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Developing Transit Station Design Criteria with a Focus on Intermodal Connectivity

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# Developing Transit Station Design Criteria with a Focus on Intermodal Connectivity

by Geophrey Mbatta, Thobias Sando, and Ren Moses

*The safe and efficient movement of passengers to and from the high-capacity transit system to other modes of transportation is of paramount importance to transportation officials. Transit stations are the primary interfaces for passengers with the transit system. This paper presents a procedure which could be used to develop station design criteria and guidelines with a focus on intermodal connectivity. The proposed procedure may be used for developing station design criteria and guidelines for high-capacity transit systems including rail project and Bus Rapid Transit (BRT). A successful implementation of the transit projects will result in higher ridership rates and hence reduce dependency on automobile driving along Florida highways.*

## INTRODUCTION

Accessibility of transit facilities is of paramount importance to transportation officials. The importance is further heightened by the Federal Energy Independence and Security Act of 2007 which urges state and local governments to consider policies designed to accommodate all users, including motorists, pedestrians, cyclists, transit riders, and people of all ages and abilities in order to serve all surface transportation users by creating a more interconnected and intermodal system. The Act further emphasizes the use of environmentally friendly options such as public transportation, walking, and bicycling. Transit stations are the primary interfaces for passengers with the transit system. Adopting a station area facility design which focuses on seamless movement of passengers as they change their modes of transportation at the station would help accomplish safe and efficient movement of passengers as they access and egress the station area.

Different local and state agencies have established their own design guidelines for station facility design. In the state of Florida for example, there are 26 local transit agencies. While all these agencies oversee operation of their local bus system, only two agencies, i.e., Tri-Rail and Miami-Dade County Transit, operate rail systems. Tri-Rail runs the commuter rail system in Palm Beach, Broward, and Miami-Dade counties while Miami-Dade County Transit manages the heavy rail system in Miami-Dade County. Tri-rail, operated by the South Florida Regional Transportation Authority (SFRTA) has published Station Design Guidelines (2004) with criteria for the design and construction of Tri-Rail stations and support facilities. Sections 4 and 5 of the Tri-Rail guidelines provide standards for the station platform design and station amenities. On the other hand, Miami-Dade Station design criteria are covered in Volume II of the Miami-Dade County Rapid Transit System Extensions Compendium of Design Criteria (2007).

Florida Department of Transportation (FDOT) districts located in areas with commuter rail systems have established guidelines for the design of transit facilities within their districts. FDOT District 4 published Transit Facility Guidelines (2007) to facilitate engineering details of transit facility design. The primary focus of the District 4 Transit Facility Guidelines is to provide minimum design criteria for transit facilities. District 4 guidelines have more general application with limited guidance for the design of transit station facilities. FDOT District 6 published Facility Planning Guidelines and Design Criteria (1997) specifically for the Miami Intermodal Center (MIC) Project. In anticipation of the proposed future projects such as the Tampa Intermodal Center and Bus Rapid Transit (BRT) in several local jurisdictions within Districts 1 and 7, the two FDOT districts were recently involved in a joint effort to publish the FDOT District 1 and 7 Transit Facility

Handbook (2007). This handbook provides comprehensive guidance for planning and design of transit facilities, activities, and services for the two districts. The primary focus of the handbook is to provide minimum design criteria for transit facilities with the intent of achieving safety, comfort, and accessibility to passengers. As it is with District 4's guidelines, the District 1 and 7 Guidelines have limited guidance for transit station facilities.

To ensure higher rates of ridership, station areas need to be designed with features known to enhance transit patronage (Porter 1997). The long-term success of transit projects is closely linked to creating connectivity to all modes in the station areas. Of high importance is the station area design which encourages the use of all modes of transportation including pedestrian and bicycle connectivity. Transit stations are often conducive to other public transportation services. Station area principles that promote the use of public transportation in compatibility with private automobiles are also imperative to successful multimodal services.

