell time exceeds 30 seconds per bus;
- Improvements such as widening are planned; and
- Roadway profile low points can be avoided and a 2% cross slope can be achieved on the roadway.

Alternatives should be looked at when:

- The traffic volumes exceed 1,000 vehicles per hour per lane; and
- In high-density commercial areas with on-street parking, bus nubs are potential alternatives to bus bays.

At a specific location, the factors may be conflicting and a balance must be obtained based on the designer's judgment. Table 2.5 provides a comparison of advantages and disadvantages of bus bays.

Table 2.5: Bus Bay

Advantages	Disadvantages
- Provides a protected area away from moving vehicles for both the stopped bus and bus patrons - Minimizes delay due to through traffic and thus assists in maximizing the vehicle capacity of the roadway - Reduces probability of rear-end crashes when buses stop	- Merging into traffic may be challenging during peak-hour traffic - Installation, compared to curbside stops, is more expensive - If required, it cannot be relocated - May increase rates of sidewipe or rear-end crashes as buses re-enter the traffic stream - Potential conflicts with bicyclists in bicycle lane

➘ Priority Merge Rule

Florida Statute 316.0815 specifies that a transit bus entering in the direction of traffic from a designated pullout bay has the right-of-way. Even though not every vehicle will yield, but even if one vehicle does, it can significantly reduce merging delays and can result in increased service reliability, decreased travel time for passengers, less stress on bus operators, and less impact on bus operations due to traffic congestion.

➘ Types Of Bus Bays

Different combinations of stopping area, acceleration lanes, and deceleration lanes can be used to best fit the site conditions. The following four types can be considered:

♦ Closed Bus Bay

What it is: It consists of a deceleration lane, a stopping area, and an acceleration lane (Figure 2.13).

Where it is used: It is generally suitable for placement at all three types of stop locations – near-side, far-side and mid-block.

Minimum condition: A bus bay on the near-side should be avoided to minimize conflicts with vehicles in right-turn lanes. If identified as a requirement in special circumstances, an acceleration lane of adequate length for applicable traffic conditions should be provided.

Best condition: A bus bay on the far-side of a highly congested, signalized intersection or at the far-side of a less-congested un-signalized intersections.

Figure 2.13: Closed Bus Bay

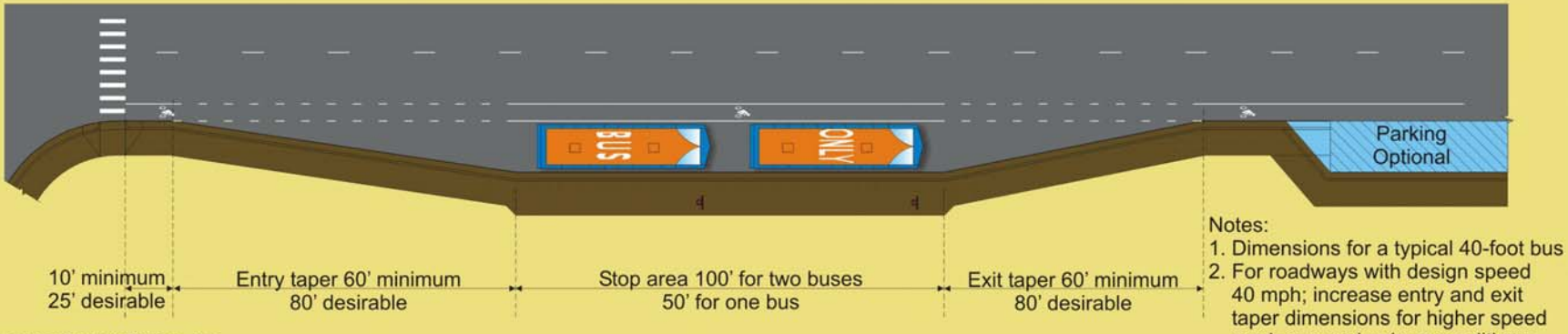


Image source: Gannett Fleming, Inc.

♦ Open Bus Bay

What it is: It consists of a stopping area and an acceleration lane. It does not have a deceleration lane (Figure 2.14).

How it works: The bay is kept open for the upstream intersection and the buses use the intersection for deceleration and to switch lanes.

Where it is used: Suitable for far-side stops. The shorter overall length helps overcome right-of-way constraints.

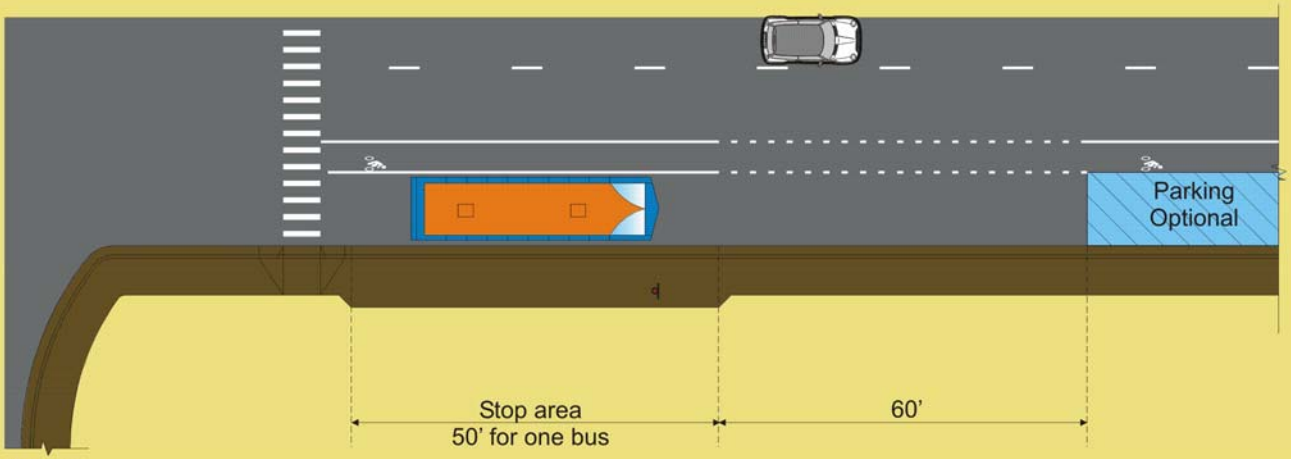
♦ Queue Bypass Bus Bay

What it is: It provides priority treatment to buses by allowing them to bypass queues at signalized intersections.

How it works: It provides a double benefit by removing stopped buses from the traffic stream and guiding them through congested intersections. However, it may cause delays to right-turning vehicles if the bus stop is located at the beginning of the right-turn lane.

Where it is used: It is best suitable for near-side stops, right turn lanes and far-side open bus bay on high frequency bus service routes on streets with traffic volumes of 250 vehicles per peak period hour or level of service “D” or worse.

Figure 2.14: Open Bus Bay



Notes:
1. Dimensions for a typical 40-foot bus and roadways with design speed 40 mph

Image source: Gannett Fleming, Inc.

♦ **Bus Bay – Right Turn Lane Combination**

What it is: It consists of a stopping area and a deceleration lane. The right-turn lane is used for transit vehicle acceleration (Figure 2.15).

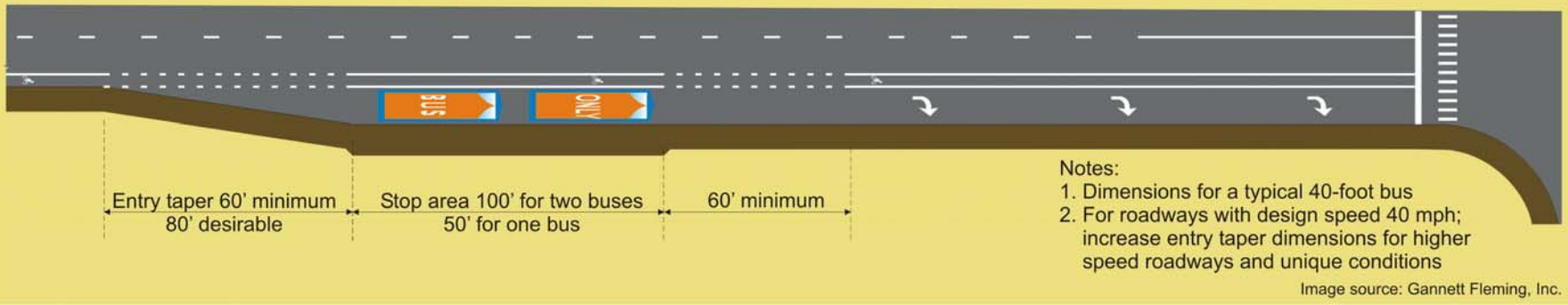
How it works: While this has all the advantages of a closed bus bay, it may cause delays to right-turning vehicles if the bus stop is located at the beginning of the right-turn lane.

Where it is used: In many instances, conflict between buses and right-turning vehicles exist. To address this conflict, it may be appropriate to develop a combined bus bay/right turn lane, which can accommodate both transit and right-turning vehicles. It can be used for near-side bus bays with an intersection auxiliary right turn lane or far-side bus bays with an auxiliary right turn lane for a succeeding turnout connection.

Desirable condition: The bus bay is placed partially upstream from the right turn lane so that the bus bay and right turn lane share the bus exit and right turn entry taper.

Best condition: The bus bay is placed entirely upstream from the right turn lane.

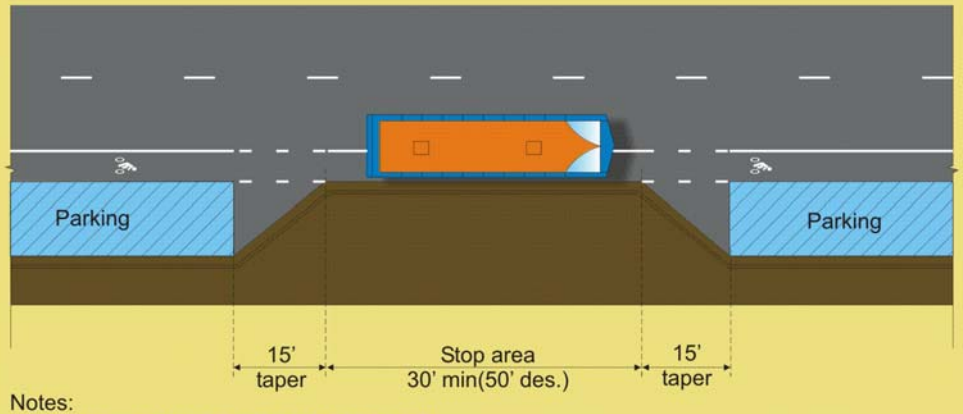
Figure 2.15: Bus Bay in Right-turn Lane



♦ **Bus Bulbs**

Bus bulbs are a form of curbside stops and have the potential for improving the safety and operation of bus transit and pedestrian movements (Figure 2.16). It is an arrangement by which a sidewalk extends towards the travel lane for a bus stop so that a bus can stay in its traffic lane to pick up or drop-off passengers thus allowing buses to avoid being delayed. Typically, the bus bulb replaces a part of a roadway with a parking lane and is most commonly employed in Central Business Districts (CBD). Table 2.6 provides a comparison of advantages and disadvantages of bus bulbs.

Figure 2.16: Bus Bulb



Notes:
1. Dimensions for a typical 40-foot bus and roadways with design speed 40 mph

Image source: Gannett Fleming, Inc.

Table 2.6: Bus Bulbs

Advantages	Disadvantages
- Permits on-street parking - If a crosswalk is provided, it decreases the walking distance (and time) for pedestrians crossing the street - Provides better sight lines to bus patrons waiting for the bus - Provides additional sidewalk area for bus patrons to wait - Segregates waiting bus patrons from pedestrian flow on the sidewalk - Minimizes delays due to bus merging in the traffic - Provides additional space for amenities including bus shelters - a big advantage when the sidewalks are narrow - Enables better wheelchair access	- Can cause traffic to queue behind a stopped bus, thus causing traffic congestion - May cause non-transit vehicle drivers to make unsafe maneuvers when changing lanes to avoid a stopped bus - Installation is more expensive compared to curbside stops

Important to Note

FDOT Design Standards provides guidance on specifications related to pavement design. clear zone and sight distance requirements.

2.4.2 Typical Cross Sections and Pavement Design

In urban areas, if right-of-way exists, a bus bay can easily be incorporated in a new facility that is being planned or designed (Figure 2.17.1). In this case, the water accumulates in the gutter placed along the bus bay curb. The gutter should be placed such that water does not accumulate near the bus doors.

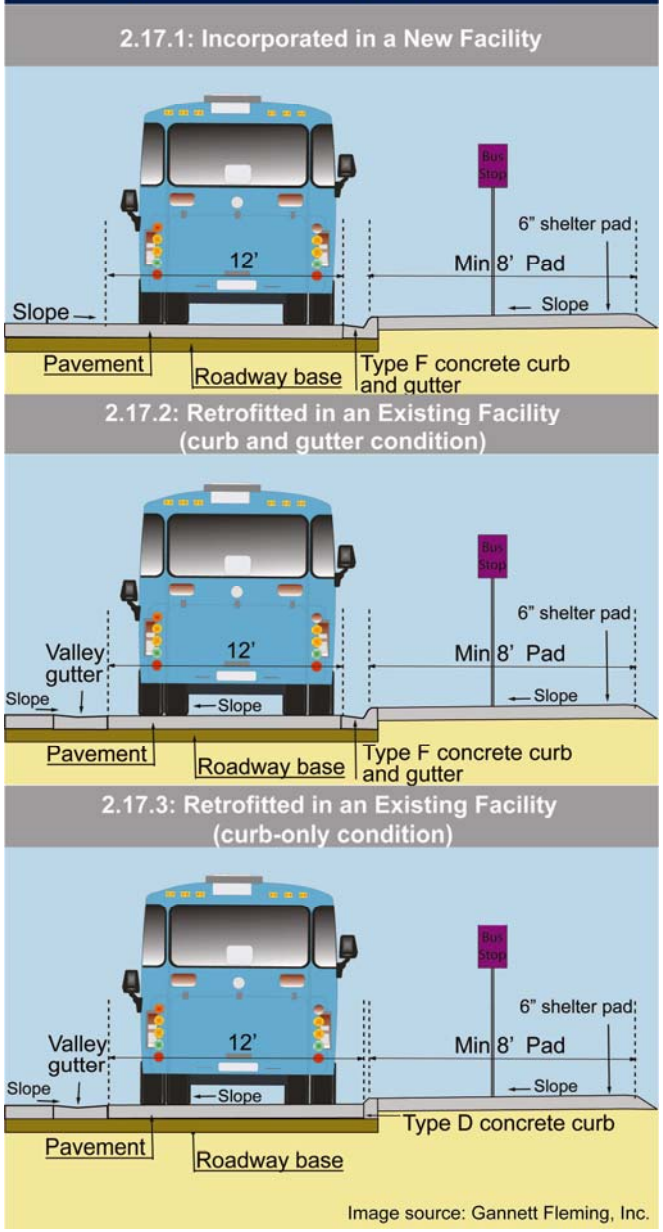
Figures 2.17.2 and 2.17.3 are often the most commonly seen examples of a roadway cross-section where a bus bay is included in an existing facility. In such cases, type D or F curbs can be used.

In rural areas, in the absence of curb and gutter, the cross-section in Figure 2.17.1 can be used, where the curb will be provided on the bus pad which will direct storm water towards the roadway slope. It is important not to locate stops where water frequently accumulates.

The type of pavement is determined by analysis of:

- Volume and composition of traffic;
- Soil conditions;
- Availability of materials;
- Initial cost, and estimated cost of maintenance; and
- Projected number of buses to use a bus bay and expected layover times.

Figure 2.17: Bus Bay Cross-section



Pavement must be able to withstand weight loads from transit vehicles as the buses start, accelerate, stop, and take turns. Bus bays are constructed with a flexible (asphalt) or rigid (concrete) pavement section that covers the entire turnout area. Usually, the pavement material used for roadways is also used for bus bays. However, in urban curb and gutter situations, it is also possible to easily accommodate a concrete bus bay on an asphalt roadway. For all closed bus bays, concrete pavement is recommended. Wherever conditions permit, concrete pavement should also be used for other types of bus bays. Refer to the FDOT Pavement Design Manual for additional pavement design criteria.

2.5. Americans with Disabilities Act (ADA) Requirements

The Americans with Disabilities Act (ADA) of 1990 covers a host of subjects regarding equal opportunity for the disabled as a civil right. Title II of the ADA Act addresses public services including transportation provided by public entities.

Under the ADA, the Access Board has developed and continues to maintain design guidelines that covers a wide variety of facilities and establishes minimum requirements for new construction and alterations. The Board maintains a similar responsibility for accessibility guidelines under the Architectural Barriers Act (ABA). The ABA requires adherence to accessibility provisions for facilities designed, built, altered, or leased with Federal funds.

The Board's guidelines become enforceable when they are adopted by the standard setting agency for the ADA and the ABA. The agencies responsible for standards under the ADA include the Department of Transportation (DOT).

Refer to:

Final Report – Public Rights-of-Way Access Advisory Committee

Careful consideration should be given to the range of disabilities in order to plan and design transit facilities in compliance with ADA requirements. All applicable local, state, and national standards should be followed. At a minimum, transit facilities should be designed to serve individuals with the following impairments:

- Mobility impairments;
- Visual impairments;
- Hearing impairments; and
- Developmental impairments.

2.5.1 Accommodation of Accessibility Requirements

The Access Board requires that elements such as ramps and circulation devices shall be placed to minimize the distance which wheelchair users and other persons who cannot negotiate steps may have to travel compared to the general public. Surfaces shall be stable, firm, and slip-resistant, and any changes in level are subject to the requirements summarized in Table 2.7.

ADA compliance in Suburban and Rural Areas

Mobility in rural and suburban communities remains a major issue. ADA ensures that transit vehicles and facilities are accessible by people with special needs. However, for rural and suburban areas without a fixed-route service, ADA compliance can be challenging. In such cases, customer feedback and special requests can be considered proxy for the need to place a fixed-stop with an ADA compliant infrastructure. In addition, transit vehicles must provide wheelchair lifts or the loading ramps for boarding and alighting customers with disabilities. In rural areas, transit services are often on-demand and on-call; therefore, the transit operator is aware of the ADA accessibility needs of the transit user.

Table 2.7: ADA Level Change Requirements for Ground and Floor Surfaces

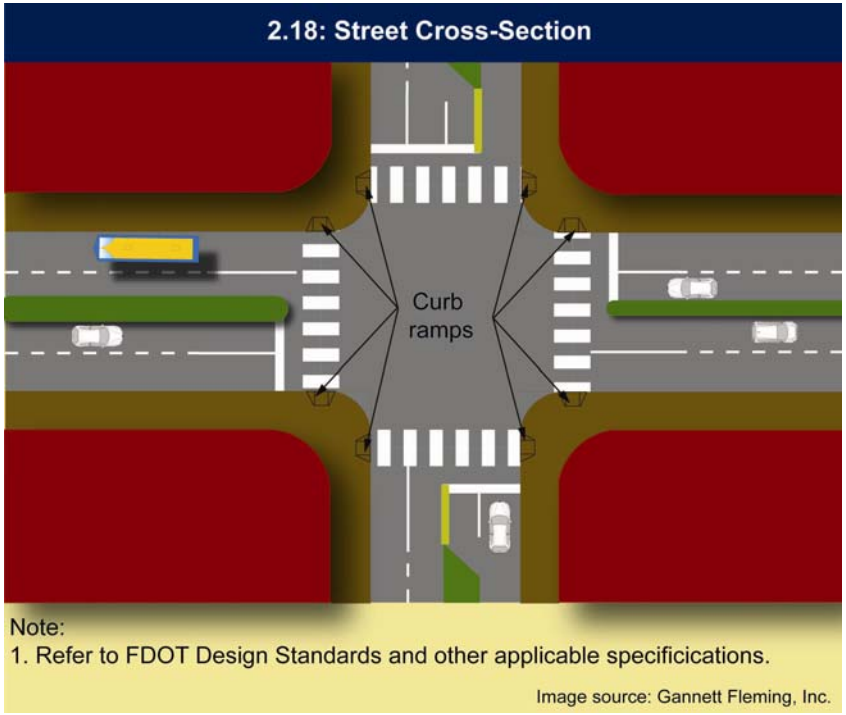
Level Change	Required Treatment
Less than ¼ inch	No special treatment required
Between ¼ and ½ inch	A bevel with a maximum slope of 1:2
More than ½ inch	A ramp with maximum slope not greater than 1:12.

Slope and rise restrictions may vary for depending on the location.

Pedestrian Crosswalks Accommodation

Crosswalk related issues are particularly important from the accessibility point of view. The following should be considered to ensure that crosswalks are in compliance with ADA requirements.

- The Access Board requires that curb ramps must be provided wherever there is a difference in level on an accessible path (Refer to Table 2.7).
- Curb ramps should not be located at places where water accumulates or the access is blocked by vehicles. Ramps should also have detectable warning surfaces and the running slope should not exceed 1:12.
- Crosswalk markings should be located so that a pedestrian in a wheelchair should not have to leave the crosswalk to enter or exit the street. In some cases, a wider ramp may be used to accommodate individuals on wheelchairs. In urban areas, it is desirable to provide two curb cuts as shown in Figure 2.18.
- The road agency with jurisdiction should be consulted about design and construction of curb ramps along public roadways.



2.6. Pedestrian Crossings

Refer to:

Safety Effects of Marked Versus Unmarked Crosswalks at Uncontrolled Locations Final Report and Recommended Guidelines

Streets are places of concentrated vehicular, bicycle, and pedestrian activities that are often conflicting. Most transit users walk to and from bus stops and crosswalks are critical in establishing the pedestrian network. An extensive network of sidewalks will have limited utility if little attention has been paid to pedestrian crossings. Marked crosswalks are designed to guide pedestrians to cross at the safest location. Street crossings in many suburban and rural intersections can be difficult for pedestrians to cross. Transit agencies, with sustained coordination with applicable agencies, can ensure that street crossings become safer.

2.6.1 Location of Crossings

The location of pedestrian crossings is determined by the volume and pattern of existing or expected pedestrian trips. Thus, in areas with high pedestrian volumes, crossings should be provided at frequent intervals. The most common location for pedestrian crossings (marked and unmarked) is at an intersection with traffic control (e.g., stop signs or traffic signals). It can be expected that transit users getting off at far-side or near-side bus stop will use pedestrian signals at intersections to reach their destinations.

At mid-block stop locations, if a significant number of pedestrians cross roadways, signalized crossings should be considered. In such cases, crosswalks should be located such that incoming traffic is visible to pedestrians.

In rural areas, in the absence of pedestrian signals, factors such as the number of motor vehicle lanes, pedestrian exposure, average daily traffic (ADT), posted speed limit, and geometry of the location should be carefully considered.

2.6.2 Signal Timing

The following types of signal timing methods for pedestrian signals should be considered:

- **Concurrent:** Vehicles may be allowed to turn left or right after yielding to pedestrians;
- **Exclusive:** Traffic stops in all directions for pedestrian movement. This method may only be effective in locations with unusually high pedestrian volumes, and
- **Leading Pedestrian Interval (LPI):** It works the same as concurrent signal with the exception of an advance signal for pedestrians before motorists get a green signal.
- The American Association of State Highway and Transportation Officials (AASHTO) recommends the following measures to reduce pedestrian-vehicular conflicts:

  - Avoid channelized right turn lanes that facilitate high-speed turns on urban roadways;
  - Prohibit right-turn on red if there are substantial pedestrian-vehicular conflicts; and
  - Provide pedestrian grade separations.

Refer to:

FDOT's Plans Preparation Manual Volume I, Chapter 10

Manual of Uniform Traffic Control Devices (MUTCD)

Different methods of signal timings from the pedestrian suitability point of view include:

- **Best condition:** Fixed-time signal operation with shorter cycle lengths and longer walk intervals. This is most commonly employed in urban areas such as downtowns with high pedestrian volumes.
- **Desirable condition:** Push buttons with optimal walk intervals for crossings. Response interval to the push buttons can be adjusted to give preferential treatment to pedestrians. Pedestrian signals at mid-block stops with considerable pedestrian volume are candidates for signalized pedestrian crossings.
- **Minimum condition:** If pedestrian signals cannot be installed, traffic calming devices and methods, installation of a "YIELD TO PEDESTRIAN" sign, appropriate markings, and a median design should be considered.

2.6.3 Median Refuge

A median refuge is a streetscape amenity and consists of an island in the center of streets. A median refuge allows pedestrians to deal with only one direction of traffic at a time and provides a safe stopping point (Figure 2.19). Median refuges should be considered in the following situations:

- Wide crossings with high pedestrian volume;
- Mid-block stops with high pedestrian volume;
- Street crossings with a high number of elderly, young pedestrians, and wheelchair users;
- Bus stops located around schools; and
- Areas where pedestrians are likely to use strollers or carry bags.

Figure 2.19: Median Refuge

2.7. Transit Provisions during Construction

Typically, roadway construction or improvement projects will have a Temporary Traffic Control (TTC) Plan that describes how traffic is to be (or will be) controlled through a work zone and includes provisions for transit stops. The following should be considered while drafting a TTC:

- Careful consideration should be given to transit operations and necessary arrangements should be made to minimize inconvenience to transit patrons;
- When detours are required, the geometry of the detour route should be compared against the operational requirements of transit vehicles;
- Traffic control devices should not be placed in locations where they will block transit stops;
- At transit stops, provisions should be made to ensure passengers can safely board and depart from transit vehicles;
- If a transit stop or route needs to be relocated, appropriate signage and advance notification to passengers should be provided; and
- While designing detours, accessibility requirements must be considered.

3. Curbside Factors

Streetside factors discussed in the previous section look at the "big picture" with respect to accommodating transit facilities. Curbside factors, on the other hand, are more closely related with the experiences of transit patrons at a transit stop. This section seeks to achieve an objective of providing safe and clean facilities at bus stops. It provides information on stop infrastructure and amenities such as transit shelters, seating areas, bicycle racks, and landscaping. Areas of discussion also include Crime Prevention through Environmental Design (CPTED) techniques, safety and security, and maintenance factors that can significantly improve the quality of the stop area environment.

Table 3.1: Transit Stop Classification

In Relation to Roadway	Service Type	Sample Picture	Characteristics
On-Street	Local or neighborhood		- Low-passenger volume - Trip originations - In residential areas - Often have minimum amenities
	Primary		- Trip attractions - Route transfer points - Typically will have more amenities
On/Off-Street	Transit station		- May serve multiple functions depending on scale and location; e.g. within transit agency's administrative facility, CBD stops - Route transfer or route originations
Off-Street	Intermodal station		- Typically attracts large ridership
	Park-and-ride station		- One type of intermodal station - Often located near trip originations - Mode and route transfer locations - Refer to Section 6

3.1. Stop Classification

Transit stops can have differing levels of activities and passenger amenities. All stops serve as transition points where transit passengers begin, end, or continue their trips. Therefore, the quality of the environment at stops is as important to passengers as is the quality of the trip. Transit stops are classified based on the number of boardings, their relation to the roadway, and scale or service type. For the purpose of this handbook, stops are categorized by their relation to the roadway and service type (Table 3.1).

Planning and design of large-scale facilities involves complex analysis and the procedures usually follow a different set of regulatory guidelines. This handbook will focus on on-street transit facilities that are prevalent to FDOT Districts One and Seven. Please refer to Section Six for a detailed discussion of park-and-ride facilities.

3.2. Stop Infrastructure and Amenities

Stop infrastructure consists of elements essential to the function of transit stops. Features such as bus route sign, bus pads, and lighting are basic features that are required for maintaining minimum safety and comfort.

Stop amenities add value to a transit trip and are primarily used for increased comfort of the transit patrons. Amenities include seating, shelter, bicycle racks, etc.

Various indicators can be used to identify the need for amenities at transit stops. Most transit agencies use the number of boardings as the only determinant for installation of shelters. A comprehensive analysis of field practices indicates that number of boardings does not suffice as the only indicator of transit amenity needs. It is important to note that transit stops do not function in isolation and are a part of the urban fabric. Therefore, the following indicators are recommended to be utilized for identifying stop area needs:

- **Number of boardings (Usage):** From a utility point of view, highly used facilities provide the most value for money spent on amenities. The number of boardings remains a useful indicator.
- **Transfer locations (Function of transit stop):** Transfer stations are stop points in the middle of a transit trip and are serious contenders for additional amenities.
- **Mobility needs (Transit dependency and healthcare facilities, etc.):** It is widely known that demographic groups such as low-income transit-dependent, youth and senior citizens may have different mobility needs. Stops with significant transit-dependent ridership, and stops near healthcare and social services should receive special consideration for additional amenities.
- **Stop potential:** More amenities should be provided at facilities on transit routes with high ridership potential especially if a new development is to act as a transit-oriented development (TOD). This method can only be useful if implemented at a larger scale. For example, a transit agency may provide high-end amenities on all stops in a particular geographic area with high ridership potential. Similarly, facilities near new development can have more features to attract ridership especially if a transit agency and partnering developer want to provide an attractive alternative to single-user auto trips.
- **Agency objectives:** Agency objectives influence day-to-day decision making of transit agencies and affect critical operational decisions such as route design and headway. It is recommended that transit operations related decisions be adequately supported by appropriate measures related to stop facility design. Stop potential and agency objectives are situation and agency specific and, prescriptive methods can not be applied to them.

Table 3.2 provides indicators for the provision of amenities at transit stops.

Table 3.2: Indicators of Bus Stop Requirements										
		Number of Daily Boardings					Transfer Points	Mobility Needs		Important to Note
(Section #)	Infrastructure/Amenity	<10	11-20	21-50	51-100	100 >		Transit dependency	Healthcare facilities, etc.	
Infrastructure										
-	Sign and pole	M	M	M	M	M	M	M	M	
3.2.1	5'X8' Bus pad	M	M	M	M	M	M	M	M	
3.2.6	Lighting	M	M	M	M	M	M	M	M	Facilities serving day routes can be exceptions
Amenities										
3.2.3	Shelter	O	O	D	M	M	D	O	D	
3.2.4	Seating	O	D	M	M	M	M	D	D	
3.2.5	Route map	O	D	M	M	M	M	D	D	
3.2.5	System map	O	O	D	D	M	M	D	D	Recommended near regional activity centers
3.2.7	Landscaping	O	O	O	D	D	O	O	O	
3.2.8	Bicycle racks	O	O	D	M	M	D	D	O	Recommended for all facilities on bike routes
3.2.9	Trash receptacle	O	O	D	D	M	M	D	D	Recommended near recreation centers
3.2.10	Shopping cart storage	O	O	O	O	O	O	O	O	At stops near malls and shopping centers
3.2.11	ITS applications	O	O	O	O	O	O	O	O	
3.4.1	Telephone	O	O	O	O	O	O	O	D	
3.4.2	Expanded sidewalk	O	O	O	D	D	O	O	D	Recommended in high pedestrian activity zones
Other										
3.3.3	Approved Advertising	O	O	O	O	O	O	O	O	Less desirable near historical properties and in single family neighborhoods but can be considered if supports historic nature of the property with an approval of relevant authorities.

M-Minimum; D-Desirable; O-Optional

The criteria listed in Table 3.2 are not an exhaustive list of factors that can be used for the assessment of stop area needs. For example, in areas with less frequent service patrons may have to wait longer. In such cases, certain amenities such as benches and shelters can be provided. Similarly, shelters may also be considered if a stop is isolated and does not have any adjacent development or landscape features to provide temporary protection from unfavorable climatic conditions.

