

# Guidelines for Bus Transit Stops in Highway Construction Work Zones

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## **DISCLAIMER**

The opinions, findings, and conclusions expressed in this publication are those of the authors and not necessarily those of the State of Florida Department of Transportation.

Prepared in cooperation with the State of Florida Department of Transportation.

## UNITS CONVERSION CHART

SYMBOL	WHEN YOU KNOW	MULTIPLY BY	TO FIND	SYMBOL
<b>LENGTH</b>				
<b>in</b>	inches	25.4	millimeters	mm
<b>ft</b>	feet	0.305	meters	m
<b>yd</b>	yards	0.914	meters	m
<b>mi</b>	miles	1.61	kilometers	km
<b>mm</b>	millimeters	0.039	inches	in
<b>m</b>	meters	3.28	feet	ft
<b>m</b>	meters	1.09	yards	yd
<b>km</b>	kilometers	0.621	miles	mi
SYMBOL	WHEN YOU KNOW	MULTIPLY BY	TO FIND	SYMBOL
<b>AREA</b>				
<b>in<sup>2</sup></b>	square inches	645.2	square millimeters	mm <sup>2</sup>
<b>ft<sup>2</sup></b>	square feet	0.093	square meters	m <sup>2</sup>
<b>yd<sup>2</sup></b>	square yard	0.836	square meters	m <sup>2</sup>
<b>ac</b>	acres	0.405	hectares	ha
<b>mi<sup>2</sup></b>	square miles	2.59	square kilometers	km <sup>2</sup>
<b>mm<sup>2</sup></b>	square millimeters	0.0016	square inches	in <sup>2</sup>
<b>m<sup>2</sup></b>	square meters	10.764	square feet	ft <sup>2</sup>
<b>m<sup>2</sup></b>	square meters	1.195	square yards	yd <sup>2</sup>
<b>ha</b>	hectares	2.47	acres	ac
<b>km<sup>2</sup></b>	square kilometers	0.386	square miles	mi <sup>2</sup>
SYMBOL	WHEN YOU KNOW	MULTIPLY BY	TO FIND	SYMBOL
<b>VOLUME</b>				
<b>fl oz</b>	fluid ounces	29.57	milliliters	mL
<b>gal</b>	gallons	3.785	liters	L
<b>ft<sup>3</sup></b>	cubic feet	0.028	cubic meters	m <sup>3</sup>
<b>yd<sup>3</sup></b>	cubic yards	0.765	cubic meters	m <sup>3</sup>
<b>mL</b>	milliliters	0.034	fluid ounces	fl oz
<b>L</b>	liters	0.264	gallons	gal
<b>m<sup>3</sup></b>	cubic meters	35.314	cubic feet	ft <sup>3</sup>
<b>m<sup>3</sup></b>	cubic meters	1.307	cubic yards	yd <sup>3</sup>
<b>NOTE:</b> volumes greater than 1000 L shall be shown in m <sup>3</sup>				

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## EXECUTIVE SUMMARY

Fixed route transit systems provide a valuable transportation service for many of our citizens. Users depend on bus transit for access to the essentials of life such as school and work. Therefore, maintaining transit service is a critical and important issue. Given the extent of nationwide bus transit systems and high level of highway construction activities, it is common to find highway construction work areas encompassing and impacting established bus stop locations, which creates safety and mobility concerns for workers, pedestrians, and transit riders.

The research team reviewed enormous amounts of information relevant to bus stops in construction zones, which included information from national and state standards, guidelines, and reports. And although there is a large amount of information available for construction work zones, only a limited amount of information is available for safely managing bus stops and transit riders while construction is underway. There are many elements missing in the existing literature, which makes it difficult for transit agencies to fully address the accessibility and safety issues of transit stops during the Maintenance of Traffic (MOT) process.

The objective of this study is to develop guidelines/recommendations for managing transit stops during adjacent highway construction operations, with a focus on workers, transit riders, and pedestrian safety. These guidelines will serve as a planning/design tool and construction guide for the MOT coordination for transit agencies, highway design engineers, and construction managers.

This report provides an overview of the useful and best practices of transit stops during construction, based on a literature review, interviews/surveys, and case studies. It takes into consideration the efficient and safe access to bus stops, which includes a number of topics, but is not limited to the following:

- Bus stop and route considerations in developing MOT designs
- Identified processes and opportunities for communications and coordination between the transit agency and the construction project team and bus customers
- Construction considerations that deal with the safety and accessibility of transit riders
- Bus stop relocation and configuration during construction, including Americans with Disabilities Act (ADA) aspects
- Intelligent Transportation Systems (ITS) technologies for providing information, monitoring traffic, and managing mobility and safety during road construction
- Case studies and surveys

There are several national and state standards currently being used in design plans that attempt to make work zone environments safer for pedestrians, but are not necessarily accessible for transit use. The most commonly used documents are:

- FHWA<sup>1</sup> Manual on Uniform Traffic Control Devices for Streets and Highways (MUTCD)
- FHWA 23 CFR 630 Subpart J, Work Zone and Mobility
- ATSSA<sup>2</sup> “Applying the Americans with Disabilities Act in Work Zones: A Practitioner Guide”
- FHWA “Final Rule on Work Zones Safety and Mobility”
- USDOT<sup>3</sup> ADA Standards for Transportation Facilities (ADAS)
- FDOT<sup>4</sup> “Accessing Transit Design Handbook”
- FDOT “Plans Preparation Manual”
- FDOT “Design Standards,” Indexes 600 and 660
- FDOT “Manual for Uniform Minimum Standards for Design, Construction, and Maintenance for Streets and Highways,” commonly known as the “Florida Greenbook”

In terms of safety and mobility, the Manual on Uniform Traffic Control Devices (MUTCD) is one of the main standard documents used for pedestrian safety in work zone areas. The main purpose of the work zone traffic control standards and guidelines is to ensure that the safety of the driver, worker, and pedestrian are all taken into account; however, no standards have been specifically created for transit stops in construction zones. For that reason, informative standards and provisions for future work zone traffic control for transit stops needs to be addressed, which is a challenge for most.

The American Traffic Safety Services Association (ATSSA, 2012) has developed a guideline titled *Applying the Americans with Disabilities Act in Work Zones: A Practitioner Guide*, which combines different state standards and condenses them into a helpful tool for accommodating disabled patrons in work zones. However, it does not address all of the transit bus stop issues that are presented in this report.

Currently, the main mechanism for communicating transit needs during construction is handled by the Temporary Traffic Control (TTC) Plans drawings and notes. The TTC plans details the proper separation of traffic through work zones during the construction period. It indicates that construction zone bus stops should have the three (3) primary elements of passenger protection, which are:

- A bus stop loading area providing ample space for loading and unloading passengers
- An adjacent area large enough at the curb line to provide a safe place for bus passengers to wait outside of the loading area

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<sup>1</sup> Federal Highway Administration

<sup>2</sup> American Traffic Safety Services Association

<sup>3</sup> United States Department of Transportation

<sup>4</sup> Florida Department of Transportation

- An accessible sidewalk or pedestrian path that connects the bus stop that provides a clear pedestrian path to and from the bus stop area

Further, TTC plan sheets shall be required when project conditions are not specifically addressed in a typical layout from the Manual on Uniform Traffic Control Devices (MUTCD) or the Design Standards, Series 600. Engineers should follow this process when preparing TTC documents, drawings, and notes, as follows:

- Consider transit and bicycle/pedestrian needs during construction.
- Maintain transit operations.
- Check the condition of any proposed detour routes. If the detour route is not on the state system, additional documentation of the agreements with local agencies will be required.
- Design should prevent or minimize interruption of local transit operations.
- Examine alternatives, which should meet objectives. Consider detour/transition locations, signal operations during construction, how to handle buses, bicycles, pedestrians, service vehicles, etc.
- Develop a detailed TTC Plan, as existing operations need to be maintained. The plan needs to consider side streets, businesses, residents, bikes, pedestrians, buses, bus stops, etc.

As construction may require a temporary disruption or relocation of bus stops for the proper continuity of services, all areas surrounding bus stops should be clearly identified for inclusion in the project development. The operating concerns of the transit agency need to be considered when choosing a safe location that conforms to the temporary access to and from bus stops in construction areas. The roadways that are available to accommodate bus service have different configurations. The many factors that influence each bus stop are usually examined on a case-by-case basis. It is important to note that bus riders need to have safe access to the bus stops in the construction zones. Pedestrians should be directed through temporary access routes by the use of signs and other way-finding devices, giving them a safe path through or around the work zone.

During construction work, maintaining safe transit operations should be the result of preparation rather than afterthought. Safety is the number one consideration, which requires agency coordination and the project-approved TTC Plan. Transit agencies need to be able to continue operating as efficiently as possible by considering how existing operations will be maintained. Further, transit service needs to be provided with safe access to and from bus stops. Consideration must be given on how to handle buses in the new detours and how to handle guidance and access to the bus stops for all pedestrians during construction.

Bus stop considerations are very crucial for the efficient planning and operations process of transit service during construction. They include the following: Agency coordination, pedestrian access, bus stop relocation, drainage issues, bus stop and customer information, ITS technologies, and

costs. TTC reports are the main mechanism used for communicating transit needs during construction, which describes how traffic will be controlled through a construction work zone. Early coordination with transit agencies can help address cost issues associated with bus stops, transit service, transit riders, and most importantly, accessibility and safety issues. Site conditions, location, and other elements during the construction process can result in cost variations.

The research team interviewed several MOT professionals in Florida, which focused strictly on the safety and accessibility of transit users at transit stops in construction zones. They evaluated the results and concluded that most federal and state guidelines are not being followed. Participants have their own outlook on handling or managing the maintenance of traffic projects, which is what the research team observed during three Florida site visits in Tampa, Jacksonville, and Palm Beach. Most of the construction sites were unacceptable in terms of safety and accessibility. There were temporary disruptions in service or relocation of bus stop locations, which is why there is a need for guidelines or regulations on managing bus stops during the highway construction of such activities.

Pedestrian access needs to be clearly designed so that it can provide a safe environment on a smooth and well-marked travel path. The level of accessibility needed for pedestrians in the TTC zone can be identified by observing existing pedestrian travel patterns prior to the start of any construction project. Better coordination and cooperation among multiple agencies is necessary, as well as the use of ITS technologies to monitor traffic and manage mobility and safety. Lastly, construction projects should include all costs involved in maintaining passenger access to temporary bus stops within the project limits.

A summary of the observations from the site visits are presented below:

- Transit agencies should work closely with local and state jurisdictions whenever road construction affects the operation and safety of bus stops. As construction roadwork continues, information should be provided to the transit authorities to facilitate the implementation and use of newly relocated services. Good coordination must be maintained before and during construction.
- Pedestrians are not to be led into areas of conflict with work site vehicles or equipment by having to move through the construction site. Walkways leading to and from bus stop areas should be level, with a firm surface. When pedestrian movement is necessary through or around a work site, a separate usable footpath should be provided away from equipment, broken sidewalks, or pavement, material, and any work operations. Walkways and ramps need to be provided to accommodate passengers with special needs.
- There is a need to clearly delineate usable pedestrian travel paths. Pedestrians should be provided with a reasonably safe and accessible path that replicates, as nearly as possible, the most desirable characteristics of a sidewalk. Marked and properly designated

crosswalks with stop signals and warning signs will allow pedestrians to safely cross the roadway. FHWA guidelines state, “In most cases, marked cross walks are best used in combination with other treatments.” This indicates that each case should be carefully studied. A detailed engineering analysis can help determine the appropriate combination of treatments.

- The flag stop is a system that allows possible passengers to wait along the side of the road at other convenient locations that may not be designated for bus stops. Transit agencies allowing the use of flag stops develop specific policies for drivers and passengers for use in determining when and where it is safe to pick up or discharge passengers at those locations.
- A continuous handrail or pedestrian rail fence or a barrier wall needs to be provided around bus stops immediately adjacent to canals, steep slopes, drainage, dangerous drop offs, or conditions that affect the safety of the bus patrons.
- Visual obstructions that impair the ability of drivers to see the pedestrians at the bus stops should be avoided. Bus stop locations can impact the safety of pedestrians. High-visibility pedestrian warning signs will increase the driver’s awareness of pedestrians, especially in high-speed and volume areas where pedestrians may not be expected.

Based on the observations, the research team recommends the following:

- Communicate and coordinate with transit agencies to find a viable solution for maintaining safe access to bus stops during construction.
- Follow transit elements steps included in the FDOT TTC Plan Development Topic #625-000-007, which cover maintaining transit operations in the construction areas.
- Consider relocating bus stops when buses impede the traffic flow and when safety is questionable for bus riders.
- Provide enough room for boarding and alighting activities.
- Adequate lighting must be provided.
- Maintain adequate lane width, following FDOT standards.
- At bus stops, remove obstructions that impact the safe bus operation and the access of transit riders.
- Provide safe access to bus stops and buses for passengers with disabilities.
- Eliminate situations where transit passengers and pedestrians could be led into conflict with work site activities.
- Find the safest and closest location to bus stops.
- Protected passenger crosswalks need to be provided, depending on road conditions.
- Maintain good drainage conditions for accessible paths and bus stops.
- Consider using ITS technologies like closed circuit television cameras (CCTV), portable dynamic message sign (PDMS), detection devices for traffic queuing and construction zones, video monitoring stations, and telephone/web-based traveler information.

The recommendations above include information on coordination, techniques, ITS technologies, and recommended practices, which can be used to better manage transit stops during construction activities.

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## LIST OF ACRONYMS/ABBREVIATIONS

AASHTO	American Association of State Highway and Transportation Officials
ADA	Americans with Disabilities Act
ADAAG	Americans with Disabilities Act Accessibility Guidelines
APL	Approved Product List
ATSSA	American Traffic Safety Services Association
BCT	Broward County Transit
CCTV	Closed Circuit Television Cameras
DOT	Department of Transportation
FAC	Florida Administrative Code
FDOT	Florida Department of Transportation
FHWA	Federal Highway Administration
FTA	Federal Transit Administration
HART	Hillsborough Area Regional Transit
JTA	Jacksonville Transportation Authority
ITS	Intelligent Transportation Systems
MnDOT	Minnesota State Department of Transportation
MOT	Maintenance of Traffic
MUTCD	Manual on Uniform Traffic Control Devices
ODOT	Oregon Department of Transportation
PCMS	Portable Changeable Message Signs
PI	Public Information
PPM	Plans Preparation Manual
PROWAAC	Public Rights-of-Way Access Advisory Committee
PROWAG	Public Rights-of-Way Accessibility Guidelines
SWZ	Smart Work Zones
TCP	Traffic Control Plan
TCRP	Transit Cooperative Research Program
TMC	Traffic Management Center
TMP	Transportation Management Plan
TO	Transportation Operations
TPAR	Temporary Pedestrian Access Route
TRB	Transportation Research Board
TTC	Temporary Traffic Control
UAM	Utility Accommodation Manual
USDOT	United States Department of Transportation
WSDOT	Washington State Department of Transportation

# 1 INTRODUCTION

Work zones are areas with construction, maintenance, or utility work activities, which can be identified by the placement of temporary traffic control (TTC) devices that may include signs, channelization devices, barriers, pavement markings, and/or work vehicles with warning lights. A work zone extends from the first advance warning sign to the last sign indicating the end of the work zone. Work zones impact many facets of the transportation operation, such as the travel way, areas adjacent to the travel way, and public transit.

Work zone traffic control has attracted a lot of attention from state Departments of Transportation (state DOTs) over the past few years. According to the FHWA's 2014 National Work Zone Awareness Week Factsheet, approximately 10-15% of all work zone fatalities are non-motorized users such as pedestrians and bicyclists; the rest are motorists and their occupants.

Since the main focus of work zone traffic control is making work zone workers, pedestrians, and drivers aware of potential safety dangers, bus transit stops, which are an essential part of transit systems, should not be ignored. Fixed-route transit systems are important to ensure mobility within a community. Users depend on bus transit to access the essentials of life, such as employment, medical care, school, and other mobility needs. Therefore, maintaining safe access to transit service in a construction zone is a critical issue. Because transit users are at some point pedestrians, and pedestrians can be found everywhere, work zone provisions and standards must be addressed for the safety and usability of transit stops for pedestrians, including those with disabilities.

In terms of safety and mobility, the Manual on Uniform Traffic Control Devices (MUTCD, 2009) is the main standard document used for pedestrian safety in work zone areas. The main purpose of the work zone traffic control standards and guidelines in the MUTCD is to ensure that the safety of the driver, worker, and pedestrian are all taken into account; however, no standards were created specifically for transit stops. For that reason, informative standards and provisions for future work zone traffic control for transit stops are being addressed. Because work zones differ from project to project, the challenge to create a nationwide standard for work zones near transit stops has only been slightly addressed.

Until now, only the American Traffic Safety Services Association (ATSSA, 2012) has developed a document titled *Applying the Americans with Disabilities Act in Work Zones: A Practitioner Guide* for ADA patrons and work zones using the MUTCD and multiple state standards, including the Washington State Department of Transportation (WSDOT), the Florida State Department of Transportation (FDOT), and the Minnesota State Department of Transportation (MnDOT). The guidelines for ADA combines the different standards of each state and condenses them into a helpful tool to accommodate disabled patrons in work zones. However, it does not address all of the transit bus stop issues that are presented in this report.

## **2 RESEARCH PROBLEM STATEMENT**

Fixed-route transit systems provide a valuable transportation mode for many Americans. It connects people to jobs, education, and their communities. Therefore, maintaining transit service is a critical issue in America and will be even more critical as our nation grows to more than 400 million people (U.S. Census) in the following decades.

Given the extent of nationwide bus transit systems and high level of road construction activities, it is common to find construction work areas encompassing and impacting established bus stop locations, particularly in the urban areas. There are solutions to address this situation on a case-by-case basis. However, there is very little or no information available concerning best practices for safely managing bus stops and transit riders during construction at construction zones. Best practices for safety management are necessary in providing a safe environment in areas where construction workers and transportation modes may compete for common or adjacent space. Every reasonable effort should be made to reduce the risk of injury in these areas of potential conflict. Creating a safe and suitable environment for all pedestrians must be addressed in all phases of road construction.

### **3 RESEARCH PROPOSED**

A review of the literature was conducted and included national and state standards, related TRB materials, research reports, agency guidelines and handbooks, and other published articles. The most helpful sources for best practices were provided by experienced transit managers and experienced professionals that were involved in construction projects. The research team held discussions with these individuals to obtain their input. Literature review, discussions, surveys, and site visits were used to secure data and practices for this project.

The safe and efficient management of bus stops during highway construction requires coordination and cooperation between the transit agency and the construction organization during planning, design, and more importantly, at the start of construction and for each Maintenance of Traffic (MOT) change. Coordination among agencies is very important to ensure that adequate provisions are made for safe pedestrian access to transit stops during periods of roadway construction or maintenance. Careful consideration should be given to transit operations, and necessary arrangements should be made to minimize inconvenience to transit patrons. The need for agency coordination is further discussed. This cooperative approach is recognized and documented during the development of this study, requiring the research team to find solutions that satisfy the needs of all parties, which can lead to a better understanding of how everyone can work together to improve both transit services and highway construction schedules under the work zone environment.

## **4 OBJECTIVES AND GOALS**

This document is the final report and presents the best practices during the MOT process. The objective of this study is to develop guidelines, recommendations, and best practices addressing the full range of management and technical issues for managing transit stops during adjacent highway construction operations, with a focus on safety for transit patrons.

In order to achieve this goal, this project will serve as a planning tool and guide in the development of statewide design and construction standards for MOT plans which ensure safe access to transit during roadway construction. Additionally, estimated costs for transit stops during construction operations will be provided. This report contains information on coordination, techniques, and new technologies that may be used to improve the management of bus stops during periods of roadway construction or maintenance, as well as to ensure that adequate provisions are made for pedestrian safety.

### **4.1 METHODOLOGY**

This report includes a literature review of national and state standards, TRB materials, research reports, agency guidelines and handbooks, and other published articles. Interviews were also conducted with transit and construction professionals and site visits to locations where transit bus routes provided service through construction zones.

The focus of the interviews was to obtain feedback from professionals who are experienced in transit and construction projects. The research team and FDOT staff identified professionals to participate in this project, who were chosen based on their MOT and transit expertise. A group of ten professionals were contacted by email and phone and asked to fill out a survey questionnaire; seven contacts completed the survey. The survey included several questions that dealt with managing transit stops adjacent to construction zones, with emphasis on the safety and accessibility of transit customers. After collecting the interview responses, the research team summarized the results, as shown in Section 6. Also, see Appendix A and B with the survey questions and responses from each of the interviewed professionals. Appendix C presents a checklist that was prepared by the research team to assist with bus stop issues in highway construction work zones. The checklist can be used as a guideline for the different phases of the MOT work.