Although much has been published on design guidelines for transit facilities (rail and BRT systems), none of the examined guidelines were prepared with a focus on intermodal connectivity. In addition, the existing guidelines have more general applications with little guidance for transit station intermodal facilities. This paper discusses the process which can be utilized in developing design criteria and guidelines for transit station intermodal facilities. Design guidelines focusing on intermodal connectivity ensure safety, seamlessness, and comfortable use. This process can be used by a wide range of transit officials including design engineers, land-use planners, and transportation planners from the public and private sectors in planning and designing transit station areas that meet intermodal standards with amenities necessary to encourage all modes of transportation, especially bus and non-motorized modes of transportation. Figure 1 shows a sketch of a typical transit station. The process of developing station design criteria with focus on intermodal connectivity is discussed next.

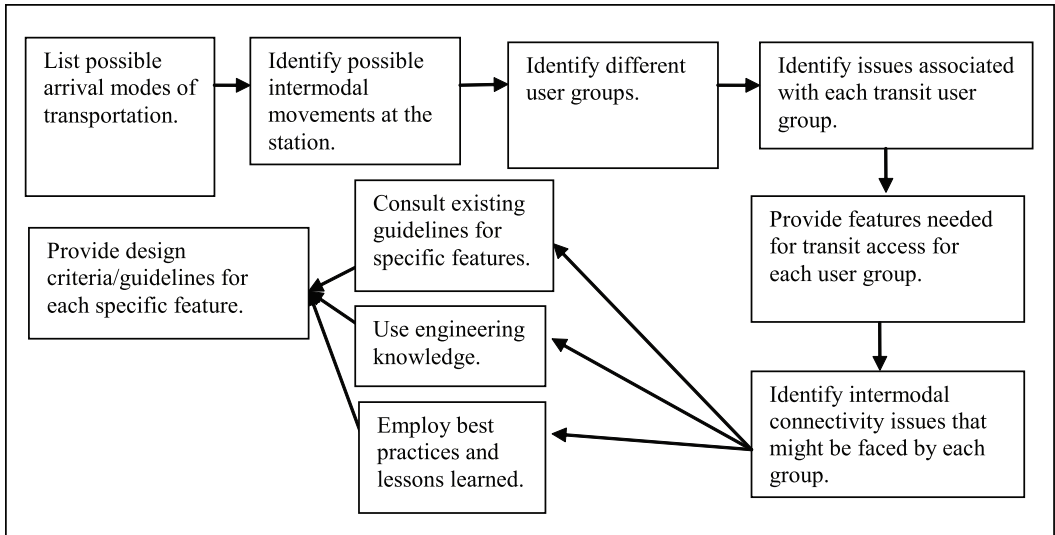
**Figure 1: Sketch of a Typical Transit Station**



## DESIGN CRITERIA DEVELOPMENT PROCESS

The design process is both applied science and art. The federal government requires compliance to the Americans with Disabilities Act (ADA) for all public facilities, including transit stations. In the last decade, there has been an emphasis on going beyond ADA requirements to universal design principles. Universal design principles promote equitable use of transit systems to all users regardless of their impairments. Clearly, universal design principles do not necessarily provide intermodal connectivity at the transit station. A comprehensive process that would examine intermodal connectivity is needed to provide design guidelines that ensure safety, seamlessness, and comfortable use of passengers. Figure 2 depicts a graphical presentation of the proposed procedure. The presented procedure is discussed in the following sections in details.