Prescriptive methods for providing amenities have often been found ineffective. It is recommended that other methods such as driver or passenger recommendations, evaluation of ridership profile, and periodic reassessment of transit infrastructure and amenities should be used to increase a system's efficiency.

Figure 3.1: Transit Stop Classification

An enhanced shelter designed to serve a new development.

➘ Infrastructure and Amenities - Minimum Requirements

All infrastructure and amenities should be:

- ♿ In compliance with the ADA Act of 1990, as amended, regulations;
- ♿ Without any sharp edges and protruding elements.
- ♿ Un-obstructive to pedestrian circulation and easily detectable by people with visual impairments ;
- ♦ Accessible by flat, stable, non-slippery paved surfaces;
- ♦ Constructed of vandal-resistant and thermal-resistant material – important for extreme summer climate in Florida;
- ♦ In compliance with Florida Building Code (as amended) wind loading criteria and other applicable wind-debris zone requirements; and
- ♦ In compliance with horizontal clearance, clear zone, and sight distance requirements. Refer to Section 2.3.2.

3.2.1 Transit Landings / Pads

Bus Pad: A typical 40-foot bus will require a 4-foot long clearance for a wheelchair access ramp or lift and an additional 4-foot length is required for wheelchair maneuverability. A flat, stable, non-slippery area with a minimum clear length of 8 feet (measured from the face of the curb or vehicle roadway edge) and width of 5 feet (measured parallel to the vehicle roadway) area, known as a bus pad should be provided as a minimum condition at all transit stops (Figure 3.2.1).

Bus pads should be connected with ADA accessible sidewalks and not obstructed by physical features such as utility poles, transit stop amenities, or advertising displays. The following special considerations should be given to bus pads in rural and suburban areas:

- On a road that is not curbed, the bus pad should be raised 4 to 5 inches above the level of the (adjacent) roadway shoulder pavement. In the absence of a raised bus pad, the bus ramp angle combined with the crown in the road becomes steep and can be dangerous for passengers on wheelchairs (Figure 3.3.1), and
- The provision of bus pads is highly desirable at all transit stops but is challenging due to low ridership and absence of other curbside infrastructure in rural and suburban areas. Transit agencies can best determine the policies most suitable for their ridership profile and service area.

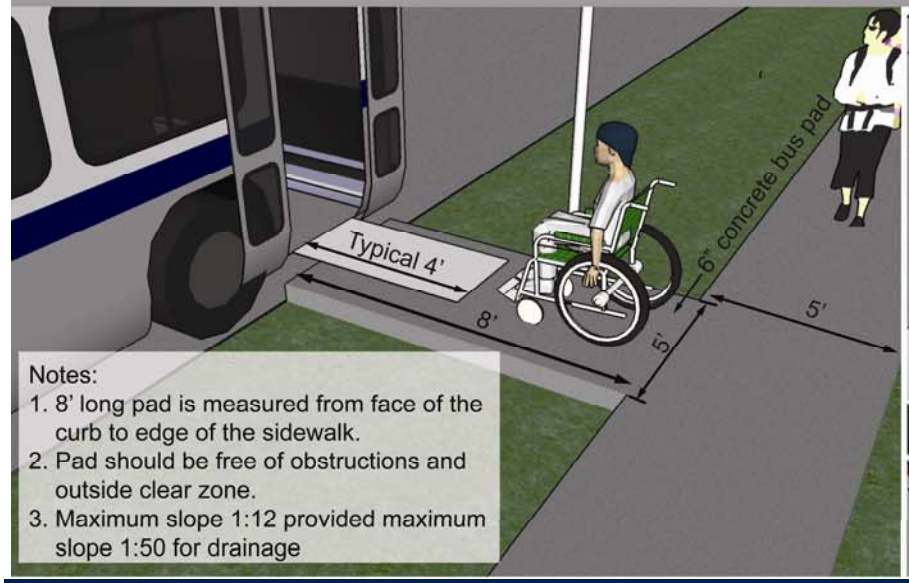
Shelter Pad: A desirable stop area condition would include the provision of a shelter pad which is a 30 feet long concrete pad along the length of shelter area (Figure 3.2.2). In areas with high ridership, the shelter pad can be 40 feet long.

The length of shelter pad should be increased by 50 feet for each additional 40-foot bus expected to simultaneously stop at the bus stop. Similarly, for a typical 60-foot articulated bus, the shelter pad length should be 70 feet.

- Stop area amenities such as benches, shelters, and bicycle racks can be placed on a shelter pad. Detailed information on amenities is provided in subsequent sections.
- Under all conditions, a 5 feet wide and 8 feet long unobstructed area should be maintained on a shelter pad.

Figure 3.2: Bus Pad Conditions

3.2.1 Minimum Requirement



3.2.2 Desirable Condition

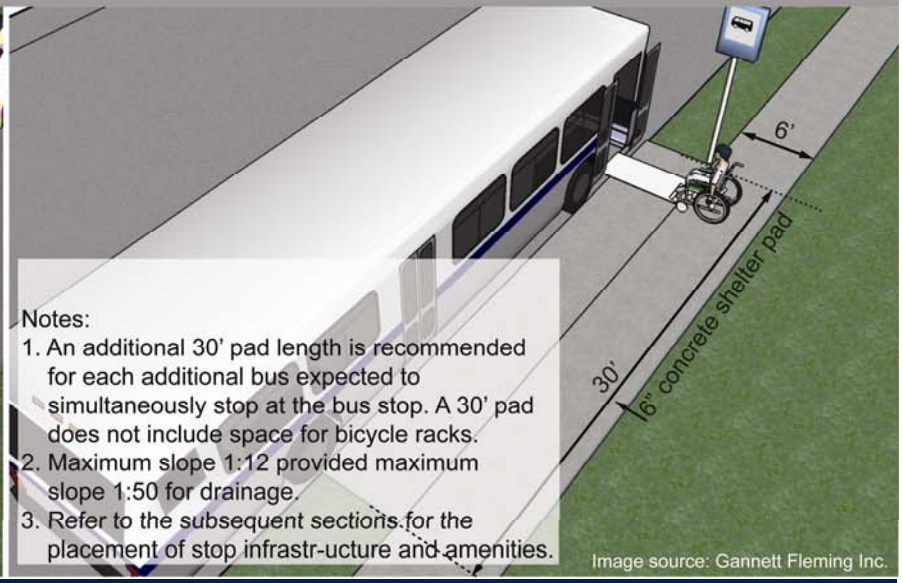
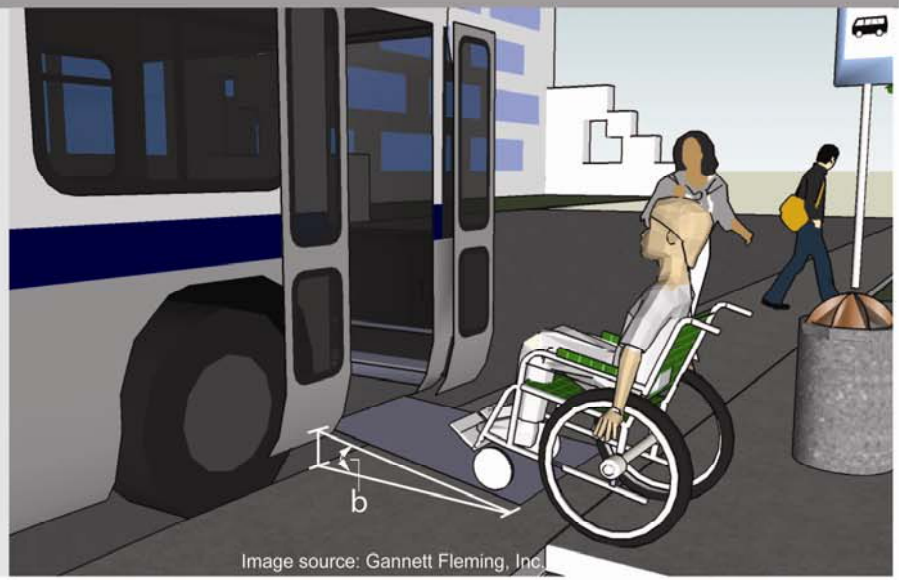


Figure 3.3: Importance of Bus Pads

3.3.1 Undesirable Condition: Stop without Bus Pad

3.3.2 Desirable Condition: Stop with Bus Pad



In rural and suburban areas, where a bus pad is raised 4 to 5 inches from the pavement and there is no sidewalk, a slope should be provided to facilitate wheelchair access (Figure 3.4). Due to shoulder conditions, it is recommended that an 8" concrete bus pad be located outside the clear zone.

3.2.2 Climate Consideration

For Florida's climate, transit patrons require sun, rain and wind protection. Shelters facing south or west require greater attention due to the harsh sun angle during afternoons and low-sun angle in the evening hours. Optimum protection can be achieved by employing the features listed in Figure 3.5.

Figure 3.4: Bus Pad in Rural/Suburban Conditions

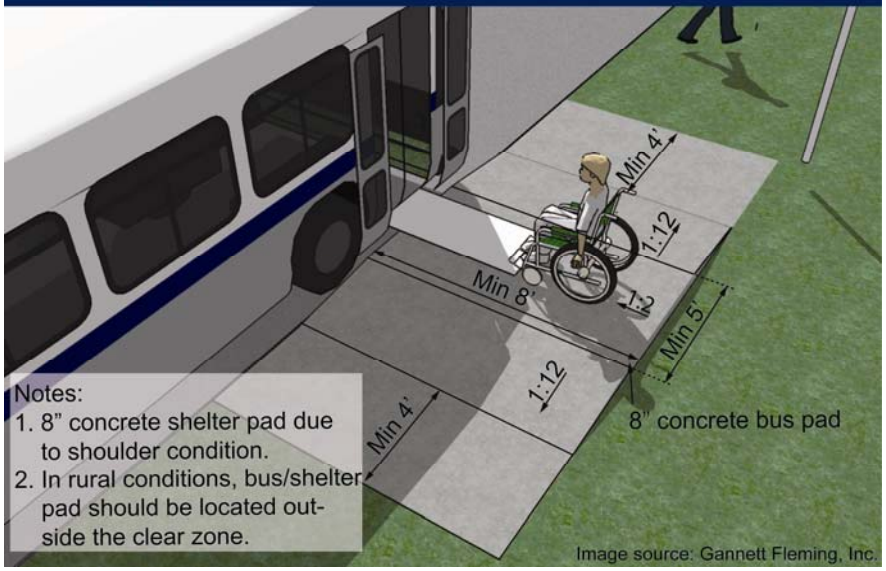


Figure 3.5: Methods to Provide Protection from Extreme Climate

Natural Features
Wherever possible, natural features such as trees and shrubs should be used to cut the undesirable sun rays. Vegetation provides shade and is highly desirable for the Florida climate.

Vegetation, however, provides limited protection from rain. Refer to Section 3.3.5: Landscaping for more details.

Transit Shelters
Shelters should preferably have an extended canopy and panels on three sides. Shelters facing west can have an elongated canopy to provide greater protection from low-angled sun rays. The following section provides a more detailed explanation of shelter design.

3.2.3 Transit Shelter

Important to Note

All transit facilities on Federal and State Highways must be in compliance with **Florida Administrative Code (FAC)**

The factors influencing the installation of transit shelters are:

- Number of daily boardings and transfers;
- Availability of right-of-way;
- Number of persons with disabilities and seniors boarding;
- Proximity to activity centers;
- Frequency of service;
- Adjacent land use compatibility;
- Transit agency's objectives; and
- Availability of public or private funding.

The Florida Administrative Code requires that:

- "The shelter location must meet the setback and minimum clear recovery zone requirements "
- "A shelter shall not obstruct any sidewalk, bike path, pedestrian path, driveway, drainage structure, or ditch, etc., and shall provide at least three feet clearance for pedestrian traffic."
- "Sides and internal dividers in shelters shall be constructed in a manner to provide visibility of waiting passengers to passing traffic and pedestrians. All transparent materials will be shatterproof. "

Figure 3.6 and Table 3.3 indicate desirable and undesirable transit shelter attributes. Various shelter placement conditions are shown in Figure 3.7.

Figure 3.6: Transit Shelter Attributes

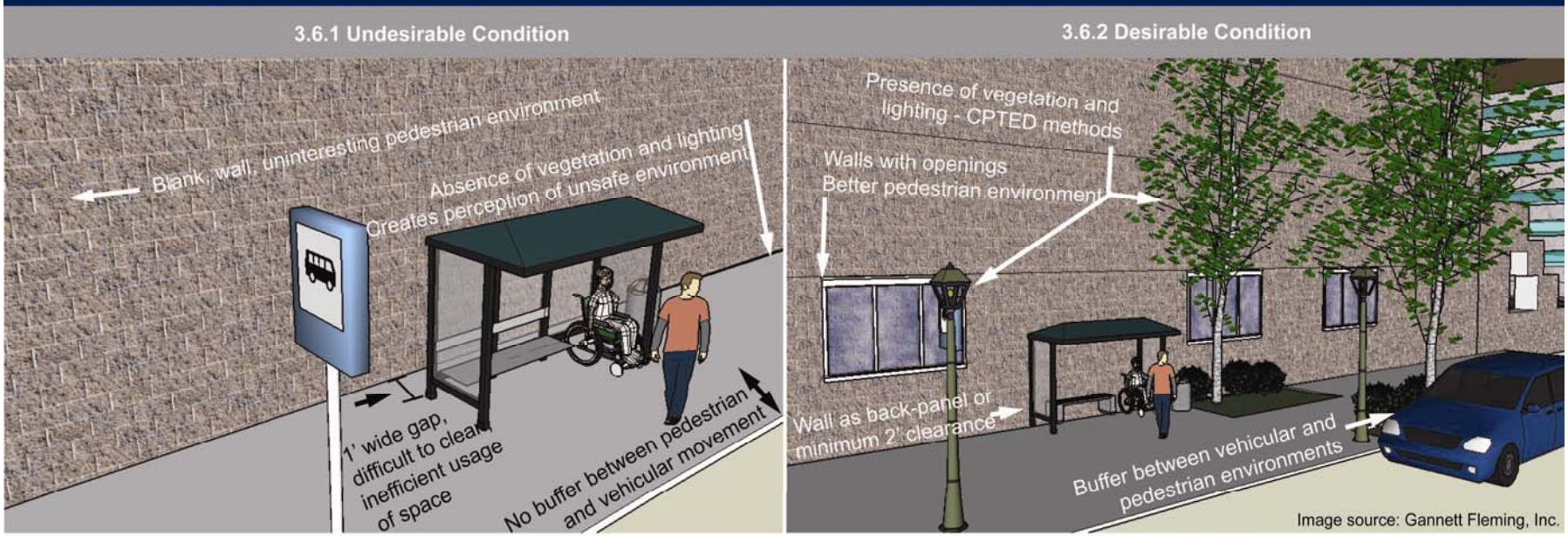


Table 3.3.: Transit Shelter Area Attributes

Required under Florida Administrative Code Section 14-20.003 for facilities located on the right-of-way of Federal Aid and State Highways

Regulatory

Clear opening between structure and the ground/foundation.

Minimum 12 feet from an intersection and 15 feet from a fire hydrant or a handicaped parking space.

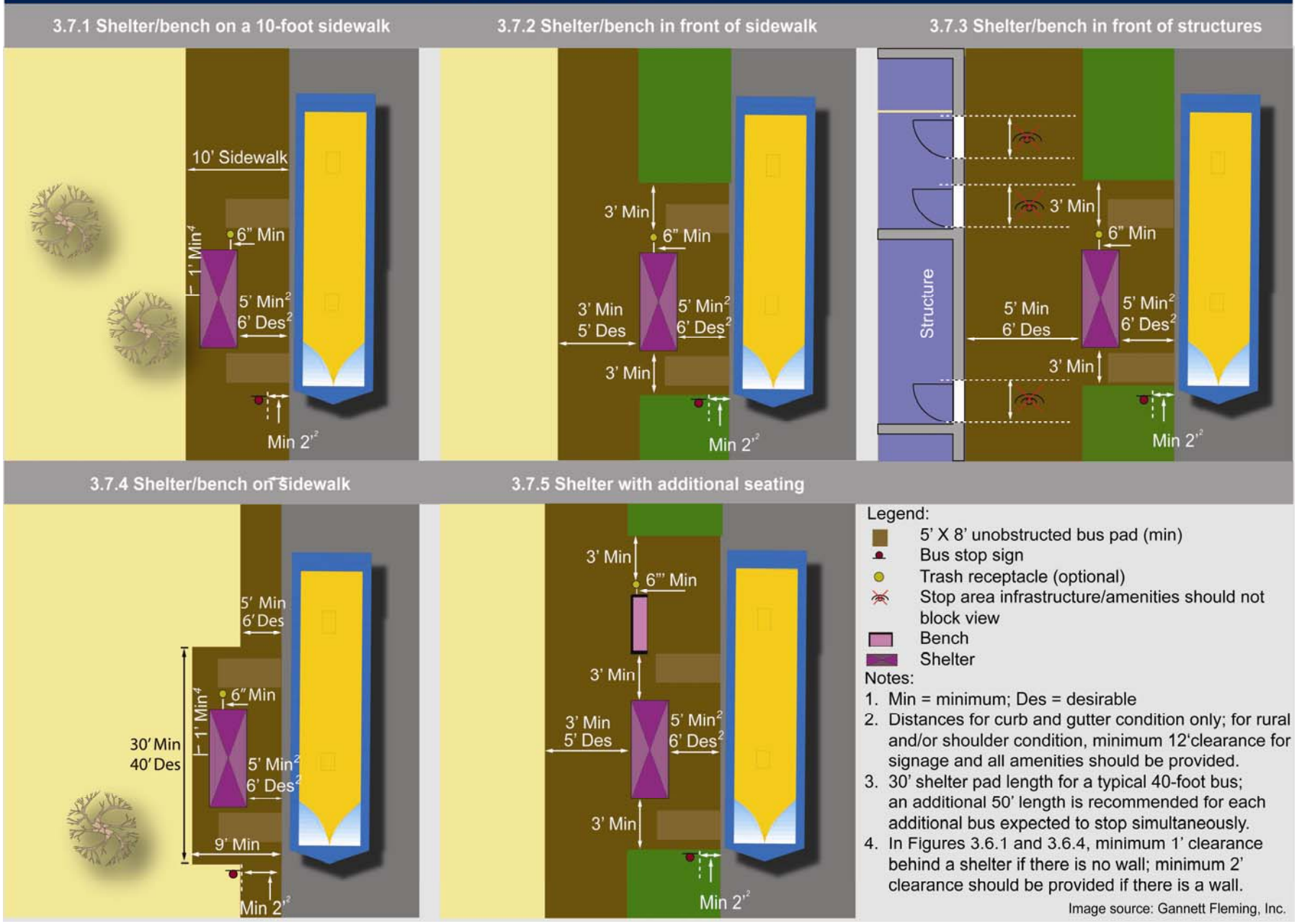
Advertising no greater than 6 feet X 5 feet/side. Maximum one advertisement per side.

Maximum height of shelter cannot exceed 10 feet.

	Desirable	Undesirable	Important to Note
Transit Service	Designs that enables efficient and orderly flow of alighting and boarding passengers		Especially important in CBDs and other fully developed areas with high peak-hour ridership
	Efficient use of interior space	Shelter area without any provision for future expansion.	
	Consistent design theme but with some flexibility to permit stations to harmonize with immediate surroundings to increase system's identifiably	Monotonous design with cookie-cutter approach across the system	This can be enabled by modifying shelter materials, but maintaining common design elements such as lighting and seating fixtures. Another example is that a shelter may not require back panel if the adjacent property is situated at the minimum distance.
Maintenance	Use of aesthetically appealing vandal-resistant materials	Use of vandal-resistant material that unpleasantly stands out from the surrounding development	Often considered a major issue when shelters are placed close to existing structures.Transit agencies, in coordination with local planning agencies, can require incorporation of stop area within or around new development.
	Requires low maintenance		A high maintenance shelter can be installed if it provides unique advantages (e.g. high maintenance shelter near historical properties).
Safety and Comfort	Bus pad - minimum 5' wide, 8' long or desirable 30' long	Stop along a shoulder without an ADA-compliant bus pad	In the absence of curb and gutter roadway edge, bus pad should be raised 4 to 5" from the pavement surface. (Refer to Figure 3.3)
	Obstruction-free bus pads and sidewalks	Bus pads with physical features such as utility poles, transit stop amenities, newspaper box and advertising material	For example, telephone kiosks are difficult to detect for people with visual impairments. Refer to Section 3.4.6 ADA Design Factors.
	Bus pads connected with obstruction-free sidewalks	Stand alone bus pads without access to sidewalks	
	Effective use of lighting and landscape		Refer to Section 3.2.6: Lighting and Section 3.2.7: Landscaping.
	Materials conducive for local climate	Materials that build up heat inside the shelter making it uncomfortable	Transit patrons, despite the availability of seating within the shelter, will seek relief elsewhere if the temperature is high inside the bus shelter (TCRP Report 19).
	Shelter atleast 15' (desirable) or 7' (minimum) from the nearest utility pole		Highly desired to minimize damage
	A minimum of 5' from curb edge, 12' from the inter-section point of curve		These distances vary with roadway type; check FDOT Design Standards; Florida Greenbook, and roadway design engineer.

Image source: Gannett Fleming, Inc.

Figure 3.7: Shelter Design and Placement Conditions



3.2.4 Seating

Seating areas at all bus stops are extremely desirable and should preferably be within transit shelters. Figure 3.8 illustrates an example of desirable attributes of a seating area. In this example, the seating area receives the maximum benefit of surrounding trees during hot afternoon hours. If present, the seating area should have the following features:

- Seating space for three adults and one space for wheelchair;
- Sidewalk should be widened to maintain minimum 3-foot clearance requirement, if required; and
- Integration of seating space with trees and lighting features.

Figure 3.8: Seating at Transit Stops

Useful Sources

For signage related detailed specifications, refer to:

ADA Accessibility Guidelines

For wind-loading criteria for signs, refer to:

FDOT Plans Preparation Manual Section 7.2.2

3.2.5 Sign Placement at Stop Areas

Information related to transit service and its schedule is useful to both occasional users and daily users. Information on service routes should be displayed on all transit stops. This information can be provided in the locations illustrated in Figure 3.9.

In addition, the following information can be considered:

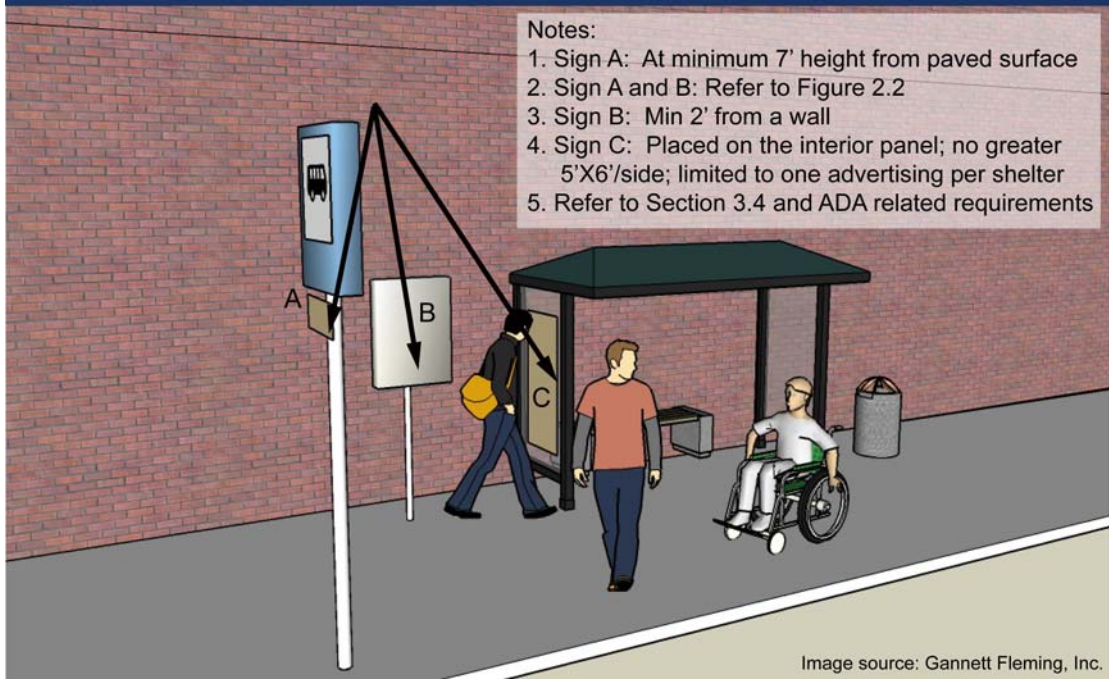
- Route and system map preferably showing major destinations;
- Service schedule;
- Map showing transfer locations (often combined with system map);
- Public announcements, and
- Customer service telephone numbers.

The type of information mentioned here is highly recommended for stops near CBDs, regional activity centers such as major hospitals, and tourist destinations. At minimum, at transit centers and stations, information material and display boards should be in compliance with ADA requirements. This may include material printed in Braille. However, the development cost of information material as well as costs associated with required periodic updates is an additional expenditure.

The following placement criteria should be considered:

- **In the absence of a transit shelter:** The information should be combined with bus stop sign to maintain a clean and uncluttered appearance of stop areas.
- **In the presence of a transit shelter:** Information should be provided on a shelter panel rather than on freestanding signs. Backlit interior panels can be used for posting this information. However, only one sign per shelter (including the roof) is permitted.
- All signs should be in compliance with FDOT wind-loading criteria and other applicable wind-debris zone requirements.
- Signs should be placed downstream of traffic such that they do not block view of passenger or bus driver.

Figure 3.9: Potential Locations for Providing Additional Information



Important to Note

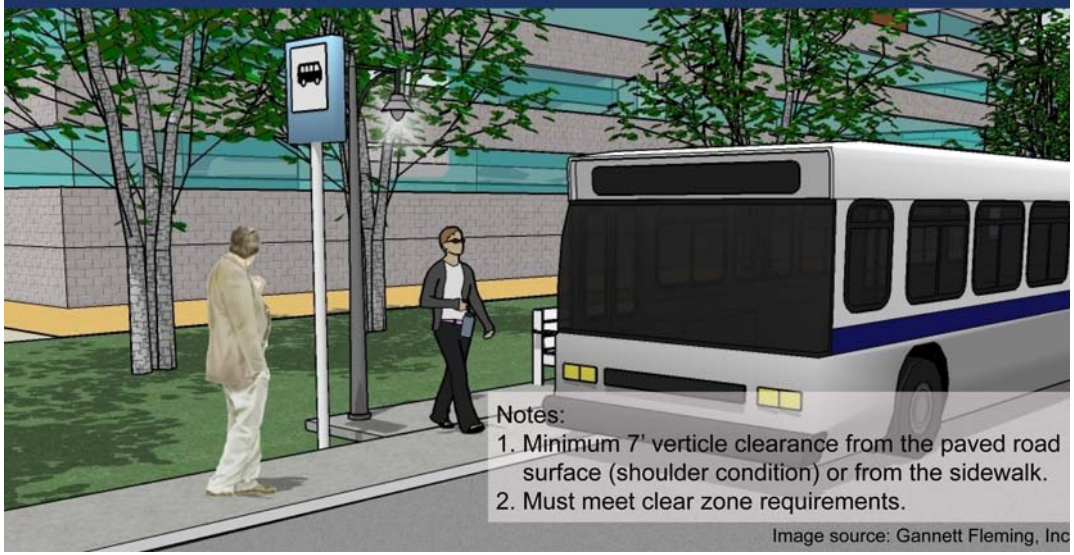
Refer to **FDOT Plans Preparation Manual Section 7.3 Lighting** to ensure lighting provision for unique stop area conditions meets the FDOT requirements.

3.2.6 Lighting

Lighting features are integral components of Crime Prevention Through Environmental Design (CPTED) methods. Adequate lighting increases visibility at the bus stop and serves as a deterrent to criminal activities. Bus stops should be located next to an existing light pole as discussed in Section 2.2.4: Lighting Access. The following should be considered for providing adequate lighting at bus stop areas:

- If an existing light source is not available at the desired stop location, the designer should coordinate with the transit agency to determine if a dedicated lighting source should be included in the design;
- In rural areas, stops should be placed near existing light poles as described in Section 2.2.4 Lighting Access;
- A minimum 7 feet vertical clearance from the paved surface should be maintained under all conditions (Figure 3.10);
- Stop areas where passengers are expected to sit, wait, or board from should be adequately illuminated;
- The uniformity of lighting is an indicator of the quality of illumination and should be considered when installing new lighting systems or enhancing an existing system. The level of illumination should be 2 to 5 horizontal foot-candles over the entire bus stop area;
- Under Florida Section 14-20.003, flashing lights on shelters are prohibited. All lights must be placed or shielded so they do not interfere with motorists on the roadway and lights are not permitted for the sole purpose of illuminating advertising. The law also requires that, all shelter utility connections shall comply with Rule 14-46.001 of Florida Administrative Code and, must be approved by the appropriate city or county building department.
- The hours of illumination should correspond to the anticipated hours of use for the stop. If identified as insufficient, an additional source of lighting should be provided;
- Lighting at transit stops should not negatively impact adjacent land uses; and
- Wherever possible solar-powered lighting fixtures should be installed.

Figure 3.10: Lighting at Transit Stops



Refer to:

Plans Preparation Manual

Florida Highway Landscape Guide

The Florida Greenbook

Figure 3.11: Landscaping

A shelter receiving maximum benefits from landscape features.

Paving pattern gives unique character to a bus stop.

Source: HART

3.2.7 Landscaping

Landscaping at stop areas consists of vegetation and pavement surfaces. Florida's climate demands landscape elements that provide shade and windbreaks to waiting transit patrons. Landscaping features also help cool the air and can be used as crime prevention methods (refer to Section 3.3.4).

In urban areas, the following should be considered while providing landscape amenities:

- Colored and embossed concrete platforms can be used in areas with high pedestrian activities. A different paving material and texture can help distinguish a stop area from the adjacent sidewalk (Figure 3.11). Local agencies and FDOT provide a list of approved paving materials;
- Vegetation should not block accessways and views of drivers and pedestrians;
- Trees with large canopies provide shade but also require regular trimming and maintenance. Native trees that require minimum maintenance should be preferred;
- The roots of certain types of trees can damage sidewalk. Trees can also be a safety hazard during hurricanes causing liability concerns in case of damages.
- Transit agencies should coordinate with local government and adjacent private development to include stop area specific landscaping features in local development plans;
- Landscaping features are an asset from a street beautification point of view. Local agencies, private owners and groups such as Downtown Development Authorities (DDA) and non-profit environmental groups are often interested in sharing landscaping related costs.

In rural and suburban areas, where right-of-way is often not a major constraining factor, the following should be considered to preserve natural landscape features at stop locations:

- Conservation of natural roadside growth and scenery;
- Relocation of existing vegetation;
- Selective clearing and thinning;
- Natural regeneration and usage of Florida native plants;
- Usage of recycled and recyclable material; and
- Plant selection and placement that minimizes impacts to natural areas.

3.2.8 Bicycle Racks

Bicycle storage facilities such as bicycle racks provide an additional option to transit riders to use bicycles for continuation of their trip. A bicycle storage facility should have the following attributes:

- Visible from surrounding areas;
- Located at the periphery of stop area;
- Should not block pedestrian or vehicular access;
- Should preferably be located on the upstream side of a stop area (Figure 3.12) and a design that does not allow the concealment of explosives;
- At a minimal walking distance from stop;
- Should be securely mounted on the ground;
- In compliance with wind-borne debris zone requirements;
- Preferably in a well-lit area that provides also protection from rain; and
- The height of bike racks should not exceed 4 feet from the paved surface.