Three sites were selected to cover different areas in Florida and were based on the availability of current transit projects in construction zones. The selected sites provided typical conditions encountered with bus stops in work areas. Further, safety conditions should apply everywhere; however, pedestrian issues are more obvious in urban areas. The visits included transit agencies that are operating bus routes through construction zones to assess the management of stops during this process. The case studies were conducted in the cities of Tampa, Jacksonville, and Palm

Beach. Findings from these visits were obtained from each of the three construction sites and are shown in Section 7.

#### ***4.1.1 REPORT ORGANIZATION***

The first section of this report presents an introduction to this research project, the proposed research, the objectives, and the methodology. This is followed by a literature review in Section 5. Section 6 presents the interviews with the transit and construction professionals, as well as the interview results. Section 7 presents the case studies of the construction sites with operating transit routes. At the end, sections 8 and 9 summarize the key findings, conclusions, and recommendations. The synthesis contains three appendices: Survey Questionnaire (Appendix A), Survey Responses (Appendix B), and MOT Checklist (Appendix C).

## 5 LITERATURE REVIEW

This section includes a review of information relevant to bus stops in construction zones. It includes a review of national and state standards and guidelines, and it covers bus stop elements, as well as other key considerations that are relevant to bus stops in construction zones.

### 5.1 REVIEW OF FEDERAL AND STATE REGULATIONS

Several national and state standards are currently using design plans that attempt to make work zone environments safer for drivers and pedestrians, but do not necessarily consider accessibility and safety for transit use. The most commonly used documents are found in Table 5-1:

**Table 5-1: Federal and State Design Plans**

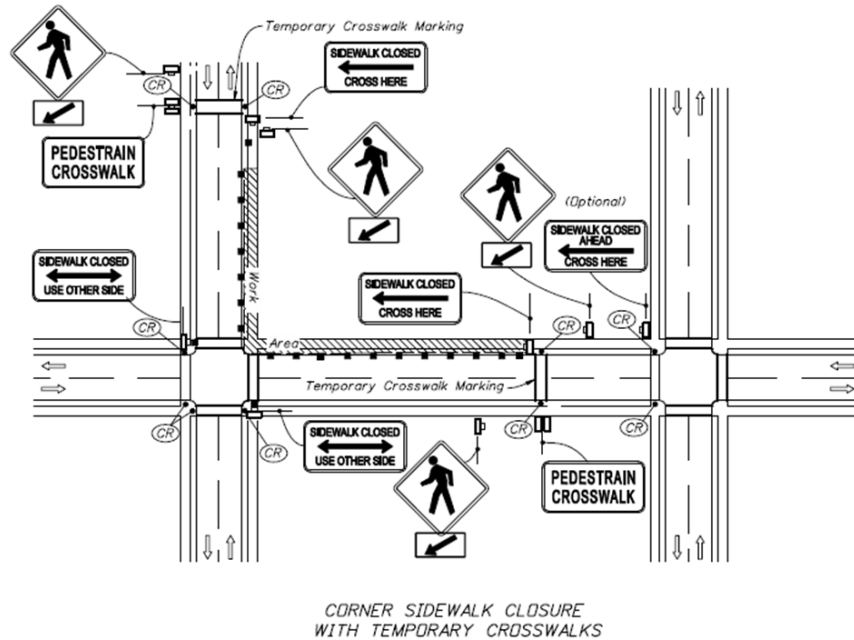
<b>Organization</b>	<b>Title</b>	<b>Year of Publication</b>
FHWA	Manual on Uniform Traffic Control Devices for Streets and Highways (MUTCD)	2009
FHWA	23 CFR 630 Subpart J, Work Zone and Mobility	2012
ATSSA	Applying the Americans with Disabilities Act in Work Zones: A Practitioner Guide	2012
FHWA	Final Rule on Work Zones Safety and Mobility	2012
USDOT	ADA Standards for Transportation Facilities (ADAS)	2006
FDOT	Accessing Transit Design Handbook	2013
FDOT	Plans Preparation Manual (Topic #625-000-007)	2014
FDOT	Design Standards, Indexes 600 & 660	2010
FDOT	Manual for Uniform Minimum Standards for Design, Construction and Maintenance for Streets and Highways, commonly known as the Florida Greenbook	2011

The following sections discuss the abovementioned documents that are currently used for work zone traffic control for pedestrians.

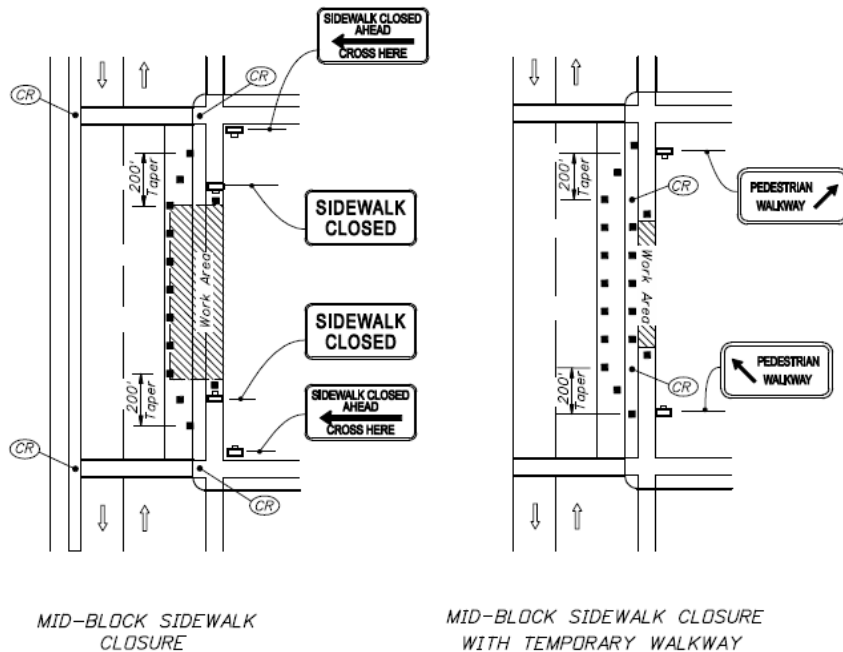
#### 5.1.1 STATE GUIDELINES AND STANDARDS

FDOT's Plans Preparation Manual (PPM) discusses general work zone facility standards, but only briefly covers the transit area. It mentions that transit facilities should remain operational during construction and that provisions should be made to guarantee that passengers have the ability to safely board and depart from transit vehicles. The manual also discusses the Temporary Traffic Control (TTC) Plan guidelines. The main focus of these considerations is that the pedestrians should not be in conflict with work zone or mainline traffic, and should be provided with a safe and convenient travel path that is in accordance with ADA and state standards (FDOT PPM, 2014).

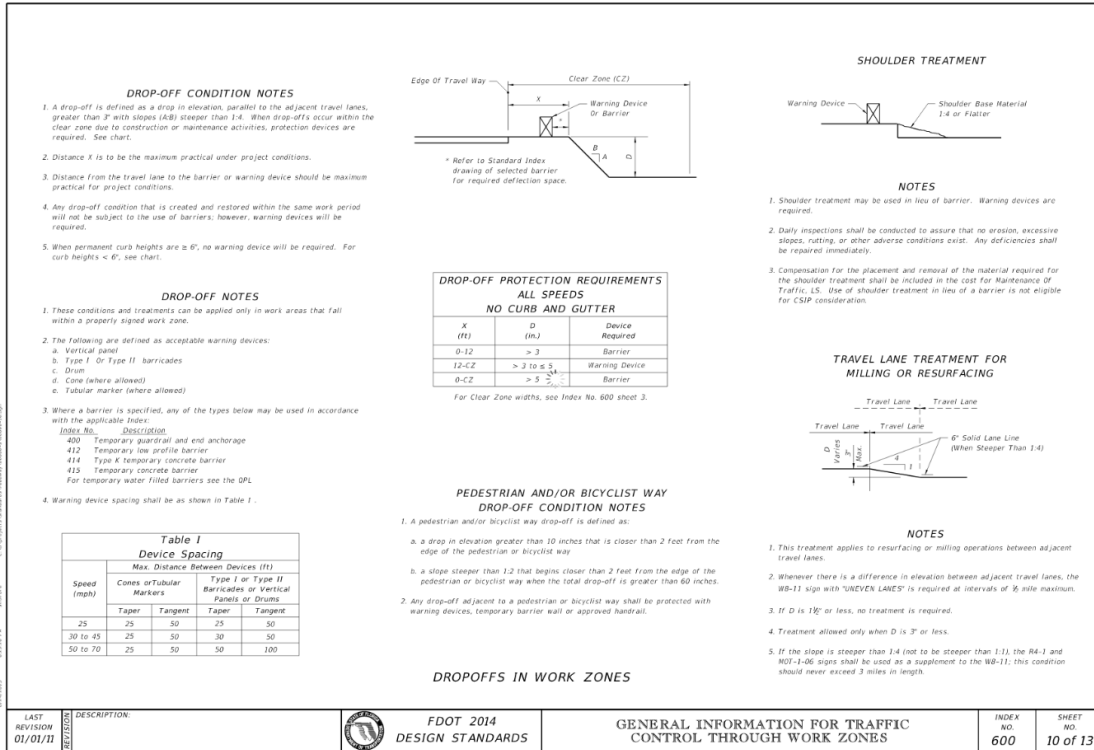
FDOT's Standard Index 660 shows typical layouts of pedestrian control for the closure of sidewalks. Figures 5-1 and 5-2 show examples of typical layouts for sidewalk closures with temporary crosswalks and general information for traffic control in work zones. Figure 5-3 shows general information for traffic control in work zones from the FDOT Design Standards.



**Figure 5-1: Corner Sidewalk Closure with Temporary Crosswalk (FDOT Design Standards, 2014)**



**Figure 5-2: Midblock Sidewalk Closure with Temporary Walkway (FDOT Design Standards, 2014)**



**Figure 5-3: General Information for Traffic Control in Work Zones (FDOT Design Standards, 2014)**

Many FDOT guidelines such as the Florida Greenbook (FDOT, 2011) and the abovementioned documents are available for the preparation and design of transit and pedestrian facilities, but they all lack the section on transit stops and work zones.

The 2013 *Accessing Transit Design Handbook for Florida Bus Passenger Facilities, Version 3* (FDOT, 2013) offers guidelines for improving the accessibility to buses and bus mobility, the bus passenger's experience, and offers guidelines for transit facilities. The handbook states that the TTC should be drafted with the following considerations in mind:

- Transit stops must accommodate passengers to be able to safely board and depart from the transit vehicle.
- Any traffic control devices must not block transit stops and passenger access to stops.
- ADA and transit operational requirements should be considered when designing detours.
- Signage and advanced notification to passengers should be provided if a bus stop or route is relocated.

The FDOT *Accessing Transit* handbook addresses transit and bus stop provisions during construction at a high level. Table 5-2 presents key issues for transit and bus stops during construction (FDOT, 2013).

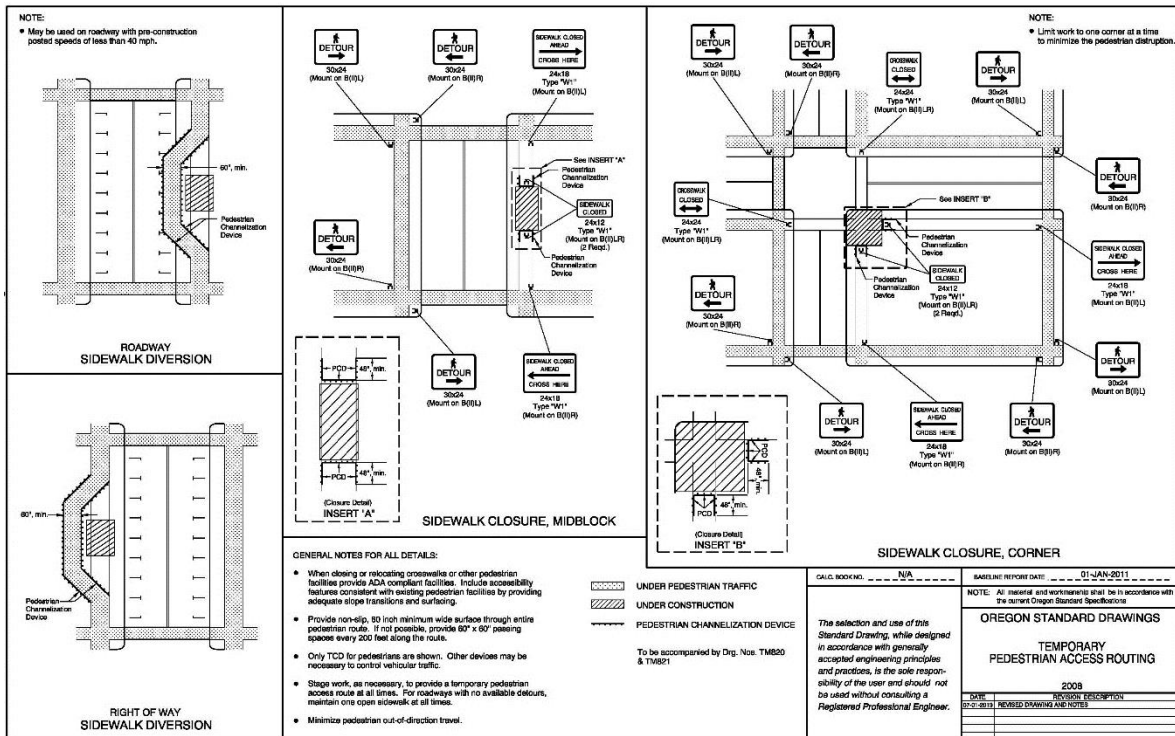
The Oregon Department of Transportation (ODOT) Traffic Plan Design Manual (2013) provides standard drawings for temporary pedestrian access routing. Figure 5-4 shows the standard drawings for sidewalk closures and diversions.

**Table 5-2: Transit and Bus Stop Provisions during Construction**

<b>Element</b>	<b>Specification/ Requirement</b>	<b>Resource</b>
Temporary Sidewalk	Minimum of 4 feet wide with a maximum of 2 percent cross-slope and a maximum of 5 percent running-slope between ramps	FDOT Design Standards, Index 660
Temporary Walkway	Less than 5' in width shall provide for a 5'-by-5' passing space at intervals, not to exceed 200'	FDOT Design Standards, Index 660
Temporary Walkway Surface and Ramps	Surfaces and ramps shall be stable, firm, and slip-resistant and kept free of any obstructions and hazards such as holes, debris, mud, construction equipment, and stored materials.	Accessing Transit Version 3 (2013)
Pedestrian Routes Blocked or Detoured	<p>Provide information on alternative routes that are usable by pedestrians with disabilities, particularly those who have visual disabilities.</p> <p>ADA prescribes that the level of accessibility existing prior to an alteration must not be reduced during the alteration.</p> <p>Alternative accessible routes and features must be provided during renovation projects.</p> <p>Proper use of signage and other pedestrian guidance methods are necessary to ensure that an accessible circulation path is maintained.</p>	Accessing Transit Version 3 (2013)
Access to Temporary Bus Stops	<p>This must be considered where temporary pedestrian routes are channelized.</p> <p>Barriers and channelizing devices that are detectable by people with visual disabilities should be provided.</p>	Accessing Transit Version 3 (2013)
Detours around Transit Stops	Applicable ADA requirements must be considered.	Accessing Transit Version 3 (2013)

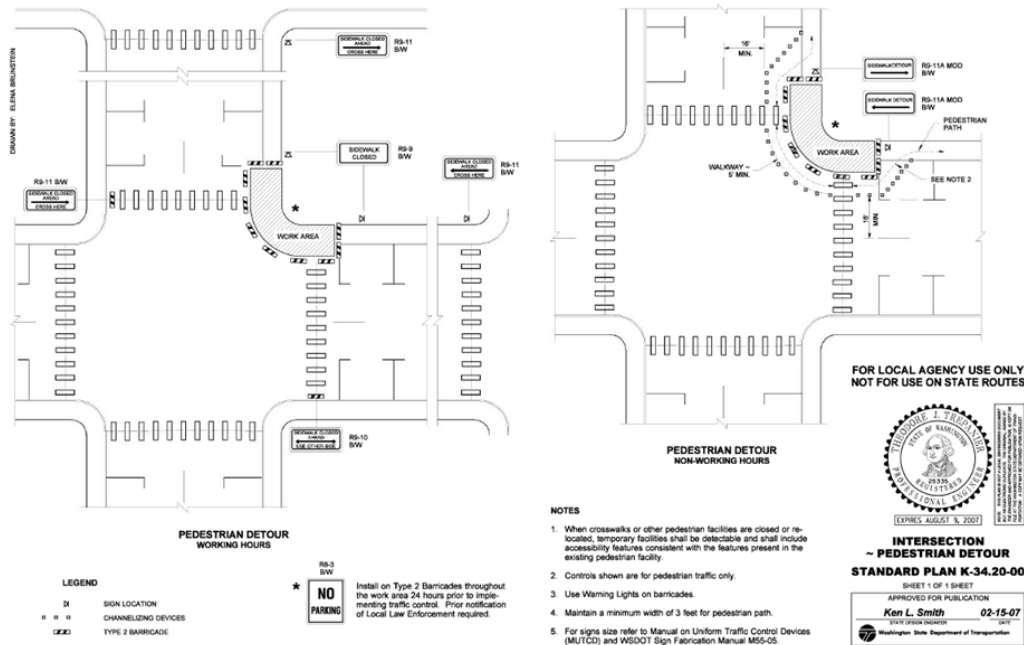
**Table 5-2, continued**

Transit Stop or Route needs to be Relocated	Appropriate signage and advance notification to passengers must be provided to maintain accessibility of the facility.	Accessing Transit Version 3 (2013)
Transit and Bus Stop Provisions during Construction	Additional Requirements, please refer to the design manuals.	MUTCD and FDOT Design Standards, Index 660
Temporary Ramps	Shall meet the requirements for curb ramps.	FDOT Design Standards, Index 304
Temporary Path	Measures are required to provide a temporary path anytime a vehicle, equipment, or workers or their activities encroach on a sidewalk for a period of more than 60 minutes.  If a barrier is constructed, it must be a detectable barrier to encourage compliance and communicate with pedestrians that a sidewalk is closed.	FDOT Design Standards, Index 660



**Figure 5-4: Temporary Pedestrian Access Routing (ODOT Traffic Plan Design Manual, 2014)**

Figure 5-5 provides basic provisions for pedestrian routing and shows the placement of the standard signage necessary for rerouting pedestrians. The Washington State Department of Transportation (WSDOT) has similar standards implemented in their design manual.



**Figure 5-5: Intersection Pedestrian Detour (WSDOT Standard Plans, 2012)**

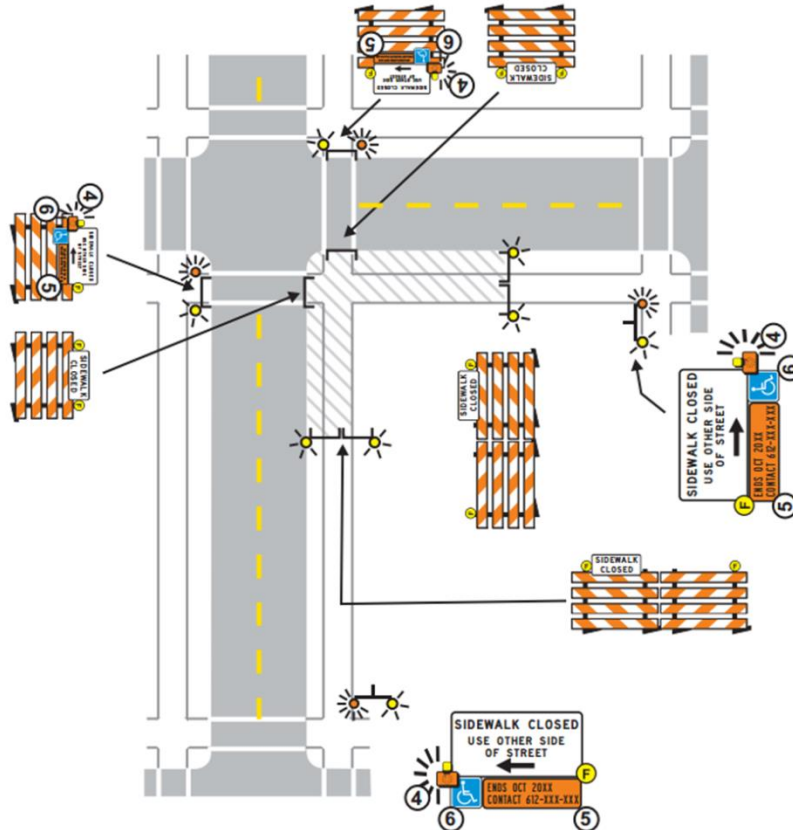
The MnDOT constructed their own version of the MUTCD, called the Minnesota Manual on Uniform Traffic Control Devices. This version has a field manual that contains more details relating to the specifications and special provisions of part 6 in the original MUTCD. This manual has typical layouts for different situations that can occur. Below are some typical notes from the Minnesota MUTCD (MnDOT Field Manual, 2011):

1. Temporary facilities must include accessibility features consistent with the ones present in the existing pedestrian facility that is being blocked or closed.
2. Show only traffic devices that relate to pedestrians.
3. Visually impaired pedestrians must be accommodated by using approved devices for providing tactile or audible messages.
4. Typical message sign for detours should include the duration of the closure and project contact number.
5. The International Symbol of Accessibility should recognize. Temporary Pedestrian Access

Routing (TPAR) compliant work zones.