**Figure 2: Design Criteria Development Procedure**



### Possible Arrival Modes of Transportation

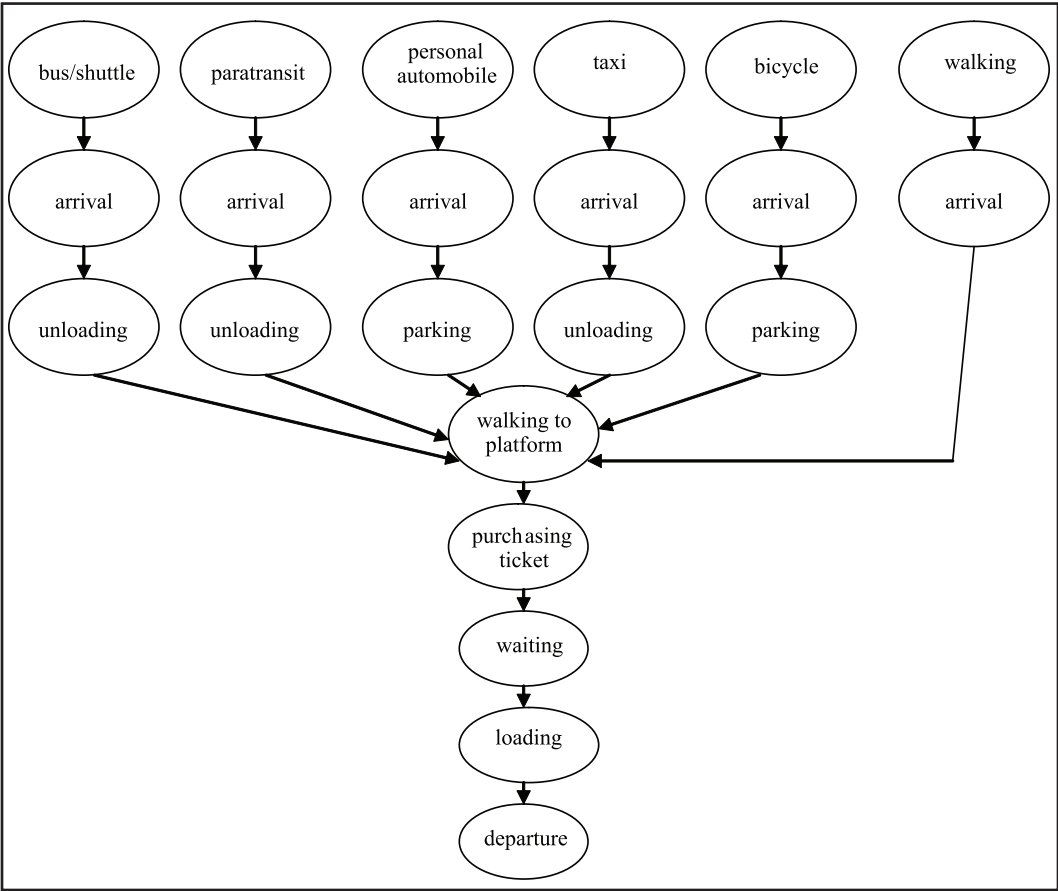
Passengers may arrive at a transit station by a variety of means (Figure 3). The means include walking, arriving in a private vehicle, being dropped off from a car, riding a van, riding a feeder bus, using paratransit service, or from another transit mode. Station design should include features necessary for providing access to station by all common modes of transportation. Features such as bus bays for buses and shuttles, kiss-and-ride for drop-off vehicles and paratransit vehicles, park-and-ride for private automobiles, and bicycle racks for cyclists are typically provided for accessibility of the aforementioned arrival modes. Normally, the last mode of transportation before boarding the transit vehicle is walking. Design criteria should ensure seamless and safe movements of pedestrians as they interact with other modes at the station.

### Identify Possible Intermodal Movements at the Station

Common intermodal movements are graphically summarized in Figure 3. Typically, the last mode of transportation before boarding the transit vehicle is walking. By definition, a pedestrian is any person who is afoot or who is using a wheelchair or a means of conveyance propelled by human power other than bicycle. Passengers arriving at the station by modes of transportation other than walking will change modes to the pedestrian mode before accessing a transit vehicle. Passengers riding buses will use a sidewalk/pathway to walk toward the platform after unloading from buses.

On the other hand, passengers arriving by private automobiles will have to use crosswalks to cross circulation roads at the park-and-ride facility before reaching the sidewalk on the way to the platform. Provision of transit facilities should ensure seamless, safe, and convenient interaction of all modes of transportation as they access and egress the station.