Stop locations in rural areas can greatly benefit from the provision of bicycle racks as stops are less frequent and transit riders will otherwise have to walk a substantial distance.

Figure 3.12: Provision of Bicycle Racks at Transit Stops

Notes:

Bicycle racks should be:
1. securely fastened to the ground and in compliance with wind-borne debris zone requirements;
2. not an obstruction in wheelchair circulation;
3. kept on the upstream side of stop area;
4. for site distances refer to Section 2.3.2 Considerations for Impediments > Site Distances.

Image source: Gannett Fleming, Inc.

3.2.9 Trash Receptacles

Trash receptacles are necessary for health, safety and aesthetic purposes and should be considered for all stops. The most common issues associated with the installation of trash receptacle are:

- Installation of trash receptacles can be counter productive if this measure is not supported by regular pick-up and maintenance. Transit agencies should coordinate maintenance with adjacent property owners and/or local authorities who can “adopt” maintenance responsibility for trash receptacles;
- Agencies should avoid locating receptacles in direct sunlight as heat may cause foul odors from trash;
- Receptacles should be securely mounted on the ground to comply with wind-debris zone requirements;
- In sensitive areas, the design of trash receptacles should deter or minimize potentially harmful uses such as placement of hazardous materials or explosives; and
- In rural areas, trash pickup at stop locations can be combined with a roadside maintenance contract.

3.2.10 Shopping Cart Storage

Transit stops near major malls, grocery stores, and other shopping facilities can be provided with a shopping cart storage area. This amenity should be evaluated on a case by case basis and installed only where agreements have been reached with adjacent trip attractors. The following should be considered:

- Transit agencies can work with local agencies to require installation of amenities like shopping cart storage at the transit stops by private developers;
- Private developers can be made responsible for regular and frequent removal of carts from transit stop areas; and
- Any cart storage infrastructure should not block sidewalks, driveways, bus pads, or shelters but should follow the general site circulation guidelines described in previous sections.

Useful Sources

TCRP Synthesis 48: Real-Time Bus Arrival Information Systems

Safer Stops for Vulnerable Customers

3.2.11 Intelligent Transportation System (ITS) Applications

ITS applications can be installed at stop areas for communicating information and increasing safety and security. The following applications are being utilized by several transit agencies:

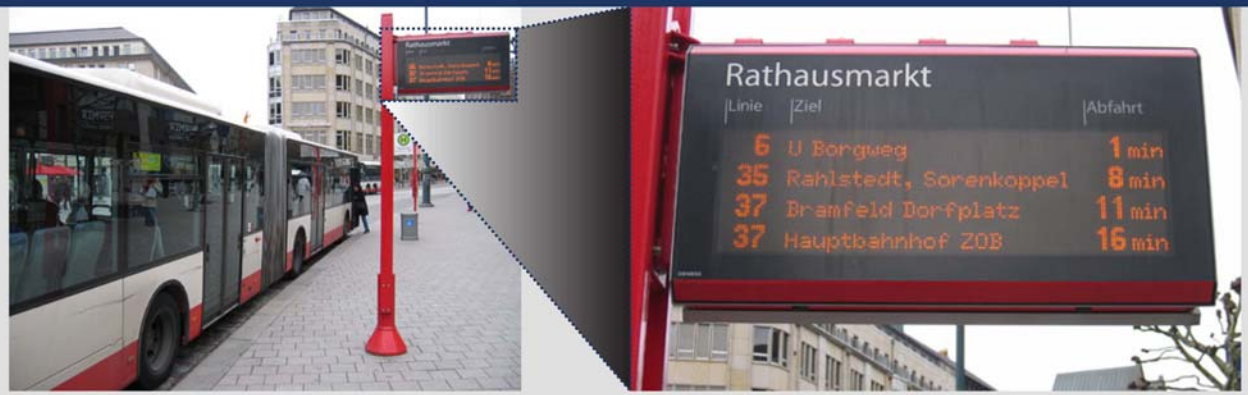
- Real-time next-bus arrival information (Figure 3.13);
- Electronic posting of schedules;
- Smart fare payment system;
- Personalized automated vehicle arrival information
- Audible signage; and
- Access to information through wireless connection.

Much security related ITS applications have been successfully tested across the nation and initial findings are encouraging. The following technologies have been installed at several stops:

- Installation of a panic button; and
- Cameras can be installed inside and outside the shelters and transit stations to monitor activities inside as well as the situation up and down the street.

ITS applications, due to their high installation and maintenance cost, are typically installed at stops with high number of boardings. As a first step towards installation of these technologies, 4-inch cable conduits can be provided at new bus stop locations.

Figure 3.13: Intermodal Facilities



The above is an example of a real-time bus arrival system in Europe. An estimate suggests that such systems are being used by more than 40 transit agencies in North America.

3.3. Stop Design

This sub-section explains factors that often restrict the provision of stop infrastructure and amenities. Wind-debris zone requirements, for instance, increase safety but also often lead to higher development cost. Other issues such as provision of shelter advertising and Crime Prevention Through Environmental Design (CPTED) techniques, are also discussed.

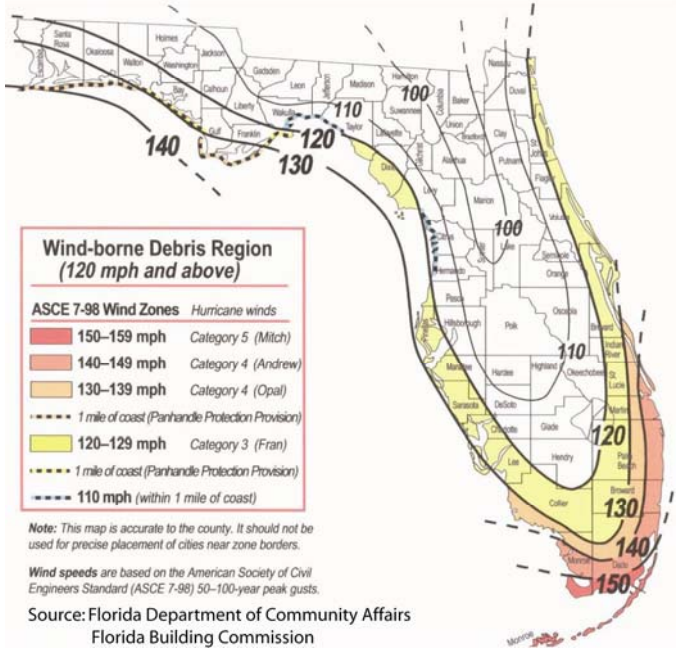
3.3.1 Transit Stops in Wind-borne Debris Regions

Many counties in FDOT Districts One and Seven are susceptible to hurricane winds up to 130 mph (Figure 3.14). Recent unfortunate natural events have indicated that transit services can play an important role in emergency situations. To achieve that, it is important that transit operations are ably supported by transit facilities.

Stop area infrastructure and amenities are required to be in compliance with the Florida Building Code which specifies the minimum structural requirements. Local codes may have stricter design and construction specifications. Compliance with Wind-borne Debris Zone requirements is also important to ensure that shelters or amenities do not become the source of flying debris during high wind events.

The Florida Building Code requires that shelters be adequately anchored to the ground. Transit stops, if identified and included in an emergency evacuation plan, must be provided with signage indicating the same.

Figure 3.14: Florida Wind-borne Debris Region



3.3.2 Right-of-Way Limitations

The availability of right-of-way (ROW) can positively influence size, capacity, and location of bus stops. It is often a factor limiting the provision of safe, secure, and convenient stop areas. Right-of-way issues include:

- Major constraints in dense urban areas, such as existing CBDs, can potentially influence route design and therefore stop locations;
- There are fewer right-of-way limitations in rural and suburban areas due to availability of land and a limited number of stops;
- In unavoidable circumstances, where right-of-way is limited, bus stop shelters are placed directly on the sidewalk with adjustments to provide walk around access way. Although this provision ensures transit patrons receive a shelter at the bus stop, this may negatively affect pedestrian and wheelchair movement;
- Regardless of ROW constraints, a 3-foot wide minimum clearance for continuous pedestrian travel along the sidewalk must be maintained; and
- Coordination with local planning agencies can help ensure a desirable shelter area in planned developments. Please refer to Section 9: Institutional Issues for more information.

3.3.3 Advertising

Advertising at transit facilities can be an important source of revenue and promotional strategy for a transit agency. Most transit agencies contract out advertising spots to private contractors who bring in their expertise and resources to efficiently market advertising spots at transit stops. The Florida Administrative Code 14-20.003 requires the following:

- “Advertising on a shelter shall be no greater than 72 inches by 60 inches per side of the shelter including the roof.”
- “There shall be no more than one advertisement per side.”
- “The owner of abutting property shall be notified by certified mail of the proposed shelter location if there will be advertising. Such owner of the abutting property shall be provided an opportunity to comment.”
- “Companies engaged in the business of outdoor advertising shall obtain and maintain a current license pursuant to Section 479.04, Florida Statutes, and Rule 14-10.003, F.A.C.”
- “Lights are not permitted for the sole purpose of illuminating advertising.”

Figure 3.15: Advertising for Transit Promotions

Useful Source

Special Event Transportation Service Planning and Operations Strategies for Transit

Advertising panels may obstruct views from and through a bus stop, making it difficult for patrons to see incoming buses and for drivers to see waiting customers. Advertising panels and kiosks should be placed downstream of passing traffic. In the case of near-side stops, panels may block the view for right-turning vehicles. Under all circumstances, advertisement should meet sight distance and clear zone requirements. Stand-alone advertising panels should be in compliance with ADA requirements. Refer to Section 3.4.1 ADA related design features.

There are a few examples of transit agencies that do not accept advertising on transit facilities for aesthetic reasons to maintain a visually clean appearance of facilities. There appears to be no major disadvantage to shelter advertising if planned and executed creatively and sensitively. Revenues from advertising contracts help provide more convenient and comfortable transit service for customers. Shelter advertising programs can also increase the transit agency's ability to add shelter to more stops as the cost of shelters is borne by advertisers.

Transit agencies usually permit advertising at transit stops under the following types of contracts:

- **For Revenues:** Transit agencies display advertising on their properties for generating revenues and for noncommercial purposes such as displaying social-service messages.
  - Usually transit agencies reserve 10% of the total advertising space for enhancing the agency's customer communications (Figure 3.15).
  - Advertising panels as part of the shelter or stand-alone are the most popular methods of generating additional revenue. For this form of advertising, the advertising panels should follow design and safety requirements for stop areas listed in previous sections.
- **Co-promotions:** Transit agencies contract with event organizers to advertise events and promote transit usage to those events. A few transit agencies also use in-house advertising space for co-promotions with local attractions such as sports stadiums, museums, and special events. Co-promotions are particularly useful for events where there is limited availability of parking or are conducted during off-peak hours.
- **Media trades:** Media trades are another method of advertisement where transit agencies assign display spaces on benches and shelters to other media organizations such as newspapers, radio and television agencies and in turn, advertise transit services on their respective platforms.

Figure 3.16: Shelter Advertising

Florida Administrative Code requires that shelter advertisement size should not exceed 6 feet by 5 feet and there should not be more than one advertisement per shelter.

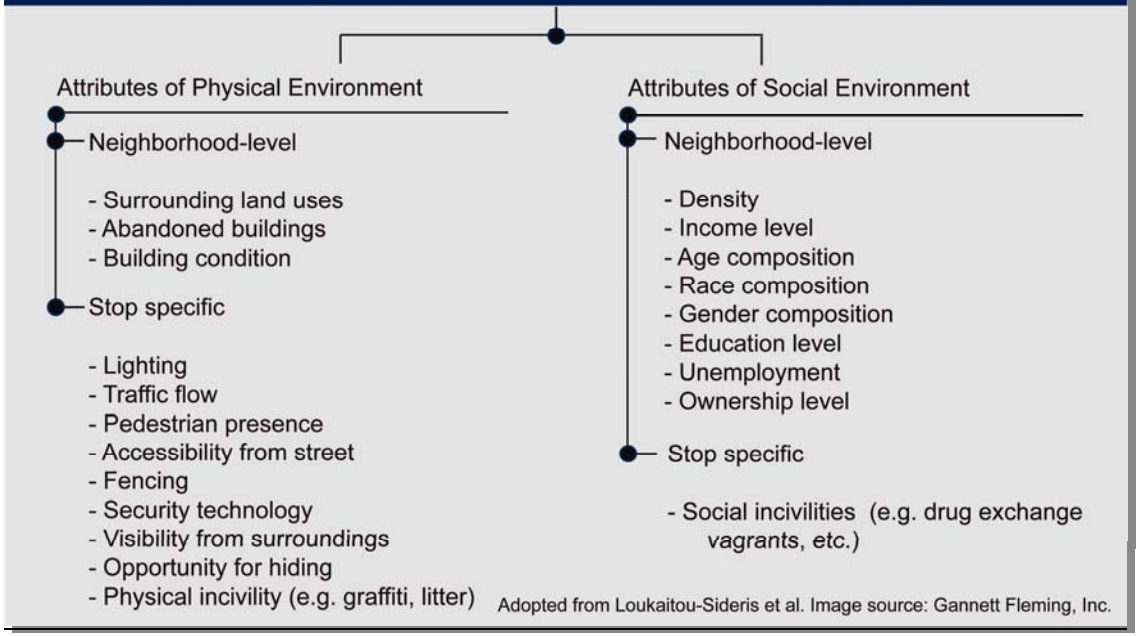
- **Providing benches and shelters:** In other instances, advertising companies provide and install benches or shelters at no up-front cost to the transit agency and in return, place advertisements on benches and/or shelters. They may offer a share of their advertising proceeds to the transit agency and are typically responsible for maintenance of the respective shelters. Following are some issues associated with this type of contract:
  - Transit agencies and local jurisdictions provide guidelines to limit the size, content, and placement of advertisements. These guidelines are often required to be consistent with local codes and regulations. In some cases, transit agencies allow the contracting agency to decide the content of advertising and to defend it in case of a law suit;
  - Local zoning codes often prohibit advertising at stop areas. Such cases should be analyzed individually. It is also not unusual that a transit agency will first select areas where shelter advertising can be placed before negotiating a contract with advertising agencies. This practice ensures there are no conflicts at a later stage. Similarly, stops in highly visible areas are desirable and often most sought after for the purpose of advertising. Often, the best markets for advertising are not necessarily the areas with the highest need for shelters;
  - Advertisements are typically in the form of display posters but other media such as video screens and electronic signs are increasingly being used at bus shelters; and
  - Similarly, advertising agencies may be less interested in providing benches or shelters along rural roadways as they may not be the best place for advertising due to the limited market. This results in unequal distribution of curbside stop infrastructure which may deter patrons. Transit agencies can use a screening mechanism to focus shelters where most needed regardless of the advertising impact and group highly desirable shelter locations with less desirable locations to make advertising contracts appealing to private agencies.

3.3.4 Crime Prevention Through Environmental Design (CPTED) Methods

CPTED is a "positivist" crime-prevention approach that focuses on changes in the environment to reduce crime related incidents (Figure 3.17). Crime is measured in both the actual crimes committed and feelings associated with the perception of crime. The perception of crime cannot be totally eliminated; however, with appropriate design measures, it can be significantly reduced. The following are a few major findings of the studies on transit related crime.

- A study of a Los Angeles-based transit system found that 32% of the crimes occurred at the bus stop and 46% of the crimes occurred on a bus. The rest occurred on the way to or from the bus stop.
- An analysis of a transit system in Milwaukee indicated that there is a strong correlation between personal security and bus ridership.
- The Milwaukee study also found that the second hand knowledge or perception of crime increases a potential rider's fear, discouraging an individual from riding transit.
- A study of a transit system in North Carolina showed that non-riders' crime perception of transit facilities (37%) was significantly higher than that of the riders (8%).

Figure 3.17: Attributes Influencing Crimes at Transit Stops/Stations



Adopted from Loukaitou-Sideris et al. Image source: Gannett Fleming, Inc.

Although the numbers may vary for situations in Florida, it is reasonable to assume that a significant number of transit related crimes can be eliminated by adopting adequate measures at transit facilities. Similarly, by making transit facilities more inviting and less threatening, the stigma attached to transit can be reduced in the long term.

Crime at transit stops is often targeted at seniors, women, first-time transit users, and individuals new to the area. CPTED methods seek to prevent certain crimes within a specific distance of the transit stops by manipulating variables within the physical and social environment. Figure 3.17 lists the most commonly found variables influencing crime around transit stations.

From a transit facility design point of view, physical features such as lighting, landscaping, and shelter materials can be modified to reduce crime rate and the perception of crime. Social factors, on the other hand, require measures at macro scale. Transit agencies, however, can work with local police departments to patrol the selected stop locations.

Please refer to Sections 3.2.6 Lighting and 3.2.7 Landscaping for a description of desirable attributes.

3.3.5 Maintenance

The mere availability of curbside infrastructure may not serve the desired purpose if not adequately supported by regular maintenance. All shelters must be maintained for aesthetics, function, and safety. The following are maintenance related issues that should be considered:

- Transit agencies can enter in a maintenance contract with the vendor at the time of shelter purchase;
- Agencies should apply an anti-graffiti coating to shelters to facilitate maintenance;
- In cases of vandalism, the transit agency should work with the neighborhood leadership and property owners nearby to identify culprits and minimize damage;
- Stop amenities should be scrupulously maintained to avoid any deterioration that is hazardous to transit patrons, pedestrians, or transit vehicles;
- Florida Administrative Code Section 14-20.003 requires that a clear opening between the shelter structure and the foundation must be maintained to facilitate cleaning and prevent the accumulation of debris;
- If the transit agency has a contract with an advertising agency, maintenance can made be a part of the contract; and
- Transit agencies can also utilize adopt-a-stop, similar to adopt-a-road programs, where an organization commits to the maintenance of the facility.

Refer to:

ADA Accessibility Guidelines

Access Board Revised Draft Guidelines for Accessible Public Right-of-way

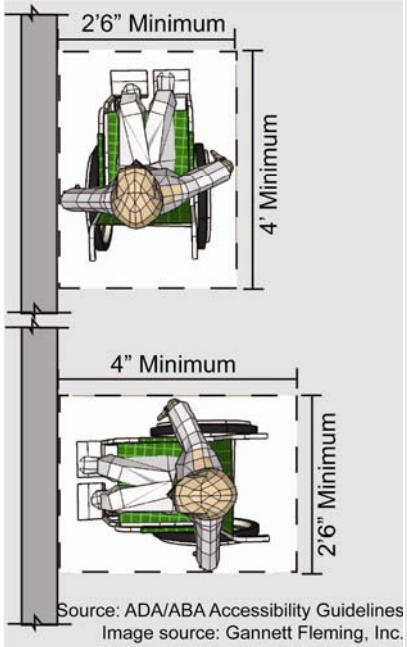
3.4. Accessibility

3.4.1 Design Factors for Accessibility

This section addresses design factors related to stop infrastructure and amenities.

- **Detectable Warning Surfaces:** These are also known as tactile surfaces and are installed at hazardous locations where there is no definitive cue denoting the boundary between pedestrian and vehicular ways or there is a drop-off (platform edges, stairs). Their surface material and color should be significantly different from adjacent pavement surfaces;
  - Detectable warning surfaces are required on the surface of curb ramps, and at other areas where pedestrian ways blend with vehicular ways.
  - Detectable warning surfaces are also used along the platform edge of fixed-guideway stations as shown in Figure 3.19.
- **Directional Surfaces:** These surfaces warn people with visual impairments of hazards. Best practices from other industrialized nations show extensive usage of directional surfaces that are part of comprehensive tactile wayfinding systems. However, no standards or guidelines have been established to date in the U.S. for the use of directional surfaces.

Figure 3.18: Wheelchair Clearance

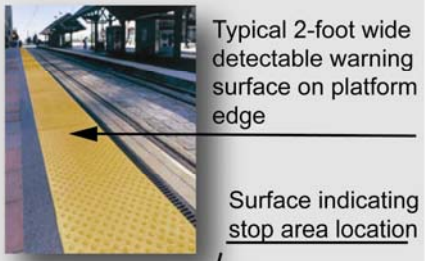


Source: ADA/ABA Accessibility Guidelines
Image source: Gannett Fleming, Inc.

Figure 3.19: Detectable Warning and Directional Surfaces

Detectable warning surfaces at stations

- Widely used in other countries along the edge of boarding areas
- Used primarily at railway stations and streetcar platforms

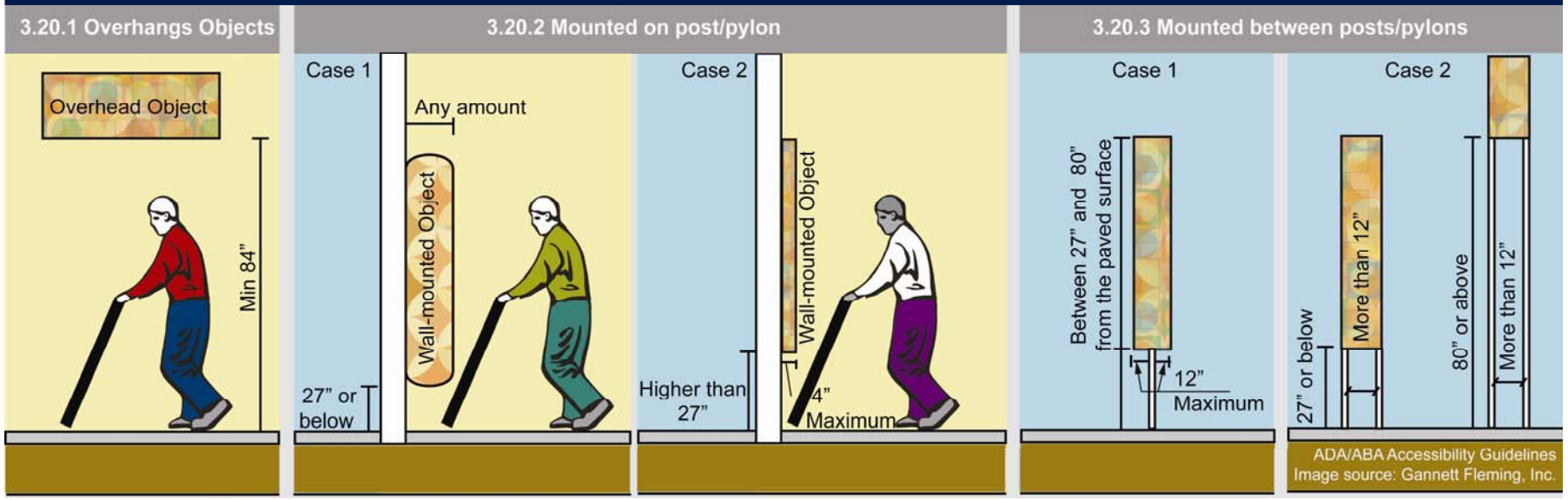


Directional surfaces

- Form a tactile wayfinding system for people with visual impairements

- **Wheelchair accessibility:** Stop infrastructure and amenities should be accessible from a route that has a minimum clear width of 5 feet and a minimum of 3 feet at any given point. Refer to FDOT design manuals for detailed specifications.
- **Protruding objects:** An object mounted on a post or pylon within the critical range of 27-inch to 80-inch can protrude no more than 4 inches into an accessible path (Figure 3.20).
- **Mounted objects:** Free-standing objects mounted on posts can protrude 12 inches (maximum) when located between 27-inch and 80-inch. If an object is mounted between posts with a clear distance greater than 12 inches, the lowest edge of the object should either be 27 inches or lower, or 80 inches or higher from the paved surface.
- **Telephones:** All telephones must be in compliance with the Access Board's requirements including floor and ground space, mounting height, and protrusion into an accessible route or space. In addition, at least one phone should be hearing-aid compatible (t-coil for use with hearing aids) with a volume control and push button operated where the telephone company can incorporate such a device. If a directory is provided, it must also be ADA accessible.

Figure 3.20: ADA Requirements



Useful Source

[USDOT Designing Sidewalks and Trails for Access]

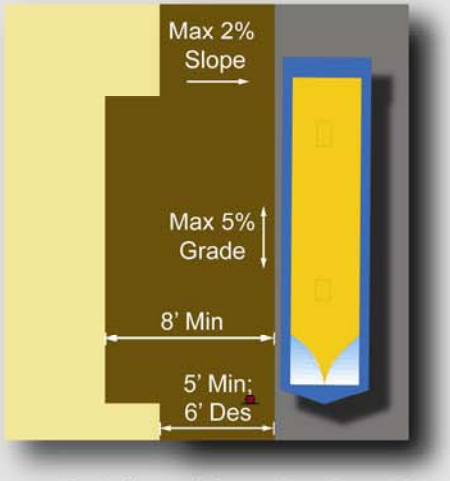
3.4.2 Sidewalks

Sidewalks should be a minimum 5-foot wide, well-drained, obstruction-free, and made of non-slippery material. An obstruction-free sidewalk access to bus stops is extremely important from an ADA compliance point of view. ADA requires that there be 'barrier-free' trips for transit patrons.

Narrower sidewalks can be equipped with wider passing spaces at regular intervals. Figure 3.21 provides examples of different sidewalk conditions. Factors such as speed and volume of auto traffic, presence of shops and window displays along the sidewalk would make wider sidewalks advisable.

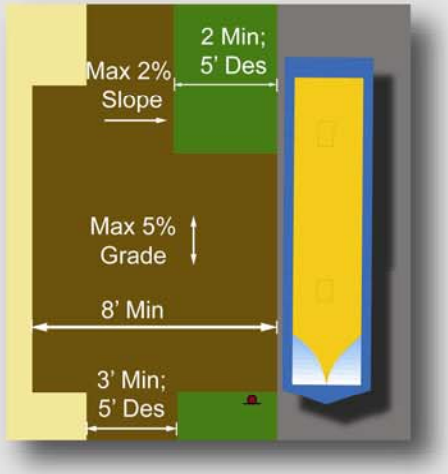
Figure 3.21: Sidewalk Conditions and Desirable Attributes

3.21.1 Minimum Condition



- In absence of a buffer, a 6-foot wide sidewalk is desirable.
- Not a preferred situation due to close movement of vehicular traffic.
- Placement of stop infrastructure and amenities is difficult.
- More suitable for low-ridership stops.
- Less desirable for stops near intersections with high pedestrian movement.
- Less desirable if car and building doors open in the sidewalk.
- Less desirable if utility poles are anchored within the sidewalk.
- The provision of driveways cutting narrower sidewalks, makes the cross-slope too steep.

3.21.2 Desirable Condition



- Due to the buffer, a 5-foot wide sidewalk can be placed.
- Preferred method as the buffer increases safety and comfort.
- Enables safe placement of stop infrastructure and amenities.
- Highly suitable for both, high and low-ridership stops.
- More desirable for intersections with high pedestrian movement.
- Pedestrian movement less affected by on-street parking; sidewalk width can be further increased to make allowance for door openings in the sidewalk.
- Most commonly utility poles are anchored within the buffer area.
- Cross-slope due to driveways cutting the sidewalk is less steep due to addtiional width of the planting strip.

Information Source: FHWA; Image Source: Gannett Fleming, Inc.

Useful Source

Transportation Research Board (TRB) publication: Transit: Intermodal Transfer Facilities, Rail, Commuter Rail, Light Rail, and Major Activity Center

3.4.3 Special Consideration for Schools

Transit facilities near schools should have the following safety related measures:

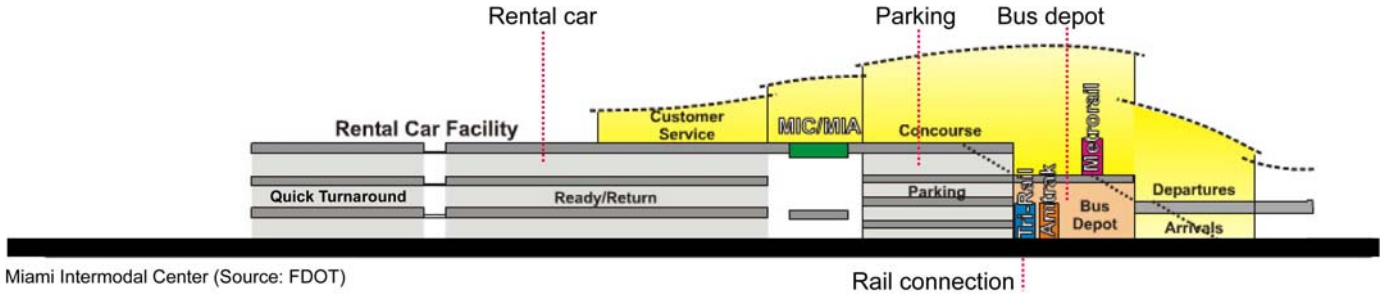
- Near grade schools, stops should be placed in an area where they can be visually monitored by school personnel and/or crossing guards to increase security;
- The transit facility should not have any material that can be easily torn or broken;
- Glass should not be used as the paneling material. An alternative material that complies with the transit agencies' specifications should be installed;
- Mid-block stops near schools are not recommended.

3.5. Regional and Intermodal Connections

Intermodal connections refer to linkages between modes of transportation and use of multiple modes for a single trip. Most bus transit systems serve airports and railway stations and have become an integral part of intermodal transportation systems.

Bus services have the unique advantage of the last-mile connectivity and can receive significant benefits as intermodal stations typically experience high passenger volumes. These stations will have permanent structures and an expanded set of amenities. Transit agencies should coordinate with airport management or rail transit authorities to integrate transit stations closer to passenger terminals and car rental facilities. All intermodal facilities can also be called transfer facilities. In recent years, greater attention has been placed on making transfers easier and more seamless. Park-and-ride stations are also a type of intermodal station and are explained in greater detail in Section 6.

Figure 3.22: Intermodal Facilities



Miami Intermodal Center (Source: FDOT)

3.6. Safety and Security

The most common curbside safety issues arise in the presence of one or more of the following:

3.6.1 Transit Facility Related Safety Issues

(Refer to Section 2.3.2 for impediments/hazards related stop placement considerations)

- Location of canals, storm drains and catch basins, which puts passengers at risk of having a foot caught when boarding or alighting a bus;
- Uneven surfaces which could result in a fall;
- Slope of the terrain surrounding the landing area, which can place passengers in danger of falling;
- Presence of hazardous objects such as broken street furniture and jagged edges;
- Explosive or harmful objects or materials within transit facilities or amenities such as trash receptacles;
- Surface traction (for example, wet stone aggregate can be slippery for wheelchair use);
- Water accumulation areas which can result in icy surfaces in winter months;
- Splashing due to water accumulation as buses enter or leave a stop area;
- Patrons having to step through a puddle to board on a bus;
- Overgrown bushes which could potentially present a security hazard as well as obstruct the approach on the sidewalk and landing area;
- Absence of a connection between the back of the curb and the edge of the sidewalk or obstacles on the sidewalk;
- Insufficient or no lighting at facilities served by night routes;
- Absence of ADA required infrastructure such as bus pads, and detectable warning surfaces; and
- Inadequate pedestrian infrastructure (especially at mid-block stops).

Transit agencies do not build all infrastructure and amenities but procure many amenities such as trash receptacles and benches from private contractors. The agencies can include safety related requirements for such contracts. For instance, for trash receptacles, agencies can include a design requirement to ensure explosives or hazardous materials cannot be hidden inside the receptacles.