6. Pedestrian signal controls must be covered for closed crosswalks.

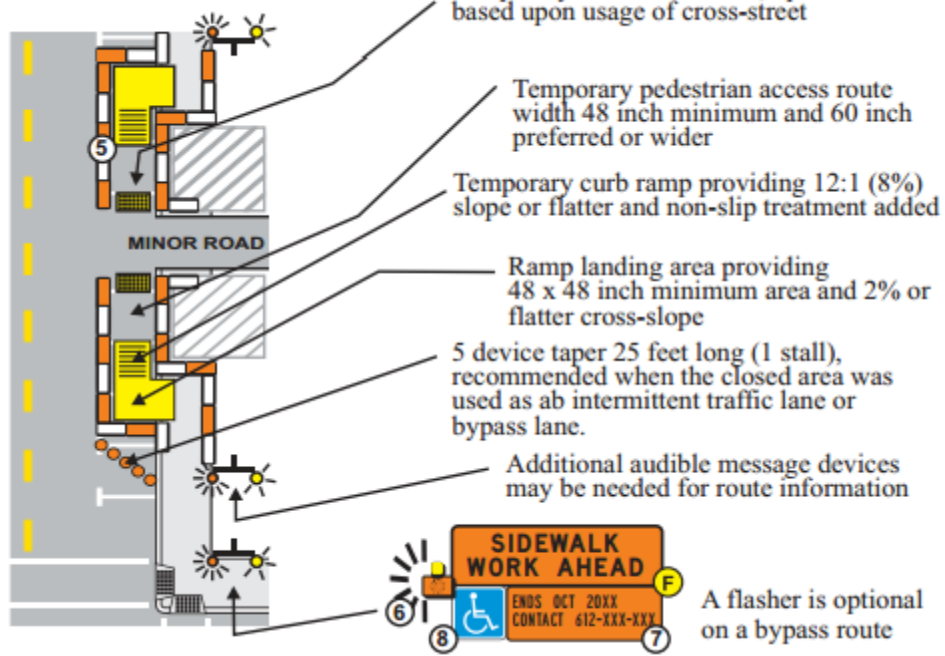
Figure 5-6, from the Minnesota State Department of Transportation (MnDOT), shows the typical layout for a crosswalk closure and pedestrian detours with typical dimensions and signage/barricade placement.



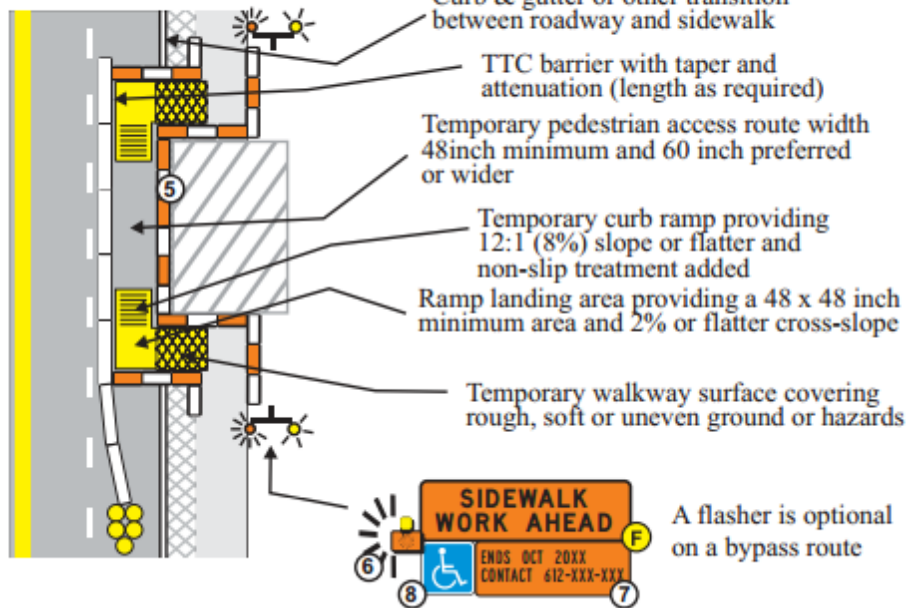
**Figure 5-6: Crosswalk Closure and Pedestrian Detour (MnDOT Field Manual, 2011)**

The Field Manual (MnDOT, 2011) also shows the typical layout for bypassing a sidewalk. Figure 5-7 provides a typical layout of a low-speed and high-speed sidewalk bypass. The layout shows the typical dimensions, cross slopes and additional information required according to MnDOT. In addition, it uses a specific barricade for the TPAR, which can be seen in Figure 5-8. The barricade has been modified for the temporary pedestrian access route.

**LOW-SPEED ROADWAY**



**HIGH-SPEED ROADWAY  
or  
LOW-SPEED MULTI-LANE**



**Figure 5-7: Side Walk Bypass (MnDOT Field Manual, 2011)**

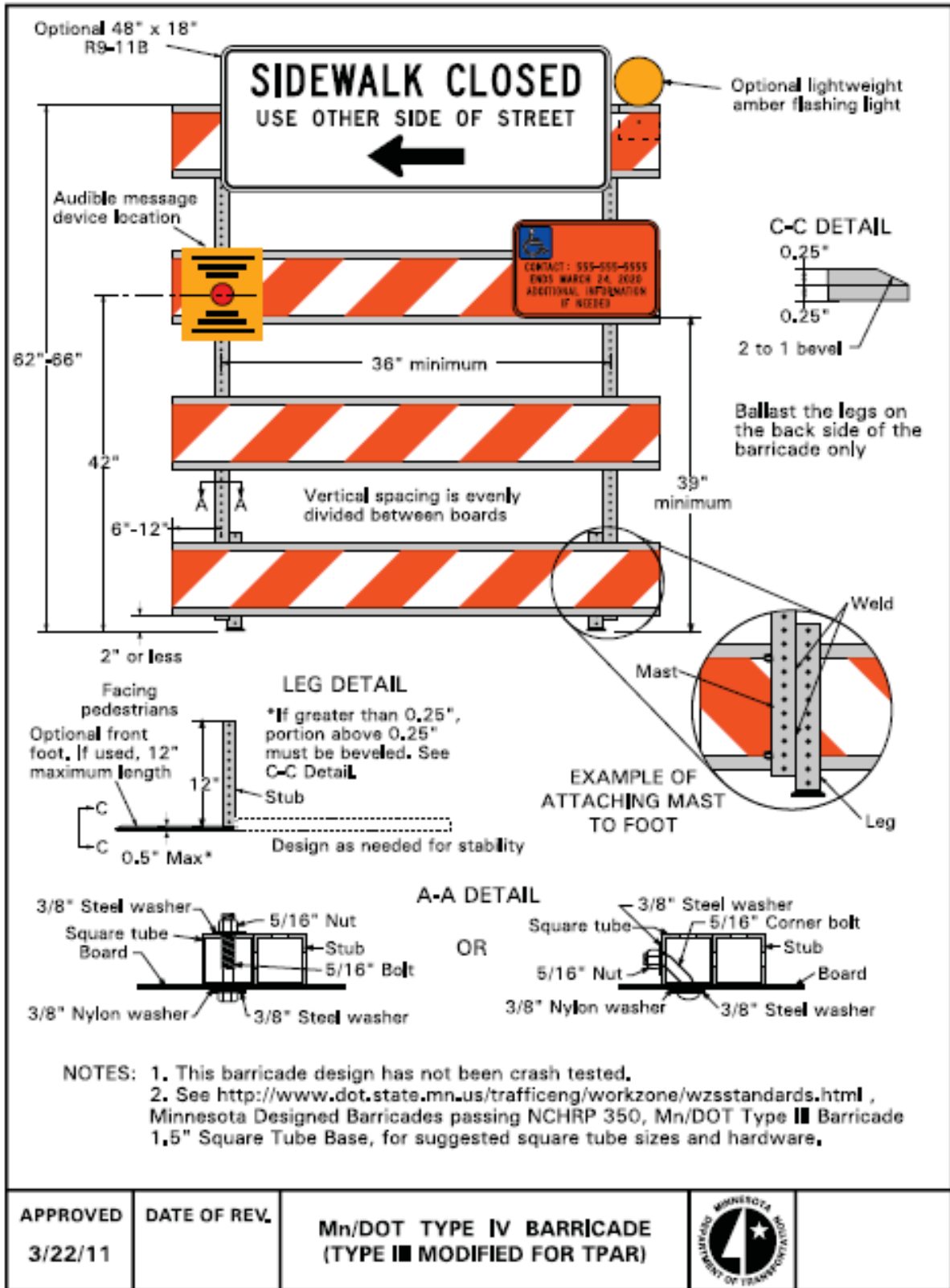


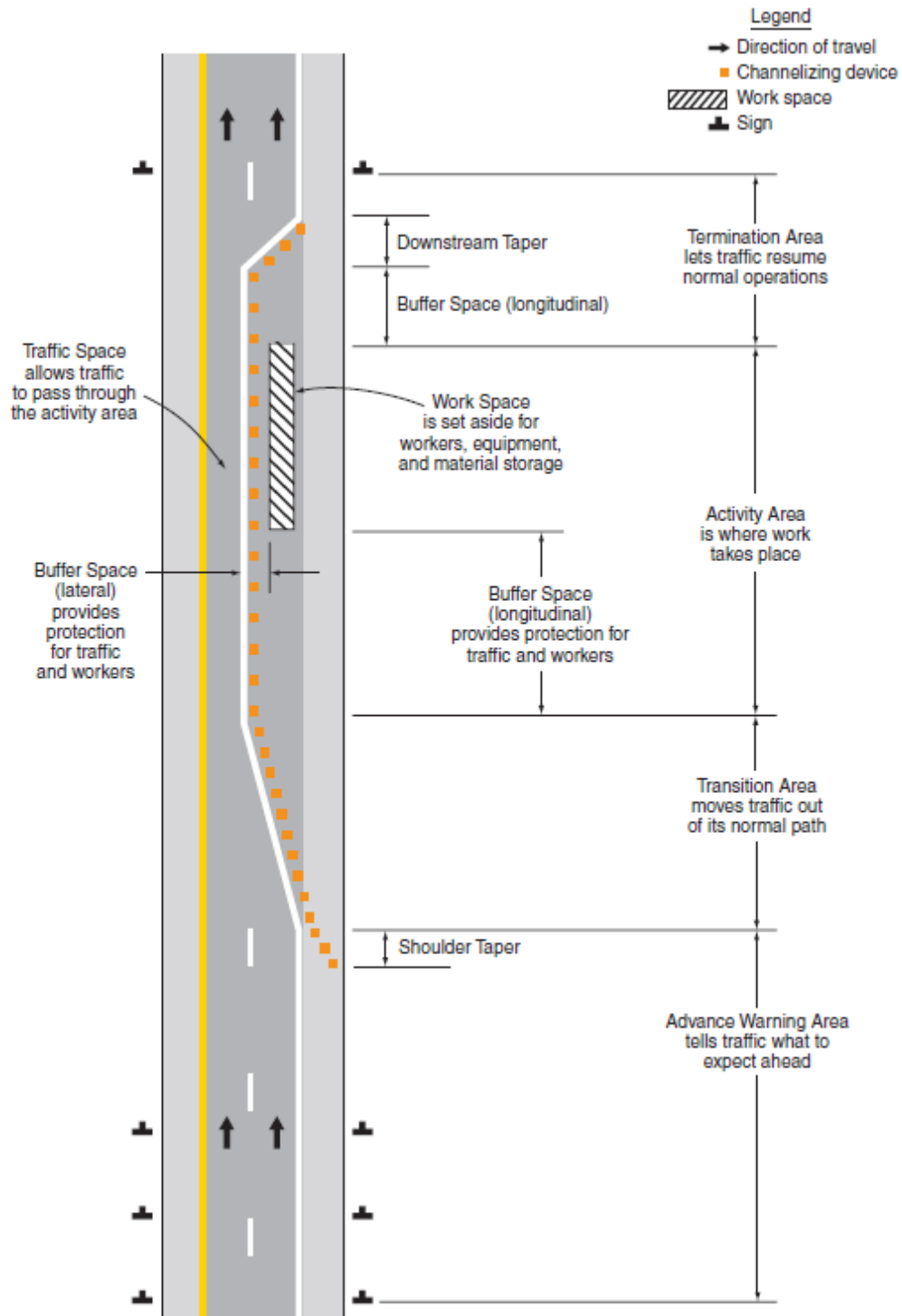
Figure 5-8: TPAR Modified Barricade (ATSSA, 2013)

Many DOT's, such as WSDOT, MnDOT, ODOT, and FDOT, for example, have similar standards for pedestrian detours and rerouting. However, none have specific standards for transit stop work zones or relocation of stops. The DOTs at the abovementioned states follow the MUTCD guidelines, as well as the 23 CFR 630 Subpart J, and Work Zone and Mobility guidelines to develop their standard drawings.

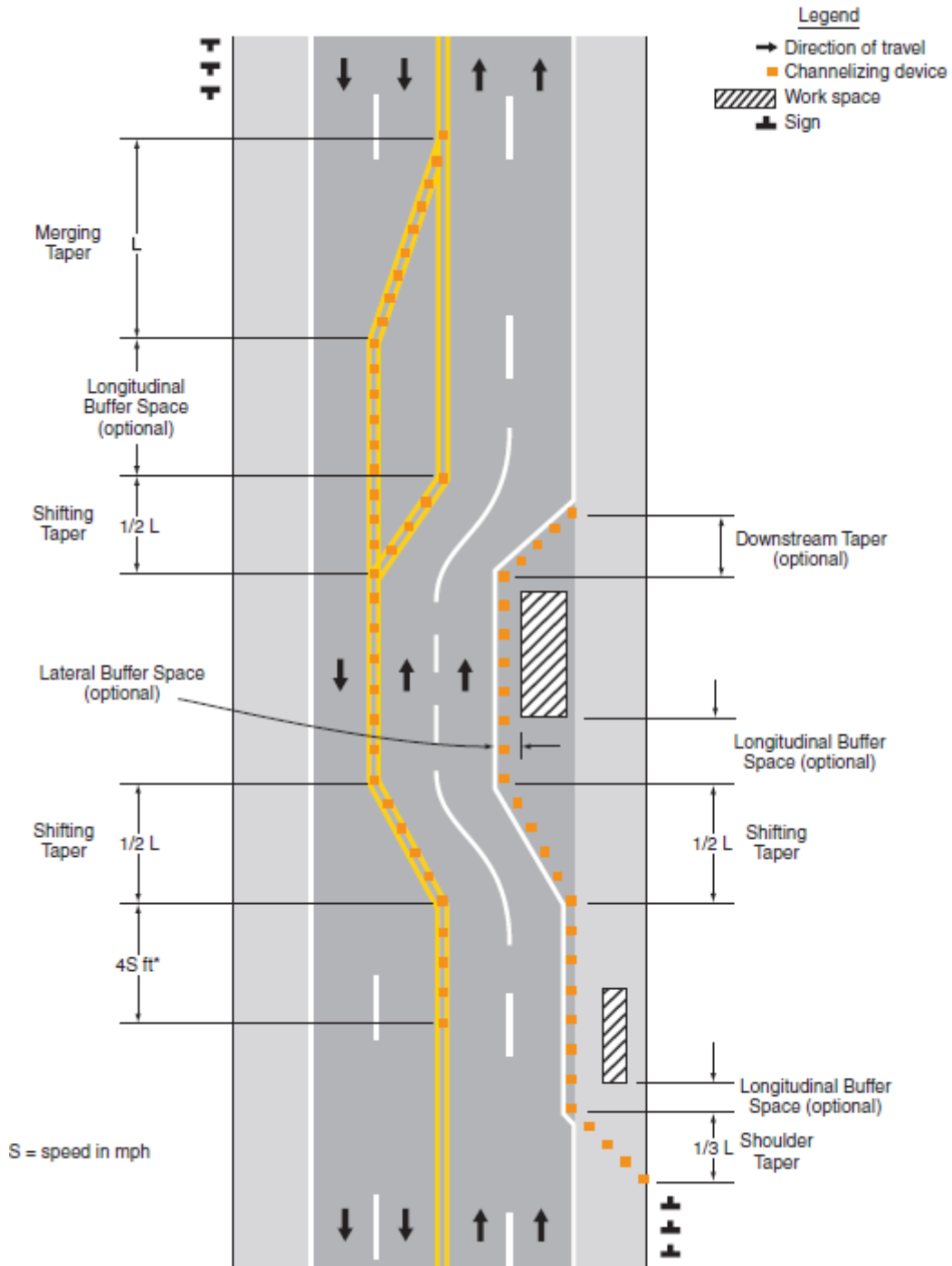
### **5.1.2 NATIONAL STANDARDS**

MUTCD part 6 provides options, support, and guidance for pedestrian safety and mobility. The main focus is to ensure that pedestrians are not placed in vulnerable situations or dangerous zones. The four main components of temporary traffic control zones are (as shown in Figures 5-9 and 5-10):

1. Advanced warning area: The area that informs road users of the upcoming work zone or incident area. A single sign or a series of high intensity signs may define this area.
2. Transition Area: The area that redirects road users from their normal path to a new path. This area involves the use of tapers, which are placed strategically to redirect the road user.
3. Activity Area: The area where the work is taking place. This area is usually delineated by temporary barriers, which are strategically placed to exclude vehicles and pedestrians from entering the work area. This area typically has a buffer space, which separates the road user from the workspace.
4. Termination Area: The area that returns road users to their normal path of travel. The termination area typically extends from the end of the work area to the last work zone sign.

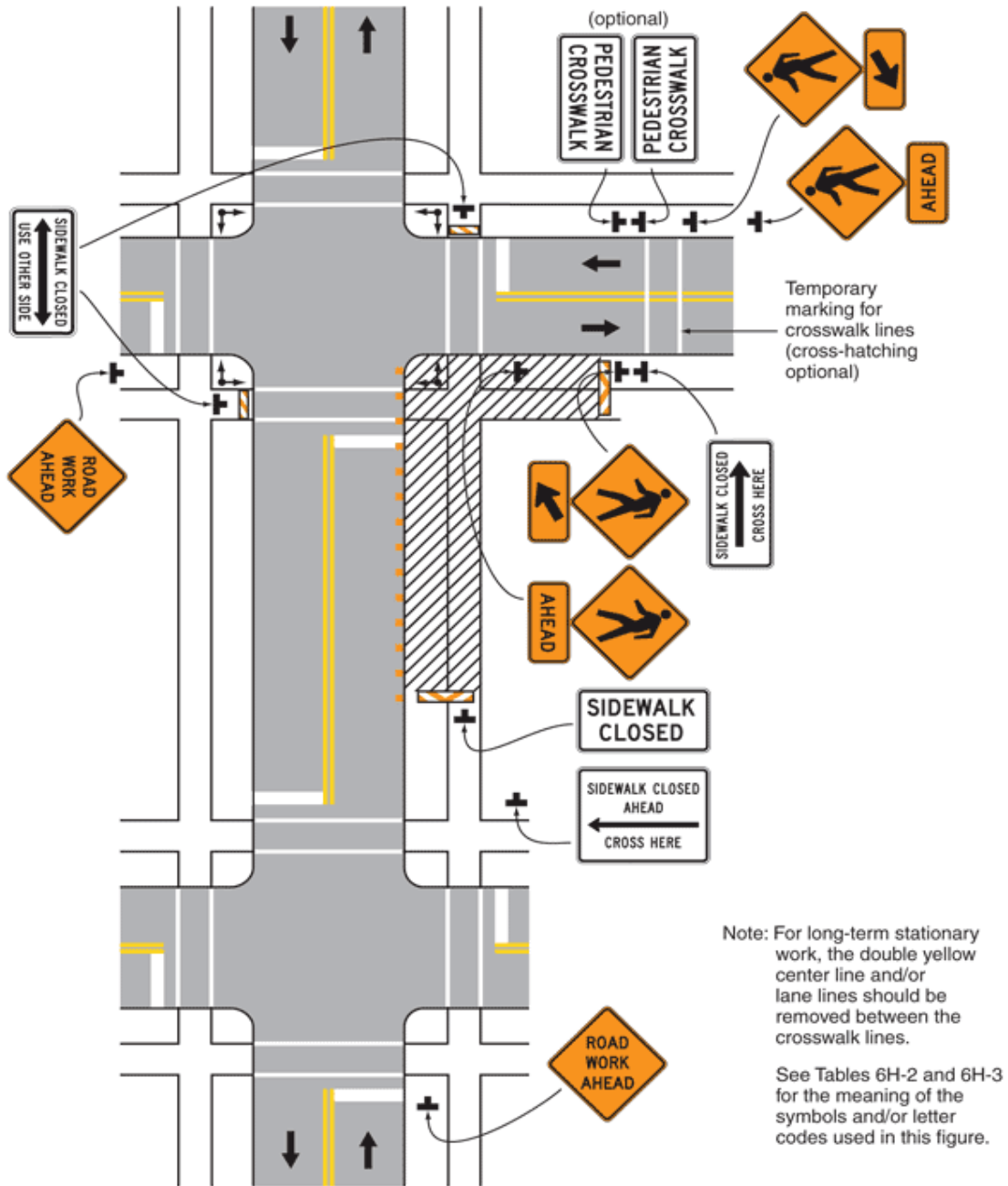


**Figure 5-9: Component Parts of a Temporary Traffic Control Zone (MUTCD, 2009)**



**Figure 5-10: Types of Tapers and Buffer Spaces (MUTCD, 2009)**

The MUTCD has typical applications and guidelines that are being followed by many state DOTs. Figure 5-11 shows an example of a typical application of a crosswalk closure and pedestrian detours.