Figure 3: Arrival Modes at Transit Station



Identify User Groups of Different Modes of Transportation

ADA requires all facilities built for public use to adhere to the design principle which will not discriminate any person regardless of his/her disability. According to the Literacy Volunteers of America (2000), 13-15% of Americans are on the lowest literacy level, which is considered as functionally illiterate (those who cannot read or write English). According to the National Health Interview Survey by the National Center for Health Statistics (2008), on average during 2001–2005, almost 30% of the noninstitutionalized adult U.S. population (approximately 62 million people) had basic actions difficulty. More than one-fifth of the noninstitutionalized adult population reported difficulty with basic movement actions such as walking, bending, reaching overhead, or using their fingers to grasp something. About 13% of the adult population reported vision or hearing difficulties. Three percent reported cognitive difficulties. According to the report, these statistics vary with demographic characteristics such as age and income, among other factors. Sixty-one percent of the population aged 65 years and over reported difficulty in basic actions while almost 40% of those with basic actions difficulty reported family incomes below 200% of the federal poverty threshold, compared with only about one-fourth of nondisabled adults.



Equitable use of transit facilities is a sensitive issue. Transit users range from able-bodied people who are fit and agile to physically challenged users who suffer from different infirmities. The universal design handbook (2001) categorizes people with limited mobility in eight levels. In level 1 are fit and agile people, those who can run and jump, leap up stairs, and carry loads of heavy baggage. In level 2 are the generality of normal adult able-bodied people who can walk, with flights of stairs not troubling them. Level 3 consists of people who may not be considered as disabled but are of small size/stature, and hence have limited mobility compared to people with normal size. In level 4 are older people who are not perceived as being disabled. By comparison with younger adult people, however, these are people who are commonly prone to discrimination caused by steep steps or stairs without handrails. Also in level 4 are people with infants in strollers. Ambulant people with disabilities are in level 5. People in level 6 are independent wheelchair users while in level 7 are people with disabilities who drive electric scooters and those who use wheelchairs who need another person to facilitate their mobility. The top level (level 8) consists of wheelchair users who need two people to help them when they go out.

Special accommodation is needed for people with vision impairments. Vision impairment spans a continuum, from total blindness at one extreme to partial sight, or low vision, at the other. Other types of impairments include hearing, cognitive, and language impairments. Passengers with more than one type of impairment are faced with even more difficulties in using transit station facilities and amenities. Table 1 summarizes special features that might be needed to facilitate usage of transit station by passengers with different impairments.

### Identify Issues Associated with Each Transit User Group

Design guidelines have to address key accessibility issues associated with each transit user group. Identification of issues associated with each type of impairment is necessary to ensure that stations are designed to accommodate all types of passengers. Table 2 summarizes some common station features and issues faced by each user group.

**Table 1: Special Features for Different User Groups**

Group	Impairment	Physical aid(s) used	Features needed for station accessibility
<b>Mobility 1</b>	Physically fit	N/A	Loading/unloading area
<b>Mobility 2</b>	No use of legs	Wheelchairs, scooters	Clear path, loading / unloading area
<b>Mobility 3</b>	Limited strength, endurance, dexterity, balance, coordination	Wheelchairs, scooters, canes, crutches, walkers, seating, leaning posts, assistants	Clear path, loading / unloading area
<b>Visual 1</b>	Total blindness	Canes, dogs, assistants	Auditory, tactile surface, consistency
<b>Visual 2</b>	Partial blindness	Canes, dogs, assistants	Auditory, tactile surface, Consistency, color, contrast, lighting
<b>Hearing</b>	Deafness	Hearing aids	Visual displays
<b>Cognitive</b>	Impaired development, language, comprehensive	N/A	Simple language, consistency, symbols
<b>Language illiterate</b>	Impaired reading, speaking, lack of English skills	N/A	Simple language, symbols

### **Provide Features Needed for Transit Access for Each User Group**

There are specific features tailored to a specific user group. For example, tactile surfaces are meant to help patrons with visual impairment while ramps are specific to people using mobility aids such as wheelchairs. Table 3 lists specific features meant to facilitate easy movement of passengers with different impairments. Some of the provisions such as tactile surfaces have been blamed to be hazardous to users other than the blind. While it is apparent that such surfaces can be uncomfortable, and sometimes hazardous, the design community is convinced that tactile surfaces are essential for people who are blind, hence the tradeoff is worthwhile.