For maintenance related issues, it is recommended that transit agencies adopt an inspection plan that best complement their operational characteristics. In addition, agencies should set the minimum operations standards for facilities and incorporate them where possible in local codes.

3.6.2 Passenger and Institutional Safety Issues

- Inappropriate or harmful behavior of waiting passengers or pedestrians at bus stops;
- Unsafe practices by transit agency staff (e.g. careless driving, lack of attention to boarding or alighting passengers);
- Inadequate safety training of transit staff if an incident occurs at the time of boarding or alighting; and
- Inadequate incident reporting mechanism.

The above mentioned issues can best be addressed by increasing safety awareness among both the transit patrons and transit staff. Advertising areas at the stops can be utilized for communicating safety tips. The agency's contact details can be provided at all transit stops to facilitate communication. In rural areas, emergency communication infrastructure can be placed within the stop area. Technology applications such as surveillance cameras can be used for stops in and around high-crime areas. Transit agencies can also coordinate with local police to provide additional security at stop locations.

Field experience suggests that a standardized method of implementation and maintenance serves the dual purpose of accident prevention and, in case of legal issues, supporting evidence.

4. Transit Vehicles

Important to Note

The dimensions should be modified based on:

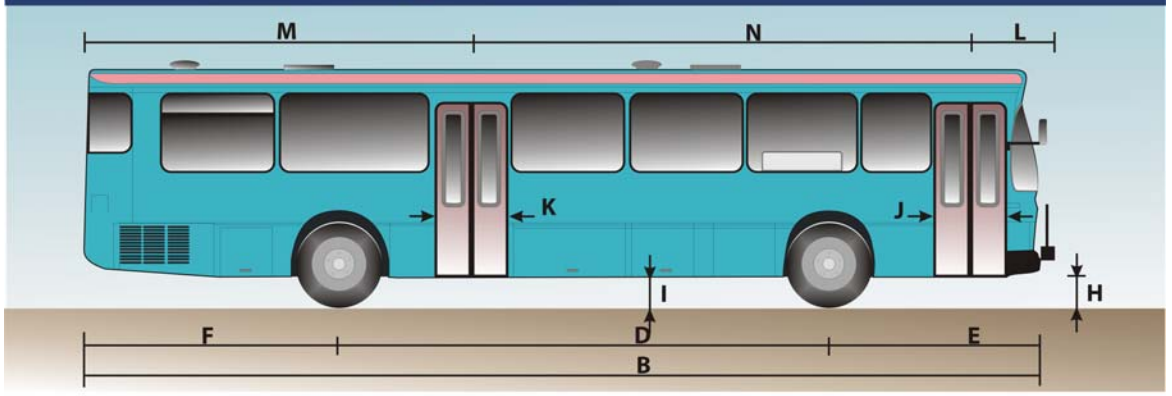
- Specific vehicle type
- Bicycle racks in the upright and straight positions
- Accessories such as radio antenna
- Rear view mirrors set to driver's preferences

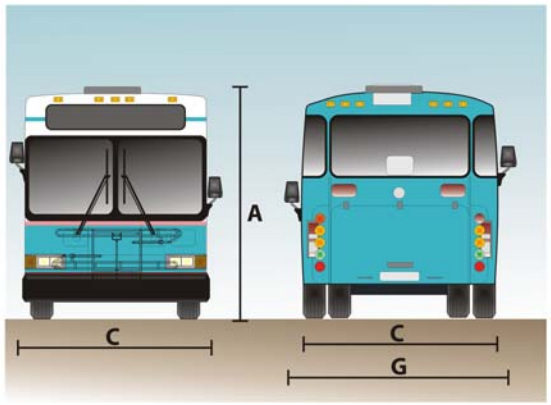
Transit operations are safest and user-friendly when careful consideration has been given to vehicle measurements and its operational characteristics. Transit agencies typically use 30-foot, 35-foot and 40-foot buses depending on route demand and operational limitations. This handbook prescribes operational requirements of a typical 40-foot long bus as the minimum requirement and recommends that key roadway features such as lane and shoulder widths, pavement design, vehicle stop area dimensions, acceleration and deceleration distances, turning radii and clearances should be designed for a typical 40-foot

4.1. Transit Vehicle Dimensions

Dimensions of a typical 40-foot bus are given in Figure 4.1.

Figure 4.1: 40-foot Bus Dimensions

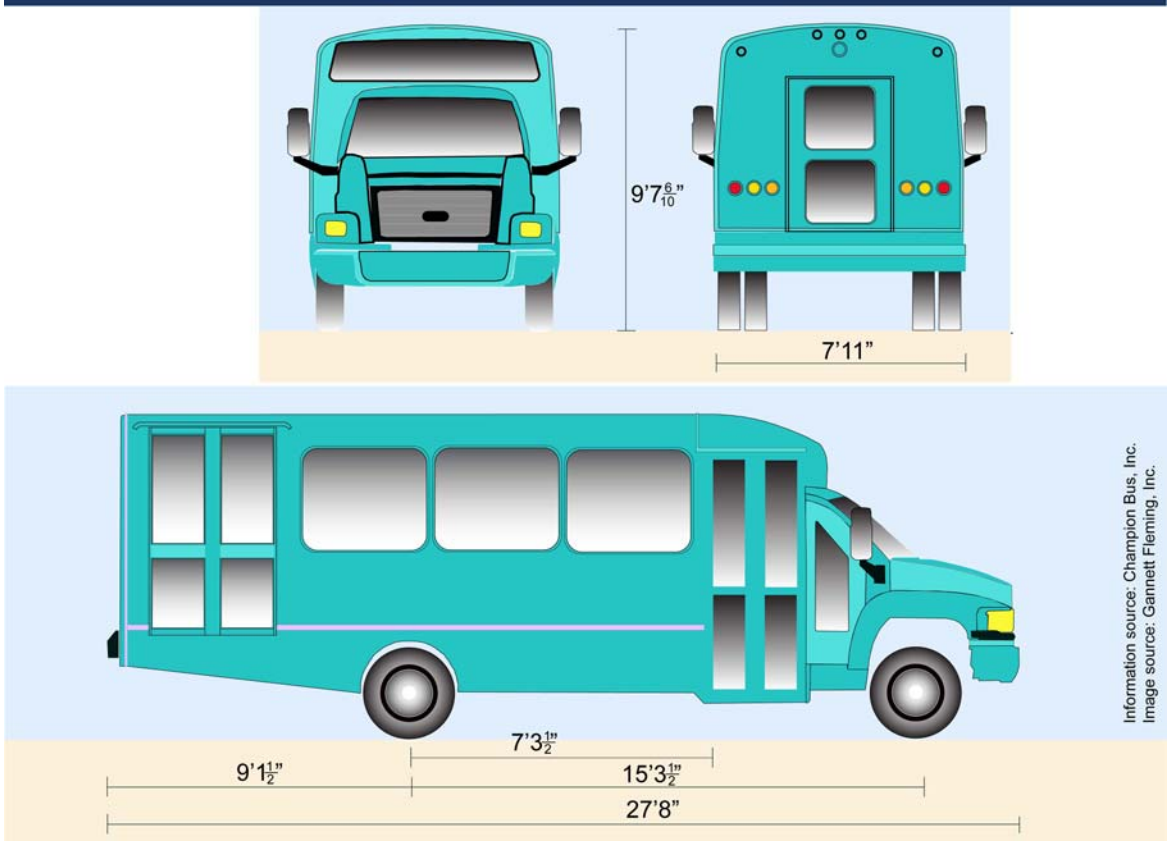




A	Overall Height	10'9"
B	Overall Length	40'0"
C	Overall Width	08'6"
D	Wheel Base	23'9"
E	Front Axle to Bumper	07'3¾"
F	Rear Axle to Bumper	09'4¾"
G	Edge Mirror to Mirror	10'2"
H	Step to Ground (Entrance)	01'5"
I	Step to Ground (Exit)	01'4½"
J	Clear Door Opening (Entrance)	03'8"
K	Clear Door Opening (Exit)	03'8".
L	Centerline Door to Front	03'0"
M	Centerline Door to Rear	17'11¼"
N	Centerline Door to Door	19'8"

Dimensions of a typical 27-foot bus are shown in Figure 4.2. As mentioned previously, these dimensions should be used as a general guidance only. Section 7 Bus Rapid Transit provides standards for other types of buses.

Figure 4.2: 27-foot Bus Dimensions



4.2. Transit Vehicle Turning Templates

Turning movement of a transit vehicle limits its operational capability. For instance, certain vehicles may not be operationally suitable for developed and congested areas such as CBDs. Figure 4.2 provides minimum turning dimensions and turning paths for typical single-unit 40-foot and 27-foot buses operating at a speed less than 10 mph. Buses from different manufacturers will have different turning radii and will vary based on model specifications. Additional clearances may be required for higher vehicle speeds and in areas with severe traffic congestion and restricted sight clearances.

The turning template dimensions can be utilized for:

- Route design;
- Calculating time required for making turns and its impact on signal timings;
- Vehicle suitability in physically restricted or congested areas;
- Identifying the extent of bus encroachment into adjacent lanes;
- Identifying potential conflict with pedestrians and non-transit vehicles; and
- Determining minimum curve radii at intersections.

Figure 4.3: Turning Templates

Figure 4.3.1: Typical 40-foot Bus

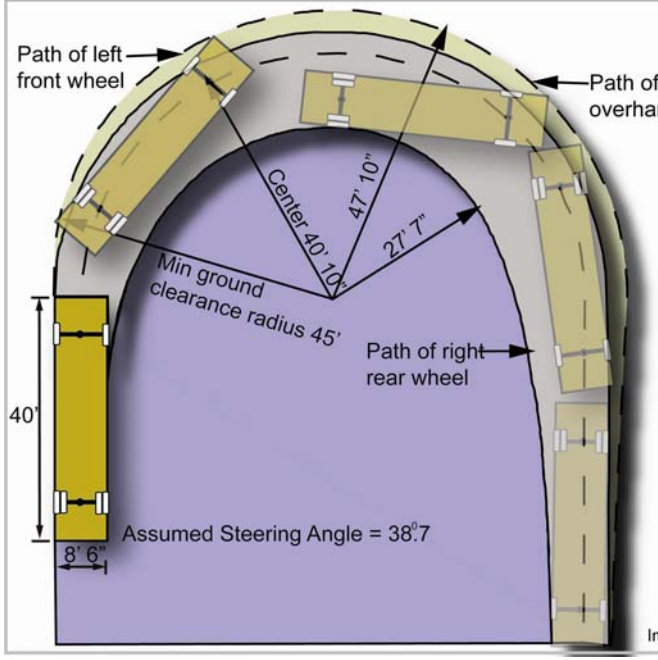


Figure 4.3.2: Typical 27-foot Bus

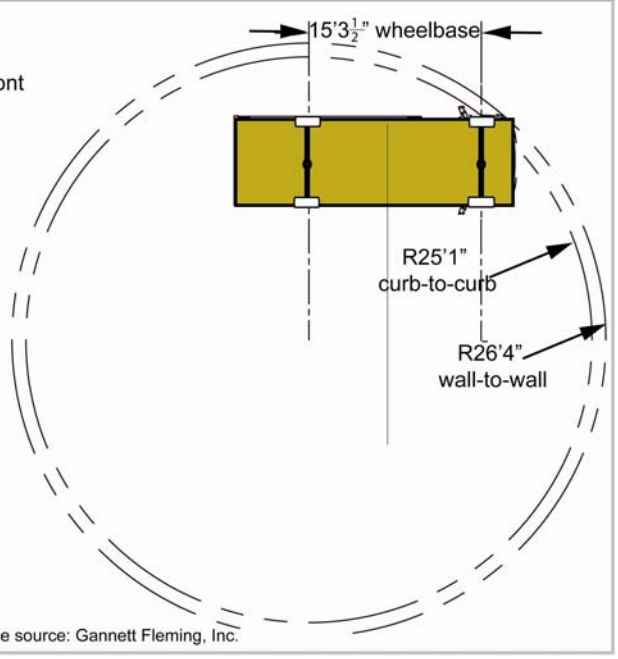


Image source: Gannett Fleming, Inc.

4.3. Intersection Design for Transit

A well-designed intersection will facilitate bus operating speeds and reduce conflicts between transit and non-transit vehicles (Figure 4.3). The intersection design is influenced by the following major factors:

- On-street parking;
- Angle of intersection;
- Number and width of roadway lanes; and
- Vehicle operating speeds and volume.

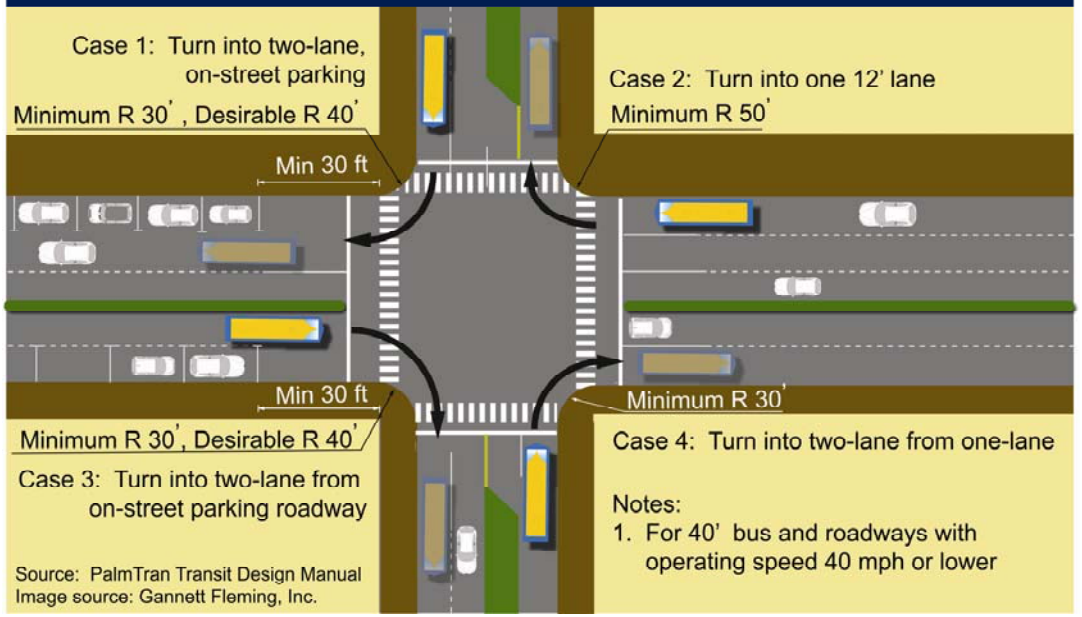
It should be noted that increasing turning radii at an intersection increases pedestrian crossing time and may need to be supplemented by additional median treatments (Refer to Section 2.6.3 Median Refuge).

The following are often limiting factors while modifying an intersection to suit transit:

- Availability of right-of-way;
- Physical features such as utility poles;
- Unauthorized activities and encroachment along the curb side; and
- Trade-off between the need for on-street parking and achieving desirable radii suitable for a transit vehicle.

The above-mentioned issues can best be addressed by sustained coordination among agencies.

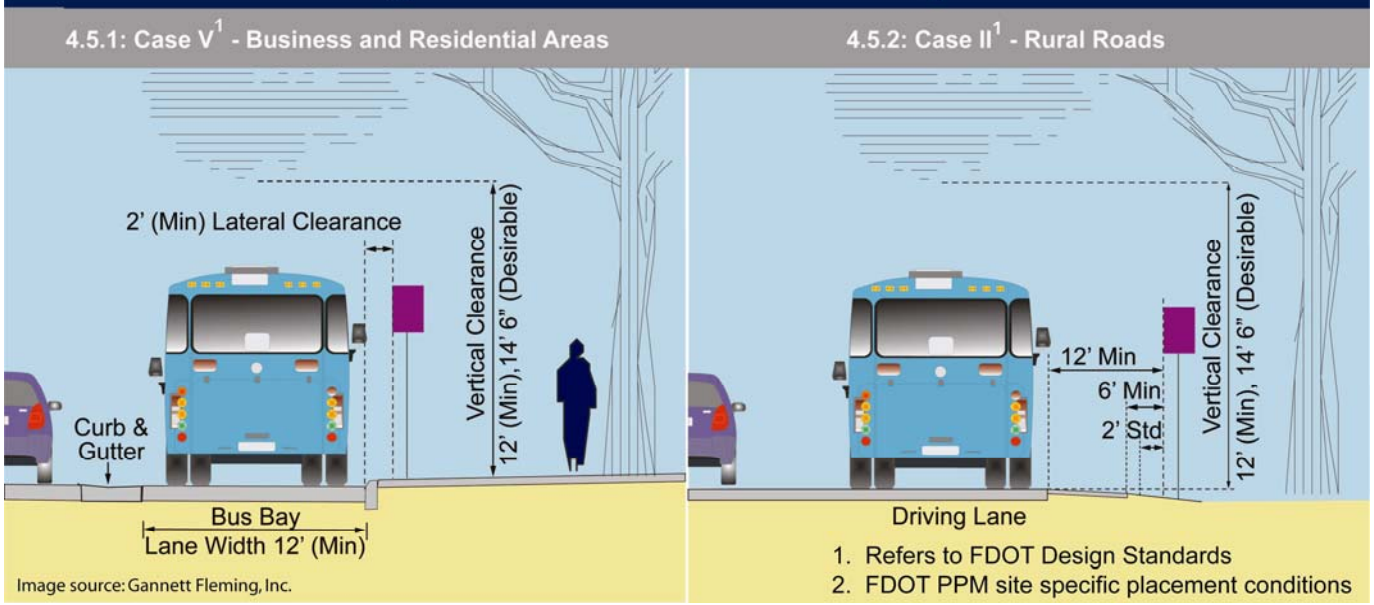
Figure 4.4: Desirable Intersection Design Features for Transit Operations



4.4. Clearance Requirements

Adequate lateral and vertical clearances are critically important for transit passenger safety. The minimum desirable lane width is 12 ft (14 ft including gutter). The following illustration shows minimum clearance required for a 40-foot bus around a stop location. The conditions shown below refer to FDOT Design Standards Index No. 17302. For site-specific placement conditions and clearances refer to the FDOT Design Standards, the FDOT PPM, and other applicable codes. In case of a sidewalk or accessway, a 5-foot unobstructed width should be maintained for ADA compliance.

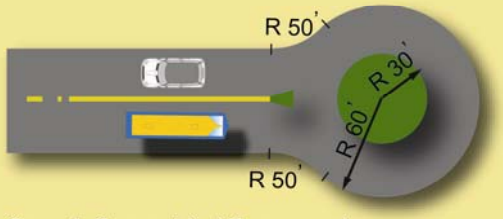
Figure 4.5: Recommended Clearances at Stops



4.5. Turnarounds for Transit

Turnarounds are not the preferred method of changing the transit route direction (Figure 4.5). However, these are occasionally used as parts of an internal street system to enable buses to return to major arterials.

Figure 4.6: Turnarounds For Transit



Case 1: Symmetrical Turnaround

Case 2: Asymmetrical Turnaround

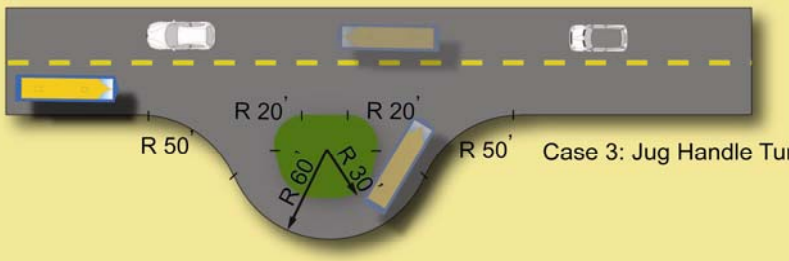
Notes:
Symmetrical and Asymmetrical Turnarounds
1. Low-height plants recommended for islands
2. No on-street parking

Jug Handle Turnaround
1. Recommended for two-lane streets only
2. Not recommended near intersections
3. Alternatives include open-bus bay at far-side of a signalized intersection to facilitate U-turn
4. To be generally avoided

These turnarounds can have low curb height or flush curb to allow buses to use few inches of islands.

All three should in compliance with all applicable FDOT and local agencies' specifications.

Adopted from: PACE Development Guidelines
Image source: Gannett Fleming, Inc.



Case 3: Jug Handle Turnaround

5. Bus Rapid Transit

The following section has been developed to provide general guidelines to transit agencies in regards to the implementation of Bus Rapid Transit (BRT) services. The scale of BRT services varies from city to city based on financial, physical, market, and political constraints and opportunities unique to the area. Consequently, the final BRT product will need to be specially tailored to best address local constraints and also take advantage of distinctive opportunities. This section includes discussion on a BRT system's characteristics, operational strategies, station design, park-and-ride, vehicle design, and policy issues.

5.1. Service Characteristics

BRT is defined by the Federal Transit Administration as "A rapid mode of transportation that can provide the quality of rail transit and the flexibility of buses." BRT combines a variety of physical and operating components into an integrated system that displays a distinct identity and high quality image. These components include:

- Running Ways
- Stations
- Vehicles
- Service Characteristics
- Route Structure
- Fare Collection
- Intelligent Transportation Systems
- Branding

Figure 5.1: BRT Components

Figure 5.1.1: Running ways

Vehicles operate primarily on dedicated bus lanes that should be easily identifiable and exclusively for buses.

Figure 5.1.2: Vehicles

Vehicles are rubber-tired, easy to board, comfortable to ride, environmentally friendly, and high capacity.

Figure 5.1.3: Stations

Stations are attractive, easily accessible, conveniently located, and integrated into the community

Figure 5.1.4: Services

Short headways, long service spans, and integration with local service allow for short walking distances and short wait times.

Figure 5.1.5: Route Structure

Simple color coded routes should be laid out on maps. Direct, one-seat trip opportunities to multiple destinations are desirable.

Figure 5.1: BRT Components

Figure 5.1.6: Fare Collection

A simple system makes it fast and easy to pay, preferably before boarding to reduce boarding time.

Figure 5.1.7: ITS

Digital technologies improve convenience, speed, reliability, and safety.

Figure 5.1.8: Branding

Distinct color schemes, logos, and design features distinguish BRT as a premium service.

5.1.1 Benefits of BRT

Although bus transit is a versatile mode of transportation, it often suffers from poor public image due to low expectations of reliability, comfort, safety, and speed. Rail may be more reliable, more comfortable, safer, and faster, but is costly and relatively inflexible. BRT combines many of the benefits of both modes while addressing their shortfalls.

- **Reduced Travel Time** through faster boarding, smarter roadway configurations, and technology.
- **More Reliability** through elimination of variables such as traffic and traffic signal stops and responsive transit management.
- **Greater System Capacity** with larger vehicles and shorter headways.
- **Lower Risk** than rail due to less investment in rights-of-way, vehicles, and construction, shorter implementation times, and greater vehicle flexibility.
- **Increased Comfort** through added amenities, attractive facilities and vehicles (inside and out), and passenger information systems.
- **Improved Safety** through added lighting, security systems, removing dangers, and additional ridership.

5.1.2 Route Alignments

BRT route alignments should reflect the service area's geography and travel characteristics. Route configurations range from single linear routes to advanced multi-route systems. Routes can be stand alone express busways or they can connect to local all-stop feeder services. Major issues to consider when designing BRT routes include:

- **Route length:** Route lengths of less than 2 hours of total round trip travel improve system reliability. This generally translates to a maximum route length of 20 miles.
- **Route Structure:** It is preferable to design routes to be as linear and simple as possible for two reasons: 1) Linear routes provide direct trips and 2) simple route structures are easy to understand and minimize passenger confusion.

Figure 5.3: Corridoror Characteristics

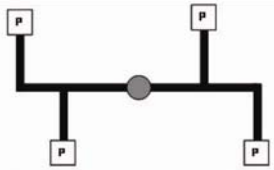
Areas with high densities, down-towns, and transit friendly markets are ideal conditions for BRT.

Figure 5.2: Route Alignments

Figure 5.2.1: Single Route

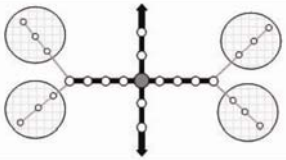
The simplest form of BRT service. One linear route provides service to the central business district. Neighborhood routes provide feeder service to BRT stations.

Figure 5.2.2: Commuter Route



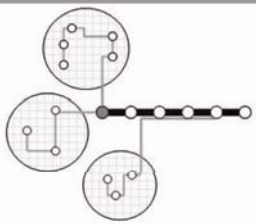
The majority of BRT service users consist of park-and-ride facility users who go to the CBD. This route structure can benefit from the use of HOV or HOT lanes on highways.

Figure 5.2.3: Multiple Routes



Multiple routes are in operation with feeder services provided by the regular local bus service. Transfers between BRT lines are available to customers.

Figure 5.2.4: Integrated Route



BRT routes are fully integrated with the local bus service. Regular local bus service provides both feeder and all-stop service along the BRT corridor.

5.2. Corridor Characteristics

Prior to considering BRT as a viable transportation alternative, an area should meet urbanized area characteristics conducive to supporting a successful rapid transit service. BRT should be relegated to urban areas with high population and employment densities. Areas that do not have intensely developed downtown areas may want to integrate traditional express bus service instead of BRT. To develop a full-scale BRT operation, three conditions should exist:

- Intense downtown development and activity, limited on-street parking, and costly off street parking.
- High commercial and residential densities which can support a rapid transit system's high service frequencies.
- Markets where buses are heavily utilized and where bus lanes can be considered.

Table 5.1: Corridor Characteristics (000's)

Determining Factor	Rail	Rail/ BRT	BRT
Urban area population	2,000	1,000	750
CBD floor space (sq.ft.)	50,000	25,000	20,000
CBD employment	100	70	50
Central city population	700	500	400
Central city population density (persons/ sq mile)	14	10	5
CBD function	Regional	Sub-regional	Sub-regional

Adapted from TCRP Report 90, "Bus Rapid Transit: Implementation Guidelines."

Figure 5.4: Operational Strategies

Figure 5.4.1: Transit only lane

Figure 5.4.2: Transit signal priority

Figure 5.4.2: Dedicated runningway

5.3. Operational Strategies

Two major obstacles in maintaining the speed and reliability of any bus transit service include traffic signals and traffic congestion. BRT is characterized by operational strategies that minimize the impact of those obstacles and improve the speed and efficiency of the service. Specific types of BRT operational strategies include:

- **Bus Preferential Treatments:** Give buses traveling through busy intersections varying levels of priority over other vehicles.
- **Dedicated Lanes and Runningways:** Exclusive and easily identifiable transitways.

Three types of bus preferential treatments include:

- **Transit Signal Priority:** Traffic signal operation is modified or interrupted to facilitate the movement of transit vehicles through intersections. Examples of transit signal priority can be found in Section 1, Streetside Factors, of this handbook.
- **Queue Bypass Lanes:** Bus-only lanes or right turn lanes enable buses to pass through congested intersections with reduced delay.
- **Queue Jump Operations:** Transit signal priority and queue bypass lanes are combined to allow buses to "jump" ahead of traffic queues by transmitting signals directly to an exclusive bus priority signal.

Figure 5.5: Queue Jump

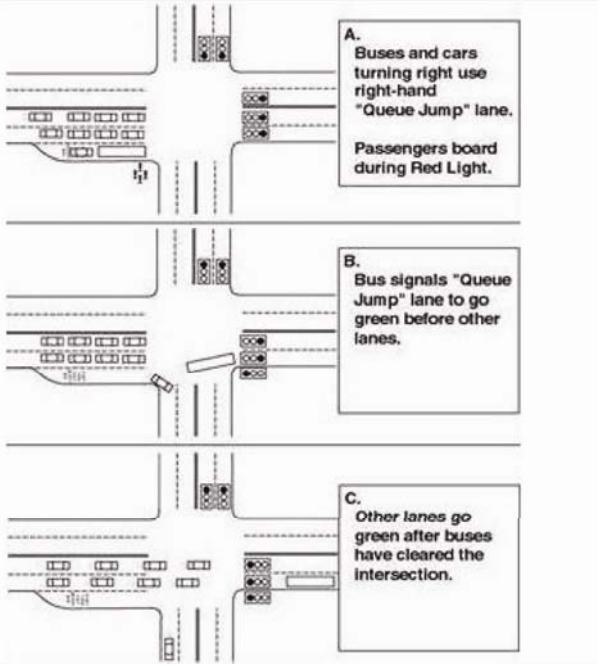
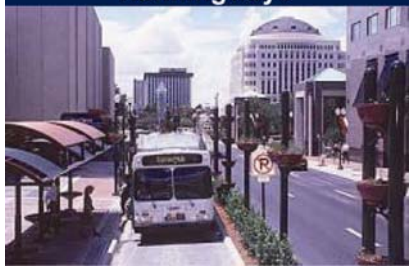


Figure 5.6: Dedicated Runningways



5.3.1 Dedicated Runningways

Exclusive runningways represent one of the most visually distinguishing features of full-scale BRT systems. Exclusive runningways allow BRT to act similar to light rail transit in terms of speed and reliability. BRT runningways can take many forms depending on traffic conditions, corridor development characteristics, and the availability of right-of-way.

Figure 5.7: Transitways

Figure 5.7.1: Mixed operations

Buses operate in regular traffic, but are given preferential treatment at intersections.

Figure 5.7.2: Concurrent flow bus lanes

Bus only lanes that run along street curbs or beside parking near the curb.

Figure 5.7.2: Contra-flow bus lanes

Bus only lanes operated on one way roads in the opposite direction of normal traffic.

Figure 5.7.4: Median bus lanes

Bus only lanes in the center of the road or along the center median.

Figure 5.7.5: Median arterial busway

A system of physically separate busways and stations located at center of the street. Limited access only.

Figure 5.7.6: Bus streets

Automobile free streets used solely by buses at certain times during the day.

Figure 5.7.7: High-occupancy toll lane

Lanes similar to HOV lanes, however, low occupancy vehicles may pay a toll for the privilege of using the HOV lane.

Figure 5.7.8: High-occupancy vehicle lane

Lanes for high occupancy vehicles (typically three or more occupants) only.

Figure 5.7.9: Busways

Dedicated runningways which are often grade separated from traffic used for line-haul transit. These may be guided busways or retrofitted with light rail transit operations later.

Important to Note

When BRT runs on exclusive roadways, Federal regulations and Florida Administrative Code (FAC) for fixed-guideway transit station design apply. When BRT runs in mixed traffic, regulations and codes for bus transit apply.

Refer to Chapter s1455 and 1490, FAC.

Important to Note

Because runningway types and designs will vary from system to system, and the variations can be numerous, specific guidelines are not provided here. General BRT runningway ROW requirements are available in **FDOT's Bus Rapid Transit Functional Classification Study (2003)**. That document is available through the **FDOT District IV Office of Modal Development**.

Regardless of the type of transitway selected, BRT runningways should incorporate, at a minimum, each of the following components.

- Limited bus and automobile conflict to provide for safe and convenient bus motion.
- Bus lanes with distinctive appearance to differentiate from regular traffic lanes.

Enforcement of bus only lanes through fines and traffic violations.

BRT runningways will vary by system based on several factors. Some of these factors include the scale of BRT service, any ROW constraints, the design of the BRT vehicle, and also the signal priority system. All of these factors should be considered when selecting, designing, and implementing appropriate runningway types for BRT operations. In many instances, it is the selected runningway type that dictates the type and scale of BRT elements to be integrated into the service.