**Figure 5-11: Midblock Sidewalk Closure with Temporary Walkway (MUTCD, 2009)**

A wide range of roadway users such as young, elderly, and disabled pedestrians may be affected during roadway construction. At some point, all transit users are pedestrians; these transit users will inevitably need to access a transit stop in a work zone. Transit facilities impacted by the work zones must be incorporated in the Temporary Traffic Control (TTC) Plan. It is necessary to maintain access to these facilities, as indicated in the TTC. When providing access to pedestrian facilities in a TTC, one of the most important factors that it must consider is safety. The road users (drivers, pedestrians, and workers) must be provided with safe conditions in order to use the

roadway during construction. Exposing pedestrians to stationary and/or moving equipment that is being used at the work zone should be avoided, and pedestrians should be kept at an acceptable distance away from roadway traffic. As indicated in the MUTCD, a smooth and well-marked travel path must be provided. If implemented, the alternate pedestrian pathway must be in accordance with the ADA Standards to accommodate those with disabilities.

The 2009 MUTCD states in Section 6C.01 (page 551):

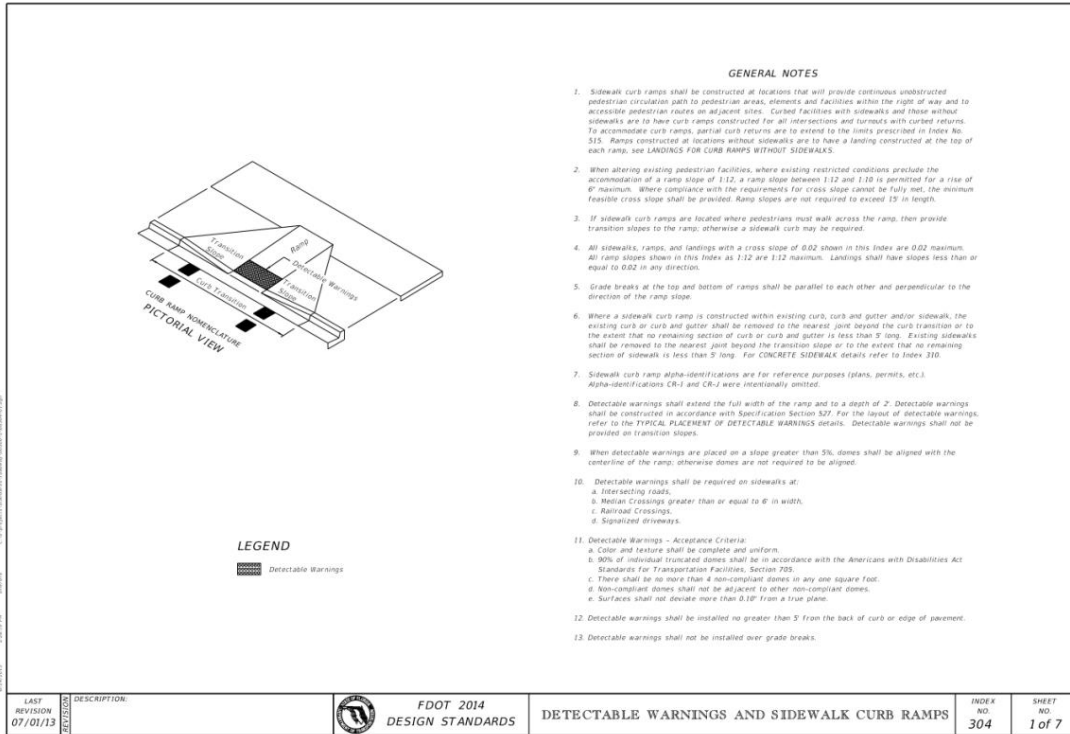
*“Provisions for effective continuity of accessible circulation paths for pedestrians should be incorporated into the TTC process. Where existing pedestrian routes are blocked or detoured, information should be provided about alternative routes that are useable by pedestrians with disabilities, particular those who have visual disabilities. Access to temporary bus stops, travel across intersections with accessible pedestrian signals, and other routing issues should be considered where temporary pedestrian routes are channelized. Barriers and channelizing devices that are detectable by people with visual disabilities should be provided.”*

Pedestrian paths should be free of obstacles that would impact pedestrian mobility. It is reported in the “Mobility for All: Accessible Transportation around the World” report authored by Tom Rickert that every year, tens of thousands of pedestrians are killed or become disabled around the world due to lack of or poorly designed pedestrian facilities. When providing alternate pedestrian routes/paths, the TTC must ensure that the path is free of traffic control devices, barriers, equipment, and drainage ditches. Alternate pedestrian facilities must be designed to improve access for persons with disabilities and making it more convenient for their use, per ADA guidelines.

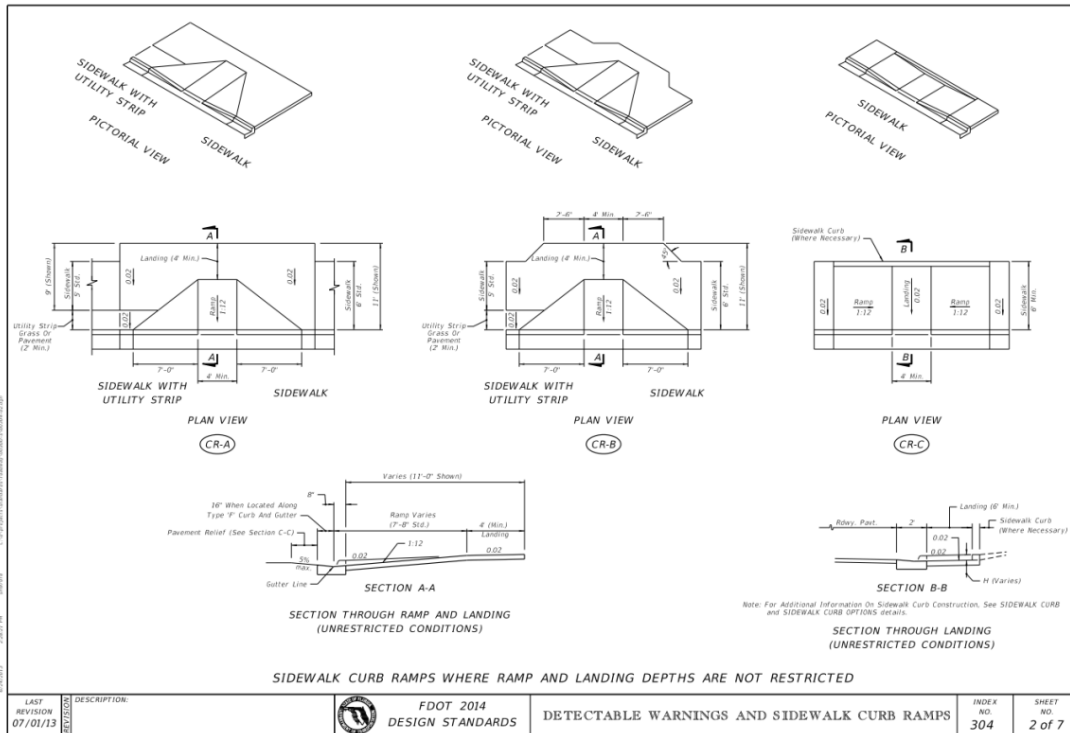
The Florida Greenbook noted that the width of a sidewalk is dependent upon the roadside environment, volume of pedestrians, and the presence of businesses, schools, parks, and other pedestrian attractors. The minimum sidewalk width suggested by the Florida Greenbook (Chapter 3: Geometric Design, Section C.7.d) is 5 feet, and may be reduced to 4 feet when physical constraints exist. Refer to Chapter 8 of the Florida Greenbook for more guidelines on constructing sidewalks. To ensure compliance with the ADA Accessibility Guidelines and the Florida Accessibility Code for Building Construction, the Florida Greenbook recommends the following criteria (section C.10.a.3):

- Minimum clear width: 36 inches
- Maximum cross slope: 2.0%
- Maximum slope: 1:20

Figures 5-12 and 5-13 depict design standards for detectable warnings and sidewalk ramps.



**Figure 5-12: 2014 FDOT Design Standard for Public Sidewalk Curb Ramps (Index 304, Sheet no: 1 of 7)**



**Figure 5-13: 2014 FDOT Design Standard for Public Sidewalk Curb Ramps (Index 304, Sheet no: 2 of 7)**

Provisions for effective continuity of transit should be incorporated into the TTC planning process because oftentimes, public transit buses cannot be efficiently detoured in the same manner as other vehicles (particularly for short-term projects). Where applicable, the TTC plan should provide features such as accessible temporary bus pull-outs and satisfactory waiting areas for transit patrons, including disabled persons.

If relocating a transit bus stop or rerouting a pedestrian facility is required due to a construction work zone, the “Mobility for All” guide suggests that the engineer/contractor may find it necessary to coordinate with the local transit authority to ensure all passengers can access the affected stop. This will ensure an unbroken path of travel to the transit stop. It is also recommended that all waiting areas should be well illuminated for safety reasons. Bus stop markers, benches, and shelters should contrast with their surroundings, and seats should be provided at the relocated bus transit stops to assist all passengers, including frail elders and those with disabilities, as suggested by Tom Rickert in his “Mobility for All” report. Curb ramps at the transit stop should be accessible and in compliance with ADA standards for those with mobility impairments. The report recommends that even if a paved sidewalk is not available, a 2-meter (approximately 6’7”) or longer raised curb between the road and the passenger waiting area may provide greater safety, assist people with disabilities in reaching the first step of a bus, and provide orientation to those with a visual impairment.

As required by the ADA Standards, existing and relocated transit stops should be marked with large print signs, and route and schedule information should be displayed and accessible to every transit patron, including those with disabilities.

Furthermore, the MUTCD provides some guidelines on how to deal with pedestrian facilities affected in the TTC zone, as follows:

- If the TTC zone affects an accessible and detectable pedestrian facility, the accessibility and detectability shall be maintained along the pedestrian route.
- If establishing or maintaining an alternate pedestrian route is not feasible during the project, an alternate means of providing for the pedestrian may be used, such as adding free bus service around the project or assigning someone the responsibility of assisting pedestrians with disabilities through project limits.
- Walkways should be adequately lighted for nighttime use.

In the event that a pedestrian facility is impacted by work zones, the MUTCD Section 6D.02 Accessibility Considerations recommends the following:

- When existing pedestrian facilities are disrupted, closed or relocated in a TTC zone, the temporary facilities shall be detectable and include accessibility features consistent with

the features present in the existing pedestrian facility.

The MUTCD section 6D.01 provides three typical considerations for pedestrian safety in work zones:

- A. Pedestrians should not be led into conflicts with vehicles, equipment, or operations.
- B. Pedestrians should not be led into conflict with vehicles moving through or around the worksite.
- C. Pedestrians should be provided with a convenient and accessible path that replicates as nearly as practical the characteristics of the existing sidewalk(s) or footpath(s).

This section also discusses considerations for accommodating pedestrians and those with disabilities. The following guidelines are taken from the MUTCD and should be followed when temporary pedestrian pathways are to be designed:

- A. Provisions for the continuity of accessible paths for pedestrians should be incorporated into the TTC plan.
- B. Access to transit stops should be maintained.
- C. A smooth, continuous hard surface should be provided throughout the entire length of the temporary pedestrian facility. There should be no curbs or abrupt changes in grade or terrain that could cause tripping or be a barrier to wheelchair use. The geometry and alignment of the facility should meet the applicable requirements of the "Americans with Disabilities Act Standards for Transportation Facilities (ADA Standards 2006)."
- D. The same width of the existing pedestrian facility should be provided for the temporary facility if practical. Traffic control devices and other construction materials and features should not intrude in the area of the usable width of the sidewalk, temporary pathway, or other pedestrian facility. When it is not possible to maintain a minimum width of 60 inches throughout the entire length of the pedestrian pathway, a 60 x 60-inch passing space should be provided at least every 200 feet to allow individuals in wheelchairs to pass.
- E. Blocked routes, alternate crossings, and sign and signal information should be communicated to pedestrians with visual impairments by providing devices such as audible information devices, accessible pedestrian signals, or barriers and channelizing devices that are detectable to the pedestrians traveling with the aid of a long cane or who have low vision. Where pedestrian traffic is detoured to a TTC signal, judgment should be used to

determine if pedestrian signals or accessible pedestrian signals should be considered in crossings along an alternate route.

- F. When channelization is used to delineate a pedestrian pathway, a continuous detectable edging should be provided throughout the length of the facility such that blind or visually impaired pedestrians using a cane can follow it.
- G. Signs and other devices mounted lower than 7 feet above the temporary pedestrian pathway should not project more than 4 inches into an accessible pedestrian facility.

The Federal Highway Administration (FHWA) published regulations for work zones, such as the 23 CFR 630 Subpart J, Work Zone and Mobility, which applies to all federally funded state and local governments. The Work Zone Safety and Mobility Rule requires the agencies to develop an agency level work zone safety and mobility policy, and the process and procedures to sustain the policy. The MUTCD sets forth basic principles and standards, which are recognized as the national standard, but the subpart J is an additional guidance that systematically addresses the safety and mobility that is impacted in the work zone areas. The subpart has state level processes and procedures that should be implemented. Below are the four (4) main processes and procedures taken directly from the 23 CFR 630 Subpart J:

- a) Work zone assessment and management procedures. States should develop and implement systematic procedures to assess work zone impacts in project development, and to manage safety and mobility during project implementation. The scope of these procedures shall be based on project characteristics.
- b) Work zone data. States shall use field observations, available work zone crash data, and operational information to manage work zone impacts for specific projects during implementation. States shall continually pursue improvement of work zone safety and mobility by analyzing work zone crash and operational data from multiple projects to improve state processes and procedures. States should maintain elements of the data and information resources that are necessary to support these activities.
- c) Training. States shall require that personnel involved in the development, design, implementation, operation, inspection, and enforcement of work zone-related transportation management and traffic control be trained, appropriate to the job decisions each individual is required to make. States shall require periodic training updates that reflect changing industry practices and State processes and procedures.
- d) Process review. In order to assess the effectiveness of work zone safety and mobility procedures, the states shall perform a process review at least every two years. This review

may include the evaluation of work zone data at the State level, and/or review of randomly selected projects throughout the State's jurisdictions. Appropriate personnel assigned to represent the project development stages and the different offices within the State and the FHWA should participate in this review. Other non-State stakeholders may also be included in this review, as appropriate. The results of the review are intended to lead to improvements in work zone processes and procedures, data and information resources, and training programs to enhance efforts to address safety and mobility on current and future projects.

The regulation also specifies that in the project level, the states must develop a transportation management plan (TMP) that includes Temporary Traffic Control (TTC), Transportation Operations (TO), and Public Information (PI) components. The implementation of the subpart has ensued in many states that are developing design standards for pedestrian access routes.

### **5.1.3 PROPOSED STANDARDS FOR CONSTRUCTION ZONES**

According to a practitioner guide titled *Applying the American Disabilities Act in Work Zones* developed by the American Traffic Safety Services Association (ATSSA), if a pedestrian facility has a transit bus stop that is affected by construction work zones, the engineers should contact the respected transit agency to determine whether a temporary transit bus stop will need to be implemented either inside the traffic control zone or external to it. The guide further suggests that if the construction is intense enough to impact multiple stops, the engineer/contractor may find it necessary to arrange for a shuttle service or provide a temporary route that transports pedestrians safely around the work area. Any changes to the transit schedule and route due to construction work zones must be communicated to the transit patrons to avoid confusion. In the event that an alternative route is created that requires pedestrians to cross multi-lane intersections, the 2009 MUTCD recommends including a pedestrian walk phase timing to accommodate disabled persons so that they have adequate time to cross a street.

The Public Rights of Way Accessibility Guidelines (PROWAG) is a new guideline that is expected to be recognized by the US Department of Transportation and the US Department of Justice as the new minimum standard under the ADA for both new and alterations of pedestrian facilities in the public right-of-way and uses recommendations from the Accessible Public Rights-of-Way: Planning and Designing for Alterations. The PROWAG has done case studies on Work Zone Accessibility, which shows a temporary bypass of a construction area on the sidewalk. Figure 5-14 shows a plywood surface where the route crosses a grassy area, United States Access Board (2007). The connection joint of the plywood is painted in a different color to show contrast between changes in levels. Many of the studies consist of curb ramps, sloped terrain, addition of pedestrian signals, etc. Although it does discuss alterations to existing facilities, it does not specifically address the issue of transit stops in work zone areas. It references the MUTCD for temporary routes and states that project planning must include temporary, usable routes.



**Figure 5-14: Work Zone Accessibility**

A Temporary Traffic Control (TTC) Plan should always be implemented to provide safe access for pedestrians and transit patrons to existing pedestrian facilities and transit stops/stations. All access paths must be accessible for all pedestrians, including those with disabilities. All alternate/temporary pathways to pedestrian facilities and transit stops and stations must maintain the same level of accessibility, safety, and comfort as the existing facilities. In the event that a safe and accessible path cannot be provided for transit patrons to access an existing transit bus stop during construction work zones in the Temporary Traffic Control Plan, the engineer may choose to either relocate the bus stop or provide a free shuttle service to transit patrons to the closest unaffected bus stop location. The decision to either relocate or provide a shuttle service may be dependent on factors such as funding available and/or the duration of the work zone. It is preferable to relocate a bus stop for a long-term stationary work zone when temporary access to the transit bus stop cannot be provided. Work durations are defined in the 2009 version of the MUTCD, Section 6G.01 as follows:

1. Long-Term Stationary: Work duration that occupies a location more than 3 days.
2. Intermediate-Term Stationary: Work duration that occupies a location more than daylight hours up to 3 days, or nighttime work lasting more than 1 hour.
3. Short-Stationary: Daytime work that occupies a location for more than 1 hour within a single daylight period.
4. Short-Duration: Work that occupies a location up to 1 hour.
5. Mobile: Work that moves intermittently or continuously.

## 5.2 BUS STOP CONSIDERATIONS DURING CONSTRUCTION

This section includes key considerations that are important to the efficient planning, design, and management of stops during construction. They include the following: agency coordination, pedestrian access, bus stop relocation, drainage issues, bus stop and customer information, ITS technologies, and costs.

The predominant mechanism for communicating transit needs during construction is included in the TTC drawings and notes, which describe how traffic will be controlled through a construction work zone. All highway projects shall have a temporary traffic control plan, as required by Florida Statute and Federal regulations. The TTC details the proper demarcation of traffic through the work zones during the construction period. Furthermore, TTC Plan sheets shall be required when project conditions are not specifically addressed in a typical layout from the following manuals: Manual on Uniform Traffic Control Devices (MUTCD) or the Design Standards, Series 600.

The Temporary Traffic Control Plan is part of the Transportation Management Plan and ensures that transit can safely operate and board and alight passengers along a roadway. It prevents or reduces interruptions of transit operations and emergency services. The plans shall be developed and implemented in a coordinated effort with involved stakeholders, such as other transportation agencies, transit operators, utility suppliers, police, fire, emergency, business communities, and other local, regional, and state agencies. The goal is to minimize the time and exposure of motor vehicles, transit, bicyclists, and pedestrians that have to go through construction zones.