### **Identify Interconnectivity Issues That Might be Faced by Each Group**

Transit stations serve as an interface between the transit system and other modes of transportation. The stations are characterized by interaction between various modes of transportation. If not properly designed, interaction between different modes can result in conflicts between modes which might in turn discourage patrons from using the transit system. A station designed with interconnectivity in mind provides a seamless, safe, and convenient movement of patrons as they access and egress the station. Examples of station design which pose interconnectivity issues include but are not limited to (1) a design for which bus stops, park-and-ride, and other facilities are located across a busy street, (2) inefficient park-and-ride configuration, (3) improper wayfinding sign placement and design, (4) designs which do not serve all types of impairments, and (5) inefficient circulation of traffic at the station. Identification of these and many other issues in the process of developing design criteria and guidelines would help eliminate connectivity issues, hence enhance efficiency, safety, and convenience of patrons as they enter and leave the stations.



Table 2: Specific Issues by User Group and Specific Station Features

Feature/Group	Mobility 1	Mobility 2 & 3	Visual 1 & 2	Hearing	Cognitive	Language illiterate
Park-and-ride	Distance to the platform	Disabled parking Distance to the platform Obstructions Crossing	Distance to the platform Obstructions and crossing	Distance to the platform	Distance to the platform Obstructions and crossing	Distance to the platform
Drop-and-ride	N/A	Distance to the platform Obstructions	Connection path to platform	N/A	N/A	N/A
Bus terminal	Crossing location	Gap between platform and bus door Crossing location	Crossing location	Crossing location	Crossing location	Crossing location
Bicycle racks	Location	N/A	N/A	Location	Location	Location
Sidewalk	Width	Barriers Width Lack of curb ramp Connectivity	Barriers Width Identification of crossing	Width Connectivity Width	Connectivity Barriers Width	Connectivity Barriers Width
Walkway	Width Connectivity	Obstructions Width Lack of curb ramp Connectivity	Obstruction on the path Width Tactile before crossing Lack of curb ramp Connectivity	Width Connectivity	Connectivity Barriers Width	Connectivity Barriers Width
Ramp	Width Slope Glare surface No railing	Width Slope Glare surface Slope	Width Slope Glare surface	Width Slope Glare surface	Width Slip surface Glare surface	Width Slip surface Glare surface
Stairs	Treads Tactile strip	N/A	No handrail Treads Connectivity Identification	Treads Tactile strip	No handrail Treads Tactile strip	Treads Tactile strip
Elevators	Cab size	Cab size	Cab size Floor identification	Cab size	Cab size Floor identification	Cab size Floor identification

Table 2: Specific Issues by User Group and Specific Station Features (continued)

Feature/Group	Mobility 1	Mobility 2 & 3	Visual 1 & 2	Hearing	Cognitive	Language illiterate
Signage	inconsistency	inconsistency Lack of eye-level	Not able to read conventional signs Small fonts Lack of contrast	Directions	Direction Lack of contrast Reading difficulty	Direction
Ticket booth	Difficult to use Location	Difficult to use Location Front or side reach	Difficult to use Location Front or side reach	Difficult to use Location	Difficult to use Location	Difficult to use Location
Platform	N/A	Gap between platform and vehicle's door	No warning strip	N/A	N/A	N/A
Bench	Few benches if waiting time is >15 minutes	Few benches if waiting if time is >15 minutes	No indication of bench	Few benches if waiting time is >15 minutes	Few benches if waiting time is >15 minutes	Few benches if waiting time is >15 minutes
Shelter	No leaning rail	No area for wheelchair/ scooter	No indication of shelter	No leaning rail	No leaning rail	No leaning rail