5.4 Station Design

Stations are a key element in any successful BRT system. Safe, unique, and attractively-designed stations are a high priority for any BRT operation. Detailed attention to these issues will improve the comfort, convenience, and experience of passengers. Considerations when planning and constructing BRT stations include:

- BRT systems serve high-demand corridors and have only a limited number of stops.
- The number of customers using a BRT station typically will be higher than at local bus stops.
- BRT stations are generally more pronounced in terms of visibility and aesthetic appeal.
- Many existing BRT systems integrate a variety of transit infrastructure elements at their stations to make the service more attractive and to improve the perception and experience of system users.
- Stations can range from simple stops with well-lit basic shelters to complex intermodal terminals with a mix of amenities such as real-time passenger information, newspaper kiosks, coffee bars, parking, pass/ticket sales, and level boarding.

5.3.2 Station Types

There are a wide range of BRT station types which vary in cost and complexity. The decision to implement a particular type of stop is determined based on the amount of travel demand at any particular station location. Stations experiencing higher levels of ridership should provide more infrastructure and amenities for transit users.

Factors influencing the design of BRT stations include service demand, station layout, station length, and passenger amenities. Stations should be scaled according to expected passenger utilization. As such, the layout of stops and stations should be designed to accommodate the expected user demand for the system. Station design and amenities will vary accordingly. The following table describes four BRT station classifications and provides guidelines for infrastructure and amenities for each BRT station type.

Figure 5.8: BRT Station Types

Simple Stop:
Consists of a basic "off the shelf" simple shelter.

Enhanced Stop:
Includes specially designed BRT shelters, lighting, and other weather protection amenities. Often incorporates additional design treatments and passenger amenities such as benches, trash cans, and pay phones.

Super Stop:
Includes level passenger boarding and alighting, possible grade separated connections from platform to platform and includes a full range of passenger amenities and passenger information. Future capabilities should include 2- to 3- bus accommodations.

Intermodal Transfer Center:
The most complex and costly of all BRT stations. Includes a host of amenities and transfer opportunities between local bus service, park-and-ride facilities, and/or any other public transport modes.

Table 5.2: Indicators of BRT Stop Requirements				
	Simple	**Enhanced**	**Station**	**Transfer Center**
↘ **Sign & Pole**	M	M	M	M
↘ **Route Designation**	M	M	M	M
↘ **Sidewalk Connectivity**	M	M	M	M
↘ **Benches**	M	M	M	M
↘ **Shelter**	M	M	M	M
↘ **Schedule Information**	M	M	M	M
↘ **Information Kiosk**	O	D	M	M
↘ **Individual Bus Bay**	O	O	M	M
↘ **Park-and-Ride**	O	O	O	D
↘ **Lighting**	D	M	M	M
↘ **Bicycle Rack**	O	M	M	M
↘ **Trash Receptacle**	O	M	M	M
↘ **Landscaping**	O	D	M	M
↘ **Intermodal Transfers**	O	O	M	M
↘ **Telephone**	O	O	M	M

M – Minimum; D – Desirable; O – Optional

Table 5.3: Station Spacing	
By primary arrival mode	
Walking	0.25 - 0.33
Bus	0.50 - 1.00
Car	2.0
By station location	
CBD	0.25 - 0.50
Suburb	1.00- 2.00
	Distance in miles

5.3.3 Station Spacing

BRT stations should be spaced farther apart than standard local bus stops. Allowing for greater station spacing concentrates more passengers at fewer stations, allows for higher sustained vehicle speeds, lessens accelerating and decelerating times, and lessens delays associated with station stops. Greater speeds resulting from greater station spacing can also make up for additional access time.

The mode of arrival to the station and the density of the surrounding station area should be considered when planning the location and spacing of stops. Stations in the central business district are more likely to be accessed by foot, while suburban stations are more likely to be accessed by automobile. The tables below are a guide to stop spacing under various conditions. However, it should be noted that each BRT system will have different requirements, and no single set of requirements will satisfy every situation.

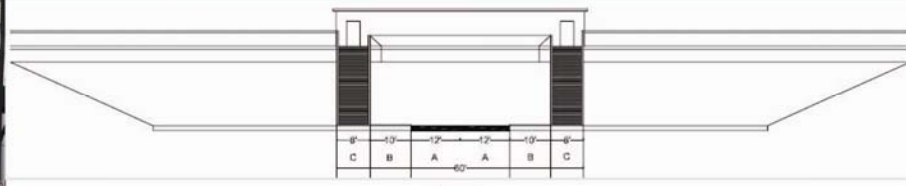
5.3.4 Platform Design

BRT allows for a variety of options in platform design and layout. Some dimensions to consider include:

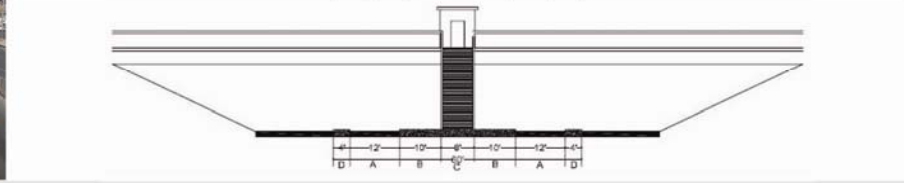
- **Width:** Should be guided by ten-year projected patronage. Curbside platforms should have a 10 to 12 foot width and center platforms should have a width of 20 to 25 feet.
- **Configurations:** Various side and center configurations are displayed in the figures below.
- **Platforms Location:** Tend to be on either side of the bus, rather than in the center because the doors on most buses require right side boarding. Custom made buses may be necessary for center platforms. However, in bus contra-flow situations center street platforms become possible without custom-made buses as typical bus doors will face the platform.
- **Height:** Raised curbs and level platforms allow for faster boarding and alighting, and are especially helpful to the elderly, children, and disabled.

Figure 5.9: Platform Design

5.9.1: Side

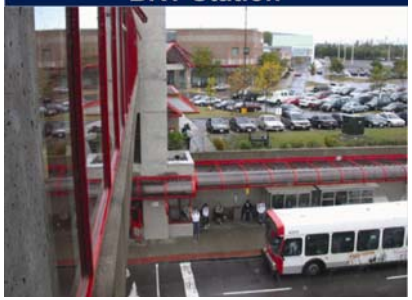


5.9.2: Center island



Legend: A-Bus travel lane; B-Station waiting area; C-Staircase; D-Seperator

Figure 5.10: Park and Ride at BRT Station



5.3.5 Park-and-Ride Requirements

Park-and-ride facilities should be provided when large numbers of potential riders live outside of walking distance to the station. Park-and-ride facilities can expand the BRT service area, allow for greater station spacing, and reduce the need for bus feeder services. Cheap or free parking in park-and-ride facilities encourages the use of the BRT system among choice riders. Issues that should be considered are:

- **Location:** Parking lots should be easily accessible, visible, and in areas where future expansion of the facility is possible.
- **Size:** Parking spaces should be provided at a rate of 1.2-5.0 spaces per rider depending on the number of feeder buses connecting to the route. Ten percent to 15 percent more spaces than the projected need should be added to ensure ample space. When over 800 spaces are needed, structured facilities should be considered to shorten walking distances within the parking lot.
- **Site Planning Considerations:** As with all stations, BRT stations and park-and-ride facilities should afford easy access to pedestrians. A maximum of 400 to 600 feet is recommended. (refer to Section 6, Transit-Oriented Development, for more information) and space for “kiss and ride” applications.
- **Use Conflicts:** Conflicts between automobiles, pedestrians, and transit vehicles should be minimized. One method of minimizing conflicts is to provide walking spaces for pedestrians and separate entrances for automobiles and buses.

Figure 5.11: Park and Ride at BRT Station

5.11.1: Los Angeles BRT Vehicle

5.11.2: Inside a BRT Vehicle

5.4. Vehicle Design and Amenities

5.5.1 Vehicle Design

BRT vehicles define the speed, capacity, environmental friendliness, and comfort of the BRT system. In addition, vehicles utilize distinctive branding by which they are easily recognized by both patrons and non-patrons of the BRT system. BRT vehicles break the mold of typical bus vehicles. Vehicles should be designed to allow fast boarding and alighting, and comfortable movement within the vehicle itself, and they should also include enhancements to the exterior and interior of the vehicle. The following table provides recommended configurations for BRT vehicles. However, bus design may vary and lane width should consider the design of the specific vehicle features such as mirror width, bumper design, and turning radii. In order to ensure the correct turning radii, agencies should be sure to request specific updated data for all purchased and potential future vehicles from the manufacturer.

Figure 5.12: Vehicle Specifications

Figure 5.12.1: 45-foot bus turning radius

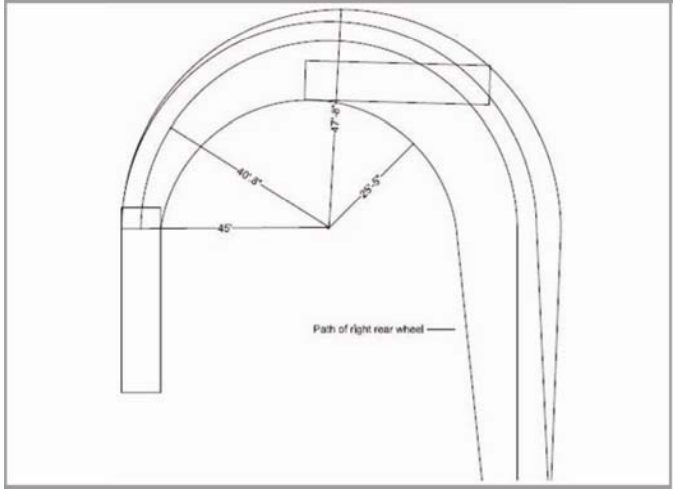


Figure 5.1.2: 60-foot bus turning radius

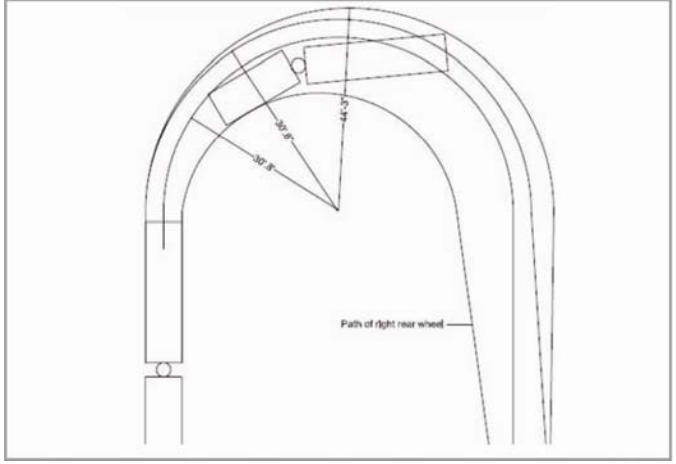


Table 5.4: Typical U.S. BRT Vehicle Dimensions and Capacities

Length	Width	Floor Height	Number of Doorways	Number of Seats	Maximum Capacity
40 ft	96-102 in.	13-36 in.	2-5	35-44	50-60
45 ft	96-102 in.	13-36 in.	2-5	35-52	60-70
60 ft	98-102 in.	13-36 in.	4-7	31-65	80-90
80 ft	98-102 in.	13-36 in.	7-9	40-70	110-130

Table 5.5: Suggested Standards for BRT Vehicles	
Element	**Suggested Standard**
Floor Height	Preferably at or close to level with the platform to provide easy and swift entrance and exit of the vehicle.
Size	Should be large enough to comfortably carry all passengers during peak hours under regular frequencies.
Doors	One door for every ten feet of vehicle length should be provided. Doors placed on both sides of the vehicle allow for center and side platform boarding. Wider doors allow for faster boarding and alighting if fare is collected prior to boarding. Doors should be positioned as to allow for even loading and unloading of the vehicle (roughly equal spacing of doors).
Aesthetics	The aesthetics of the vehicle should project a premium service image in order to attract choice riders to the system. Using distinct colors, premium buses, and attractive body styling can add to the successful image of the BRT. Interior aesthetics should also be stylish with good lighting, large windows, cleanliness, and comfortable seating.
Circulation	Increasing aisle width with alternative seat layouts, additional doors, better ADA accommodations may add to the circulation, feeling of openness, boarding speed, and passenger comfort.
Passenger Information Systems	On bus information provided to passengers will attract more passengers because they are more likely to feel comfortable boarding a bus. Reassurance is key to rider comfort. Visual and audio announcements about stops should therefore be considered.
Guidance Systems	Guidance systems provide the opportunity for automated movement of vehicles along runningways and into and out of stations based on electronic detection of either magnetic or painted markers. This type of system mimics the accuracy of rail modes by allowing for precision docking and comfortable tracking. In addition, riders experience more comfortable rides and no-step boarding of vehicles.

Important to Note

For more information on development around BRT stations, please refer to Section 7: Transit-Oriented Development.

5.5. Policy Issues

In planning and programming BRT service, a number of policy issues need to be considered. The scale of the BRT service will be largely influenced by how well BRT can be retrofitted into a well developed urbanized area. The range of alternative elements within each BRT component allows for flexibility in the application of such components within differing operating environments. As such, the implementation of each desired BRT component should be carefully examined prior to the expenditure of limited resources. A summary of policy issues to consider when planning for BRT is provided here.

- **Serving BRT markets:** BRT service should penetrate major travel markets along corridors with high density residential and commercial areas. Potential destinations for the service include central business districts, university campuses, major commercial centers outside of the center city, and area attractors. In addition, service characteristics and BRT design should cater to the target transit markets in the area in order to improve the appeal of the system and in turn gain ridership.
- **BRT parking requirements:** Parking plays a major role in BRT sustainability, and transit friendly parking policies at BRT park-and-ride facilities should be adopted when beginning BRT services.
- **Incremental development of BRT:** Many BRT systems have benefited from a phased, incremental approach in implementing their service. A phased approach gives the transit agency the opportunity to systematically integrate and evaluate BRT services.
- **Land use for BRT:** Concurrent transit friendly land use policies must be enacted to sustain and grow BRT ridership. Land use policies should encourage development of substantial density near or around transit stations. Incentives such as enterprise zones, density bonuses, and transit overlay zones should be provided to encourage developers to build transit-oriented development near BRT stations. Pedestrian connections should be built and parking concerns should be balanced with pedestrian concerns in building stations and park-and-rides.
- **Inter-juristictional arrangements:** A BRT project may operate across multiple jurisdictions. In such a case it becomes important for transit agencies to reach agreements on issues pertaining to infrastructure, technologies, operations, and responsibilities.

- **Interdepartmental arrangements:** Many different agencies and organizations may be involved in the planning of a BRT system on the private, municipal, county, state, and federal levels. Agency cooperation has a large impact on the BRT system and may affect the feasibility of implementing such a service. Intergovernmental agreements that define the role, responsibilities, and funding for the service may be needed. Issues that may arise vary and depend on the individual circumstances unique to each locality.
- **Documenting BRT plans:** BRT plans should be included in a county comprehensive plan as part of the capital, transportation, and land use elements to facilitate interagency consensus on implementation.

6. Park-and-Ride Facilities

Useful Source

For more information on promoting park-and-ride programs:

FDOT State Park-and-Ride Manual

Park-and-ride facilities are intermodal facilities which enable travelers to change from an automobile travel mode to a transit or other mode, allowing for critical transit ridership to be met even in lower density areas (Figure 6.1).

Park-and-ride design can be a large project, and varies depending upon the size, function, and location of the specific facility. There is no standard park-and-ride design. Therefore, each park-and-ride facility must be designed on a case-by-case basis. For that reason, this Section provides general guidance on creating park-and-ride facilities rather than laying out a specific standard for park-and-ride facilities.

The remainder of this section discusses park-and-ride facilities in detail. This section seeks to achieve an objective of creating park-and-ride facilities that are multimodal in nature, focusing on various methods of making the station accessible to all means of transportation and patrons, as well as increasing circulation within the station. Other considerations include facility site selection and safety.

Figure 6.1: Park-and-Ride Facility

6.1. Benefits and Drawbacks of Park-and-Ride Lots

Negative aspects to consider of park-and-ride facilities are listed below. It should be noted that construction of parking garages, as opposed to surface parking lots, may lessen some of these potentially negative impacts.

6.1.1 Benefits of Park-and-Ride

Some of the benefits of park-and-ride facilities include:

- Providing an alternative to using an automobile for entire trips, by providing the opportunity to easily switch to transit.
- Concentrating transit demand densities to a level that could make transit feasible in low density areas.
- Making transit more accessible to those in low density areas through car travel to the transit stop.
- Reducing vehicle miles of travel by encouraging transit use and reducing automobile driving distances.
- Shifting parking away from the CBD and into outlying areas, removing downtown congestion, lowering parking requirements, and allowing for more walkable downtowns.
- Moving parking demand outside of the CBD to free up land for more productive uses.
- Organizing parking for transit into a single location to alleviate uncontrolled parking and increase on street parking capacities.
- Reducing congestion by encouraging transit, providing a cheaper alternative to building more roadway capacity.
- Can promote patron safety by placing park-and-ride facilities near activity centers.

Figure 6.2: Benefits of Park-and-Ride Facilities

Park-and-ride lots allow travelers to switch from single occupancy to higher occupancy modes. Above are good examples of intense use park-and-ride design from Springfield, Missouri (left), and Sarasota (right).

6.1.2 Drawbacks of Park-and-Ride

Some of the negative aspects of park-and-ride facilities to consider include:

- Excessively large lots remove land from potentially more productive uses.
- Stormwater drainage and management must be considered in the development of large parking lots to avoid excessive runoff.
- Parking lots may prevent establishing transit-friendly development by extending the distance between pedestrian origins and destinations.
- Pedestrian entrances to park-and-ride facilities may be long and monotonous, creating unpleasant conditions for pedestrians.
- When there is no cost for parking, the development and maintenance of park-and-ride facilities must be subsidized from other sources and may reduce funding for other capital projects.
- Park-and-ride facilities attract traffic to the local area and may create automobile congestion on local roadways and intersections.

Figure 6.3: Drawbacks of Park-and-Ride Facilities

Park-and-ride lots that are excessively large may create conditions that are pedestrian unfriendly.

Figure 6.4: Location

Transfer centers are ideal locations for park-and-ride facilities

6.2. Function and Location

Park-and-ride lots can be classified either by function or by location. Facilities should be categorized by criteria in order to identify design needs for various types of park-and-ride lots. The FDOT State Park-and-Ride Lot Program Planning Manual outlines the site selection process using location criteria so that facilities may be identified by the markets they serve. Both types of criteria will be defined here, as well as other factors of design and location that will be discussed.

6.2.1 Functional Classifications

There are six types of park-and-ride facilities that are classified by their functional characteristics and their intended use. The six types of facilities are listed and described below:

- **Informal Park-and-Ride Lots:** These are transit stop or car/van pool meeting locations to which motorists drive and leave their cars parked nearby. When individuals begin forming informal facilities, more formal facilities should be considered for implementation.
- **Joint Use/Opportunistic Lots:** These lots take advantage of extra parking space, either on a publicly-owned right-of-way or a privately-owned parking lot with an agreement between the lot owner and the transit agency. Joint use lots are discussed further in Section 6.4.
- **Park-and-Pool Lots:** These lots are typically smaller facilities used exclusively for car/van pool operations.
- **Suburban Park-and-Ride Lots:** Located at the outer edge of the urban landscape, these lots serve to collect potential transit users at a location near their homes for long haul trips. These facilities typically connect to express bus routes and are good locations for multiple uses, transit-oriented development (see Section 7) and joint development (see Section 6.5.4).
- **Transit Center:** Adding a park-and-ride lot to a typical transit or transfer center can increase ridership at the location and can help to offer riders greater transit services from that location.
- **Peripheral Lots:** This lot would be placed at the edge of an activity center to provide inexpensive parking alternatives to on-site parking within the activity center itself.

Refer to:

FDOT State Park & Ride Manual

FDOT Districts One and Seven Transit Facility Practitioner's Guide

6.2.2 The Two Step Process

The FDOT State Park-and-Ride Lot Program Planning Manual defines a two step process for selecting a park-and-ride facility site. The first step is to determine the feasibility of park-and-ride in the area. The second step is to identify specific sites for locating the park-and-ride facility.

➘ Step One: Area Identification

Criteria that should be incorporated into area identification for a park-and-ride facility include:

- Informal park-and-ride activity
- Density of residential areas
- Intensity of employment centers
- Distance between residential and employment centers
- Current and future roadways levels of service

Additional standards are set based on the location of the specific park-and-ride facility. The types of park-and-ride locations are described below.

- **Urban Corridor Lots** are located within major commute corridors within an urban area and are served by HOV lanes or line haul transit. Trip origins are dispersed and trip destinations are concentrated.
- **HOV Corridor Lots** are located next to major commuting highways with HOV lanes and are designed to maximize HOV lane use. Trip origins are dispersed and trip destinations are concentrated. Park-and-ride lots may also be directly connected to the HOV lanes to provide a direct incentive for using transit and car/van pools.
- **Peripheral Lots** are located on the outer edge of activity centers, and are built to provide inexpensive parking alternatives to on-site parking within the activity center itself.
- **Urban Fringe Lots** are located on the outer edge of urban development, trips tend to originate outside the fringe of the urban area, and destinations are either concentrated or dispersed. These lots are not typically served by transit, although there are exceptions.
- **Remote Lots** are located outside the urban area in rural locations. Trip lengths are typically longer than for other types of park-and-ride trips.

Useful Source

FDOT District One has developed a Park-and-Ride Evaluation Process, to be used in the recommendation, selection, and funding of park-and-ride lot projects within District One.

For more information regarding this guide, please contact the District One Office of Modal Development.

Figure 6.5: Site Selection

This park-and-ride facility in Long Beach, California, combines accessibility, visibility, transit service, and a positive atmosphere.

➘ Step Two: Site Selection

In order to select a site, a set of criteria must be established to rank all potential sites. Point scores can be assigned for each potential site based on their available features. When point scores are totaled, the highest scoring site may be the most desirable site. The most important factors for site selection are:

- **Right-of-Way:** Lower costs associated with right-of-way acquisition and construction are ideal.
- **Atmosphere:** Safety and environment issues, both real and perceived should be addressed through site selection.
- **Site Size:** Lots that are too small result in lower available capacity, and lots that are too large result in over-expenditure of funds.
- **Visibility:** The lot should be seen from adjacent travel routes to increase awareness of the availability of the service and discourage crime inside the facility.
- **Access:** Lots should be directly, safely, and easily accessible from main corridor roads.
- **Transit Service:** Lots must be located along current or planned transit routes.
- **Access Road Congestion:** Sites should be located to minimize congestion between the main roadways and the lot.
- **Transit Design Features:** Inadequate turning radii, aisle width, and pavement design may reduce the ability to use transit at the site.
- **Traffic Circulation:** Site should have minimal impact on the adjacent roadways.
- **Bicycle and Pedestrian Access:** Easy access to alternative modes of transportation can attract additional riders.
- **Stop Spacing:** Park-and-ride locations should be an adequate distance from other park-and-ride facilities to avoid duplication and overlap.
- **Expansion Potential:** Future growth may require additional space for expansion.
- **Environmental Issues:** Both the urban and natural environments may be affected by the addition of large parking facilities, and the effect should be considered in the placement of lots.

Figure 6.6: Site Consideration

Park-and-ride entrances should be designed for minimal impact on street traffic, which can be accomplished by removing the facility entrance from the main road.

6.2.3 Additional Considerations for Site Location

- **Entrance Location:** Park-and-ride facility entrances should be sited and designed so that:
  - Safety is maximized.
  - Traffic congestion is minimized during peak daily loads.
  - It is accessible and convenient for patrons.
  - There is a positive impact on local land use.

These objectives may be accomplished in several ways:

- Facilities should be located to the right of the larger traffic stream so as to minimize conflicts involved in crossing opposing traffic upon entering the park-and-ride facility.
  - Adequate queuing space must be available so that lines of autos may wait for parking without disturbing adjacent facilities or overflowing into street traffic.
  - Large park-and-ride lots should connect to multiple streets to minimize the effect on traffic along a single street.
  - Area traffic patterns must be studied to evaluate the impacts of park-and-ride traffic on local street traffic.
  - Provision of accessible pedestrian routes.
- **Design Implications of Service Type:** Park-and-ride facilities are more likely to be used for long haul, rather than short haul trips for convenience purposes. When used for short haul trips, park-and-ride use is usually due to the lack of parking at the destination. Designs are not necessarily mutually exclusive to a single service type. For example, adding car/van pool service to an express park-and-ride can create a synergetic reaction by creating multiple uses for a park-and-ride, which may also add to the customer awareness of alternative transportation modes.

Design Implications of Various Transit Services

- **Local Routes:** Smaller lot with few amenities required. Pedestrian access is a very important aspect. Shelters are recommended.
- **Express Routes:** Lots are slightly larger with more amenities. Shelters are a must, and bicycle parking should be available. Well ventilated bus idling areas and kiss-and-ride areas should be included. Separate bus lanes may be installed.
- **BRT Routes:** High capacity lot, full scale waiting area with a range of amenities, including bicycle storage and kiss-and-ride should be added. Busways must be separate from car lanes. Local bus docking areas should be near BRT loading areas.

Important to Note

In order to avoid conflicts, it is beneficial to consult local planning documents, such as Long Range Transportation Plans and Transit Development Plans, for locations of planned future park-and-ride facilities.

Figure 6.7: Joint Use Facililties

Good joint use facilities may be lots that are not used during the work day such as churches, libraries, meeting halls, sports facilities, theaters, and other commercial land uses.

Design Implications for Commuter Services

- **Regional van/car pools:** Shared use is most cost effective. Parking along a walkable median may be ideal.

➘ **Joint Use Facilities:** Joint use facilities are locations where a park-and-ride lot is joined with a parking lot for another use such as retail. The transit agency may arrange with a lot owner to use a portion of an existing facility for park-and-ride activities.

This is different from joint development in that joint development's primary use is a transit facility with complementary uses added. Joint use facilities are ideal for car/van pool park-and-rides because they do not require the same level of consideration as a bus park-and-ride. When considering a joint use park-and-ride facility, the following should be considered:

- **Size:** The facility should be large enough for immediate use with room for expansion.
- **Conflict:** Interference with parking for other uses should be minimized.
- **Bus Accessibility:** Altering the park-and-ride facility for bus accessibility both structurally (asphalt strength) and geometrically (turning radii) may be necessary.
- **Amenities:** These include shelters, benches, schedules, and vending.
- **Complementary Uses:** If possible the adjacent uses should complement transit or provide goods and services that transit riders would be attracted to.

6.3. The Elements of Park-and-Ride

Park-and-ride lot elements should work together to create a synergy that increases ridership through accessibility to all modes of transportation. For that reason, it is important to examine each element of a park-and-ride facility both separately, and together. Additional elements that may provide additional benefits in terms of ridership, safety, and capacity are also considered in this section.

6.3.1 Major Elements

Successful park-and-ride lots provide for congruence between the various elements. If some elements are lacking or missing, the park-and-ride as a whole may be deficient. Table 6.1 describes where and when to implement the various elements and issues that may arise in implementation.

The major elements of park-and-ride are described below and illustrated in Figure 6.8.

- **Bus Idling Area:** Located before the loading area, but should provide the possibility for unloading passengers prior to idling.
- **Waiting Area:** Between the parking area, pedestrian access, and kiss-and-ride areas, and the vehicle loading area. Shelters should be provided.
- **Loading Area:** Separate from roadways used by other vehicles. Accessed by transit vehicle directly from the street. Should accommodate the largest bus sizes.
- **Vehicle access:** Enough access so that volume per lane should not exceed 250 vehicles per hour. One exit for every 300 cars. Should not increase arterial or freeway congestion.

Figure 6.8: Elements of Park-and-Ride Facility

Table 6.1: Elements of Park-and-Ride Facilities

Elements	When/Where to Include	Design Issues
Bus Idling Areas	When buses idle at the facility	Fluidity, excess space, air ventilation system
Waiting Areas	When waiting for the bus	Access of people, aesthetics,
Bus Loading Areas	To separate buses from other traffic	Separation, location, speed, access
Vehicle Access Points	Separate from access with all other modes	Reducing impact on traffic on the arterial roadway
Kiss-and-Ride Area	Near Loading Zone for passenger drop-offs	Connection to bus loading zone/walkways, limiting conflicts with parking vehicles, adding waiting areas
Bicycle Parking	Urban/Suburban area	Protection, location, potential for pedestrian conflicts
Vehicle Parking	Within 300 Feet of Bus Loading Zone	Connection to bus loading zone/walkways, access to parking
Pedestrian Access (Walkways)	For external access and internal circulation	Safety, limiting conflict with vehicle traffic
Accessible Parking	Near the Bus Loading Zones	ADA requirements, accessibility, location

- **Kiss-and-Ride Waiting Area:** For pick up and drop off should be provided near the passenger waiting area with a full circular entry and exit. Access should not mix with bus flow.
- **Bicycle Parking:** Should be located near passenger waiting areas with places to secure bikes. Should avoid mixing with pedestrian traffic.
- **Vehicle Parking:** Maximum walking distance from parking of 300 feet. Minimum conflict between pedestrians, motorists, and buses.
- **Pedestrian Access:** Should avoid conflicts with all other modes. Pedestrian access and circulation should take priority over vehicular traffic.
- **ADA Accessible Parking:** Should be the closest parking to the loading area and have accessible routes throughout the facilities.

Figure 6.9: Park-and-Ride Design Scheme

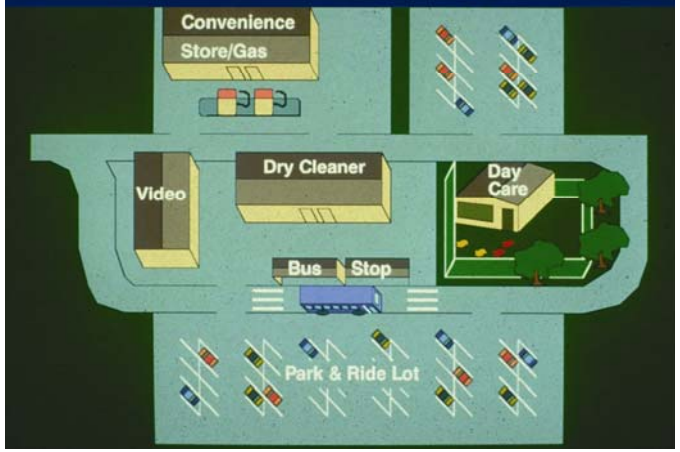


Figure 6.10: Signage

Directional signs like the ones above inform drivers of park-and-ride lot locations.

6.3.2 Lot Size

The size of the lot should be determined based on existing and projected transit ridership for the life of the park-and-ride. A good rule of thumb is that 90 to 100 spaces can be placed on each acre.

- When pedestrian or transit intermodal access is likely, such as in transit-oriented developments, fewer parking spaces are required.
- Transit Services that attract greater ridership should have more parking spaces (i.e. an express bus service park-and-ride will need more space than for a local bus service).
- Depending on the size and layout of the parking lot, walkways may be necessary to avoid pedestrian/automobile conflicts.

6.3.3 Signage

In order to reduce the park-and-ride's impact on traffic and increase accessibility, including signs to inform drivers of the location of the park-and-ride is essential. Signs should be clear, concise, unobstructed, and easy to see from the street. Signage should follow the MUTCD, FDOT, and local guidelines.

Figure 6.11:Joint Development

A joint development tenant at the SunTran Central Transfer Station in Ocala; Dee Dee's Dog House.