The following is a list of issues that should be followed by designers when preparing temporary traffic control plans:

- Consider transit and bicycle/pedestrian needs during construction.
- Maintain transit operations.
- Designers should check the condition of any proposed detour routes. If the detour route is not found in the state system, additional documentation of the agreements with local agencies will be required.
- The design should prevent or minimize interruption of local transit operations.
- Examine alternatives that meet objectives. Consider detour/transition locations, signal operations during construction, and how to handle buses, bicycles, pedestrians, service vehicles, etc.
- Develop a detailed TTC Plan, as existing operations need to be maintained. The plan needs to consider side streets, businesses, residents, bikes, pedestrians, buses, bus stops, etc.

The TTC plan phase submittals should include the following:

1. **Phase I** – A typical section for each phase, as well as a description of the phasing sequence and work involved.
2. **Phase II** – A majority of the TTC plan completed (75-90%), including the information outlined in Section 10.3.1.1 of this chapter, and a list of the pay items needed.
3. **Phase III** – A final TTC plan, including all notes, pay items, and preliminary quantities.

Different factors must be considered when determining the location of a transit stop in an area under highway construction.

The final decision for bus stop locations incorporates localized factors such as:

- Traffic volume and space availability
- Safety requirements relating to the proximity of crosswalks and access paths
- The needs of persons with disabilities
- High boarding locations such as schools, residences, businesses, parks, and others

Currently, the predominant mechanism for communicating transit needs during construction is handled by the temporary traffic control plan's (TTC) drawings and notes, where the construction zone bus stop should have the three (3) primary elements of passenger protection, as follows:

- A bus stop loading area that provides ample space for loading and unloading passengers.
- An adjacent area large enough at the curb line to provide a safe place for bus passengers to wait outside of the loading area.
- An accessible sidewalk or pedestrian path that connects the bus stop and provides a clear pedestrian path to and from the bus stop area.

(Section 6C.01 of the Manual of Uniform Traffic Control Devices (MUTCD) provides issues to present. “Where applicable, the TTC plan should provide for features such as accessible temporary bus stops, pull-outs, and satisfactory waiting areas for transit patrons, including persons with disabilities....”)

The transit planning TCP element should include coordinated efforts while working with transit authority representatives. If a transit stop or route needs to be relocated, appropriate notification should be provided.

A plan needs to be developed to maintain a reasonable bus transit and include pedestrian access in the work zones when:

- a) The construction project will disrupt the street system.
- b) During the construction process, work activities are next to active bus stops.
- c) Construction work requires the temporary displacement of bus stops to other activity areas.
- d) Bus stops lack a pedestrian system that is protected from a constrained natural terrain with drops, water ditches or channels, and stockpiles of soil and construction materials.
- e) Establishing priorities by addressing the number of bus stops that need to be reduced.
- f) Developing strategies to work with property owners' driveways to improve the pedestrian access to bus stops.

### ***5.2.1 AGENCY COORDINATION***

Better coordination and cooperation among multiple agencies is necessary during the MOT process since many entities are involved and often associate with multiple jurisdictions. Today, there is a more concentrated focus on coordination than at any time in the past. Many transportation agencies are involved in the design, location, construction, and maintenance of transit facilities, including state and local agencies, regional authorities, and private sector entities. These agencies represent an extensive variety of disciplines, including permitting, transit planning, land use and development, roadway design, utilities, traffic operations, and right-of-way. Planning with these agencies to determine route locations, stop locations, and passenger access facilities can produce solutions that are most suitable and/or can accommodate all methods of travel.

### ***5.2.2 PEDESTRIAN ACCESS***

Pedestrian access needs to be clearly designed to provide a safe environment on a smooth and well-marked travel path. The pedestrian side of bus stop design is as important as the street side. Well in advance of all activities, the level of accessibility needed for pedestrians in the TTC zone is determined and can be identified by observing existing pedestrian travel patterns prior to the start of work. Where it is necessary to divert pedestrians from the roadway, barricading or channelizing devices shall be provided to separate the pedestrian walkway from the adjacent traffic lane. Pedestrians need to safely reach bus stops (see FDOT Design Standard Index No. 660 for pedestrian accessibility through work zones).

To avoid pedestrian conflicts with work site vehicles, workers, equipment, stockpiled materials, or construction operations, it is better to relocate these work zone bus stops to nearby non-construction areas. Bus stops should be located in a place that will not interfere with or place pedestrians in danger.

The Proposed Accessibility Guidelines for Pedestrian Facilities in the Public Right of Way (PROWAC) of July 2011, also called the Public Right of Way Accessibility Guidelines (PROWAG) written by the US Access Board, provides more specific information than the ADAAG for transportation facilities placed within the roadway right-of-way. The Public Rights-of-Way Access Advisory Committee (PROWAAC) R308.1 indicates that transit stops should be located where there is a level and stable surface for boarding vehicles, and should maintain wheelchair accessibility for all bus stops.

When bus stops are not accessible, bus operators must know that they cannot drop off or pick up passengers in the construction area. Bus drivers need to be trained if a flagging stop is being used. Figure 5-15 is an example of dangerous conditions for pedestrians and transit passengers. All temporary bus stops, sidewalks, pathways, and ramps must be ADA compliant and maintain the minimum width and smooth surface for wheelchair access.



**Figure 5-15: Sidewalk Closed Due to Construction**

Figures 5-16 and 5-17 depict non-compliant construction conditions. Refer to Index 660 for proper pedestrian handling during construction.



**Figure 5-16: Non-Compliant Pedestrian Platform**



**Figure 5-17: Inadequate Bus Stop Access**

MOT TCP designers must anticipate that young, elderly, and persons with disabilities (such as mobility, visual, or hearing impaired) will be traversing the work site to find their bus stop.

A basic requirement of work zone traffic control in the TTC process is the needs of pedestrians, including disabled persons. To prevent visually impaired people, or others, from inadvertently entering a closed area, physical barricades, such as Longitudinal Channelizing Devices LCDs, shall be installed to prevent unsafe passage and facilitate a detectable handrail guidance system.

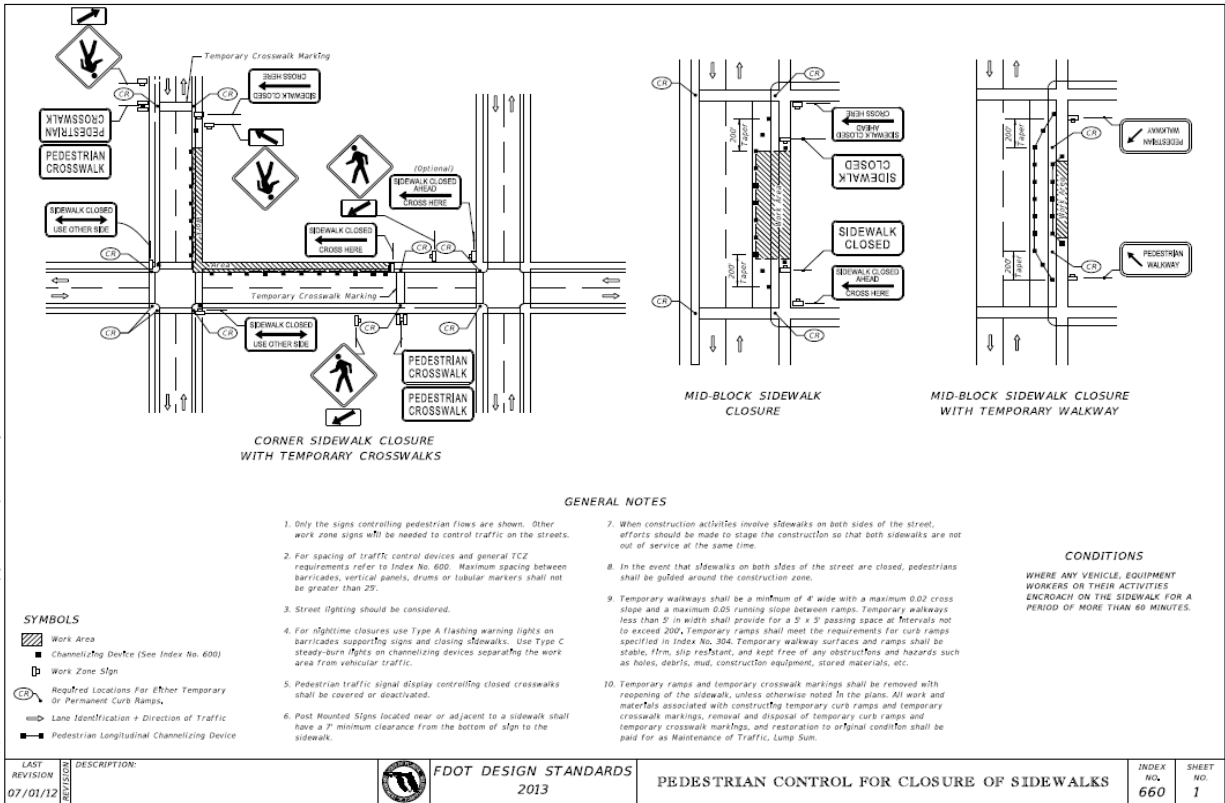
The location of pedestrian walkways must be designed in such a way that pedestrians are protected from tripping hazards and moving equipment. Refer to the FDOT Design Standards Index 600, 12 of 13, for the LCDs, and to Index 660 for pedestrian control where any vehicle, equipment, workers or their activities encroach on the sidewalk for a period of more than 60 minutes, which is shown in Figure 5-18.

Section 6 F 71 of the Manual of Uniform Traffic Control Devices (MUTCD). The Longitudinal Channelizing barricades are not to meet the requirements of a temporary traffic barrier; rather, they are used for pedestrian traffic control and to provide a safe channelizing pathway.

From the MUTCD, separate individual channelizing devices with tape or rope used to connect the individual devices are not detectable by persons with visual disabilities and are incapable of providing detectable path guidance.

If the temporary facilities shall include accessibility features consistent with the features present in the existing pedestrian facility that was closed or relocated in a TTC Plan, anticipate the fact that work zones are likely to create ingress/egress problems.

To reduce the potential for queuing buses to overflow into or block the intersection. In situations where two or more buses stop at a far side bus stop, which spills over into the intersection and additional length is not available, the bus stop should be placed adjacent to the intersection.



**Figure 5-18: Pedestrian Control for Closure of Sidewalks**

### 5.2.3 BUS STOP RELOCATION

Bus stop relocation is simply moving a fixed route bus stop to another location. In the event that a bus stop relocation is required, a safe and accessible pedestrian pathway shall be provided to lead the transit patrons to the relocated transit bus stop(s). The relocated bus stop must have all of same accessibility features as the existing stop and must be designed and located in compliance with ADA and local transportation authority standards. Additional engineering studies may be needed to determine the appropriate and/or preferable location for the relocated bus transit stop.

Proper guidelines must be followed when choosing the location for a bus transit stop. Although the relocating transit bus stop is temporary, the engineer must consider all factors as if he/she were to build a permanent transit bus. The bus stop should be located in an area that is convenient, safe, and visible to passengers. In the 2013 Accessing Transit report from FDOT, some location factors to be considered in bus stop configuration are provided, as follows:

- Where existing pedestrian routes are blocked or detoured, information must be provided about alternative routes that are usable by pedestrians with disabilities, particularly those who have visual disabilities. The ADA recommends that the level of accessibility existing prior to an alteration must not be reduced during the alteration.

- Access to temporary bus stops must be considered where temporary pedestrian routes are channelized. Barriers and channelizing devices that are detectable by people with visual disabilities must be provided.
- Where applicable, the TTC plan and the Maintenance of Traffic (MOT) plan should provide for features such as accessible temporary bus stops, pullouts, and satisfactory waiting areas for transit patrons, including persons with disabilities, if applicable.
- 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 or passenger access to stops.
- At transit stops, provisions should be made to ensure that 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 must be provided.
- While designing detours, ADA requirements must be considered.
- If a road improvement project affects transit services, transit agencies should be involved in the planning of traffic control during construction.
- Signage should be used to direct pedestrians to safe street crossings in advance of an encounter with a work zone. Signs should be placed at intersections so pedestrians, particularly in high-traffic-volume urban and urbanized areas, are not confronted with midblock crossings.
- Ensure that the transit agency bus stop coordinator or other staff person is aware of construction activities planned at or around bus stops and other transit facilities, and works with roadway agencies and their contractors to ensure that adequate pedestrian access routes are provided during construction periods.

As previously mentioned, the relocated transit bus stop must maintain all features that were present in the existing transit bus stop, which may include bus stop elements such as bus stop signs, shelters and benches, shelter lighting, and trash receptacles. Similar to all aspects of engineering design, safety is the most important element and should be given much consideration during the bus stop design/relocation. The engineer should assure that the proposed location of the alternative bus stop will not affect sight distance for pedestrians using the parallel and transverse crosswalks at the intersection, as well as for parallel and cross traffic. The relocated transit bus stop must be designed in accordance with local transportation and transit agencies' standards. Guidelines such as the "Accessing Transit: Design Handbook for Florida Bus Passenger Facilities (Version 2, 2008 and Version 3, 2013)," and "Transit Cooperative Research Program (TCRP) Report 19: Guidelines for the Location and Design of Bus Stops," developed by the Florida Planning and Development Lab at Florida State University and Federal Transit Administration respectively, provide guidelines on curb-side and street-side transit bus stop design.

According to FDOT Design Standards, Index 660, any temporary sidewalk must be a minimum of 4-feet wide with a maximum of 2 percent cross-slope and a maximum of 5 percent running-slope between ramps.

- Temporary walkways less than 5 feet in width must provide a 5-foot-by-5-foot passing space at intervals, not to exceed 200 feet.
- Temporary ramps must meet the requirements for curb ramps specified in the FDOT Design Standards, Index 304.
- Temporary walkway surfaces and ramps must be stable, firm, and slip-resistant, and kept free of any obstructions and hazards such as holes, debris, mud, construction equipment, and stored materials

#### **5.2.4 DRAINAGE ISSUES AT BUS STOPS**

Many factors may decrease accessibility and safety, including construction, drainage issues, and poor maintenance. Bus stops should be regularly monitored to ensure that they are clear of damaging issues. Drainage at bus stops and stations is an important consideration for the accessibility and safety of transit riders. It is important that neither the location nor the design of a bus stop allow water ponding to occur.

Pedestrian walkways across excavations shall be free of cracks, holes, and irregularities that could cause tripping. Avoid pedestrian walkway surfaces that become slippery when wet. Continual maintenance of travel paths so that they are free of any obstructions and hazards such as holes, debris, mud, construction equipment or debris, and stored materials.

The requirements of ADAAG require that drainage inlet grates in pedestrian areas or bus bays be heel-proof and non-slippery, with elongated openings perpendicular to the pedestrian path of travel, with no larger openings more than 1/2 inch in width. Drainage inlet grate openings greater than 1/2 inch could cause unsafe conditions, including the trapping of wheelchair wheels or walking sticks.

Areas that tend to accumulate standing water should be avoided or improved. Bus stops should not be located where passengers are required to step over catch basins when waiting for the bus, as this creates a potential tripping hazard. Rider safety is compromised when poor drainage and a grassy/muddy waiting area create slippery conditions. Figures 5-19 and 5-20 show bus stops located too close to drainage areas, which are hazardous for transit passengers. A continuous handrail or pedestrian/bicycle rail on a barrier wall should be provided around stops immediately adjacent to canals. Figure 5-21 depicts a picture of poor drainage at a bus stop.



**Figure 5-19: Bus Stop near a Drain Pipe**



**Figure 5-20: Bus Stop Close to Drainage**



**Figure 5-21: Poor Drainage Location at a Bus Stop**

### ***5.2.5 BUS STOP INFORMATION***

Relocation of a bus stop can generate a lot of confusion for transit patrons. It is extremely important for the engineer/contractor to furnish information about the relocated bus stop in a timely and effective manner. Throughout the construction period, information should be continuously displayed at the relocated bus stop. That information should include, but is not limited to, items such as the effective start and end date of the relocated bus stop, new system map and schedule, fare information, and contact information for the engineer/contractor in charge.

According to the “Accessing Transit Design Handbook,” providing system maps and fare information at bus passenger facilities is useful to passengers and gives the transit agency an opportunity to educate passengers and potential passengers about bus transit services. Route maps and schedules should be presented in a manner that allows all transit patrons to understand. Maps and schedules should be provided in a uniform graphic standard, sizes, and color codes. Color schemes should be highly contrasted in a manner that complies with the ADA guidelines.

### **5.2.6 TRANSIT RIDER INFORMATION**

Before bus stops are removed due to impending construction work, transit agencies/construction companies should have available in advance the affected stops posted with an informational flier. This alerts transit customers and allows the time that is needed to receive rider comments.

The typical message for a temporary change could include the information on the tentative duration of the new traffic conditions, or of any walkway restrictions. A contact number for questions and/or for reporting hazards could be provided. Conditions that are beyond recommended standards, non-compliant, or with missing key restrictions or hazardous with non-ADA recommended elements should be reported.

According to the Accessing Transit Design Handbook for Florida Bus Passenger Facilities, throughout the construction period, information should be displayed at the relocated bus stops and provide the transit agency the opportunity to educate patrons about the bus transit services being provided.

A public outreach campaign that targets the general public should also be a consideration. This pre-work notification in a website or in the immediate vicinity of the relocated bus stop locations allows bus patrons to be well informed.

### **5.2.7 ITS TECHNOLOGIES DURING CONSTRUCTION**

According to Hadi et al. (2008), Smart Work zones (SWZ) are automated systems that provide real-time information on work zone traffic conditions. In recent years, transportation agencies across the nation have deployed portable ITS technologies to monitor traffic and manage mobility and safety during the construction and maintenance of highways. Portable ITS systems provide a solution for deployment, maintenance, and operation during these conditions. Most of these systems collect traffic data in real time and can display speed and delay information on integrated portable changeable message signs (PCMS). Further, by using a website, agencies can also provide motorists with pre-trip information to allow for better trip planning. A few agencies have used portable ITS to help manage merging behavior approaching work zone lane closures. Other types of SWZ include speed advisory systems, dynamic speed limits, and automated speed enforcement. ITS technologies have also been used in construction projects that include closed circuit television cameras (CCTV), portable dynamic message sign (PDMS), detection devices for traffic queuing and construction zones, video monitoring stations, telephone/web-based traveler information, and a traffic management center (TMC).

Transit agencies use advanced computer and communications technology, known as Intelligent Transportation Systems (ITS) for a variety of services that improve the convenience and safety of transit passengers and improve transit operations. ITS technologies can provide real-time “next

bus” arrival information to transit passengers. These types of messages reduce bus passenger anxiety by informing the actual arrival of their next bus. This is particularly important for transit passengers at construction zones. ITS can help improve the security of passengers at bus stops by providing information and sending warning messages to motorists and bus operators through Dynamic Message Signs or other mechanisms like web and mobile applications.

According to the TCRP Report 48, most real-time bus information systems use a dynamic message signs (DMSs) with liquid crystal displays to present the bus arrival information with color displays. Figures 5-22 and 5-23 show the TriMet real-time message signs. DMSs show the current time, route number, and destination. GPS tracks the location of vehicles, and supports the real-time electronic “next-vehicle” displays at transit stops. The “next arriving bus” information can be conveyed in the form of voice announcements. These systems can also display current traffic conditions, and emergency weather conditions.



**Figure 5-22: TriMet Crystal Color Display**



**Figure 5-23: TriMet DMS Sign**

### ***5.2.8 COSTS IN CONSTRUCTION WORK ZONES***

Normal construction includes the cost of any work that is necessary to meet the requirements of contractual documents. Contracts specify costs on a unit cost basis for the quantity of work that is needed. Such costs may be generally included together in a pay item (e.g., FDOT Maintenance of Traffic pay item No. 0102- 1). In situations where a project requires a pay item that is not listed, a request for a new pay item must be submitted.

The FDOT Standard Specifications for Roadway and Bridge Construction Specification, Specification No. 4-3.2.1 “Allowable Costs for Extra Work” provides the following guidelines for items not-covered: “The Engineer may direct in writing that extra work be done, and at the Engineer’s sole discretion, the Contractor will be paid pursuant to an agreed Supplemental Agreement or an accepted Engineer’s Estimate.” The contract document that clearly defines the work associated for payment under each related pay item is to be found under the Florida Department of Transportation (FDOT) “Basis of Estimates” Topic Item No. 600-000-002.