Table 3: Provisions to Specific Station Features

Feature/Group	Mobility 1	Mobility 2 & 3	Visual 1 & 2	Hearing	Cognitive	Language illiterate
Park-and-ride	Minimize distance to the platform. Delineated raised Crossing	Provide Disabled parking. Minimize distance to the platform.	Minimize distance to the platform. Delineated raised Crossing	Minimize distance to the platform. Delineated raised Crossing	Minimize distance to the platform. Delineated raised Crossing	Minimize distance to the platform. Delineated raised Crossing
Drop-and-ride	N/A	Minimize distance to the platform.	Provide connection path to platform	N/A	N/A	N/A
Bus terminal	Locate crossing in front/back of the bus stop	Minimize gap between platform and bus door	Locate crossing in front/back of the bus	Locate crossing in front/back of the bus	Locate crossing in front/back of the bus	Locate crossing in front/back of the bus
Bicycle racks	Near shelter	N/A	N/A	Near shelter	Near shelter	Near shelter
Sidewalk	Provide enough width	Clear path Provide enough width Provide curb ramp Maintain connectivity	Clear path Provide enough width Provide tactile strip before crossing	Provide enough width Maintain connectivity	Maintain connectivity Clear path Enough width	Maintain connectivity Clear path Enough width
Walkway	Provide enough width Connectivity	Clear path Provide enough width Provide curb ramp Maintain connectivity	Clear path Provide enough width Tactile before crossing Provide curb ramp Maintain connectivity	Provide enough width Maintain connectivity	Maintain connectivity Clear path Provide enough width	Maintain connectivity Clear path Provide enough width
Ramp	Provide enough width Non-slip or glare surface Continuous railing	Provide enough width Non-slip or glare surface Slope	Provide enough width Non-slip or glare surface	Provide enough width Non-slip or glare surface	Provide enough width Non-slip or glare surface	Provide enough width Non-slip or glare surface
Stairs	Provide handrail Provide wide treads Tactile on top step of stair approach	N/A	Provide handrail Provide wide treads Tactile on top step of stair approach	Provide handrail Provide wide treads Tactile on top step of stair approach	Provide handrail Provide wide treads Tactile on top step of stair approach	Provide handrail Provide wide treads Tactile on top step of stair approach

Table 3: Provisions to Specific Station Features (continued)

Feature/Group	Mobility 1	Mobility 2 &3	Visual 1 & 2	Hearing	Cognitive	Language illiterate
Elevators	Enough turn-around room to all elevator cabs Floor announcement	Enough turn around room inside elevator cabs	Enough turn around room for elevator cabs Floor announcement	Enough turn around room for elevator cabs Floor announcement	Enough turn around room inside elevator cabs	Enough turn around room inside elevator cabs
Signage	Maintain consistency	Maintain consistency Provide eye-level signage	Tactile labels Appropriate font size Contrasting signage	Visual display directions	Symbol direction Contrasting signage Appropriate font size	Symbol direction
Ticket booth	Locate in the immediate area	Locate in the immediate area Provide enough front or side reach	Audible instructions and tactile labels. Locate in the immediate area Provide enough front or side reach	Locate in the immediate area Contrasting information label	Audible instructions Locate in the immediate area	Simple step displays Locate in the immediate area
Platform	N/A	Wheelchair pad Minimize gap between Platform and vehicle's door	Provide a warning strip	N/A	N/A	N/A
Bench	Provide enough benches when waiting time is >15 min	Provide enough seats for non-wheelchair users	Provide guidance to benches	Provide enough benches when waiting time is >15 min	Provide enough benches when waiting time is >15 min	Provide enough benches when waiting time is >15 min
Shelter	Provide leaning rail	Provide area for wheelchair/scooter	Provide guidance to shelter	Provide leaning rail	Provide leaning rail	Provide leaning rail

## Determination of the Minimum Design Criteria and Guidance

Station area design must address all accessibility issues faced by each user group as they access and egress stations. There are numerous authoritative design guidelines published by different entities ranging from federal agencies to local authorities. Minimum criteria and recommended practice can be found in these guidelines. In addition to the existing design guidelines, the process of developing transit station design guidelines should utilize the lessons learned and best practices from past experiences. Equally important, the process should involve engineering judgment based on the principles of science and engineering.