6.3.4 Joint Development

Joint development is development, other than the transit facility itself, located within the park-and-ride facility. Joint development can help in the creation of transit-oriented development. A sense of place can be established when joint development provides a complementary use to a transit facility. Also, transit can complement the joint development if the development is a possible focal point of activity. See Section 7 for more information regarding transit-oriented development. However, one must be careful not to compromise the ease of access to the park-and-ride itself in the design of joint development. Figure 6.11 shows a high-quality park-and-ride lot design with joint development.

Joint development can be car friendly on the edges of the facility and pedestrian friendly near the transit facility. It should be geared to the needs of transit passengers and improve their mobility and quality of life.

Complementary development includes:

- Retail Shops
- Convenience Shops
- Grocery Shops
- Dry Cleaners
- Day Care
- Gas Stations (in a corner of the facility)
- Food Vendors
- Newspaper Stands

When involved in joint development, an agency must consider the positives and negatives of different types of development and management schemes (Refer to Table 6.2).

Table 6.2: Park-and-Ride Lot Joint Development Pros and Cons

Type of Property	Pros	Cons
New Development	Can be designed to complement transit	No guarantee that development will be a successful attractor, may be expensive
Redevelopment	Lower cost than new development	May not be designed for complementary use, may have stigma associated with the previous use
Privately-Owned	Real estate deal may earn revenue for transit agency, less risk for loss of public funds, no funding issues	Less control over use and design of development
Publicly-Owned	Greater control to ensure complementary use of land and transit oriented development	Greater risk of loss from unsuccessful development, development may likely be funded publicly

Refer to:

For additional information on station design for accessibility, refer to:

Section 3.4 Accessibility and Section 7, Transit-Oriented Development

6.4. Accessibility

Accessibility is the most important factor in deciding to use a given mode of transportation. Therefore, designing the facility for accessibility is the most important aspect of facility design. The remainder of this section includes information and ideas to create more accessible park-and-ride facilities.

The following is a list of ideas for designing park-and-ride facilities for intermodal accessibility.

- All transit modes in an intermodal park-and-ride facility should be interconnected using pedestrian paths.
- Drop off zones for kiss-and-ride activities should be located as close to the transit loading area as possible to reduce pedestrians crossing into automobile traffic.
- Automobile access to park-and-rides should be from collector or access roads that intersect arterials in order to avoid congestion on arterials.
- Bus turning movements into opposing traffic lanes should be avoided at station entrances.
- Van/car pool facilities may be located near the entrance, and away from the transit right-of-way.
- Transfers between transit vehicles and transit modes should be possible with minimal walking by consolidating transit facilities to a single area. For example, a passenger should be able to disembark a bus and board a train by only crossing the station walkway.

Figure 6.13: Circulation

Raised and colored crosswalks provide additional safety for pedestrians by signaling to cars that pedestrians are given right of way.

Bicycle amenities, such as this covered bike rack in Central Station, Belfast, can add ridership by encouraging bicyclists to use transit and can save money by decreasing the necessary number of parking spaces for cars.

6.4.1 Right-of-Way Priorities

Figure 6.12 illustrates how a park-and-ride can successfully integrate the various modes utilized within a park-and-ride facility. When designing accessible park-and-ride stations, priority should be given as follows:

- **Pedestrians:** Providing a safe and convenient path to the station will encourage more people to walk and will provide a greater level of safety.
- **Transit:** Transit generates a high level of pedestrian activity and is the mode park-and-rides attempt to promote, and should therefore be given priority.
- **Kiss-and-Ride:** Requires proximity to the station and should therefore be located closer to the station than parking facilities.
- **Parking:** Requires all-day parking for commuters and uses a large amount of space which could detract from other modes if given priority.

6.4.2 Pedestrian and Bicycle Considerations

Pedestrian walkways should provide a direct means of access from all points in the facility to the bus loading area.

- Locate sidewalks next to all curbside parking lanes and loading areas.
- Walking distances from car to loading zone should be a maximum of 300 feet.
- Avoid conflict with other modes.
- If modal conflict is necessary, provide crosswalks with the clearest possible crosswalk markings.
- Paths should be interconnected with no dead ends.
- Paths should be highly visible and well lit.
- Resting areas should be available along longer distance paths.

Figure 6.12: Intermodal Connectivity

Transfers between transit vehicles and transit modes should be possible with minimal walking by consolidating transit facilities to a single area.

Figure 6.14: Modal Seperation

Note the separate right-of-way for buses at the Houston, Texas facility, above. Also, note the kiss-and-ride facilities to the right of the terminals. The park-and-ride facility above is along a connector road that intersects the arterial, which can be seen at the top of the picture.

ADA accessible parking should minimize conflict with cars, be near the facility entrance, and be clearly marked. Pathways should be accessible as well.

- Pedestrians should have the right-of-way at crosswalks.
- Provide accessible routes from parking areas to bus waiting areas and other site amenities.

Bicycle access should be encouraged to increase ridership.

- Provide connections to bicycle paths from the station.
- Direction to bicycle parking should be posted.
- Bicycle racks and lockers should be considered.
- Covered bicycle racks encourage bicycle storage.
- Bicycle connections should not impede pedestrian movement.
- Even when bike racks are not provided, it should be noted that many buses have bike racks attached. Provisions should therefore be made for bicycle usage at park-and-ride facilities.

6.4.3 Modal Separation

Because transit has the highest priority of any motorized travel mode, transit's access to the station must not be compromised by automobile traffic. Therefore, transit flow should be unidirectional and separated from all other traffic inside the park-and-ride facility. Kiss-and-ride should also be separate from park-and-ride facilities.

Figure 6.15: Safety

Park-and-ride lots should have adjacent uses that add security to person and property within the facility such as retail businesses, and police facilities. This train station (top) connects to a park-and-ride and its own business district with a police precinct.

Consider selling tickets at the gate entrance or instituting monthly passes to control parking lot usage when parking is tight or crime is perceived to be a problem.

6.4.4 Accessibility Considerations

Parking spaces for disabled patrons should be located near the bus loading zone. The same considerations should be considered in vanpool park-and-rides. ADA accessible parking spaces should include the following considerations:

- Disabled riders should be able to park so as to minimize conflicts with cars. Walkways should be planned so that disabled patrons need not move behind cars.
- Parking spaces must be at least 12 feet wide with an adjacent 5 foot access aisle. Two spaces may share a single access aisle.
- Parking for disabled only should be clearly labeled.

In addition, accessibility from external locations should include ADA considerations such as:

- Wide walkways (4 feet required, 8 feet desired);
- Pathways that are accessible at all points in the facility; and
- Entrances to structures flush to outdoors.
- One should consult to ADA Accessibility Guidelines and the Florida Greenbook for official requirements.

6.4.5 Safety Considerations

An improperly designed and protected park-and-ride facility may lend itself to crimes to both person and property. Therefore, proper design and enforcement for crime prevention is essential for both the actual and perceived safety of patrons and their cars.

- Provide unobstructed views throughout the facility.
- Avoid isolating the facility from the community and ensure open windows at adjacent buildings that offer a sense of community surveillance.
- Lighting must be adequate.
- Provide two-way communication between security personnel and patrons via alarms, emergency phones, and surveillance cameras.
- Encourage frequent police patrols of the facility.
- Create a community watch in the area.
- Avoid the use of objects or landscaping which could be used as hiding spaces.
- Create concentrated on-site activity.
- Offer round-the-clock transit service.

- Limiting access to the facility for authorized uses only through the use of access gates.
- Add telephones for emergency use by patrons.
- Issues of enforcement of park-and-ride use for facilities should be discussed prior to design. Issues to be discussed include:

- Police patrol of park-and-ride facility
- Overnight parking
- Parking for uses other than transit
- Crime prevention

Access to the facility should be limited to authorized usage in order to prevent crime and make parking spaces available for transit patrons and other authorized uses by implementing:

- Police patrol of park-and-ride facility on a regular basis
- Overnight parking disallowance or segregation
- Controlled access to parking lot
- Closed circuit television for security

7. Transit-Oriented Development (TOD)

Improving the design of public transportation facilities not only means improving bus service, bus stops, and rail stations, it also means orienting development patterns to be more conducive to transit use; TOD encompasses this pattern.

TOD is a method of integrating land-use and public transportation, combining mixed-use developments with transit that provides connections to the places where people live, work, and play. The central component of a TOD is a bus or rail station with dense land-use close to the station becoming progressively less dense as development radiates away from the station.

7.1. Defining TOD

Generally, TOD is characterized by compact, more dense activity centers and developments that are served and connected by high quality public transportation services. More efficient services create "transit-friendly" nodes and corridors, resulting in increased transit use, walking, and bicycling.

Automobile use is still accommodated in a TOD, but is not treated as the primary mode of transportation. Some significant site related development characteristics that should be considered in a TOD include the location of automobile parking and building location and design.

Figure 7.1: Transit-Oriented Development

Figure 7.2: TOD Benefits

TOD provides benefits to transit riders and the community at large in terms of improved accessibility and quality of life.

7.1.1 Objectives

There are six objectives that a successful TOD should accomplish:

- **High Location Efficiency**: The ability of TOD residents and workers to get where they need to go in more ways than driving alone through easy access to transportation and services using non-motorized methods accomplished through a mix of uses in an area, high quality transit, and a pedestrian friendly design.
- **Value Recapture:** The ability of the residents of a TOD to regain their investment through value gains such as cheaper transportation costs, location efficient mortgages, and reduced parking costs.
- **Higher Quality of Life:** Through improved air quality, lower gasoline consumption, increased mobility options, decreased commute burdens, improved access to destinations and public spaces, better health and public safety, and better economic health.
- **Acceptable Return on Investment:** Public sector returns take the form of both social returns (better quality of life) and financial returns (tax revenues, higher transit ridership). Developers, however, must have full financial return on their investment or they will not devote financial resources to TOD.
- **Increased Options:** Residents, shoppers, and workers in a TOD must have alternate transportation choices, a mix of housing options in scale with the surrounding community, and a variety of stores that are accessible by walking and public transportation.
- **Efficiency of Land Use:** Development should be denser near the transit station, public transportation should connect TOD to desirable destinations, and if possible, stations should serve as destinations themselves by clustering commercial and public uses close to the station or using the station as a civic center or shopping mall area.

7.1.2 Benefits

While TOD should meet multiple objectives for the community at large, various stakeholders benefit from TOD in more specific ways.

The following table indicates the benefits of TOD for the community, developers, transit riders, and transit systems compared to conventional development patterns.

Table 7.1: Benefits of TOD Over Conventional Development		
	Conventional Development	**Transit-Oriented Development**
To local community	➘ Congested traffic conditions. ➘ Develops outward, leading to overdevelopment. ➘ Declining areas are abandoned in favor of new developments. ➘ Cost of housing increases due to fewer housing units per acre. ➘ Neighborhoods are car based, discouraging social interaction.	➘ Reduces congestion through location efficiency and encouraging use of alternative transportation. ➘ Promotes compact, mixed-use development that preserves open space and farmland. ➘ Spurs economic growth in declining areas. ➘ Promotes affordable housing by using compact development. ➘ Walking environments improve social interactions, initiating community involvement.
To the developer	➘ Declining areas become a pariah, focusing growth in new developments. ➘ Low density units yield less return on investment. ➘ Infrastructure costs for sewage, roads, and water increase due to more spread out land use patterns. ➘ Lack of mobility options makes areas less desirable to buyers. ➘ Retail activities take place in centers which require shoppers to make special shopping trips, reducing foot traffic in retail zones.	➘ Helps to revitalize declining neighborhoods, converting them into viable options for development and redevelopment. ➘ Increases sellable floor space through compact growth patterns and lower parking requirements. ➘ Decreases infrastructure costs for water, sewage, and roads, thereby decreasing impact fees. ➘ Proximity to transit allows for mobility options for residents and access to a larger labor force for employers, making TODs more desirable. ➘ Retail activity increases due to increased foot traffic and more “on the way” shopping activities.

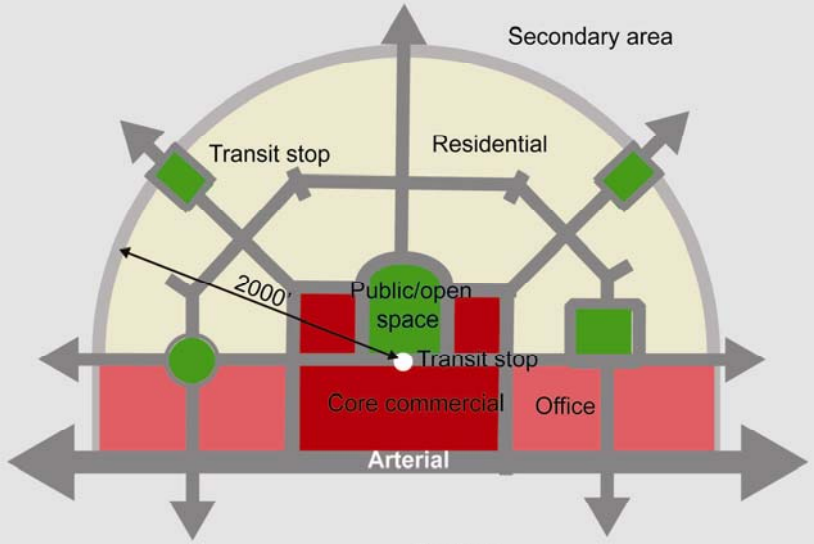
Table 7.1: Benefits of TOD Over Conventional Development		
	Conventional Development	**Transit-Oriented Development**
To transit rider	➘ Car ownership is a necessity, as travelers must either drive to work or to a park-and-ride facility. ➘ Requires more than one car per household, and car trips for all travel activities, entailing major household investments in travel.	➘ Provides mobility choices by creating activity nodes linked by transit. ➘ Decreases the need to drive, saving travelers between $3,000 and $5,000 annually.
To Transit System	➘ Sprawl decreases the ability of transit to function due to increased walking and travel times. ➘ Transit requires land investment to accommodate cars in park and rides and drop off areas.	➘ Dense development provides for increased ridership in TODs areas by 20-40% and 5% regionally. ➘ Increased revenues from joint and co-developments through air rights and ground leases.

7.2. Characteristics of TOD

In order for TOD to be successful, it is vital that walking, bicycling, and public transit become attractive alternatives to automobile travel. To that end, adding various characteristics to an area become essential in the creation of a transit-oriented space. Additional desirable elements may not be required; however, they are beneficial for encouraging the use of non-automobile modes of travel. On the next nine pages, essential characteristics of TOD are compared to conventional developments in various development types.

The focal point of TOD is often a transit station or stations (Figure 7.2), surrounded by a compact, high density mix of land uses (office, retail, residential). Developments with complementary purposes encourage pedestrian traffic by reducing walking distances and the number of necessary trips (dropping off clothing at the dry cleaners and stopping at the bank on the way to the train station). Automobile-oriented facilities, such as gas stations and drive through facilities, are discouraged. The key element of TOD design is the walkable scale of the community, generally not more than ½ a mile in diameter. Land-use in TOD will be discussed in more detail later in this section.

Figure 7.2: TOD Benefits



Essential
Medium to high-density development
Mixed-use development
Short- to medium-block lengths
Transit routes every one-half mile
Two- to four-lane streets
Wide, conditnuous sidewalks
Safe street crossings
Appropriate traffic buffering
Street-oriented buildings

Nice/Somewhat incidental
Streetwalks
Functional street furniture
Coherent, small-scale signage
Special pavement
Public art and loveable objects

Desired
Supportive commercial uses
Grid-like street networks
Traffic calming along access routes

Closely spaced shade trees along access routes
Minimal 'dead space' or visible auto parking
Nearby parks and public spaces
Small-scale buildings
Aesthetically pleasing transit facilities

Source: Ewing, Pedestrian and Transit-friendly Design, 1996
Image source: Gannett Fleming, Inc.

Figure 7.3: Comparison between TOD and Conventional Development

7.3.1: Conventional residential development

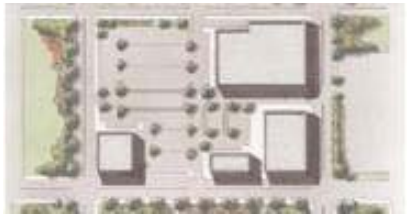
- Floor area ratio of less than 0.25 developed at a rate of 6 to 8 units per acre.
- Cul-de-sacs restrict traffic and maximize out of direction travel.
- Limited access to transit stops and limited sidewalks provided.
- All trips are made along arterial roadways.
- Large blocks; developments have access to arterials, no connections between complimentary buildings and destinations.

7.3.2: Preferred transit-oriented residential development

- Floor area ratio preferably between 0.5 and 1, at a rate of 12 to 16 units per acre.
- Street network minimizing out of direction travel, using traffic calming measures to prevent the negative effects.
- Blocks are at pedestrian scale; and continuous sidewalk network maximizes accessibility to transit stops.
- Collector and local roads provide alternatives to arterials.
- Developments are connected through collector streets that connect arterials and local roads.

7.3.3: Conventional commercial development

- Floor area ratio of less than 0.25; 4.5 parking or more per 1000 feet of building space
- No connections between complimentary buildings and destinations; pedestrian facilities and store entrance.
- Separation from nearby developments makes walking trips longer.
- Building entrances may be far from transit routes either separated by fences or parking lots.
- Buildings are not attractive with large blank walls and little weather protection.
- Sidewalks are not separated from traffic; little or no landscaping.



7.3.4: Preferred transit-oriented commercial development

- Floor area ratio approaching 0.5; 1 to 3 parking spaces per 1000 feet of building space.
- Pedestrian connections are provided between buildings; Store walkways connect to sidewalks, not just parking lots.
- Transit riders have safe and comfortable access to destinations.
- Parking is located at the center of the site.
- Building facades facing the transit and pedestrian areas have windows or displays. Awnings provide weather cover.
- Use of public art and landscaping buffers pedestrians from the street and are visually interesting.

Figure 7.3: Comparison between TOD and Conventional Development

7.3.5: Conventional office development

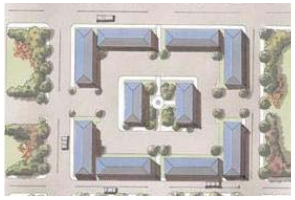
- Floor area ratio of less than 0.25 and 4 to 5 parking spaces per 1,000 feet of building.
- No connections to complimentary buildings and limited weather protection.
- Buildings are oriented to the parking lot, and walkways do not extend to the perimeter sidewalks.
- Windows are oriented to parking lots.
- Little landscaping to buffer from auto traffic, or provide shade in the parking lot or near the building.

7.3.6: Preferred transit-oriented office development

- Designed to allow for further development.
- Perimeter sidewalks are provided and building location enhances pedestrian accessibility.
- Buildings are oriented to the street and entrances are oriented to pedestrians, crosswalks are provided.
- Building facades facing the pedestrian and transit networks have windows or displays and awnings provide weather cover.
- Landscaping buffers pedestrians from the street, and trees provide shade on pedestrian rights of way.

7.3.7: : Conventional multi-family development

- Two Stories yields 22 to 24 units per acre
- Underutilized densities with the majority of space reserved for parking



7.3.8: Preferred transit-oriented multi-family development

- Three stories yields 30 units per acre
- Parking spaces limited to one per unit.

Figure 7.3: Comparison between TOD and Conventional Development

7.3.9: Conventional automobile-oriented development

- Parking lots separate the building from the pedestrian right-of-way, causing pedestrians to contend with automobiles and weather conditions in the parking lot, and extending walking trips.

7.3.10: Preferred transit- and pedestrian-oriented development

- Parking is moved away from the street, and behind buildings to move the building next to the sidewalk, and provide more pedestrian and transit friendly development.

7.3.11: : Conventional development

- Buildings are spread out along the street or in long strip malls along a road.

7.3.12: Preferred transit-oriented development

- Multiple buildings are clustered together to minimize walking distances.
- Transit stops are located in central locations to the building clusters.

Figure 7.3: Comparison between TOD and Conventional Development

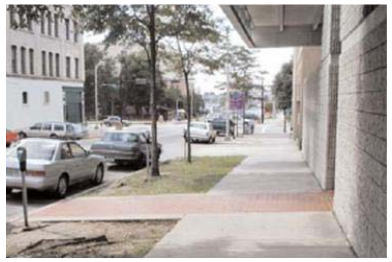
7.3.13: Street corners of conventional development

- Any development, including large parking lots and gas stations can be located on street corners.

7.3.14: Preferred street corners of transit-oriented development

- Dense corners are developed with transit supportive commercial uses, such as convenience stores, fast food restaurants, and services, such as banks and dry cleaners, which make it easier for transit users to conduct many of their daily business activities without getting into an automobile.

7.3.15: Pedestrian walkways in conventional development



- Boring facades provide no interest to pedestrians.
- Pedestrian movement is not linked
- Sidewalks are not weather protected.
- No street furniture.
- Sidewalks end at the street curb.
- Areas where pedestrians and vehicles interact favor car movement.
- Parking areas near perimeter sidewalks.
- Signage oriented to automobiles.
- Pedestrian areas are not differentiated from automobile areas.

7.3.16: Preferred pedestrian walkways in transit-oriented development

- Interesting and varied facades.
- Shaded, wide, continuous sidewalks linking all probable pedestrian movements.
- Comfortable and functional street furniture that is shaded and protected from rainfall.
- Buffering from vehicular traffic for sidewalks and open space.
- Traffic calming in areas where pedestrians and vehicles interact.
- Minimized views of parking areas and other “blank” spaces.
- Pedestrian scale signage.
- Textured, colored pavement and other features to delineate pedestrian areas from automobile areas.
- Proper lighting provides a feeling of safety at night.

Figure 7.3: Comparison between TOD and Traditional Development

7.3.17: Typical bicycle facilities in conventional development

- Few or no accommodations for bicycles at park and rides.
- No bicycle lanes in roadways.
- No bicycle signage.

7.3.18: Typical bicycle facilities in transit-oriented development

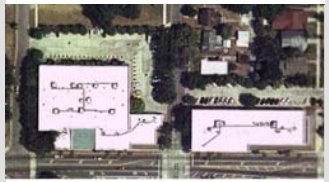
- Bicycle compatible roadways or bicycle lanes along transit station access roads.
- Bicycle paths into and through park and ride lots.
- Priority siting of bicycle parking/storage facilities near the transit vehicle loading zone and are provided with lighting.
- Bicycle paths from neighboring communities that are shorter in length than roadways.
- Clearly visible signs using the bicycle symbol for bicycle routes, parking/storage facilities, and bus stops serving bicyclists.
- Transit station design and siting accommodating to bicycles (curb cuts at parking locations, convenient parking locations).
- Protection from weather at parking/storage sites.

Figure 7.4: Essential Characteristics of TOD

7.4.1: Connectivity

- Mixed-use development should allow pedestrians to move from origin to destination easily, providing good access to transit with walkable connections. Various situations involving a mix of residential and office commercial uses with retail areas.

7.4.2: Parking space allocation

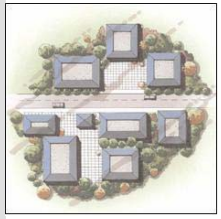


- Reducing the parking spaces per square feet, providing a larger floor to area ratio, locating at least some buildings adjacent to the street, and moving parking to the back of the building, much like these developments in Tampa, can make development transit and pedestrian friendly.

7.4.3: Pedestrian entrances

- Office building with attractive pedestrian entrances adjacent to the street and easy connections to complimentary uses (Note the retail building in the background).

7.4.4: Build space planning and design



- Dense street corners, left, and clustered buildings, right, allow for efficient land use and minimal walking distances, which encourages transit use. Transit stops should therefore be located in these locations.

7.4.5: Non-motorized transportation

TOD should make non-motorized means of transportation more attractive with pedestrian amenities such as attractive landscaping, weather protection, traffic calming measures, and stores oriented toward the pedestrian right-of-way.

7.4.6: Encouraging pedestrian activities

Objects that encourage pedestrian use encourage transit use. Restrooms, arcades, landscaping, storefronts, trash receptacles, and seating are all good additions to the TOD streetscape. The Baywalk area in St. Petersburg provides many of these pedestrian amenities to encourage the use of alternative modes of transportation.

7.2.1 Pedestrian Friendly Streets

In order for streets and development to be transit friendly, they must first become pedestrian friendly. People must be willing to walk in order to use transit.

Therefore, it is vital for TOD to also be pedestrian-oriented development. Below are some tips about how to create a more pedestrian friendly environment and thereby encourage transit use.

Figure 7.5: Pedestrian-friendly Streets

7.5.1: Sidewalks

- Sidewalks should be continuous and free from obstructions. They should be shaded using plants and awnings, and provide a direct route between congruent land uses, origins, and destinations. Ideal development includes sidewalks on both sides of the street. Sidewalk length should be 5-6 feet on side streets and 8-12 feet on main pedestrian thoroughfares with a 5 foot buffer between the road and the walkway. Street furniture should be provided, but should not obstruct the walkway. Aspects that add to the comfort of pedestrians, such as alternative sidewalk material may be considered.

7.5.2: Crosswalks

- Crosswalks should be highly visible to drivers using crosswalk strips. Different color pavement provides a perception of greater connectivity across streets. Signals should provide sufficient crossing time. Countdown signals, offset median refuges, and pedestrian actuated signals are good ideas and provide comfort, convenience, and safety to pedestrians. Warning signs and raised crosswalks are helpful in notifying drivers of upcoming pedestrian crosswalks. When blocks are long, mid-block crosswalks provide pedestrians with easy and direct access to destinations on the other side of the street. When streets are very busy (10 or more lanes) grade separated crossing should be provided. Not all these applications can be used in all situations, but consideration of safety should always be given priority.

7.5.3: Lighting

- Lighting should be at pedestrian scale and always located at crosswalks, intersections, bus stops and building entrances. Lighting fixtures should be decorative, designed for crime prevention, and placed between the roadway and the sidewalk.

Figure 7.5: Pedestrian-friendly Streets

7.5.4: Bicycle lanes

- Bicycle lanes should be used where auto speeds and volumes are high, reducing auto lanes in favor of bicycle lanes. Bicycle lanes should be a minimum of 4 feet when they are next to the curb, 5 feet when next to a parking lane, and should be placed to the left of right turn lanes. Bicycle parking racks should be placed at the entrances of buildings and at transit stops. A good rule of thumb is one bike space for every 20 auto parking spots.

7.5.5: ADA accessibility

- Sidewalks should meet ADA (Americans with Disabilities Act) requirements. Clear paths of 5x5 feet and short, shallow curb ramps provide a direct path for mobility disabled pedestrians. Tactile warning strips should be placed at grade changes. Protrusions into the walkway should be limited. In addition, access to transit stations from the sidewalks should be direct and ADA accessible.

7.5.6: Intersection design

- At intersections, crosswalk guidelines should be followed. Other good ideas for intersections include pedestrian refuges when crossing 8 or more lanes, curb extensions, and median nose extensions to serve as pedestrian refuges in order to provide safer and more comfortable crossing for pedestrians.

7.5.7: Traffic calming

- Traffic along pedestrian thoroughfares should be calmed using methods such as on street parking, reduced lane widths, curb extensions, roadside plantings, and crosswalk enhancements. If possible, roundabouts should be utilized rather than speed humps. Street networks should provide easy pedestrian access in a grid like system instead of using cul-de-sac layouts.

Figure 7.6: TOD Supportive Land uses

Provisions for transit travelers with buildings oriented to transit in Tampa.

Streets as multi-modal activity centers with buildings oriented to pedestrians and provisions for non-motorized transportation in Winter Haven.

7.2.2 TOD Supportive Types of Land-Usage

Certain land uses are better suited for a TOD than others. Those land uses that are typically of a higher density and do not have to rely strongly on automobile access for their patronage, such as the land uses displayed in the pictures to the right, should be sited in a TOD or other area identified for increased transit, bicycle, and walking access. Land uses that cater to the motorist, should not be located in an area being developed as a TOD. Table 7-2 serves as a guide to the general transit supportiveness of various land uses.

In order to create TOD in a given area, it is often necessary to have land use policies that encourage the development of land uses that generate pedestrian activity and transit use. Such policies include:

- Compact regional growth can be managed by managing residential densities and concentrating development in centers and corridors.
- In order to make pedestrian and transit trips attractive, mixed use development is necessary so that several activities can be performed during a single trip.
- Adding provisions for non-motorized means of transportation causes streets to become multimodal activity centers, ideal for transit use.
- Government can play a lead role in transit friendly development by locating public and semi-public activity centers near transit stops.
- In a development, parking should be limited to the average peak need for that type of development.
- Streets and sidewalks should be linked.
- Buildings should be required to be accessible by pedestrians, not just cars.
- Provide usable open space. Design for use by people rather than just for visual appeal.

Important to Note

The Practitioner's Guide includes a list of policies that encourage TOD along with ideas for implementing them.

7.3. TOD Station Design

TOD stations should be designed to be both pedestrian friendly and usable spaces. Accessibility is the first priority for TOD, especially for a transit station within a TOD. Ideally, the station should be built as a focal point for the community and should become a gathering point for the entire community.

Figure 7.8: Station Design

7.8.1: Station parking facilities

- Station Parking Facilities: Parking ratios should be as low as can be appropriately placed at a station. It should be considered that not as many parking spaces will be needed due to the accessibility of the station to alternative means of arriving at the station such as transit, walking, and bicycle riding. This can help lower development costs while also decreasing local traffic. Parking should not create a barrier between the station and the surrounding areas for alternative transportation.

7.8.2: Station as a part of community

- Stations should be at the heart of the community, but should also be integrated into the community. Matching the community in terms of architectural style, scale, and color are ways to ensure that the station becomes a landmark while incorporating itself into the surrounding environment. It is best to place the transit station in the center of downtown rather than at its perimeter to encourage transit use.

7.8.3:Station as places

- Stations should be more than just an area to wait for a bus. They should also become landmarks and focal points for the community. They should have distinctive designs that make them easily identifiable, and create a community center. Shops, services, open spaces, and transit connections should all be incorporated together into a transit station to help make it a destination for residents as well as transit users.

Figure 7.8: Station Design

7.8.4: Accessible stations

- Stations in a TOD must be easily accessible to all modes of transportation using pedestrian and bicycle friendly elements. There should not be any barriers, such as highways, parking lots, or walls, that separate the station from the TOD community, and pedestrians should be able to travel around the station easily as well. Streets should be oriented towards the transit station as the major destination.

7.8.5: Planning for multiple modes

- Planning for Multiple Modes: Design of a transit facility in a TOD should consider multiple modes with regards to pedestrian access, bicycle parking, and kiss-and-ride drop-off facilities along with parking considerations. Crosswalks should follow pedestrian friendly guidelines, and bicycle parking and entranceways should be available.

7.4. Governmental Issues in TOD

7.4.1 Techniques to Encourage Transit-Oriented Development

There is no absolute formula for successfully encouraging transit-oriented developments in a given area. Each community must consider its unique position in establishing TOD. However, certain implementation tools have been proven to encourage developers and businesses to invest in TOD.

The table below lists various ideas that local governments and developers can use to encourage TOD. The Practitioner's Guide includes more details on these techniques as well as ideas on how and when to implement them.