The following is a list of pay items that FDOT uses for MOT projects:

**102-13.23 Payment Items**

- Item No. 102- 1- Maintenance of Traffic - lump sum.
- Item No. 102- 2- Special Detour - lump sum.
- Item No. 102- 3- Commercial Material for Driveway Maintenance - per cubic yard.
- Item No. 102- 14- Traffic Control Officer - per hour.
- Item No. 102- 60- Work Zone Sign - per each per day.
- Item No. 102- 61- Business Sign - each.
- Item No. 102- 62- Barrier Mounted Work Zone Sign – per each per day.
- Item No. 102- 71- Barrier Wall - per foot.
- Item No. 102- 75- Temporary Lane Separator - per foot.
- Item No. 102- 94- Glare Screen - per foot.
- Item No. 102- 73- Guardrail (Temporary) - per foot.
- Item No. 102- 74- Channelizing Devices - per each per day.
- Item No. 102- 76- Arrow Board - per each per day.
- Item No. 102- 77- High Intensity Flashing Lights (Temporary - Type B) - per each per day.
- Item No. 102- 78- Temporary Retroreflective Pavement Markers - each.
- Item No. 102- 81- Crash Cushion (Gating) (Temporary) - per location.
- Item No. 102- 89- Crash Cushion (Redirective) (Temporary) - per location.
- Item No. 102- 99- Portable Changeable Message Sign (Temporary) - per each per day.
- Item No. 102-104- Temporary Signalization and Maintenance - per intersection per day.
- Item No. 102-107- Temporary Traffic Detection and Maintenance - per intersection per day.
- Item No. 102-150- Portable Regulatory Sign - per each per day.
- Item No. 102-150- Radar Speed Display Unit - per each per day.
- Item No. 102-909- Temporary Raised Rumble Strip Set - per set per day.
- Item No. 102-911- Removable Tape (White/Black) - per foot.
- Item No. 102-912- Removable Tape (Yellow) - per foot.
- Item No. 710- Painted Pavement Markings.
- Item No. 711- Thermoplastic Traffic Stripes and Markings.

Following are examples of pay items from FDOT projects; included is a general idea of costs during construction. However, these costs vary from contract to contract.

**Pay Item No. 0102- 1** includes all of the costs of maintaining passenger access to bus stops within the project limits, for providing and maintaining temporary bus stop locations when they are necessary during construction, and all costs associated with the installation of permanent bus stop signs provided by others.

**Pay Item 050- A** is used for the Design/Build projects where the complete work is covered under a single Lump Sum agreement. This lump sum payment includes all of the Maintenance of Traffic issues, and Pay Item 0999- 25 (2999- 25) with an Initial Contingency Amount.

**The pay item 0102- 14** is for the Traffic Control Officer in the work zone paid under the man hours needed to assist in controlling and directing traffic.

**The pay item 0102- 60** is for Work Zone Signs, with areas less than 20 square feet, paid per day as needed.

**The pay item 0102- 71- AB** is for Temporary Concrete Barrier Wall paid per lineal feet. This is mainly for the protection of the traveling public and workers. When this item is used, the lights or the glare screen should be included.

**The pay item 0102- 74-A** is for Temporary Barricades and Channelizing Devices paid per day and are have different types.

**The pay item 0102- 79** is for a type C Steady burn light used in delineating/channelizing traffic control devices or barrier walls paid per day.

**The pay item 0102- 98- A** is for Barricades Type III, for each to remain for closures.

**The pay item 0102- 104- A** is for the Temporary Traffic Control Signals paid per day.

**The pay item 0102- 150- 1** is for any Portable Regulatory Sign paid per day.

Other Valid Item cost/pay codes include the following:

**Item 0102- 3** is for the Commercial Rock Material used for the driveway maintenance paid per cubic yard. The estimated FDOT average cost is at \$12.77 per cubic yard.

**Item 0399- 1** is for the use of Miscellaneous Asphalt Pavement paid per tons. The estimated FDOT average cost is at \$145.97 per ton.

**Item 0522 – 1** is for the use of a 4-inch thick Sidewalk Concrete, which is paid by the square yard. The estimated FDOT average cost is at \$28.00 per square yard.

**Item 0522 – 2** is for the use of a 6-inch thick Sidewalk Concrete, which is paid by the square yard. The estimated FDOT average cost is at \$37.21 per square yard.

**Item 0522 – 3** is for the Bus Boarding Pad Concrete, which is paid by the square yard. The estimated FDOT average cost is at \$45.05 per square yard.

**Item 0522 – 4** is for the thicker Bus Boarding Pad Concrete, which is paid by the square yard. The estimated FDOT average cost is at \$62.92 per square yard.

**Items 0653182 to 0653193** is for the Pedestrian Signals, which is paid by the assembly. The estimated FDOT average cost is at \$1,260.00, \$607.50, \$1,183.68, and \$1,500.00 per different assemblies.

**Item 0653300** is for the Pedestrian Signal installation, which is paid by the assembly. The estimated FDOT average cost is at \$138.24 per assembly.

**Item 0653400** is for the Pedestrian Signal relocation, which is paid by the assembly. The estimated FDOT average cost is at \$370.73 per assembly.

**Item 0522 1** is for the 4-inch thick Concrete Sidewalk and Driveway, which together is paid by the square yard. The estimated FDOT average cost is at \$50.00 per square yard.

**Item 0522 2** is for the 6-inch thick Concrete Sidewalk and Driveway, which together is paid by the square yard. The estimated FDOT average cost is at \$225.00 per square yard.

**102-13.3 Special Detours:** Price and payment will be full compensation for providing all detour facilities shown in the plans and all costs incurred in carrying out all requirements of this Section for general MOT within the limits of the detour, as shown in the plans.

**102-13.7 High Intensity Warning Lights:** Price and payment will be full compensation for furnishing, installing, operating, relocating, maintaining, and removing high intensity flashing lights (Type B).

Following the Basis of Estimates, for payment under individual items, either the number of hours or the quantities of material that are needed must be provided, as follows:

- Item 0102-104-A is for Temporary portable Traffic Control Signal paid per day.
- Item 0102-3 is for Commercial Material used for Driveway Maintenance. It is paid per cubic yard.
- Item 0399-1 is for Miscellaneous Asphalt Pavement. It is paid per tons.
- Items 0653182 Through 0653193 are for Pedestrian Signal, paid per assembly.
- Item 0653300 is for Pedestrian Signal installation, paid per assembly.
- Item 0653400 is for Pedestrian Signal relocated, paid per assembly.

When considering transit costs in construction zones, early coordination with transit agencies can help address any issues associated with bus stops, transit service, and transit riders. Some elements that deal with providing a safe access, including ADA issues, need to be addressed early in the construction process. The costs of these elements can vary depending on site conditions, location, and other variables during the construction process. Other elements not clearly defined in the Payment Items include lighting, bus stop information, way-finding devices, DMS signs, etc.

For planning purposes only, costs vary depending on site conditions. Costs can be obtained from the 2012 & 2014 Florida Department of Transportation Statewide CESP005 Item Average Unit Cost and the 2010 & 2012 Highway Construction Estimating Manual. Figure 5-24 shows an example of a conceptual cost form that could be used for estimation of construction costs.

<u>CONCEPTUAL CONSTRUCTION CURBSIDE BUS STOP COST</u> <u>WORKSHEET.</u>					SHT. OF
PROJECT.					
SUBJECT.					QUANTITY
ITEM	EQUIPMENT	LABOR	MATERIALS	SUPPLIES	SUBTOTAL
Maintenance of Traffic Item 0102 1.	-	-	-	-	To \$523.45 DA (2014)
Replace Sign at Stop. Remove and Relocate \$120.00	-	-	-	-	Avg. \$140.00
Pipe Handrail Aluminum Item 0515 1 2	-	-	-	-	Avg.\$37.19 LF (2012)
Pavement Marking.	-	-	-	-	\$3.5 to \$4.00 LF
Pedestrian Marked Crosswalk Marking	-	-	-	-	Avg. \$100.00 to \$300.00
ITS CCTV Camera. Item 0682 1 11	-	-	-	-	-
Tree Pruning	-	-	-	-	-
Bus Bays	-	-	-	-	-
Drainage	-	-	-	-	-
Concrete 4" thick Sidewalk. (sidewalk connecting path) Item 0522 1	-	-	-	-	Avg. \$28.00 to \$34.20 SY (2012)
Concrete 6" thick Sidewalk (driveway connecting path) Item 0522 2	-	-	-	-	Avg. 37.21 to \$40.29 SY (2014)
Bus Boarding Concrete Pad Item 0522 3	-	-	-	-	Avg. \$45.05 SY (2012)
Boarding and Alighting Concrete Area	-	-	-	-	Avg. \$200 to \$600 EA
Traffic Separator Variable Width Raised Crosswalk Item 0520 70	-	-	-	-	Avg. \$47.95 SY (2012)
<b>TOTALS:</b>					

**Figure 5-22: Example of a Construction Cost Worksheet**

## 6 INTERVIEWS WITH TRANSIT AND CONSTRUCTION PROFESSIONALS

This section presents feedback from professionals who participated in a survey as part of the research. The research team identified professionals in the state of Florida that had knowledge and experience with the Maintenance of Traffic (MOT) process and had dealt with transit stops in construction zones. The selected individuals have several years of experience in one or more of the following areas:

- Design
- Construction
- Maintenance
- Utilities
- Traffic Operations
- Transit Operations

The research team selected a group of ten professionals to fill out a survey questionnaire; seven completed the survey. The following table includes the individuals who participated in this project:

**Table 6-1: MOT Professionals**

<b>MOT Expert name</b>	<b>Title</b>	<b>Organization</b>	<b>City</b>	<b>State</b>
Kevin M. Hoyt	Transit Operations Chief	Manatee County Public Works	Bradenton	FL
Arethia Douglas, P.E.	Service and Capital Planning	Broward County Transit (BCT)	Plantation	FL
Andy Rodgers	Design/Construction Project Manager II	Jacksonville Transportation Authority (JTA)	Jacksonville	FL
Jacqueline Hriljac	Route Service Specialist	Palm Tran	Palm Beach	FL
Keven Belanger	Engineer	Florida Department of Transportation (FDOT)	Brooksville	FL
James Lewis	Project Administrator	Bergmann Associates	Palm Beach	FL
Dan Rodriguez	Project Manager I	Hillsborough Area Regional Transit (HART)	Tampa	FL

The focus of the survey was to identify engineering and management challenges, customer services and safety issues, and best practice solutions. After reading and analyzing the responses, the research team summarized the results in section 6.1. See Appendix B with the detailed responses from each of the survey participants.

## 6.1 SURVEY RESULTS

This section summarizes the answers to the survey questionnaire. Please note that this section presents a summary of each question answered by the selected professionals. For information about the survey questionnaire, refer to Appendix A. The survey responses are included in Appendix B.

### *Q1. Before construction starts, how do you plan the accessibility and safety of transit riders?*

MOT professionals mentioned that in the planning stages of the MOT process, the transit agency is contacted for guidance. Safety, operation, and ADA compliance are the primary considerations in developing an MOT that includes transit services. This stage includes internal meetings, site visits, pre-construction meetings, and preparations for a public notice. The goal is to always make the operation of the construction zone as safe as possible, with the lowest amount of impact on all of the parties involved in the project, including riders, construction personnel, etc. The need to ensure that ADA compliance and accessibility are addressed in the planning stages was also emphasized.

During pre-construction, it is important to discuss with the contractor the better option to maintain which bus stop areas. The contractor needs to provide, if needed, a temporary location following ADA requirements.

One professional mentioned that it is the responsibility of the project owner to ensure that the contractor that is awarded the project is aware that there is transit present and that the project creates the least amount of impact as possible.

### *Q2. What documents/manuals/reports do you use as guideline?*

The following is a list of the most common documents used during the MOT process:

- FDOT Plans Preparation Manual
- FDOT Design Standards
- Manual on Uniform Traffic Control Devices (MUTCD)
- AASHTO Manuals
- Accessing Transit Design Handbook
- Statewide Transit Facility Standards, Criteria, and Guidelines
- FDOT Design Standards Index 600
- FDOT District 4 Transit Guidelines
- ADA Standards for Accessible Design
- JTA Mobility Handbook

- City standards
- General requirements in contract documents
- FDOT Forms

***Q3. How do you inform transit riders of temporary closure and/or relocation of bus stops before construction starts?***

According to the professional participants in this project, transit riders are informed by different means. Most of the agencies place notices on the stop signs or shelters. They also post information inside the buses that serve that location and post this information on their websites.

***Q4. If bus stop spacing is affected during construction, how do you plan for this?***

When stop spacing is affected, if the closure results in significant distance between stops, temporary stops are added. If possible, these stops are located somewhere in between. Some agencies try to keep as many stops as originally available. If this is not possible, they notify the public. To provide temporary stops, agencies work with the contractor to facilitate this process.

***Q5. If a sidewalk is included in the construction phase, how do you accommodate people with disabilities?***

When asked about sidewalks and how to accommodate people with disabilities, they responded that agencies try to comply with ADA by providing alternative paths, detours, ramps, and provide guidance through signage to access the stops. If necessary, an alternative route is provided, with permanent or temporary ADA access. It is the responsibility of the Department/County/City or project owner or contractor to provide a safe passage through or around the work area with proper signage.

The contractor shall provide the boarding and alighting area with a firm stable surface. The boarding and alighting area shall provide a clear length of a minimum of 96 inches (2440 mm), measured perpendicular to the curb or vehicle edge, and a clear width of a minimum of 60 inches (1525 mm), measured parallel to the vehicle roadway. Boarding and alighting areas shall be connected to streets, sidewalks, or pedestrian paths by an accessible route consisting of the following components:

- Walking surfaces with a running slope no steeper than 1:20.
- Walking surface with a cross slope no steeper than 1:48.
- Walking surface with a minimum clear width of 36 inches (915 mm),
- Walking surface with a minimum of 60 inches (1525 mm) of passing space at minimum intervals of 200 feet (61 m).

- Walking surface of a 180-degree turn with a minimum 48 inches (1220 mm) of clear width.

They mentioned the use of the ADA of 1990, as amended, and all regulations issued related thereto, including but not limited to 49 CFR Part 37, Appendix A. Minimum ADA BUS STOP requirements as outlined in paragraph 810.2.

***Q6. How do you determine where the stop will be located during construction and how passengers will access the stop?***

This is usually based on the construction project, user needs, and the experience and expertise from the transit agency. When a stop is within a short walking distance of the impacted stop, transit riders are typically directed to that stop. If the next stop is far away, agencies attempt to add a temporary stop as close to the impacted stop as possible. When the construction limits make this impossible, they are directed to the closest available stop. In some cases, they have to create a bus detour, with temporary stop(s) on those streets. During the pre-construction meeting, a location can be identified for the bus stop and how it can be accessed.

One professional suggested using Automated Passenger Counters (APCs) to determine the number of passengers affected at specific locations.

***Q7. If a bus stop needs to be relocated as a result of a new construction, how do you determine the cost of removing and relocating the bus stop?***

In-house staff typically determine the cost of removing and relocating bus stops. They use the FDOT's Basis of Estimates Manual and calculate the cost of the work. In addition, they check Appendix K in the Accessing Transit Design Handbook (2008) for Florida.

It was mentioned that bus stop relocation is included in the Bid or in the cost of the project. Further, the cost of relocating the stop is minimal, especially if it is only relocating the bus stop sign, which could be done by the contractor. However, one participant from a transit agency mentioned that they typically have their bus stop maintenance crew move the stops. They prefer not having the contractor of the construction project complete this work, due to issues with scheduling and damages that occurred in incidents in the past. If a shelter is involved, they use the existing shelter contract, which has predetermined line item costs.

***Q8. How do you minimize the costs of construction near or on transit stops?***

Costs can be minimized by making decisions early, so that it can be planned accordingly. If new construction of a bus stop is required and that it be included as part of the project by the project owner, and in turn, the construction can benefit from the economies of scale, including existing

mobilization and MOT expenses. If the impacted stop does not have a shelter, costs are very low. Other professionals suggested that costs can be reduced by negotiating with the contractor and/or the governmental authority in charge of the project.

***Q9. When relocating a bus stop, will it be visible to bus drivers?***

Yes, the signs should be visible to bus drivers and follow signage rules in accordance with MUTCD. Stops not in use are commonly covered during construction. As a general rule, bus operators are always notified when stops and routes are impacted. Some agencies require that all signage meet MUTCD, as well as FDOT and County requirements.

***Q10. How do you provide transit drivers clear directions to understanding the construction zone?***

This is provided with drivers' notices that show maps with the area affected describing the route they must follow. These notices can be placed on the board of the transit agency, usually in the drivers' room, as well as placing a flyer in the drivers' mailboxes that normally serve the affected route.

***Q11. How do you notify pedestrians and riders of the new stop locations and access points?***

It is usually up to the transit agency and/or the agency in charge of the project. This can be discussed at the pre-construction meeting on how to communicate with the public about the construction impacts.

Proper use of signage and pedestrian guidance is necessary to ensure that an accessible circulation path is maintained. The old stops can have flyers with removal dates and stop relocation directions. Announcements are made to patrons on effected routes. This can also be posted in the agency website or advertised by a local media. Some agencies may not have a formal notification in place.

***Q12. What happens if the construction zone is near or in front of an area with high passenger activity?***

Most agencies attempt to provide a safety area for the public. If this cannot be ensured, the stop can be temporarily closed and relocated as near as possible to reduce the inconvenience to the public. A detour can be also planned. Additionally, restrictions may be placed, such as asking the contractor to work during non-peak hours.

A thorough evaluation in advance should be considered to address all issues during construction to better decide the best way to minimize the impact on all the parties.

***Q13. If possible, can construction be done at night or weekends to reduce the impact on transit riders? If not, can it be done during periods of low traffic volumes?***

Yes, some construction can be done at night or during weekends. However, this depends on the contractual documents with the contractor. Night-time construction costs can be expensive due to the plant's opening fees and workers overtime. On the other hand, transit agencies may prefer that construction be done during off peak hours, so that very little disruption occurs during high volume times.

***Q14. What are the decisions taken to relocate and re-design bus stop placement during design and construction?***

In regard to this question, there are a variety of opinions. Some take into consideration ridership, while others consider location and safety. When considering ridership, if a stop has high-ridership stop, it will be relocated. If it is very low ridership, it may be closed without relocation during construction. A bus stop can be moved if the location can be improved. That is having a stop with a better location, better amenities, or improved safety.

It was also mentioned that bus stops are only relocated if designing and construction is not feasible on the existing location or that this will benefit the public and the service within the area.

***Q15. What efforts are used to maintain existing transit service?***

Every possible effort is made to maintain the existing transit service and to be kept close to normal operating conditions as much as possible. Meetings with the contractor can help reduce the construction impacts on the affected area. If possible, bus stops are not moved to maintain the existing service. Existing transit service should remain during construction if it can be completed without creating safety hazards to passengers in the areas of impact. If not, temporary stops and/or detours can be added.

***Q16. Do you consider the level of service that is needed and what can be realistically provided?***

Yes, the needed level of service is considered along with the cost and its feasibility. A transit agency uses ridership data from APCs to determine how many people use the affected stops. Most transit agencies attempt to continue providing a normal level of service.

***Q17. Have you consider short-term and long-term impacts?***

All of the survey participants agreed that both short- and long-term impacts are considered. That is why transit agencies have to be involved in the approval of the MOT, because they need to

minimize the impact to patrons as much as possible. An agency uses data to make intelligent decisions for the short- and long-term impacts to passengers.

***Q18. What are the considerations you use for safety, accessibility, and visibility of stops during construction?***

Most agencies follow FDOT and AASHTO standards, as well as general requirements in contract documents, including the use of the transit's criteria, engineering/industry judgment/practice, and feasibility. The following items should be considered to improve safety, accessibility and visibility: traffic signals, sign post, barriers, pavement marking, walking surface, pedestrian crossing, street light, and safe distances for arriving or departing buses, and bike lines if they are in the area.

A participant mentioned that it is not so much consideration, but common sense while construction is taking place. The MOT is planned and required by FDOT, and when using the proper index codes, these are all accomplished.

In addition, keeping a safe, accessible, and visibly safe and clearly visible stop location during construction is of the utmost importance. The contractor should be responsible for the right-of-way during construction, which would include boarding and alighting areas at bus stops, either at existing locations or at relocated areas.

***Q19. Any comments on the approval process?***

Get everyone involved early and have reasonable expectations. Transit agencies should be actively involved in the MOT process and review the construction plans and submit comments. Most agencies are good about this and should add notes with information for the contractor prior to any work that has an impact on bus stops.

Palm Tran attempted to use an in-house designed ADA accessible ramp, and FDOT was very concerned about safety. Further, the MOT reviewers at the State Construction Office level found that these installations were unacceptable. Nevertheless, suitable devices are needed to provide access to people with disabilities.

***Q20. Do you have any other comments or suggestions regarding this project?***

One participant mentioned that in the beginning it is hard for a person who has no experience with Construction or Transit to choose a safety location for buses and/or people without a guide. Existing documentation for establishing a bus stop can be used, but they do not specifically address issues of stops during construction. Therefore, some guidance is needed on how to best deal with

transit stops during the MOT process. In addition, it was suggested that training videos showing different situations that are common in construction areas, and how to solve them can be helpful.

The other comment was that nearly all projects that require substantial MOT or lane and street closures be done by the owners of the right-of-way.