**Consult Existing Guidelines for Specific Features.** There are many existing guidelines prepared by agencies ranging from federal to local jurisdictions. Most of these guidelines are not exclusively transit related but contain clauses and components which need to be adhered to by the design of transit systems. Some of the nationally recognized documents which could be used in developing transit station design criteria and guidelines are discussed next.

Several federal agencies have established guidelines that are often referenced in the design of transit stations. One of the most popular guidelines used is the Americans with Disabilities Act Accessibility Guidelines (ADAAG) for Buildings and Facilities (1994). This report contains technical requirements for accessibility to buildings and facilities with disabilities under the Americans with Disabilities Act (ADA) of 1990. The ADA guidelines are applied in the design, construction, and alteration of facilities. A handbook entitled Accessibility Handbook for Transit Facilities was prepared by the Federal Transit Administration (FTA) in 1992. This handbook provides detailed information to help transit designers and planners to construct and renovate transit facilities so that they are accessible to individuals with disabilities of all types including mobility impairments requiring the use of a wheelchair. This handbook also provides facility accessibility checklists to facilitate compliance with the disabilities act.

The American Association of State Highway and Transportation Officials (AASHTO) has published several guidelines that are used to determine minimum design criteria for intermodal and other highway facilities. AASHTO guidelines include A Policy on Geometric Design of Highways and Streets (2004); AASHTO Guide for Park-and-ride Facilities (2004); and AASHTO Guide for the Planning, Design, and Operation of Pedestrian Facilities (2004). The AASHTO Policy on Geometric Design of Highways and Streets (commonly known as the AASHTO green book) documents the minimum criteria for the design of pedestrian and bicycle facilities such as sidewalks, pedestrian storage islands in intersection medians, and pedestrian signals. It also reports the minimum design criteria for other modes of transportation such as buses, taxis, etc, used in the engineering practice. The AASHTO Guide for Park-and-ride Facilities provides necessary information for the design of parking facilities including minimum criteria necessary for circulation and accessibility. The AASHTO Guide for the Planning, Design, and Operation of Pedestrian Facilities provides guidance on planning, designing, and operations of pedestrian facilities along highways and streets. The manual's primary focus is to provide guidance on how pedestrians can best be accommodated on public right-of-way. It also provides minimum design criteria for accessibility of pedestrian facilities.

The Highway Capacity Manual (HCM) (2000) and its companion the Transit Capacity and Quality of Service Manual (TCQSM) (2003), both published by the Transportation Research Board, are another set of nationally recognized manuals. While the HCM was specifically prepared to provide methods for evaluating quality of service for roadway, pedestrian, and bicycle facilities, the TCQSM is aimed at assisting transportation practitioners to have a consistent set of techniques for evaluating the required capacity and quality of transit services, facilities, and systems.

The Manual of Uniform Traffic Control Devices for Streets and Highways (MUTCD) (2003) published by the Federal Highway Administration defines the standards used to install and maintain traffic control devices on all streets and highways. The research sponsored by the Transit

Cooperative Research Program (TCRP) produced the Guidelines for Transit Facility Signing and Graphics (1996), also known as TCRP Report 12. The report describes the use of signs and symbols that provide for the safe and efficient movement of passengers to and through transit facilities. The general format of the report was developed to lead transit providers through the entire process from wayfinding design to actual installation of the signs. Several versions of common symbols in English, Spanish, French, German, Italian, Korean, and Chinese are listed in the report. The report further discusses the ability of symbols to communicate meaning in various languages.