Table 7.2: Techniques to Encourage TOD

Technique	Government Agency	Developer
➘ A Station Area Plan establishes an area around a transit station for which particular land use objectives and development plans apply.	✓	
➘ A Comprehensive Circulation Plan with locations and facilities types should form the basis of off-street improvements and reserving future rights of way.	✓	
➘ Plans should be reviewed by a Planning Board to insure plans meet the Station Area Zoning Plan	✓	
➘ Establish Enterprise Zones which offer tax break incentives for developers building within those zones with high density.	✓	
➘ Land may be acquired by government agencies for improvement in a station area through negotiations or eminent domain in order to redevelop it for uses more appropriate for a station area.	✓	
➘ Amenities Enhancement Programs provide revitalization through community volunteer programs or community service programs, adding fixed amenities and maintenance services for cheap or free. In addition to improvements, this can increase public awareness of and commitment to the station area.	✓	✓

Table 7.2: Techniques to Encourage TOD		
Technique	**Government Agency**	**Developer**
➘ Special Improvement Districts can be established in station areas by ordinance, imposing a special property assessment for the purpose of promoting the economic and general welfare of the district.	✓	✓
➘ Educate banks about successful TOD programs so that they are more willing to invest in TOD.	✓	✓
➘ Joint Development in which a partnership is made between developers and government agencies to improve the station area in a way that is beneficial to both parties.	✓	✓
➘ Market studies and marketing campaigns can be undertaken in order to ease developer concerns that there is a market for transit-oriented development in a given area.	✓	
➘ Transit Overlay Zones can be added to zoning ordinances as zones that are "overlaid" onto existing zones to allow for increased density and a pedestrian friendly environment around a transit facility.	✓	
➘ Decreased parking requirements in transit zones can encourage use of public transit.	✓	✓
➘ Charging for the real cost of the additional space taken up by parking areas so that only as many parking spaces as necessary are utilized by residents.		✓
➘ Inclusion of transit into the County Comprehensive Plan and the County Transportation Element.	✓	
➘ Support for the Transit Operations Plan in the county Capital Improvement Plan.	✓	✓
➘ Reducing level of service requirements for transit zones can be justified because transit users and pedestrians do not require the same level of service as automobiles.	✓	✓
➘ By-right zoning regulations in transit zones, which are precise regulations, that if met by the developer, the city must approve the developer's plans. This provides a sense of certainty for the developer and increases the speed at which permits may be obtained.	✓	✓

Source: "Building Livable Communities: A Policymaker's guide to Transit-Oriented Development." The Center for Livable Communities, 1996.

7.4.2 Intergovernmental Coordination and TODs

The need for congruency of land use, road networks, and transit planning in the establishment of TODs often makes it necessary for multiple government agencies to collaborate in developing TOD design in a given area. The planning agency must design land use to induce pedestrian activity and transit ridership, the transportation engineering department must design the road networks to accommodate transit and non-motorized mobility, and the transit agency must plan its system with development plans, road construction, and safety in mind. Each interdepartmental arrangement is different, and therefore it is not possible to discuss every possible issue that may arise between agencies. However, it is important to remember that, for TOD to be successful, all involved agencies whether on a city, county, or state level, must operate together in the formation of TOD.

In addition, the more extensive a region's transit system is, the more effective TOD can become and the more potent TOD's effects become. This outcome is logical because a larger transit system offers a greater choice of destination points, causing greater transit demand. Therefore, it may be necessary for multiple agencies and counties to join in the creation of a regional transit system that serves TODs. This will allow TODs to flourish in multiple areas within the region and connections to be made that will increase the mobility options of those who live, work, and shop in TODs region-wide.

For more information on intergovernmental coordination for transit, see Section 9, "Institutional Issues"

7.5. Mobility Friendly Design in Florida

The transportation infrastructure, policy environment, development history, unique cultural influences, and socioeconomic and household characteristics in Florida are different than those of other states that have implemented TOD. Florida's increasing senior population may mean a greater number of non-drivers due to age. Concurrency and zoning issues, as well as the nature of the transportation infrastructure and land development in most areas, provide some difficulty when creating transit friendly environments. Therefore, it is necessary to consider innovative methods for making TOD successful in Florida.

7.5.1 Policies for Implementation

Although land development codes have historically been used to encourage automobile use by instituting setback requirements and single use districts, it is possible to use policy methods such as land development codes and comprehensive plans in order to encourage TOD instead. Some examples that have been instituted in Florida include:

- Replacing single use districts with activity center districts that promote mixed-use development.
- Enforcing a minimum density requirement for specific zones.
- Include a maximum parking space requirement in addition to any minimum requirement associated with concurrency.
- Institute bicycle and pedestrian amenity requirements in front of all commercial, retail, and residential developments.
- Requiring maximum setback standards, varied depending on a specific zone's location.
- Provide a transit system that is competitive with the automobile through shorter headways and travel times.
- Create a manual for mobility design for use by architects, planners, landscape architects, engineers, local officials, and developers to provide a detailed guide for integrating TOD into new growth and redevelopment.

Figure 7.9: TOD in Florida

A mixed-use activity center district planned for Orlando.

Transit must provide regional connectivity in addition to successful local transit if TOD is to thrive. The Tri-Rail in Southeast Florida is a good example of an inter-county transit system.

- Multimodal Transportation Districts (MMTD) and Transportation Concurrency Exception Areas (TCEA) are zones that can be designated by governing bodies that permit higher densities, limited parking, and central major destination with the goal of creating a pedestrian and transit friendly environment within these zones and regionally.
- Including transit in all comprehensive plans. Comprehensive planning should determine where future transit corridors will be located when developing plans for the future expansion of land usage. Then the future arterial transit routes should be mapped out prior to approving development.
- Incorporating transit services into the design phase of all new developments should be required in order to create a TOD. One way of doing this is to require all new development to meet transportation demand management (TDM) standards in the design of the development.
- Providing a legal mechanism to allow for the design flexibility necessary to develop TOD. Planned Unit Developments (PUD) allow governmental control of development of individual tracts of land by specifying the types of permissible development within the area. This enables a greater emphasis on site planning than in traditional developments. By creating a PUD an area can become a mixed use development by legislation, and disallow uses that are inconsistent with TOD principles.
- If TOD is to be successful on the development and local level, comprehensive regional transit must also be developed. Seamless inter-county transit services must be in place in order to make TOD viable on a regional scale.

Figure 7.10: Retrofitting TOD

7.5.2 Retrofitting

Communities that are already built out are often more difficult to develop into TOD than a new development. However, it is possible to retrofit TOD elements into an established development in order to make the area more transit friendly.

Retrofitting communities can be accomplished by adding pedestrian friendly amenities into the neighborhood such as:

- Wider walkways;
- Benches;
- Street furniture;
- Lighting;
- Crosswalks;
- Traffic calming measures; and
- Pedestrian pathways.

Pedestrian walkways can be built in the appropriate locations to create an artificial grid network for pedestrians, even when the street network is not a grid system. Required walk-through openings at regular intervals should be incorporated or retrofitted along walls in all current and future gated communities. This will minimize the walking distance to enter and exit a gated community, thereby making the community more pedestrian and transit friendly.

Developing the areas around park-and-ride locations allows transit agencies and local governments to concentrate development around transit and make efficient use of the land they already own. This is a tradeoff because the more land that is developed for TOD, the less land is available for parking which could affect transit ridership.

Priority for retrofitting of established communities to become TOD should be given to areas that exhibit the most characteristics favorable to TOD. This will ensure that those living in the area are most likely to use alternative means of transportation if the mode is sufficiently convenient, as well as a current layout that will make transit use possible. In addition, locating TOD in areas with a high concentration of college students, single adults, childless couples, empty nesters, and immigrants and other amenable transit markets will increase the chance that a retrofitted TOD can succeed in the area.

Figure 7.11: New TOD

7.5.3 New Developments

New development, even in locations where transit is not yet available, should include mixed-use development and should be developed to be transit ready for when transit routes are put into place.

By incorporating transit services into the design phase of all new developments, a development is guaranteed to be transit ready for when transit services begin in the area. One way of doing this is to require all new development to meet transportation demand management (TDM) standards in the design of the development. TDM standards include limited parking spaces, minimum density requirements, walkable streets, transit stop locations, and mixed-use requirements. New development should also support existing community and economic development.

Suburbia provides a perception of country estate living with safety, privacy, and quiet at a relatively low cost. This has been especially so in Florida where the conventional suburban development and gated community reigns supreme. To compete with conventional suburban development, TOD must offer many of the benefits of the suburban lifestyle, such as safe environment, and attractive landscaping as well as a typical TOD offers that suburbia cannot. If a TOD can offer a sense of privacy, spaciousness, and exclusivity, while also offering nightlife, variety, and the ability to walk to activity centers, it will be able to compete with suburbia successfully, and in most cases be more attractive than conventional suburban communities.

8. Education Awareness Programs

By definition, the state-of-the-art in transit design is always changing. Therefore, it is necessary for professionals to constantly educate themselves and the public regarding these changes. This section was created with the intent of providing a starting point for professionals seeking to improve their knowledge of transit, by listing sources and contacts for professional development and education. In addition, methods of educating the public regarding public transportation are discussed in this section.

Figure 8.1: Education Awareness Programs

8.1. Professional Development and Education

8.1.1 National FTA Funded Training Institutes

University of South Florida's Center for Urban Transportation Research and the National Center for Transit Research

Education Opportunities: Courses, workshops, summits, and forums are offered on a regular basis on transit subjects. The National Center for Transit Research (NCTR) releases the Journal of Public Transportation on a quarterly basis. A listserv is also available with various forums for professionals to collaborate.

Sample Programs: BRT Workshops, Transit Networking Workshops, Land Use Courses, Access Management Courses, Florida Transit Planning Network Forum, BRT Forum, Administration of the State Rural Transit Assistance Program (RTAP) Program.

Phone: (813) 974-7810

E-mail: buffington@cutr.usf.edu

Website: http://www.cutr.usf.edu; http://www.nctr.usf.edu

National Transit Institute at Rutgers University (NTI)

Educational Opportunities: Provides training and education programs via classes offered throughout the United States and Multimedia training. Topics include advanced technologies, Management Development, Multimodal planning, Transit Management, and Workplace Safety.

Sample Programs: Planning of Bus Rapid Transit, Context Sensitive Solutions in a Multi-Modal Environment, Flexible Community Transit Services: Planning, Design, and Technology, Federal Transit Administration (FTA) Real Estate Requirements, ITS for Transit, Management of Transit Construction Projects, Transit Facility Maintenance.

Phone: (732) 932-1700

Website: http://www.ntionline.com

University Transportation Centers (UTC)

University Transportation Centers (UTC) can provide a multitude of information on many transportation subjects including databases, clearinghouses, and netcasts. Each UTC has its own theme, many themes include transit.

Website: http://utc.dot.gov/listing1.html

Volpe Center Professional Capacity Building (PCB)

Educational Opportunities: Technical assistance, a web-based information clearinghouse, and symposia lecture series.

Sample Programs: Focus is on Intelligent Transportation Systems, transportation planning, roadway safety, environmental issues, and security and emergency management.

Website: www.volpe.dot.gov/index.html

Transportation Planning Capacity Building

Educational Opportunities: Peer programs, training courses, data resources, publications.

Sample Programs: Peer exchange, roundtable, workshops, operations classes, funding classes, planning classes, public involvement classes.

Website: http://www.planning.dot.gov

8.1.2 Programs at CUTR

The Center for Urban Transportation Research is not only a vital resource nationally, but also a resource of training and information for local professionals. In fact, CUTR manages many of the training programs sponsored by and prepared for the Florida Department of Transportation's local districts and central office. Some of CUTR's programs are displayed on the following page.

National Center for Transit Research

Education Opportunities: Long term education, Certificates, Streaming video presentations, Information clearinghouses, Listservs, Publications, Journal of Transportation Research.

Sample Programs: 511, TDM, Car Use on Campus, Commuter Benefit Programs, TOD, BRT, Land Developer Participation in Providing for Bus Transit Facilities and Operations, Shared Use Park-and-Ride Impacts on Property.

Website: www.nctr.usf.edu

National BRT Institute (NBRTI)

Educational Opportunities: Online educational and research resources about BRT.

Phone: (813) 974-9833

E-mail: hiebaugh@cutr.usf.edu

Website: http://www.nbrti.org

Transit Training Newsletter

Educational Opportunities: A newsletter that provides information on upcoming training opportunities in Florida and nationally.

Website: http://www.cutr.usf.edu/research/fmtp/newslett1.htm

Other FTA and FDOT Sponsored Programs at CUTR

- Florida Journey to Work Website
- Florida Transit Planning Network
- Florida Transportation Indicators
- Resource for Advanced Public Transportation Systems
- Florida RTAP
- Technology Transfer
- Transportation Planning
- Transportation Program and Economic Analysis
- Transit Research
- Florida Bus Operator Trainer Program
- Fixed Guideway Transportation Safety and Security Program
- Florida Maintenance Training and Technical Assistance Program (FMTP)
- Florida Transit Training and Technical Assistance Program
- Bus Transit Safety and Technical Assistance Program
- Reports, Papers, and Journals
- TDM Clearinghouse
- Transportation Demand Management

8.1.3 Other National Programs

American Public Transportation Association (APTA)

Education Opportunities: Meetings, Conferences, Education, Training, Standards, "Webinars," Data, Internet resources. Hosts various workshops throughout the United States and Canada. Internet resources on standards, data, and articles. Online Reports and publications. Bookstore. Catalog of publications and services.

Sample Programs: Online Statistics, Reports and Publications, Bus and Paratransit Conference, Intermodal Operations Planning Workshop, Sustainability and Public Transportation Workshop.

Phone: (202) 496-4870

Contact: http://www.apta.com/contact/info_request.cfm

Website: http://www.apta.com/

Transportation Research Information System (TRIS) Online and the National Transportation Laboratory (NTL)

Educational Opportunities: The web based version of the Transportation Research Information Services bibliographic database. TRIS contains over half a million records of published transportation research, indexed and abstracted, and some with links to full text. The NTL is a digital collection of electronic resources on transportation with links to government and other significant websites. NTL and TRIS are administered by the Bureau of Transportation Statistics.

TRIS Website: http://ntlsearch.bts.gov/tris/index.do

NTL Website: http://ntl.bts.gov/

Transportation Research Board (TRB)	
	Education Opportunities: A bookstore and publications are available on the website. The TRB is responsible for various periodical research reports such as the Transportation Research Record (TRR), the Transportation Cooperative Research Program (TCRP), TR News, and various others. Many reports are available online and in searchable format. Research in progress is also featured in a searchable format. The TRB also sponsors more than 70 transportation and transit conferences, workshops, and symposiums as listed on the TRB website. **Sample Programs**: TCRP, TRR, TR News, National Cooperative Highway Research Program, Rural Public and Intercity Bus Transportation, BRT Conference, Transit and Intermodal Transportation Law. **Phone**: (202) 334-2934 **E-mail**: TRBSales@nas.edu **Website**: http://www.trb.org/
Center for Transportation Excellence	
	Educational Opportunities: Online resources, Occasional workshops and conferences. **Sample Programs**: Responding to Critics, Factoids, Reports, Trends, Transit Initiatives Conference. **Phone**: (202) 234-7562 **E-mail:** info@cfte.org **Website**: http://www.cfte.org

ITS America	
	**Education Opportunities**: Conferences, workshops, exhibitions, online and actual forums, industry news, and a virtual library on the topic of Intelligent Transportation Systems (ITS). **Sample Programs**: Rural ITS Conference, ITS Exhibition, Annual Meetings. Public Transportation Forum, Innovative Mobility Showcase. **Phone**: (202) 484-4847 **E-mail**: info@itsa.org **Website**: http://www.itsa.org
Bureau of Transportation Statistic	
	**Educational Opportunities**: Information on transportation statistics, including online data and a bookstore with educational material. **Phone**: (Office of Transportation Information Resources) (202) 336-1270 **E-mail:** answers@bts.gov **Website**: http://www.bts.gov
Institute of Transportation Engineers	
	**Educational Opportunities:** Certification programs, training clearinghouse, courses on CD-ROM, online learning, web seminars, publishing, and education **Sample Programs:** Transportation Impact Analysis for Site Development, Trip Generation, Designing Accessible Pedestrian Facilities in the Public ROW, Professional Certification Programs. **Phone:** (202) 289-0222 **E-mail:** ite_staff@ite.org **Website**: http://www.ite.org

Planetizen

Education Opportunities: Online planning resources with podcasts, forums, information, link ratings, book ratings, a newsletter, and web-based planning courses.

Sample Programs: Transit-Oriented Development Toolbox, American Institute of Certified Planners (AICP) Exam Preparation course

Website: http://www.planetizen.com

Community Transportation Association of America (CTAA)

Educational Opportunities: Customized training courses, workshops, conferences, summits, and certification. Online financing information, and an online resource for various community transportation topics.

Sample Programs: Transit Program Administrator Certification (CTPA), Transit Financing Lending, Employment Transportation, Coordination, Technology, APTS: Making the Most of Technology, Implementing New Technologies in Transit, Service Redesign, Alternative Financing for Transit Development.

Phone: (800) 891-0590 x705

E-mail: training@ctaa.org

Website: http://www.ctaa.org

Federal Transit Administration (FTA)

Educational Opportunities: Internet resources and links for professional development, training, research, and technical assistance. Links to various transportation and transit courses on intelligent transportation design.

Sample Programs: Bus Technology, ITS for Transit, BRT, Transitweb, New Starts Project Planning & Development, Transit Finance.

Phone: (404) 562-3500

Website**: http://www.fta.dot.gov**

National Rural Transit Assistance Program

Education Opportunities: Training materials, workshops, peer to peer technical assistance, trainers, presentations, reports, training manuals, multimedia training, and a catalog of available published data.

Sample Programs: Coordination, Safe Transport of the Public Under the ADA, Special Transit and Rural Transit Safety, Financial Management

Phone: (202) 408-4541

E-mail: nationalrtap@apwa.net

Website: http://www.nationalrtap.org

American Planning Association

Educational Opportunities: CD-ROM training opportunities, live web conferences, training workshops, conferences, and educational products. AICP certification.

Sample Programs: Smart Growth Street Design, Complete Streets, Planning Law Review, The Transportation/Land Use Connection, Parking, Improving Transit Access in TODs, Implementing Multimodal Transportation Plans, Transit, Walking, and Other Non-Auto Alternatives, Bus Rapid Transit. AICP Training Workshops.

Phone: (312) 431-9100

E-mail: Education@planning.org

Website: http://www.planning.org

8.1.4 Programs at the Florida DOT

The FDOT offers a variety of courses on a regular basis as well as several courses offered as needed. In addition, the FDOT offers several online handbooks and documents for transit planning professionals, and a virtual library. FDOT also sponsors many of CUTR's programs as listed earlier in this section. FDOT district offices often promote, attend, and support central office programs. Often the FDOT programs will be hosted at FDOT district offices Several sample programs are listed below:

Quality/Level of Service Analysis Training

Education Opportunities: Florida Standard Urban Transportation Model Structure (FSUTMS) Modeling Training Workshops; Occasional class on modeling programs with training in Cube Voyager, online course about creating programs for involving the public in transportation decisions, online transit records such as handbooks, grant administration, facility guidelines, safety issues, and research projects

Website: **(Quality/Level of Service, Q/LOS)** http://www.dot.state.fl.us/planning/systems/sm/los/default.htm#QLOS, **(FSUTMS)** http://www.fsutmsonline.net/modeling_training.aspx, **(Public involvement)** http://www.fldot.learnsomething.com, **(Transit & Planning Virtual Library)** http://www.dot.state.fl.us/planning/library/default.htm, **(Transit planning)** http://www.dot.state.fl.us/transit/default.htm

8.1.5 Other State and Local Programs

In addition to the FDOT and the national programs, several state and local programs offer classes, databases, and other educational media for transit professionals. These programs are important because they offer the opportunity to focus on local issues rather than generalized training for transit nationwide or even statewide and offer networking opportunities for transit professionals. This page includes three local resources for education in transit.

New training opportunities arise constantly. You can stay current by using the websites and contacts listed in this section.

Tampa Bay Regional Planning Council

Education Opportunities: Occasional professional development workshops offered.

Sample Programs: Transportation Summit, Future of Growth Management in Florida Workshops, Transportation & Land Use Committee Report Workshop, Traffic Calming and Neighborhood Connectivity, Regional Transit Roundtable Recap.

Phone: (727) 570-5151

Website: http://www.tbrpc.org

Florida Chapter of the American Planning Association

Education Opportunities: A calendar on the FAPA website provides information on upcoming workshops, conferences, and summits

Sample Programs: Annual Planning Conference, Sharing Best Practices and Visions of Florida's Future

Phone: (850) 201-FAPA

E-mail: fapa@floridaplanning.org

Website**: http://www.floridaplanning.org**

Florida Public Transit Association (FPTA)

Educational Opportunities: Hosts an annual conference and expo, professional development workshops in association with CUTR and FDOT, events, board meetings

Sample Programs: Professional Development Workshop, Annual Conference and Expo, Introduction to Urban Transportation Planning

Phone: (850)-878-0855

E-mail: fpta@earthlink.net

Website: http://www.floridatransit.org

8.1.6 Long Term Educational Opportunities in Florida

University of South Florida (USF)

Relevant Certificate Programs Available: Community Design and Development, Interdisciplinary Transportation Program, Transportation Systems Analysis

Educational Opportunities: These courses provide transportation professionals the opportunity to increase their knowledge in the fields of transportation and community design, two fields of study relevant to transit facilities design. Certificates can be earned with 12 to 18 credits of class work, and can be earned on a part time basis. Masters and Bachelors programs in similar fields are also available.

Contact: USF Office of Graduate Certificates

Phone: (813) 974-7061 or 1-888-873-4968

Website: http://www.outreach.usf.edu/gradcerts/

University of Florida

Relevant Programs Available: Bachelors, Masters, and Ph.D. programs in transportation engineering. A Masters of Science in Urban and Regional Planning with a specialization in Growth Management and Transportation is also available

Educational Opportunities: Coursework in transportation engineering applications within the UF civil engineering program.

Website: http://transportation.ce.ufl.edu

University of Central Florida

Relevant Programs Available: Bachelors, Masters, and Ph.D. programs in transportation systems engineering.

Educational Opportunities: Coursework and degrees in transportation engineering.

Website: http://cee.ucf.edu/

Lehman Center for Transportation Research at Florida International University

Relevant Programs Available: Bachelors, Masters and PhD. programs in transportation engineering

Educational Opportunities: Coursework on transportation planning, engineering, materials, and computer applications within the FIU civil engineering program.

Phone: (305) 348-3814

Website: http://lctr.eng.fiu.edu

8.2. Customer Education

8.2.1 Customer Information System

511 System

Using a 511 phone number to inform passengers of transit information in addition to traffic information such as routes, access points, scheduling, and arrival times, can allow passengers to access transit easier, and allows customers to feel more comfortable with using transit. 511 provides an easy to remember phone number for accessing transit information, keeping passengers informed. Local promotions, websites, 511, and training can be complimented by using traditional advertising methods such as newspaper, radio, and television ads.

8.2.2 Local Marketing and Public Education

Customer education methods implemented locally can increase ridership by making customers feel more secure in using the public transportation system. Public outreach and education is an important marketing tool for public transportation agencies as it increases ridership, and reduces waiting times, boarding times, access times, and overall passenger confusion. Customer awareness and education can be accomplished in several ways:

Customer Training

Training programs can be made available to educate customers regarding transit accessibility and benefits of riding. A training program geared towards disabled passengers may education students about how they may use paratransit services to access fixed route stations. Weekend transit tours can also be used to educate customers.

Transit Events

Transit agencies can consider running their own community events to help promote specific aspects of transit in the community. HARTLINE ran a “Bike the Bay” campaign to promote its “Bikes on Buses” program. Contests that promote transit benefits may also be useful.

Community Events

Events provide an opportunity for transit marketing personnel to promote transit to those most likely to use it. Setting up a booth at an event may enable transit providers to provide person to person education and hand out education brochures to potential customers.

Brochures	
	Distributing brochures and newsletters either on site or through direct mail is a cost effective means of mass marketing that can educate the public about available transit, how to use area transit, and the benefits of transit. Image may also be improved using this method.
Website	
	A website may be used to assist customers in a variety of ways. Alerts, schedules, fares, station information, park-and-ride information, accessible services, connections, and destination information can all be customized to passengers using a website. A good addition to a website is an itinerary planning tool which can communicate to passengers the best way to get from one location to another using transit.
Station Information	
	Information can be provided to passengers at the stations using information systems such as kiosks, real-time audio and visual announcements, or passenger information liaisons at the station who can answer questions from passengers.
Media Cooperation	
	Using media to inform passengers of services and service charges can be an effective means to communicating with passengers, Radio, station, and newspaper press information about transit can be displayed along with weather and traffic information so that customers know about schedule changes before they travel much like travelers would note traffic information.
Commuter Choice Events and Transportation Days	
	These events offer commuters the opportunity to learn about the availability and benefits of, and enroll in, alternative commuting modes of transportation such as transit, carpools, vanpools, and telecommuting. It can be a useful tool for agencies and large businesses to grow transit and carpool ridership.

8.3. Website Listing

8.3.1 Educational Websites

Organization	Website
American Planning Association (APA)	http://www.planning.org
Florida Chapter of The APA (FAPA)	http://www.floridaplanning.org
Suncoast Section of the FAPA	http://www.suncoastfapa.org
Promised Lands Section of the FAPA	http://www.floridaplanning.org/promisedlands/index.asp
Tampa Bay Regional Planning Council	http://www.tbrpc.org
University of South Florida (USF)	http://www.outreach.usf.edu/gradcerts/
Center for Urban Transportation Research (CUTR) at the University of South Florida	http://www.cutr.usf.edu
National Center for Transit Research (NCTR) at the University of South Florida	http://www.nctr.usf.edu
Florida DOT Planning Pages	http://www.dot.state.fl.us/planning
Florida DOT Transit	http://www.dot.state.fl.us/transit/
Lehman Center for Transportation Research (LCTR) at Florida International University	http://lctr.eng.fiu.edu
Florida Public Transit Association (FPTA)	http://www.floridatransit.org
American Public Transit Association (APTA)	http://www.apta.com
Center for Transportation Excellence (CFTE)	http://www.cfte.org
Transportation Research Information Services (TRIS) Online	http://ntlsearch.bts.gov/tris/index.do
National Transportation Library (NTL)	http://ntl.bts.gov
Transportation Research Board (TRB)	http://www.trb.org
National Transit Institute (NTI) at Rutgers University	http://www.ntionline.com
Bureau of Transportation Statistics	http://www.bts.gov
ITS America	http://www.itsa.org
National Rural Transit Assistance Program (RTAP)	http://www.nationalrtap.org
National Bus Rapid Transit Institute (NBRTI)	http://www.nbrti.org
Community Transportation Association of America (CTAA)	http://www.ctaa.org

8.3.2 Sample Public Education Websites

FSUTMS Modeling Training	http://www.fsitmsonline.net
Transportation Engineering at University of Florida	http://transportation.ce.ufl.edu
Planetizen	http://www.planetizen.com
Federal Transit Administration (FTA)	http://www.fta.dot.gov
University Transportation Centers (UTC) Program	http://utc.dot.gov
Institute of Transportation Engineers (ITE)	http://www.ite.org
The USDOT National 511 Website	http://www.its.dot.gov/511/511.htm
Florida's 511 Website	http://www.fl511.com/
Bus Rapid Transit Policy Center	http://www.gobrt.org
Project for Public Spaces (PPS)	http://www.pps.org
Transit Finance Learning Exchange	http://www.tflex.org
Transit-Focused Development	http://faculty.washington.edu/jbs/tfd/
Urban Land Institute (ULI)	http://www.uli.org
Ride Connection Customer Training	http://www.rideconnection.org/training/customer.htm
Chicago Transit Authority Brochures Page	http://www.transitchicago.com/welcome/brochures.html
Santa Clara Valley Transit Authority Take One Brochure	http://www.vta.org/brochures_publications/pdf/take_one.pdf
New Jersey Transit Trip Planner	http://www.njtransit.com/sf_tp.shtml
Bay Area Rapid Transit Widgets	http://www.bart.gov/news/widgets/
Colorado Regional Transit District Kiosk Locations	http://www.rtd-denver.com/Kiosk/locations.html
San Francisco Bay Area 511 Transit	http://transit.511.org/
South Florida Regional Transit Trip Planner	http://sfrtp.cinrtosfl.com/

9. Institutional Issues

Improving the design of public transportation facilities means more than improving bus service and bus stops. It also means building relationships that cooperatively foster transit attractiveness. This requires coordination among many diverse institutions.

Because of the number of agencies involved in transit planning and implementation, many opportunities exist that may create issues or problems when agencies attempt to implement and influence development patterns, transportation decisions, and transit services. Priorities for community development and design in Florida have historically centered on growth and improving traffic conditions. Transit systems concentrate on improving the mobility of citizens choosing to use an alternative to the automobile.

Whether developing a transit facility as a stand alone project or as part of a larger multimodal transportation project, many of the same relationships and process may be needed. A stand alone transit project may require less effort in each step of the development process but coordination and relationships should be maintained regardless of the size of the project.

This section focuses on how to design transit within the institutional arrangements that exist in Florida and how to be successful in fostering the development of communities that support transit services. Many times, simple communication makes the difference in gaining approvals and creating partnerships. Knowing when and who to contact is a key element of resolving issues before they become a problem.

The remainder of this section discusses the roles and processes of different institutions. The section is designed to assist handbook users in preventing roadblocks and overcoming issues as they arise. The primary objective of this section is to provide a template for how transit agencies can work with other agencies and jurisdictions to improve services and define the proper agencies to consult at each stage. In addition, various steps from concept to concrete are defined to assist the reader to better understand the roadway project development process. In doing so, the Practitioners Guide, the FDOT approved Intelligent Transportation System (ITS), and impacts of roadway construction on transit operations are introduced.

Important to Note

Although FDOT provides funding in two year cycles for Planning, Development, and Environment (PD&E), design, and right-of-way acquisition, local agencies may expedite the process by contributing local funds to the project, which can be reimbursed by FDOT at a later time.

9.1. Project Coordination Efforts

Generally, coordination efforts must begin early and continue throughout any process that includes a transit facility as part of the improvement. The project development and design phases of projects are where specific decisions are made that impact costs and the success of the project. However, it is the planning phase where decisions are made to include major facilities in roadway projects. This sub-section highlights the steps needed to complete a roadway project from the planning phase through the maintenance of the facility. Figure 9.1 highlights the duration of each project phase.

9.1.1 Concept to Concrete

FDOT understands that a project must be managed from the conceptual plan developed during project planning through the time the finished concrete is actually used by the traveling public. This idea of "concept to concrete" is important to recognize and understand, as it provides great insight into gaining support and approval for a transit project to be constructed within FDOT right-of-way (Figure 9.1).

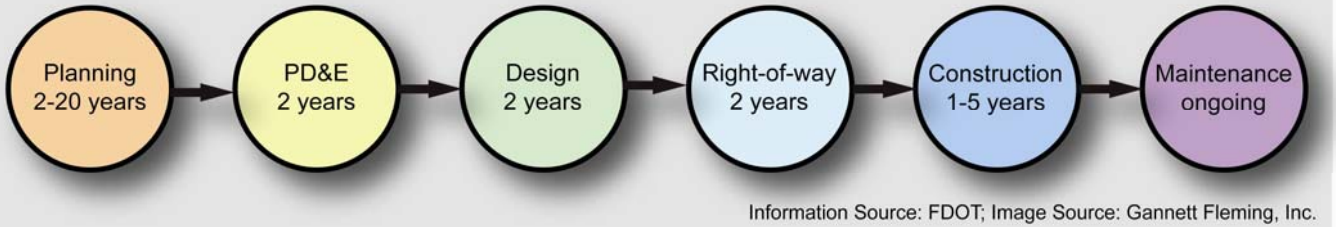
Figure 9.2 highlights each phase and the more important steps or decision points where transit projects tend to either get included or are over looked, and therefore not funded or approved.