## 7 CONSTRUCTION SITE CASE STUDY VISITS

Three construction sites were visited in Florida with operating transit routes. The reason for the visits was to determine how transit services and riders were accommodated during the construction process. The construction sites visited by the research team were Tampa (HART), Jacksonville (JTA), and Palm Beach (Palm Tran), covering different areas in Florida. The selection was based on transit agencies that have projects with bus stops in construction zones and the willingness of these agencies to participate in this project. From these visits, there were findings that were obtained from each of the three construction sites. Most of these findings were related to location, specifically on where to place the temporary bus stops during construction in work zones that must a) maintain; b) re-design; c) and/or relocate bus traffic. In addition, transit personnel in charge of these projects provided useful information. The next section goes into more detail on the construction sites that were visited.

### 7.1 PALM BEACH

Location and Description: Riviera Beach, West Palm Beach, and Palm Beach Gardens served by Route 1 on US-1. Figures 7-1 and 7-2 show the impacts of the construction area on stop location and passenger waiting areas.



**Figure 7-1: Construction Affecting a Bus Stop (Palm Beach)**



**Figure 7-2: Transit Riders Waiting for the Bus (Palm Beach)**

### Bus Stops

1. Silver Beach Road and Old Broadway
2. 34 Street and Old Broadway
3. West 34 Street and Avenue E

### ***7.1.1 OBSERVATIONS AT PALM BEACH***

The following pros and cons were observed:

#### **PROS:**

- Good coordination. Before construction started, the FDOT Consultant contacted Palm Tran in Palm Beach and reviewed the bus stop locations.

- Document Availability. They used the available contract documents to schedule and coordinate a workable plan to maintain or relocate access for public transit. Planning was done to maintain as many stops as originally available.
- Transit Agency Assistance. The transit agency provided assistance to determine where stops were to be located during construction and how the passengers were to access these stops in a location where all possible efforts were placed in maintaining the present areas of bus passenger activities for safety and accessibility.
- Bus Patron Information. Each week, the FDOT Public Information Officer issued a weekly traffic report and a written message was placed on the existing stop signs to direct and inform bus patrons to changed locations or bus stop closures.

### **CONS:**

- Missing Elements. Walkways leading to and from bus stop areas did not have a designated walkway area. Construction areas had broken sidewalks, pavement, and construction material. There was no delineation of pedestrian travel paths in construction areas.
- Safety Concerns. Pedestrians were led into conflicts with work site vehicles, or equipment, due to having to move through their work site.
- Non-standard Access. In an attempt to provide accessibility, an in-house ramp was provided. However, MOT reviewers at the State Construction Office level found that these installations were unacceptable. Non-standard plywood platform, wood railings, and ropes and tapes were used as pathways for pedestrians.
- Temporary Solution. A flag stop was used as a safety system to assist transit passengers to signal the buses to stop at non-designated areas.

### **GENERAL COMMENTS:**

1. Good coordination with the transit agency before and during construction. The transit agency provided assistance to determine where stops were to be located during construction and how the passengers were to access these locations.
2. Each week, the FDOT Public Information Officer issued a weekly traffic report, and a written message was placed on the existing stop signs to direct and inform bus patrons to changed locations or bus stop closures.
3. There is a need to clearly delineate usable pedestrian travel paths. Pedestrians should be provided with a reasonably safe and accessible path that replicates, as close as possible, the most desirable characteristics of a sidewalk.

4. Pedestrians are not to be led into conflicts with work site vehicles, or equipment by having to move through their work site. Walkways leading to and from bus stop areas should be level, and with a firm surface. When pedestrian movement is necessary through or around a work site, a separate usable footpath should be provided away from equipment, broken sidewalks or pavement, material, and any work operations.
5. Walkways and ramps need to be provided to accommodate passengers with special needs. To comply with the effective pedestrian control design standards of the ADAAG, no tape or rope that is strung between traffic control devices is to be used.
6. Approved traffic control devices, such as LCDs, will limit the use of wood railings, fencing, and other similar systems that have not been tested.
7. Marked and properly designated crosswalks with stop signals and warning signs will allow pedestrians to safely cross the roadway.
8. Temporary bus stops and new turning arrangements should be provided from the outset to ensure adequate bus service.
9. The flag stop is a system that allows possible passengers to wait along the side of the road at other convenient locations that may not be designated for bus stops. Transit agencies allowing the use of flag stops develop specific policies for drivers and passengers to use for determining when and where it is safe to pick up or discharge passengers at those locations.
10. When the sight lines between pedestrians and approaching vehicles are blocked by the stopped bus, there is an increased potential for conflict. This happens when pedestrians cross in front or behind a bus where the line of sight is blocked by the stopped bus to drivers on the opposite traffic lanes of a two-way, two-lane road, with lane widths that have been narrowed by the construction activities.

Figures 7-3 to 7-5 show the conditions of the observed construction zones.



**Figure 7-3: Sidewalk at a Construction Zone**



**Figure 7-4: Poor Conditions of Temporary Bus Stop**



**Figure 7-5: Bus Stop at a Construction Zone**

## **7.2 TAMPA**

Location and Description: North Lois Avenue from Hillsborough Ave. South to Tampa Bay Boulevard, following the HART bus route (7) West Tampa/Citrus Park, in Tampa, Florida. Figure 7-6 shows a picture from the Tampa Site Visit.

### Northbound Bus Stops

1. N. Lois Avenue and W. Dr. Martin Luther King Jr. Blvd.
2. N. Lois Avenue and W. Alva Street
3. N. Louis Avenue and W. Cayuga Street
4. N. Louis Avenue and W. Osborne Avenue
5. N. Louis Avenue and W. South Street

6. N. Lois Avenue and W. Crest Avenue

Southbound Bus Stops

7. N. Lois Avenue and W. Alva Street

8. No. Lois Avenue and W. Osborne Avenue

9. N. Lois Avenue and W. South Avenue

10. No. Lois Avenue and W. Crest Avenue

Location and Description: North Lois Avenue from Hillsborough Ave South to Tampa Bay Boulevard, following the HART bus route (7) West Tampa/Citrus Park, in Tampa, Florida. Figure 7-6 shows a picture from the Tampa Site Visit.



**Figure 7-6: Tampa Site Visit**

### **7.2.1 OBSERVATIONS VISIT TO TAMPA**

The following pros and cons were observed:

#### **PROS:**

- Good Coordination. The transit agency closely works with local and state jurisdictions when road improvements affect the safety of bus stops and bus routes.
- Handling Detours. When road construction activities do not need to detour any routes during the construction time, there are periods of time when some bus stops in the construction area are cancelled and closed. Transit detour information can be found by calling the transit agency and by the Twitter service to the e-mail address.

#### **CONS:**

- Not following Standards. Road Closure Barricade (Type 3) was shortened and a large sign covers almost the entire surface.
- Poor Visibility. Signs were not visible and some of them were mounted on utility poles.
- Poor Communication. There was no proper communication being provided to the transit authorities when construction phases took place.
- Safety Concerns. Handrails or fences were not provided to protect bus patrons from surface drop offs near bus stop.

#### **GENERAL COMMENTS:**

1. A continuous handrail or pedestrian rail fence or a barrier wall needs to be provided around bus stops immediately adjacent to canals, steep slopes, drainage, dangerous drop offs, or conditions that affect the safety of the bus patrons.
2. The incorporation of new bus stop accommodations and bus stop relocations are part of the highway project advance planning coordination. Transit agencies should work closely with local and state jurisdictions whenever road improvements affect the operation and safety of bus stops.
3. Type 3 barricades, for road closures, are not to be modified after being approved by FDOT.
4. Drivers should be aware of the presence of pedestrians near the roadway. Double-sided stop signs should be provided with possible curb or pavement markings associated with the bus stops.

5. As the construction roadwork continues, information should be provided to the transit authorities to facilitate the implementation and use of new relocated service.

### 7.3 JACKSONVILLE

Location and Description: Lenox Avenue/Normandy Boulevard/Cassat Avenue and Arlington Expressway Service Road served by bus routes WS7 and WS6 in Jacksonville, Florida. Figures 7-7 and 7-8 show pictures from the Jacksonville Site Visit. Figure 7-7 depicts a condition that requires a review of Index 660 for a temporary street walkway where any vehicle, equipment, workers, or their activities encroach on the sidewalk for a period of more than 1 hour.

#### Bus Stops

1. Arlington Expressway Service Road
2. Lenox Avenue and Normandy



**Figure 7-7: Jacksonville Site Visit**



**Figure 7-8: Jacksonville Site Visit**

### ***7.3.1 OBSERVATIONS OF JOB SITES IN JACKSONVILLE***

The following pros and cons were observed:

#### **PROS:**

- Good Coordination. A pre-construction meeting was held to determine the location of the bus stops and the access needed.
- Relocation Costs. Bus stop relocation was included in the cost of the project.

- Relocation Work. All work was done under an approved set of drawings before construction started. Bus stops are only relocated if contract drawings indicate the changes.
- Good Monitoring. The existing construction bus stop locations were monitored for safety, operation, and ADA compliance.

### **CONS:**

- Poor Visibility. The visibility of a bus stop was obstructed, creating some safety concerns due to the proximity to traffic and a driveway.
- There was not a defined appropriate pathway to the bus stop.
- Safety Issues. Conflicts between construction equipment and workers with pedestrians during sidewalks replacement.

### **GENERAL COMMENTS:**

Visual obstructions that impair the ability of drivers to see the pedestrians at the bus stops should be avoided. Bus stop locations can impact the safety of pedestrians.

It is often desirable to provide a buffer area between the sidewalk and the roadway. A simple grass strip and shrubs can be used to form a deterrence buffer that protects the pedestrians. For the safety and comfort of pedestrians, sidewalks should not be located against the curb, directly adjacent to the lanes of moving traffic.

When it is often necessary for pedestrians to cross the roadways, when traveling to and from transit stops, these crossings should be made as safe as possible.

Marked crosswalks are commonly used to identify preferred locations for the pedestrian crossings. On multi-lane roads with high speeds and high traffic volumes, marked crosswalks alone are not sufficient to assure the pedestrian safety, and in those cases, pedestrian warning signs need to be provided.

FHWA guidelines state that “In most cases, marked crosswalks are best used in combination with other treatments.” This indicates that each case should be carefully studied.

A detailed engineering analysis helps determine the appropriate combination of treatments for a pedestrian crossing.

High-visibility pedestrian warning signs will increase drivers’ awareness of pedestrians, especially in high-speed and volume areas where pedestrians may not be expected.

These signs are included in Section 2B.12 and 2C.41 of the MUTCD, and other signs are designed to remind drivers of their responsibility to yield to pedestrians in the crosswalk by stating, “STATE LAW—YIELD TO/STOP FOR PEDESTRIANS IN CROSSWALK.”

An infrastructure of improvements when implemented with education and enforcement programs will make pedestrian crossings safer and more convenient for the transit customers. Because pedestrian overpasses (bridges) allow pedestrians and bicyclists to cross unsafe streets avoiding potential conflicts with vehicles, they should be reserved for these locations where the hazards of crossing the roadway are high.

When a long detour is necessary, pedestrians and bicyclists will often choose to cross anywhere at-grade regardless of the safety conditions on the street. All grade-separated crossings should be located conveniently so that pedestrians are not forced to go out of their way to use them.

From the “Pedestrian Safety Guide for Transit Agencies,” FHWA #SA 07 017, transit agencies should coordinate with the agency or jurisdiction responsible for the roadway to pursue the installation of proper pedestrian crossing facilities and motorist warning devices before bus stops are installed.

The “Proposed Accessibility Guidelines for Pedestrian Facilities in the Public Right of Way,” also known as the Public Right of way Accessibility Guidelines or PROWAG, provides more specific information that the ADAAG for transportation facilities within the right-of-way, including pedestrian access routes and signals.

The “Americans with Disabilities Act Accessibilities Guidelines” (ADAAG) written by the US Access Board and adopted by the Department of Justice (DOJ) in 2010, includes a broad range of accessibility guidelines, including those for public access facilities, public transportation, and sidewalks.

Aside from ADA accessibility, other factors to be considered when selecting where to appropriately locate a bus stop include the adjacent land uses, the physical roadside constraints (trees, poles, driveways, and ramps), and the passenger origins and destinations.

Heavy equipment, construction materials and uneven ground have the potential to cause serious harm, and in those cases, pedestrians are asked to help by keeping their distance from the construction area sites. Barriers to pedestrian activity should be eliminated when bus stops are located along sidewalks, while a concrete boarding area repair is under construction.

## 8 CONCLUSIONS

Fixed route transit systems provide a valuable transportation service for many citizens. Users depend on bus transit for access to the essentials of life, such as school and work. Further, it is common to find public and private construction work areas surrounding existing bus stop locations. Therefore, maintaining transit service in a construction zone is a critical issue, considering the vast amount of nationwide bus transit systems and high demand of road construction activities.

One would imagine there are guidelines or procedures put in place because of these activities, but there is limited information available concerning best practices for safely managing the bus stop and transit riders while construction is underway. Work zone provisions and standards must be addressed for the safety and usability of transit stops for pedestrians, especially those with disabilities.

This report provides general information on the current practice for transit stops in construction zones, based on a literature review, interviews, and case studies. It takes into consideration the efficient and safe access to bus stops. It documents a research effort on how to manage bus stops during road construction. It provides information on federal and state standards, bus stop elements, agency coordination, customer notices, ITS technologies, and current practices for managing transit stops near construction work zones.

### Literature Review

The American Traffic Safety Services Association (ATSSA, 2012) has developed a guideline titled *Applying the Americans with Disabilities Act in Work Zones: A Practitioner Guide*, which combines the different state standards and condenses them into a helpful tool for accommodating disabled patrons in work zones. However, it does not address all of the transit bus stop issues that are presented in this report.

Currently, the predominant mechanism for communicating transit needs during construction is handled by the Temporary Traffic Control (TTC) Plans drawings and notes, where the construction zones bus stop should have the three (3) primary elements of passenger protection:

- A bus stop loading area providing ample space for loading and unloading passengers
- An adjacent area large enough at the curb line to provide a safe place for bus passengers to wait outside of the loading area
- An accessible sidewalk or pedestrian path that connects the bus stop providing a clear pedestrian path to and from the bus stop area

The following process should be followed by designers when preparing temporary traffic control plans:

- Consider transit and bicycle/pedestrian needs during construction
- Maintain transit operations
- Designers should check the condition of any proposed detour routes. If the detour route is off the state system, additional documentation of the agreements with local agencies will be required.
- Design should prevent or minimize interruption of local transit operations.
- Examine alternatives that meet objectives. Consider detour/transition locations, signal operations during construction, how to handle buses, bicycles, pedestrians, service vehicles, etc.
- Develop a detailed TTC Plan, as existing operations need to be maintained. They need to consider side streets, businesses, residents, bikes, pedestrians, buses, bus stops, etc.

Section 6C.01 of the Manual of Uniform Traffic Control Devices (MUTCD) provides issues to present. “Where applicable, the TTC plan should provide for features such as accessible temporary bus stops, pull-outs, and satisfactory waiting areas for transit patrons, including persons with disabilities....”

The sidewalks (see FDOT Design Standards Index 310, and Std. Specification Section 522) and shared use paths need to have adequately designated pedestrian facilities with proper spacing for bus stops in construction work zones to make the transit service more efficient and safe.

The proper location and spacing of bus stops is a critical issue to the safety of passengers and motorists. It should incorporate the needs of transit users, which can be ensured by the active participation of the transit agency in the construction process. This is stated in TCRP Report 19, “...incorporate transit needs into the design and operations of streets and highways...”

The Americans with Disabilities Act (ADA) of 1990 Title II and III for public services and public accommodations for persons with mobility and visual impairments also affects the bus stop planning, design, and maintenance phases in areas under roadway construction. Their Accessibilities Guidelines (ADAAG) provisions require that the route for persons with limited mobility or vision be as accessible as the route used by those without disabilities.

The operating concerns of the transit agency need to be considered when choosing a safe location that conforms to the temporary access to and from bus stops in construction areas:

- The impact of the bus stop on adjacent properties where the stops are placed at safe locations for passengers and vehicles.

- The width and direction of activities affected by bus stop placement that need to be accessed by the surrounding neighborhood traffic with intersecting transit services.

The various configurations of a roadway that are available to accommodate bus service have their own advantages and disadvantages. For their operational effectiveness issues, because of the number of factors involved, each bus stop issue is usually examined on a case-by-case basis.

It is essential to know that bus riders need to have safe access to their bus stops zones with the proper attention given to their path of travel. They should be directed through work zones on temporary pedestrian access routes by the use of signs and other way-finding devices, which give the pedestrians a safe path through or around the conflicting area. Signs should be placed at specific locations, such as intersections, so that pedestrians are not put in danger. Way-finding devices must include continuous detectable edging to allow people with disabilities to safely navigate the path. Accessible walkways are essential and need to be provided.

During roadway construction, maintaining safe transit operations is the result of good preparation rather than afterthought. Safety is the number one consideration; it requires agency coordination and the project-approved TTC Plan.

- 1) Transit agencies need to be able to continue operating as efficiently as possible by considering how existing operations will be maintained.
- 2) Transit service needs to be provided with a safe access to and from the bus stops. Consideration must be given on how to handle buses in the new detours and how to handle the guidance and access for all pedestrians to the bus stops during construction.
- 3) Notes should be included in the TTC with reference to quantities and pay items for the use of any new transit communication technology that requires its work implementation during the initial project construction phase.

The research team reviewed a vast amount of information relevant to bus stops in construction zones, which included information from national and state standards, guidelines, and reports. And although it was found that there is a great deal of information available for construction work zones, there was limited information specifically for dealing with transit stops. There are many elements missing in the existing literature, which makes it difficult for transit agencies to fully address the accessibility and safety issues of transit stops during the MOT process.

## **Bus Stop Considerations during Construction**

Bus stop considerations during construction are very important for the efficient planning and operations of the transit service during construction. They include the following: agency coordination, pedestrian access, bus stop relocation, drainage issues, bus stop and customer information, ITS technologies, and costs. The predominant mechanism for communicating transit needs during construction is included in the TTC drawings and notes. They describe how traffic will be controlled through a construction work zone.

*Agency Coordination* - Many transportation agencies are involved in the design, location, construction, and maintenance of transit facilities, including state and local agencies, regional authorities, and private sector entities. These agencies represent an extensive variety of disciplines, including permitting, transit planning, land use and development, roadway design, utilities, traffic operations, and right-of-way. Planning with these agencies to determine route locations, stop locations, and passenger access facilities can produce solutions that are most suitable and/or can accommodate all methods of travel. Therefore, good coordination and cooperation among multiple agencies is necessary during the MOT process.

*Pedestrian Access* - Pedestrian access is very important during the MOT process. Pedestrian access to bus stops needs to be clearly established to provide a safe environment on a smooth and well-marked travel path. The locations of pedestrian walkways near bus stops ensure that pedestrians are protected from tripping hazards and moving equipment. Pedestrians should not have to cross over ongoing construction areas to access bus stops. Workers need to install the necessary barriers and signs to ensure that bus stop pedestrians are well protected. Bus stops should be located to take advantage of existing sidewalks that have a safe and convenient pedestrian access pathway infrastructure.

*Bus Stop Relocation* - Bus stop relocation is simply moving a bus stop from one location to another. In the event that a bus stop relocation is required, a safe and accessible pedestrian pathway shall be provided to lead the transit patrons to the relocated bus stop. The relocated bus stop must have all the same accessibility features as the existing stop and must be designed and located in compliance with ADA and the local transportation authority standards.

Proper guidelines must be followed when choosing the location for a bus transit stop. Although the relocating transit bus stop is temporary, the factors used to build permanent bus stops must be taken into consideration. The bus stop should be located in an area that is convenient, safe, and visible to passenger.

*Drainage Issues at Bus Stops* - Many factors may decrease accessibility and safety, including construction, drainage issues, and poor maintenance. Bus stops should be regularly monitored to

ensure that they are clear of damaging issues. Drainage at bus stops is an important consideration for the accessibility and safety of transit riders. It is important that stops are not located in areas that allows for water ponding. Areas that tend to accumulate standing water should be avoided or improved.

Drainage inlet grates in pedestrian areas shall be heel-proof and non-slippery. Pedestrian walkways surfaces that become slippery when wet can be hazardous to pedestrians. A continuous handrail or pedestrian/bicycle rail on a barrier wall should be provided around stops immediately adjacent to canals. Rider safety is compromised when poor drainage and a grassy/muddy waiting area create slippery conditions.

*Bus Stop Information* - Relocation of a bus stop can generate a lot of confusion for transit patrons. It is extremely important to furnish information about the relocated bus stop in timely and effective manner. Throughout the construction period, information should be continuously displayed at the relocated bus stop. That information should include but is not limited to items such as the effective start and end date of the relocated bus stop, new system map and schedule, fare information, and contact information for engineer/contractor in charge.