Apart from the federal agencies, nationwide transit providers such as Amtrak and Greyhound have established guidelines for the design of their station facilities. Amtrak, which stands for “American” and “track,” is operated by the National Railroad Passenger Cooperation and provides intercity passenger transportation service. The Amtrak Station Manual (2001) has standards and guidelines for pedestrian access and circulation, vehicular access and circulation, and train information signage, among other station features. Some stations have connections to intercity bus transportation. Greyhound Lines Inc. is the largest provider of intercity bus transportation across North America. Greyhound guidelines (2004), also known as sizing documents, provide guidance on geometric features necessary to accommodate Greyhound buses, passenger accessibility, and bus terminal survey forms to ensure compliance to design standards.

**Employ Best Practices and Lessons Learned.** Best practices and lessons learned have been documented by numerous studies. While best practices would identify recommended practices, lessons learned would provide information on practices that need to be avoided based on past experience. For example, the study that was performed by Spillar (1997) recommended that it is important for the loading bay to be perpendicular to the parking lot to motivate good usage of available walkways and prevent the tendency of pedestrians to take shortcuts. The study that was performed to establish the Guide for the Design of Park-and-Ride Facilities (2004) recommended a raised pedestrian path above the driving surface because, apart from delineating a pedestrian crosswalk, it also acts as a speed hump.

**Use Engineering Knowledge.** The use of established guidelines and best practices should be complemented by a sound engineering knowledge. One example where the engineering knowledge could be used is on setting the maximum walking distance to the parking lot. For example, according to O’Sullivan and Morrall (1996), the general walking distance guideline is that the person will walk a maximum of about five minutes to reach the bus stop at light-rail transit stations. An average pedestrian walking speed of 4 feet per second is typically used for designing roadway facilities (HCM 2000; MUTCD 2003; AASTHO 2004). A walking speed of three feet per second is commonly used for the elderly population. Using engineering knowledge and equations of motion, these recommended design speeds with the general guideline of five minutes would result in a maximum walking distance of about 900 to 1,200 feet. Engineering knowledge of traffic conflicts and human factors in engineering design could also be used in providing guidelines of transit station facilities.

### **Provide Minimum Design Criteria/Guidelines for Each Specific Feature**

Design criteria and guidelines can be presented in a variable formats. The Design Handbook for Florida Bus Passenger Facilities (2004), for example, presents design guidelines by describing three design elements – 1) purpose, 2) location factors, and 3) design factors. In contrast, the Federal Highway Administration (FHWA) Pedestrian Road Safety Audit Guidelines and Prompt Lists (2007) uses prompt lists to provide guidance on the pedestrian road safety audit process. For each particular prompt, a detailed description of each prompt is given followed by the road safety audit example. The detailed description of the prompts includes 1) problem description to include situations where issues arise and potential specific consequences, 2) special considerations for the

road safety audit team, and 3) photographs illustrating the problem. Other agencies, such as the Easter Seals Project Action (2008), uses a compliance checklist to ensure adherence to the design minimum criteria. Conversely, other guidelines, such as the British Columbia Municipal Systems Program Design Guidelines for Accessible Bus Stops (2007), lists design guidelines in point format. The British Columbia guidelines present the minimum criteria in bolded font while other guidelines are presented in normal font.

## CONCLUSIONS AND RECOMMENDATIONS

Transit stations are locations where transit passengers change modes from transit to other modes of transportation including pedestrian, bicycling, automobile, and other transit modes. If transit stations are not well-designed, the interaction between different modes may pose safety concerns. Additionally, poor connections of modes at the stations may result in inefficient station operation and undesirable service which may hinder patrons from using transit systems. The safe and efficient movement of passengers to and from the train to other modes of transportation is of paramount importance to transportation officials. Transit stations are the primary interfaces for passengers with the transit system. Adopting a station design criteria and guidelines which focus on seamless movement of passengers as they change their modes of transportation at the station would help accomplish safe and efficient movement of passengers as they access and egress the station area.

This paper has presented a procedure which can be used in developing the transit station design criteria and guidelines which focuses on intermodal connectivity. The procedure proposed in this paper is inclusive of all user groups, including people with disabilities. The proposed process will be a valuable resource to planners, engineers, and other transportation officials responsible for developing guidelines and criteria used for evaluating new and existing designs of transit stations.

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