The six phases of FDOT roadway project development are:

➘ **Planning**, up to 20 years in the future, including;

- ♦ Long range, including the Florida Transportation Plan, the Strategic Intermodal System Plan, the LRTP of the Metropolitan Planning Organizations (MPO), and local Comp Plans.
- ♦ Short range plans such as the Five-Year Work Program and Annual Budget requests.
- ♦ Check for consistency to ensure the project is included in the various plans. Planning, which ranges from understanding local priorities and decisions to the appropriation process, is completed in an on-going cycle. Although planning takes place over 30 years, design and construction is actually much shorter.

Figure 9.1: FDOT Concept to Concrete - Time Range



Information Source: FDOT; Image Source: Gannett Fleming, Inc.

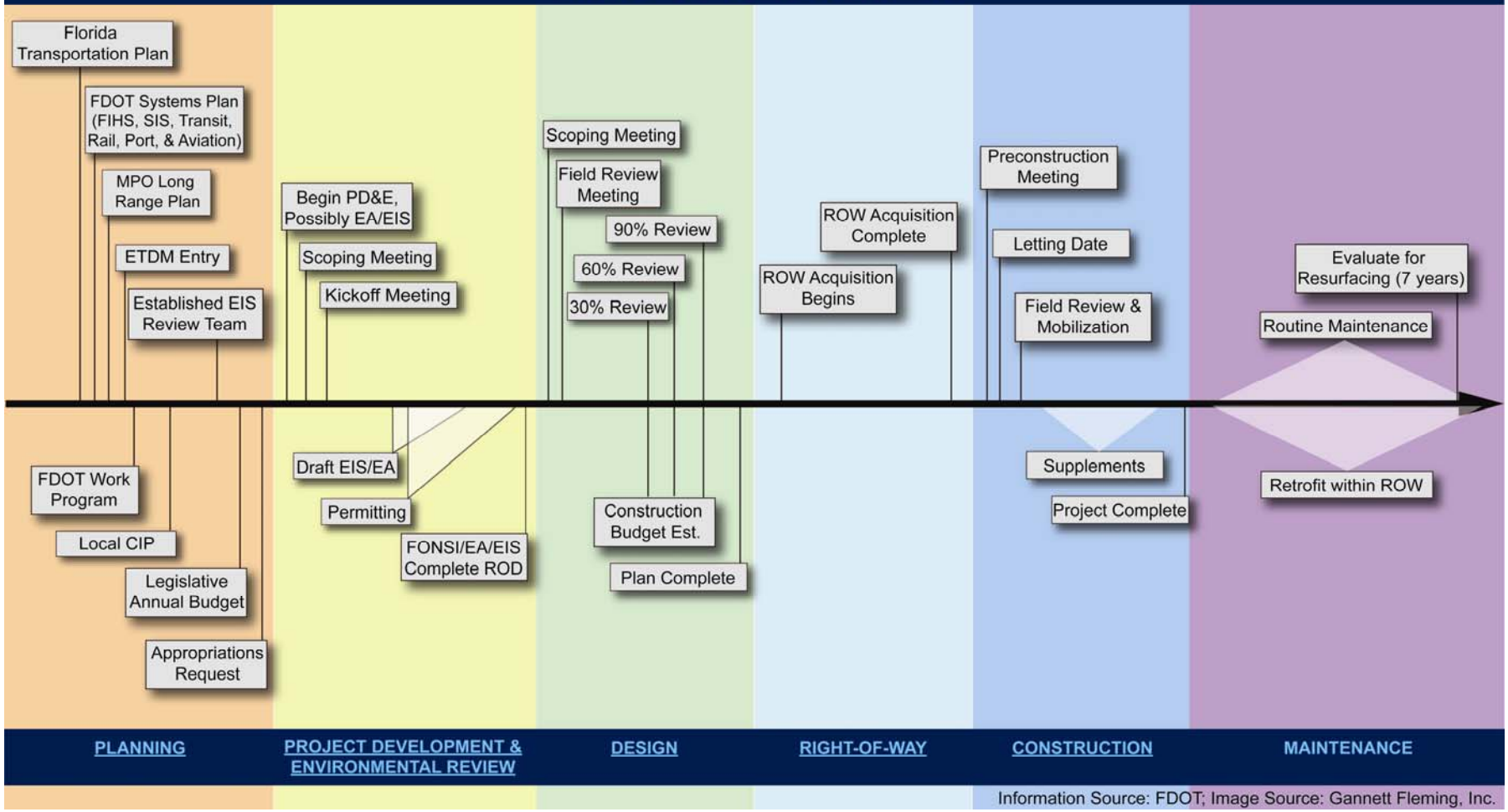
Important to Note

Refer to the glossary for explanations of the steps in the FDOT Concept to Concrete Timeline.

- **Project Development & Environmental (PD&E)**, which includes the National Environmental Policy Act (NEPA) process. Included here is initial project scoping meeting. PD&E studies are scheduled for 2 years and result in a record of decision on whether to move forward with a project and various elements of the project, including transit facilities.

There is an opportunity to review the plans while developing budget estimates for the various elements included in the plan. Once the plans are complete and a budget is set, any changes must be completed by a supplemental agreement.

Figure 9.2: FDOT Concept to Concrete



Information Source: FDOT; Image Source: Gannett Fleming, Inc.

Important to Note

When transit facilities are developed as stand alone projects, most often they can be processed under the requirements of a lower level environmental document. Please refer to the PD&E Manual, Part 1, Chapter 2, for guidance.

Design, which takes approximately two years and includes detailed cost estimates to be used in budgeting for future phases. Included here is the development of the Maintenance of Traffic (MOT) plan and the plans for traffic operations. Purchasing right-of-way may include right-of-way purchases for any previously approved transit facility included in the plans.

- **Right-of-Way Acquisition**, which usually takes about two years to complete. Purchasing right-of-way may include right-of-way purchases for any previously approved transit facility included in the plans.
- **Construction**, which can vary in length depending on how extensive the project is and how the MOT handles traffic. This phase of the project can last anywhere from one to five years, depending on the scale of the project. If transit facilities are to be built, close coordination with the construction manager is essential. Construction may cause changes in route schedules and alignments, and if so, the public must be properly notified.
- **Maintenance**, which includes the on-going monitoring of the system and the placement of retrofitted amenities. This phase is ongoing from the end of the construction phase. Transit agencies must coordinate with the managing agency because maintenance work may impact transit service along certain routes and to specific stops and stations.

Important to Note

The FDOT "gaming cycle" is the annual process of programming new projects and correcting cost estimates in the FDOT Five Year Work Program. This process takes place during the months of September through December.

Important to Note

In order to assure that a project is in compliance with the direction and policies associated with the design of local, city, and county roadways refer to:

Florida Manual of Uniform Minimum Standards for Design, Construction and Maintenance for Streets and Highways (The Florida Greenbook)

9.1.2 Other FDOT Projects

FDOT completes many roadway projects that do not go through all the phases outlined in the previous section. These projects are typically programmed during the annual "gaming" cycle, when the Department develops the Tentative Five-Year Work Program. Local agencies should contact FDOT annually, and begin programming funding for these projects early in the project schedule. Other types of roadway improvement projects include:

- **Resurfacing** (and Widening & Resurfacing): Typically prioritized and programmed three to five years before construction.
- **Traffic Operation Improvements**: Projects such as intersection improvements, turning lanes, signal timing systems, and safety related applications can be programmed from one to five years before construction.
- **Maintenance Improvements**: Projects such as sidewalk repairs, adding paved shoulders, and improving drainage issues can be programmed from one to five years before construction.
- **Enhancement Program**: The Department administers the federal surface enhancement program along with the MPO in each urban area, and many of these funds are programmed for ADA and sidewalk projects. These projects are typically prioritized and programmed five years before implementation.

Policy on how and when to incorporate transit facilities within any FDOT project, especially those listed above, are reviewed on a case-by-case basis and must be appropriately justified. For directions and information on current policy, contact the District Office of Modal Development and request assistance.

9.1.3 Local Roadway Projects

Projects constructed by local municipalities and counties, whether in state or local right-of-ways, may or may not be completed using the processes or steps identified in the previous sections. Depending on the funding source and project type, different steps could be followed to implement these projects.

It should be noted that projects using federal and state funding will most likely be required to adhere to the FDOT procedures and standards. When locally generated funding is used, local procedures are typically used, which may include a shorter time frame from "concept to concrete." It is important to learn how each jurisdiction plans and implements their projects, along with how communication and coordination are facilitated.

9.2. The Roles of Stakeholders

Stakeholders are partners with the ability to influence the approval or denial on a project. It is important to know who these stakeholders are and where their influence is most often felt.

Table 9.1: Coordination

Project Type	Agency				
	Federal	State	County	Municipal	Private
Bus Rapid Transit	FHWA for Interstate right-of-way and NEPA; FTA for NEPA, rating process, & funding.	FDOT for NEPA process, Alternatives Analysis, rating process, & funding, and when using FDOT right-of-way.	When on county roads or crossing them, and when county manages traffic control system. Also with local funding issues.	When using city streets or crossing them, and when the city manages traffic control system. Also with local funding issues.	When using private right-of-way, for access issues, station development, and funding support.
Transit-Oriented Development	FTA for funding	When modifying/using FDOT roadway or right-of-way, development review process, and potential funding.	When modifying/using county roadway or right-of-way, development review process, and potential funding	When modifying/using city roadway or right-of-way, development review process, and potential funding	In development process and for sponsorship
Park-and-Ride	FHWA for funding, FTA for funding	FDOT for funding, planning, and approval of right-of-way use.	For planning, maintenance, and approval to use right-of-way	For planning, maintenance, and approval to use right-of-way	When using private right-of-way or in joint or private developments
Curbside Improvements	FHWA for right-of-way if on Interstate; FTA for funding	For major impacts, contact FDOT	On state and county roads	On state and local roads	In developments and for joint-use and encroachment.

9.3. The Practitioner's Guide

The FDOT is developing a companion handbook to accompany this Transit Facility Guidelines manual, *The Practitioner's Guide*. *The Practitioner's Guide* includes user friendly guidelines for implementing the standards and guidelines defined in this manual for including transit facilities in the development process.

Think of *The Practitioner's Guide* as the "How To" handbook for this manual. This manual instructs agencies on what to build and the *Practitioner's Guide* will instruct agencies on how to get it built.

9.3.1 Contents of *The Practitioner's Guide*

The Practitioner's Guide contains guidance and procedures for getting transit facilities approved and included in development review processes, local plans, redevelopment projects, and other applicable plan approval processes. The guide includes sample policies, procedures, ordinances, and other guidance that can be used as reference.

Also included are samples of successful projects and policy decisions including descriptions of what made these particular projects and policy decisions successful. Along with these examples are suggestions on how to adapt them to local needs.

The guideline also includes a more detailed description of the FDOT process that was included in this section along with contact information. The concept to concrete flowchart has a companion table that reflects the level of involvement of institutions to help guide the level of coordination that should be initiated and maintained through the development of a transit project. The table will indicate which entities:

- are directly involved,
- provide reviews and approvals, and/or
- must be coordinated with.

9.3.2 User of *The Practitioner's Guide*

The Practitioner's Guide is designed to be used by transportation planners involved in the development review process, whether employed by a transit system or by local government. It will also be useful to those responsible for transit improvements, including those who manage land development projects with local governments and developers.

The Practitioner's Guide is a vital and helpful tool for those who work to change policies that enable transit facilities to be an easy choice for decision-makers and funding partners.

Useful Source

For Regional ITS Architecture information by FDOT district

Florida Statewide and Regional ITS Architectures website

9.4. Intelligent Transportation System Architecture Requirements

Intelligent Transportation System (ITS) architecture is the framework that identifies major system components and stakeholders of ITS and the communications and data flow between the systems and participants. Advanced Public Transportation Systems (APTS) is a type of ITS and fits into the ITS Architecture when sharing data with other APTS or regional ITS systems. ITS Architecture is implemented on a national, regional, and project level, and often ITS projects must be coordinated with various agencies and jurisdictions both horizontally and vertically.

- **National ITS Architecture:** It is an all encompassing set of standards that provides an overall framework for planning, defining, and integrating ITS.
- **State ITS Architecture:** It is the state adopted standard that complies with the national architecture and is designed to give guidance to the FDOT Districts in developing a regional framework to plan and implement ITS applications.
- **Regional ITS Architecture:** It is a regional framework that ensures the agreement and integration of local agencies for the implementation of ITS projects. It should be consulted at the early stages of project planning to enable the integration of the project into the regional ITS architecture.
- **Project-Level ITS Architecture** is a detailed plan for the integration of ITS components at the project, operational, and agency levels.

At the project level it is important that the following requirements be followed for all new projects:

- Conformity to the regional ITS architecture (if it is FTA funded or is integrated with other systems).
- Developed using a systems engineering process.
- Use USDOT adopted ITS standards as appropriate.
- Include the ITS components and policy conformity within the FTA grant application.

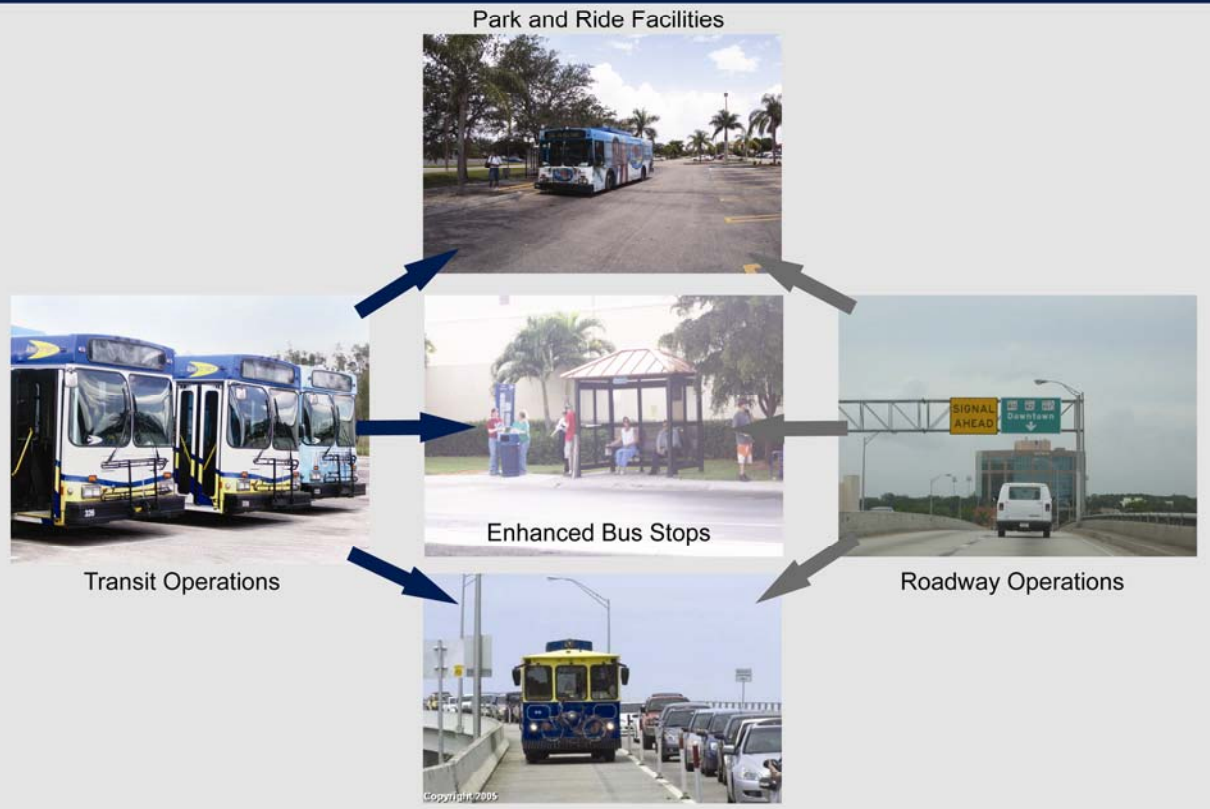
9.5. Roadway Construction Impacts on Transit

Collaboration between roadway and transit agencies is necessary for the placement of busways, transit stops, park-and-rides, and even typical bus routes. A collaborative effort will lead to a more efficient system for both the roadways and transit.

9.5.1 Construction Impacts

Early coordination can eliminate most negative impacts from roadway construction projects. Ensuring that the MOT plans consider possible and existing transit services and facilities is a good start. However, tracking and learning from experience is imperative for proper planning during the MOT process. Also being prepared for and ready to adapt to changing situations will help to minimize unexpected impacts when they occur.

Figure 9.3: Benefits of Collaboration



Types of impacts that occur during construction are:

- Bus stop sign removal
- Shelters/benches relocation
- ADA landing pad demolition
- ADA access path (paved shoulders, sidewalk, or other paved areas) disruption
- Lane closures and detours which cause;
  - Route deviation
  - Bus stops becoming inaccessible
  - Stops located behind barriers (jersey type, berms, concrete forms, etc)
  - Turning movement restrictions
  - Intermittent delays/schedule changes
- Delays for equipment and activities

9.5.2 Preventative Actions

There are several actions that can be taken to help prevent negative impacts from construction projects including:

- Tracking and documenting past impacts in order to better plan for future impacts (especially if costs can be defined)
- Knowing, and being involved in, the planning phases in order to be aware of future projects
- Reviewing, providing meaningful comments, and coordinating early in the design phases of projects, including the MOT
- Developing a toolbox of alternatives that can be used in planning or neutralizing unexpected impacts
- Reporting important issues early and then following up appropriately

Refer to:

For more information about bus stop amenities, refer to

Section 3, Curbside Factors;

The Florida Greenbook

Chapter 8 : FDOT Plans Preparation Manual

9.5.3 Impact Alternatives Toolbox

Being prepared is a key to minimizing construction impacts. Here are a few ideas for developing a toolbox of alternatives:

- Spreadsheet tracking of past impacts and resolutions
- Alternative plan ideas
  - Alternative routing and stop locations
  - Temporary solutions: Moveable landing pads, ditch or berm crossovers, and temporary signage
  - Use of parking lots for temporary stops
- Up-to-date cost estimating contract information
- Check with the responsible offices to determine when and for how long construction is planned.

9.6. Transit Stops on the Right-of-Way

Right-of-way use in building transit stops with shelters or benches often requires the transit agency to work with other local agencies in order to effect the proper installation of the new infrastructure.

Rules and regulations pertinent to the interaction between transit agencies and other agencies are listed here. A comprehensive set of rules regarding the addition of shelters and benches in the right-of-way can be found in Chapter 14-20, Florida Administrative Code, “Private Use of Right-of-Way.”

9.6.1 Placement of Shelters and Benches

- Shelters and benches may be erected upon approval by the appropriate city or county government. There is to be a “permitting” process with documentation that can be provided to the FDOT upon request.
- All FDOT standards for non-state roads are to be complied with and can be found in either the FDOT *Manual of Uniform Minimum Standards for Design, Construction, and Maintenance for Streets and Highways* commonly known as the *Florida Greenbook*.
- Prior to the installation of the shelter or bench, the impacted utility companies must be notified to determine location of utilities and prevent conflicts.

- Shelters and benches may be removed at the expense of the shelter or bench owner when required by State Road maintenance or relocation is required.
- Bus stop locations are determined by the public transit agency. However, coordination in many areas are good practice to avoid conflicts with future plans and/or activities at the selected site. For bus stop sign placement, refer to MUCTD.

9.6.2 Bus Stop Benches, ADA Compliance

In the past, many companies other than transit agencies have placed benches in roadway rights-of-way in a manner that does not comply with ADA. Therefore, the FDOT has developed policies to address the issue of bench placement in state roadway rights-of-way not in compliance with the following ADA standards.

- Bench Configuration- Bench configuration should be provided that allows pedestrians with disabilities a firm fairly high seat, a supportive back, and an armrest for making the transition between sitting and standing.
- Bench Placement- Benches should be placed to provide a clear space for wheelchairs at either end.
- Bench Location- Benches should be placed to avoid blocking the accessible route. Benches should also avoid blocking bus boarding areas. Benches should be placed on a firm, stable, and slip resistant surface that provides connections to the bus boarding area.

10. References

General Reports Listed Chronologically

- *Planning and Design for Transit Handbook*. (1996). Portland, OR: Tri-County Metropolitan Transportation District of Oregon.
- *Guidelines for the Location and Design of Bus Stops*. (1996). Retrieved August 10, 2006, from http://onlinepubs.trb.org/onlinepubs/tcrp/tcrp_rpt_19-a.pdf.
- *TCRP Report 27, Building Transit Ridership*. (1997). Washington, DC: Transportation Research Board.
- *Guide for the Development of Bicycle Facilities*. (1999). Washington D. C.: Association of State Highway and Transportation Officials.
- *Passenger Information Services: A Guidebook for Transit Systems (TCRP Report 45)*. (1999). Retrieved August 29, 2006, from http://onlinepubs.trb.org/onlinepubs/tcrp/tcrp_rpt_45.pdf.
- *A Handbook of Proven Marketing Strategies for Public Transit* (TCRP Report 50). (1999). Washington, DC: Transportation Research Board.
- *PACE Development Guidelines*. (2000). from http://www.pacebus.com/sub/guidelines/development_guidelines/default.asp.
- *A Policy on Geometric Design of Highways and Streets (AASHTO Greenbook)*. (2001). Washington D.C.: Association of State Highway and Transportation Officials.
- *FDOT State Park-and-Ride Lot Program Planning Manual*. (2001). Tallahassee, FL: Florida Department of Transportation.
- *MAG Park-and-Ride Study*. (2001). Phoenix, AZ: Maricopa Association of Governments.
- *Making Transit Work*. (2001). Washington, DC: Transit Research Board.
- *Americans with Disabilities Act (ADA): Accessibility Guidelines for Buildings and Facilities.* (2002). Retrieved August 7, 2006, from http://www.access-board.gov/adaag/ADAAG.pdfs.
- *Bus Stop Spacing* [Electronic (2002). Version], 1-4. Retrieved August 8 from http://www.its.pdx.edu/downloads/stop_spacing_lit.doc.
- Transit-*Oriented Development and Joint Development in the United State. A Literature Review.* Research Results Digest Number 52, (2002). Washington, DC: Transportation Research Board.

- *Ulmerton Road Corridor Bus Preferential Treatment Study*. (2003). Clearwater, FL: Pinellas County Metropolitan Planning Organization.
- *Bus Rapid Transit Volume 2: Implementation Guidelines* (TCRP Report 90). (2003) Washington, DC: Transportation Research Board.
- *TCRP Report 95, Transit Information and Promotion*. (2003). Washington, DC: Transportation Research Board.
- *JTA Mobility Access Program Handbook*. (2003). Jacksonville, FL: Jacksonville Transportation Authority.
- *Accessing Transit: Design Guidelines for Florida's Transit Agencies*. (2004). Tallahassee: Florida Department of Transportation.
- *Characteristics of Bus Rapid Transit for Decision-Making*. (2004) Washington, DC: Federal Transit Administration.
- *Evaluation of Shared Use Park-and-Ride Impact on Properties*. (2004). Tampa, FL: Center for Urban Transportation Research.
- *Hidden in Plain Sight: Capturing the Demand for Housing near Transit*. Oakland, CA: Reconnecting America.
- *Park-and-Ride/Pool: Traveler Response to Transportation System Changes* (TCRP Report 95). (2004). Washington, DC: Transportation Research Board.
- *Transit-Oriented Development in the United States: Experiences, Challenges, and Prospects* (TCRP Report 102). (2004). Washington, DC: Transportation Research Board.
- *Design Guidelines and Standards for Sound Transit Capital Projects*. (2005). Seattle, WA: Sound Transit.
- *Guidelines for Station Site and Access Planning*. (2005). Washington, DC: Department of Planning and Information Technology, Office of Business Planning and Project Development.
- *Impacts of Transit-Oriented Development on Public Transportation Ridership*. (2005). Tampa, FL: Center for Urban Transportation Research at the University of South Florida.
- *Manual of Uniform Minimum Standards for Design, Construction and Maintenance for Streets and Highways* (Florida Greenbook). (2005). Tallahassee: Florida Department of Transportation. Retrieved on November 26, 2006, from http://www.dot.state.fl.us/TrafficOperations/Operations/MUTCD.htm
- *Pasco County Public Transportation Transit Infrastructure Guidelines Manual*. (2005). New Port Richey, FL: Pasco County Public Transportation.

- *Advanced Public Transportation Systems: State of the Art Update 2006*. (2006). Retrieved September 21, from http://www.fta.dot.gov/documents/APTS_State_of_the_Art.pdf.
- *Design Standards*. (2006). Tallahassee: Florida Department of Transportation.
- *Livable Roadways Guidelines*. (2006). Tampa, FL: Hillsborough County Metropolitan Planning Organization.
- *Mobility Greensboro Greensboro Transit Authority Transit Infrastructure Guidelines Handbook*. (2006). Greensboro, NC: Greensboro Transit Authority.
- *Park-and-Ride Evaluation Process*. (2006). Bartow, FL: Florida Department of Transportation, District One.
- *Project Development & Design Guidebook*. Retrieved on November 21, 2006, from http://www.vhb.com/mhdGuide/mhd_GuideBook.asp, Accessed November 21, 2006
- High Occupancy Vehicle (HOV). (2006). Retrieved August 7, 2006, 2006, from http://www.ncdot.org/projects/hov/#maths
- ITS Application Areas. (2006). Retrieved September 5, 2006, from http://www.standards.its.dot.gov/learn_Application.asp
- Pedestrian Signal Timing. (2006). Retrieved August 30, 2006, from http://www.walkinginfo.org/de/curb1.cfm?codename=39f&CM_maingroup=Signals%20and%20Signs
- *Plans Preparation Manual*. (2006). Tallahassee: Florida Department of Transportation. Retrieved on, November 26, 2006, from http://www.dot.state.fl.us/rddesign/PPMManual/2007/PPM2007.htm
- RTD Bus Transit Facility Design Criteria. Retrieved on November 22, 2006, from http://www.rtd-denver.com/LightRail/bus_transit_facility_design_criteria.html, Accessed.
- National BRT Institute Online. (2007) Retrieved on October 6, 2006, from http://www.cutr.usf.edu/index2.htm.

Authored Reports Listed Alphabetically By Author

- Baker, R. J., Collura, J., Dale, J. J., Head, L., Hemily, B., Ivanovic, M., et al. (2002). *An Overview of Transit Signal Priority*. Washington D. C.: ITS America.
- Belzer, Dina; and Gerald Autler, (2002). *Transit-Oriented Development: Moving from Rhetoric to Reality*. Washington, DC: The Brookings Institution.

- Corbett, Judy; and Paul Zykofsky. (1996). *Building Livable Communities: A Policymaker's Guide to Transit-Oriented Development*. Sacramento, CA: Local Government Commission.
- Dion, F., & Rakha, H. (2006). *Integrating Transit Signal Priority within Adaptive Traffic Signal Control Systems* [Electronic Version], 1-8. Retrieved September 20, 2006 from http://www.filebox.vt.edu/users/hrakha/Publications/Transit%20Signal%20Priority%20within%20Adaptive%20Control%20%20Ver5.pdf#search=%22Integrating%20Transit%20Signal%20Priority%20Within%20Adaptive%20Traffic%20Signal%20Control%20Systems.%20%22 .
- Dion, F., Rakha, H., & Zhang, Y. (2004). Evaluation of Potential Transit Signal Priority Benefits along a Fixed-Time Signalized Arterial. *Journal of Transportation Engineering, 130*(3), 294-303.
- Dunphy, Robert; Deborah Myerson; and Michael Pawlukiewicz. (2003). *Ten Principles for Successful Development Around Transit*. Washington, DC: The Urban Land Institute.
- Ewing, Reid, (1996). Pedestrian- and Transit-Friendly Design. Tallahassee, FL: Public Transit Office, Florida Department of Transportation.
- Fitzpatrick, K. M., Urbanik, T., & Stokes, R. W. (1993). *Guidelines for Planning, Designing and Operating Bus-related Street Improvements*. Arlington, Texas: Texas Transportation Institute.
- Ghoneim, N., & Wirasinghe, S. C. (1980). Near-side or Far-side Bus Stops: A Transit Point of View. *Transportation Research Record*(761), 69-75.
- Goodwill, Julie; and Sara J. Hendricks. (2002*). Building Transit-Oriented Development in Established Communities*. Tampa, FL: Center for Urban Transportation Research at the University of South Florida.
- Grava, Sigurd. (2002). *Urban Transportation Systems*. New York, NY: McGraw-Hill.
- Miller, M. A. & Buckley, S.M. (2001). *Institutional Aspects of Bus Rapid Transit*. Berkley, CA: California PATH Program at the Institute of Transportation Studies, University of California, Berkley.
- Miller, M. A. & Buckley, S.M. (2001). *California Partners for Advanced Transit and Highways: Institutional aspects of Bus Rapid Transit Operation*. Berkeley, CA: Institute of Transportation Studies: University of California, Berkeley.
- Murray, A. (2003). A Coverage Model for Improving Public Transit System Accessibility and Expanding Access. Annals *of Operations Research*, 123(1), 143-156.

- Nes, R. V., & Bovy, P. H. L. (2000). Importance of Objectives in Urban Transit-network Design. *Transportation Research Record* (1735), 25-34.
- Parker, Terry. (2001). *Transit-Oriented Development: A Strategy for Making Transit Work Better*. California Department of Transportation Journal, Vol. 2, Issuse 3. P. 24. Sacramento, CA: California Department of Transportation.
- Ragland, D. R., Hundenski, R. J., Holman, B. L., & Fisher, J. M. (1992). Traffic Volume and Collisions Involving Transit and Non-Transit Vehicles. *Accident Analysis Preview, 24*(5), 547-558.
- Rakha, H., Medina, A., Sin, H., Dion, F., & Aerde, M. V. (2000). Field Evaluation of Efficiency, Energy, Environmental and Safety Impacts of Traffic Signal Coordination across Jurisdictional Boundaries *Transportation Research Record*(1727), 42-51.
- Schaller, B. (2001). Large City Technical Exchange and Assistance Program Final Report: Inter-jurisdictional Coordination for Traffic Management, Interagency Sharing of Fiber Optic Systems, Planning for Pedestrians in Large Urban Centers [Electronic Version], 1-179. Retrieved September 20, 2006 from http://www.nyu.edu/wagner/transportation/files/largecitytech.pdf.
- Skabardonis, A. (1998). Control Strategies for Transit Priority [Electronic Version], 1-53. Retrieved September 16, 2006 from http://repositories.cdlib.org/cgi/viewcontent.cgi?article=1405&context=its/path.
- Smith, H. R., Hemily, B., & Ivanovic, M. (2005). *Transit Signal Priority (TSP): A Planning and Implementation Handbook*. Retrieved August 17, 2006, from http://www.itsa.org/itsa/files/pdf/TSPHandbook2005.pdf.
- Spillar, Robert J. (1997). Park-and-Ride Planning and Design Guidelines. New York, NY: Parsons Brinkerhoff Inc. Retrieved November 21, 2006. http://www.pbworld.com/library/fellowship/spillar/.
- Virkler, M. R. (1998). Signal Coordination Benefits for Pedestrians. *Transportation Research Record* (1636), 77-82.

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