*Transit Rider Information* - Before bus stops are removed due to impending construction work, transit agencies/construction companies should have in advance the affected stops posted with an informational flier. This alerts the transit customers and allows the time that is needed to receive rider comments.

The typical message for a temporary change could include the information on the tentative duration of the new traffic conditions, or of any walkway restrictions. A contact number for questions and/or for reporting hazards could be provided. Conditions that are beyond recommended standards, non-compliant, or with missing key restrictions or hazardous with non-ADA recommended elements should be reported.

Throughout the construction period, information should be displayed at the relocated bus stops providing the transit agency the opportunity to educate patrons about the bus transit services that they are providing. A public outreach campaign that targets the general public should also be a consideration. This pre-work notification in a web site or in the immediate vicinity of the relocated bus stop locations allows bus patrons to be well informed.

*ITS Technologies during Construction* - Smart work zones (SWZ) are automated systems that provide real-time information on work zone traffic conditions. Transportation agencies across the nation have deployed portable ITS technologies to monitor traffic and manage mobility and safety during construction and maintenance of highways. Portable ITS systems provide a solution for deployment, maintenance, and operation during these conditions. Most of these systems take the

form of mobile traffic monitoring and management through the use of portable sensors to collect traffic data, along with integrated portable changeable message signs (PCMS) to display speed and/or delay information in real-time. Other types of SWZ include speed advisory systems, dynamic speed limits, and automated speed enforcement. Other ITS technologies that have been used in construction projects include closed circuit television cameras (CCTV), portable dynamic message sign (PDMS), detection devices for traffic queuing and construction zones, video monitoring stations, telephone/web-based traveler information, and a traffic management center (TMC).

Transit users need to feel confident that the buses will arrive on time according to the schedule, but sometimes there are delays and buses cannot meet the schedule. This is where real-time information will be very helpful to transit riders. Real-time information gives the time or location (depending on the technology) of the bus in real-time by use of an automatic vehicle locator (AVL). This information can be accessed at bus stations, kiosks, applications, or the internet.

*Costs in Construction Work Zones* - Normal construction includes the cost of any work that is necessary to meet the requirements of the contractual documents. Contracts specify the cost to be paid, on a unit cost basis, for the quantity of work that is needed. Such costs may be generally included together in a pay item (e.g., FDOT Maintenance of Traffic pay item No. 0102- 1).

When considering transit costs in construction zones, early coordination with transit agencies can help address any issues associated with bus stops, transit service, and transit riders. Some elements that deal with providing a safe access, including ADA issues, need to be addressed early in the construction process. The costs of these elements can vary depending on site conditions, location, and other variables during the construction process.

## **Interviews and Surveys**

The research team interviewed several MOT professionals in Florida by participating in a survey. The twenty-question survey focused strictly on the safety and accessibility of transit customers at transit stops in construction zones. The research team evaluated the results and concluded that everyone has their own outlook on handling or managing maintenance of traffic projects. Below is a summary of the answers to the survey questionnaire. For additional information about the questionnaire and survey results, refer to Appendix A and Appendix B.

Transit agencies should be actively involved in the MOT process and review the construction documents and submit comments. Agencies should follow industry standards, as well as using professional judgment for the location of bus stops in construction zones. Keeping a safe, accessible, and visible stop location during construction are the utmost importance.

Both short- and long-term impacts are considered. That is why transit agencies have to be involved in the approval of the MOT, because impacts to patrons must be minimized as much as possible. Every possible effort must be made to maintain the existing transit service and be kept as close as possible to normal operating conditions. If possible, bus stops are not moved to maintain the existing service. Existing transit service should remain during construction if it can be completed without creating safety hazards to passengers in the areas of impact. If not, temporary stops and/or detours can be added.

During pre-construction, it is crucial to consider safety, accessibility, and transit operations during the MOT process. This stage includes internal meetings, site visits, meetings, and preparations for a public notice.

Bus stop relocation should be included in the contract documents. Relocating the bus stop sign, which could be done by the contractor or by the transit agencies. There are a variety of issues that need to be considered in the decisions to relocate bus stops, including location, ridership, and safety. When stop spacing is affected, resulting in a significant distance increase between stops, temporary stops may be added. If possible, these stops should be located somewhere in between.

Bus stop signs should be visible to bus drivers and follow signage rules in accordance with MUTCD. Stops not in use are commonly covered during construction. As a general rule, bus operators should be notified when stops and routes are impacted.

Transit riders are informed by different means. Most of the agencies, place notices on the stop signs or shelters. They also post information inside the buses that serve that location and post this information on their websites.

Costs can be minimized by making decisions early, so that it can be planned accordingly. They can be reduced by negotiating with contractor and or the governmental authority in charge of the project.

### **Case Study Site Visits**

Along with the interviews from the MOT professionals, the research team visited transit agencies at Tampa, Jacksonville, and Palm Beach. The visits were necessary to observe how transit services and riders were accommodated during the construction process. Most of the construction sites were unacceptable in terms of safety and accessibility issues caused by temporary disruption or relocation of bus stops. Again, this reinforces the need for guidelines or regulations on managing bus stops in or near construction zones.

After extensive research, the team concluded that there is a need for guidelines or regulations for managing bus stops during highway construction of such activities. Pedestrian access needs to be clearly designed providing a safe environment on a smooth and well-marked travel path. The level of accessibility needed for pedestrians in the TTC zone can be identified by observing existing pedestrian travel patterns prior to the start of any construction project. Better coordination and cooperation among multiple agencies is necessary as well as the use of ITS technologies to monitor traffic and manage mobility and safety. Lastly, construction projects should include all costs of maintaining passenger access to temporary bus stops within the project limits.

From the site visits, a summary of the observations are presented below:

Transit agencies should work closely with local and state jurisdictions whenever road construction affects the operation and safety of bus stops. As the construction roadwork continues, information should be provided to the transit authorities to facilitate the implementation and use of new relocated service. Good coordination must be maintained before and during construction.

Pedestrians are not to be led into conflicts with work site vehicles, or equipment, having to move through their work site. Walkways leading from and to bus stops areas should be level, and with a firm surface. When pedestrian movement is necessary through or around a work site, a separate usable footpath should be provided away from equipment, broken sidewalks or pavement, material, and any work operations. Walkways and ramps need to be provided to accommodate passengers with special needs.

There is a need for clearly delineate usable pedestrian travel paths. Pedestrians should be provided with a reasonable safe and accessible path that replicates as nearly as possible the most desirable characteristics of a sidewalk. Marked and properly designated crosswalks with stop signals and warning signs will allow pedestrians to safely cross the roadway. FHWA guidelines state that “In most cases, marked cross walks are best used in combination with other treatments”. This indicates that each case should be carefully studied. A detailed engineering analysis can help determine the appropriate combination of treatments.

The flag stop is a system that allows passengers to wait along the side of the road at other convenient locations that may not be designated for bus stops. Transit agencies allowing the use of flag stops develop specific policies for drivers and passengers to use to determine when and where it is safe to pick up or discharge passengers at those locations.

A continuous handrail or pedestrian rail fence or a barrier wall needs to be provided around bus stops immediately adjacent to canals, steep slopes, drainage, dangerous drop offs, or conditions that affect the safety of the bus patrons.

Visual obstructions that impair the ability of drivers to see the pedestrians at the bus stops should be avoided. Bus stop locations can impact the safety of pedestrians. High-visibility pedestrian warning signs will increase drivers' awareness of pedestrians, especially in high-speed and volume areas where pedestrians may not be expected.

## 9 RECOMMENDATIONS

Based on the findings from the literature review, interviews, and site visits, the best practices in managing transit stops in construction zones can be summarized in the five items below.

### *Agency Coordination*

Managing construction work zones effectively requires the coordination of a number of agencies and other stakeholders. When transit elements are involved, they need to consider the following: transit needs, maintenance of transit operation, how to handle buses, and where the existing bus operations is to be maintained. Therefore, transit agencies should work closely with local and state jurisdictions whenever road improvements affect the safety of bus stops. Many transportation agencies are involved in the design, location, construction, and maintenance of transit facilities. These agencies represent an extensive variety of disciplines, including permitting, transit planning, land use and development, roadway design, utilities, traffic operations, and right-of-way. Planning with these agencies to determine route locations, stop locations, and passenger access facilities can produce solutions that are most suitable and/or can accommodate all methods of travel. Incorporating bus stop accommodations and relocations as part of the highway project advance planning increases the safety awareness.

### *Alternative Routes and Public Information*

In some cases, due to the construction conditions, there is a need to create detours with temporary stops. They require particular attention in the how to handle the guidance and access for all pedestrians to the bus stops. Temporary stops must include information regarding affected routes, construction activities, and contact information. Alternative routes should be monitored by the responsible jurisdiction or the transit agency to ensure an efficient level of service.

The use of ITS technologies, such as electronic messaging and real-time bus information, benefits both the local agencies and the transit users. With the help of ITS technology, agencies can better monitor and manage construction zones. Users will benefit from the enhanced service and information provided.

Public announcements regarding affected routes and construction activities can help the transit riding public.

### *Pedestrian access*

Special consideration must be given to the pedestrian's access and safety when the work area encroaches upon a sidewalk, pedestrian walkway or crosswalk. A maximum effort must be made

to provide and maintain an accessible, safe, clearly defined and convenient pedestrian way separated from the work area.

Construction zones need to consider ADA requirements. Agencies should follow the ADAS, FDOT Design Standards and PROWAG. They require an accessible approach to bus stop boarding and alighting areas. Surfaces shall be firm, stable, and slip-resistant when dry and when wet, and follow surface slope and cross slope that meets criteria. Bus stop locations must connect to streets and sidewalks and must have maneuvering space, and non-blocked space for people in wheelchairs.

### *Bus stop relocation*

As part of a construction project, it may be necessary to relocate bus stops from time to time or suspend service at some stops. Avoid locating bus stops near items that may restrict the proper movement. Look for conditions that affect the safety of the bus patrons.

Building temporary bus stop costs are related to whatever increased material usage and additional signs and signals are required for its safety and operational improvement. This should be explored on a project-by-project basis. Payment will include furnishing, hauling and placing all materials with the labor and incidentals that are necessary to complete the work.

Double-sided signs must be provided, as they can assist transit patrons with the location of the new bus stop location. Signs should provide visibility from both directions and must be reflectorized or illuminated for nighttime use.

### *Construction schedule*

When is the best time to conduct the construction activities? What happens if it is a long-term construction? How about the implications to construction cost related to varying timelines?

Project development is a process that involves identifying and evaluating alternatives in a preliminary design long before the final design is prepared for construction.

The bus stops should be identified on the project's general concept temporary traffic control study of construction activities.

In considering this request for a simple context sensitive solution, the best option is to select our "safety" duty as the most meaningful of all of the continuous activity, the most pertinent responsibility at hand. The safe and efficient flow of traffic through work zones is a major concern to transportation officials, industry, the public, businesses, and public bus transit carriers.

Project staff should be able to measure the safety accessibility progress much better over a long-term construction period than a short one. Time allows for identifying the existing pedestrian infrastructure needs over a range of varying conditions.

Incorporating bus bays or pull-off bays efficiently where it is possible in the work, to maintain an open lane of service, is better than using the normal side curb bus stop service. This work can be handled better in a long-term project.

Curb side bus stop service has conflicts with lane capacity considerations when the work activity operating system is not handled in the off-peak hour service time. This work can be handled better in off-peak hours.

The use of a long-term performance-type results-based contract that encompasses the routine maintenance of the bus stops, while the roadway construction is taking place, requires less time for safety inspections than any short-term contract. For short-term fast-moving contracts, it may be easier to provide a bus traffic detour.

The following list contains recommendations for coordination, techniques, and ITS technologies, which can be used to better manage transit stops during construction activities. They can be considered on a case-by-case basis.

- a) Communicate and coordinate with transit agencies to find a viable solution for maintaining a safe access to the bus stop during construction.
- b) Follow transit elements steps included in the FDOT TTC Plan Development Topic #625-000-007, which cover maintaining transit operations in the construction areas.
- c) Consider relocating bus stops when buses impede the traffic flow and when safety is questionable for bus riders.
- d) Provide enough room for boarding and alighting activities.
- e) Adequate lighting has to be provided.
- f) Maintain adequate lane width, following FDOT standards.
- g) At bus stops, remove obstructions that impact the safe bus operation and the access of transit riders.
- h) Provide safe access to bus stops and buses for passengers with disabilities.

- i) Eliminate situations where transit passengers and pedestrians could be led into conflict with work site activities.
- j) Find the safest location for bus stops.
- k) Protected passenger crosswalks need to be provided, depending on the road condition.
- l) Maintain good drainage conditions for access paths and bus stops.
- m) Consider using ITS technologies like closed circuit television cameras (CCTV), portable dynamic message sign (PDMS), detection devices for traffic queuing and construction zones, video monitoring stations, and telephone/web-based traveler information.

Appendix C presents a checklist that was prepared by the research team to assist with bus stop issues in highway construction work zones. The checklist can be used as a guideline for the different phases of the MOT work. This can be useful to designers, contractors, project engineers, transit staff, etc., who deal with transit stops in the construction zone.

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# **Appendix A:**

## **Survey Questions**

Dear Participant,

We sent out an email a few months ago about the Maintenance of Traffic (MOT) project. As you may recall, the main goal of this project is to provide transit agencies with guidelines for managing transit stops adjacent to construction zones. The focus will be on the safety and accessibility of transit customers. Furthermore, the ending product can be useful for transit agencies in the planning, design, and implementation of transit facilities during the MOT process. It will also facilitate the coordination of transit agencies with highway and traffic engineers and construction managers.

Below, you will find twenty (20) questions that can help with the MOT project. Please answer these questions to the best of your knowledge. You can use this email or the attached Word document to provide the answers. If possible, please return this questionnaire by the end of this month or let us know if you need more time. If you have any questions, please do not hesitate to send an email.

We greatly appreciate your assistance on this important project. Thank you once again.

### **Maintenance of Traffic (MOT) Questions for Professionals**

1. Before construction starts, how do you plan the accessibility and safety of transit riders?
2. What documents/manuals/reports do you use as guideline?
3. How do you inform transit riders of temporary closure and/or relocation of bus stops before construction starts?
4. If bus stop spacing is affected during construction, how do you plan for this?
5. If a sidewalk is included in the construction phase, how do you accommodate people with disabilities?
6. How do you determine where the stop will be located during construction and how passengers will access the stop?
7. If a bus stop needs to be relocated as a result of a new construction, how do you determine the cost of removing and relocating the bus stop?

8. How do you minimize the costs of construction near or on transit stops?
9. When relocating a bus stop, will it be visible to bus drivers?
10. How do you provide transit drivers clear directions to understanding the construction zone?
11. How do you notify pedestrians and riders of the new stop locations and access points?
12. What happens if the construction zone is near or in front of an area with high passenger activity?
13. If possible, can construction be done at night or weekends to reduce the impact on transit riders? If not, can it be done during periods of low traffic volumes?
14. What are the decisions taken to relocate and re-design bus stop placement during design and construction?
15. What efforts are used to maintain existing transit service?
16. Do you consider the level of service that is needed and what can be realistically provided?
17. Have you consider short-term and long-term impacts?
18. What are the considerations you use for safety, accessibility, and visibility of stops during construction?
19. Any comments on the approval process?
20. Do you have any other comments or suggestions regarding this project?

# **Appendix B:**

## **Survey Responses**

## **11/19/2013 - Andy Rodgers Responses from JTA:**

**1. Before construction starts, how do you plan the accessibility and safety of transit riders?**  
Public notice, internal meetings with safety officer and other key staff, site visits, preconstruction meeting with key personnel (internal and contractors) etc.

**2. What documents/manuals/reports do you use as guideline?**  
FDOT, AASHTO, JTA Mobility Handbook, City standards, general requirements in contract documents

**3. How do you inform transit riders of temporary closure and/or relocation of bus stops before construction starts?**

We post signs in the impacted shelters 7 days in advance of a closure, informing customers of the closure, as well as information about the closest stop and/or route change information.

**4. If bus stop spacing is affected during construction, how do you plan for this?**  
If a stop closure results in significant distance between stops, we add a temporary stop somewhere between, when possible.

**5. If a sidewalk is included in the construction phase, how do you accommodate people with disabilities?**

Create an alternate path, or direct them to the closest open sidewalk through signage.

**6. How do you determine where the stop will be located during construction and how passengers will access the stop?**

If another stop is within a short walking distance of the impacted stop, we typically direct them to that stop. If the next stop is far away, we attempt to add a temporary stop as close to the impacted stop as possible. When the construction limits make this impossible, we have to direct them to the closest available stop. In some cases, we have to create a bus detour, with temporary stop(s) on those streets.

**7. If a bus stop needs to be relocated as a result of a new construction, how do you determine the cost of removing and relocating the bus stop?**

We typically have our bus stop maintenance crew move signage. If a shelter is involved, we use our existing shelter installation and maintenance contract, which has predetermined line item costs. We typically refrain from having the contractor of the construction project complete this work, due to issues with scheduling and damages that occurred in previous incidents where that happened.

**8. How do you minimize the costs of construction near or on transit stops?**

If the impacted stop does not have a shelter, costs are very low (moving signage). When possible, we leave amenities in place at the location of impact, with signage and other measures (caution tape, etc.) to close the stop. Temporary stops are very simplistic (no shelter, few, if any, amenities).

- 9.** When relocating a bus stop, will it be visible to bus drivers?  
All drivers are notified through “all calls” and postings in the drivers’ lounge area when stops and routes are impacted.
- 10.** How do you provide transit drivers clear directions to understanding the construction zone?  
Responsibility of the contractor completing the work. If the project is a JTA project, all signage is required to meet MUTCD, as well as FDOT and/or COJ requirements.
- 11.** How do you notify pedestrians and riders of the new stop locations and access points?  
Signage at the impacted stops, notice on website and social media. If severe detours are involved, External Affairs team works with local media to provide further notices.
- 12.** What happens if the construction zone is near or in front of an area with high passenger activity?  
Additional measures are taken to minimize impacts, including provide safe access for the stop to remain, when possible. If this is not possible, the stop may be relocated a short distance away, detours may be involved to a close side street, etc. Additionally, restrictions may be placed on when the contractor can complete work (non-peak hours, etc.)
- 13.** If possible, can construction be done at night or weekends to reduce the impact on transit riders? If not, can it be done during periods of low traffic volumes?  
Sometimes. See #12 above.
- 14.** What are the decisions taken to relocate and re-design bus stop placement during design and construction?  
Primarily ridership numbers. If a stop is a high-ridership stop, it will be relocated. If it is very low ridership, it may be closed without relocation during construction.
- 15.** What efforts are used to maintain existing transit service?  
Existing transit service remains when construction can be completed without creating safety hazards to passengers in the areas of impact. If not, temporary stops and/or detours are added.
- 16.** Do you consider the level of service that is needed and what can be realistically provided?  
Yes
- 17.** Have you consider short-term and long-term impacts?  
Yes
- 18.** What are the considerations you use for safety, accessibility, and visibility of stops during construction?  
FDOT, AASHTO, City standards, general requirements in contract documents, previous experience.
- 19.** Any comments on the approval process?  
When other agencies are completing construction, we request they submit plans to us for review. When we receive plans, we submit comments to them. Most agencies are good about including

us during the review process, and adding notes with information for the contractor to contact us prior to impacting a stop.

**20.** Do you have any other comments or suggestions regarding this project?

No

## **12/2/2013 – Keven Belanger Responses from FDOT:**

- 1.** Before construction starts, how do you plan the accessibility and safety of transit riders? In the planning stages, the transit agency is contacted and stops are moved or changed as needed, and during construction these locations are monitored for safety, operation and ADA compliance.
- 2.** What documents/manuals/reports do you use as guideline? The FDOT uses PROWAG, the Designs Standards, and the Plans Preparation Manual with reliance on transit agency expertise.
- 3.** How do you inform transit riders of temporary closure and/or relocation of bus stops before construction starts? Based on construction work, spacing, walkability, and ADA compliance.
- 4.** If bus stop spacing is affected during construction, how do you plan for this? Coordination with the transit agency is required to meet the construction and user needs.
- 5.** If a sidewalk is included in the construction phase, how do you accommodate people with disabilities? Comply with ADA criteria like providing detours and ADA complaint ramps, routes and notification to the public and transit agency.
- 6.** How do you determine where the stop will be located during construction and how passengers will access the stop? Based on the construction needs, user needed routes and practicality with expertise from the transit agency.
- 7.** If a bus stop needs to be relocated as a result of a new construction, how do you determine the cost of removing and relocating the bus stop? By using the FDOT's Basis of Estimates, engineer calculates the cost of the work.
- 8.** How do you minimize the costs of construction near or on transit stops? By closing the stop or reduce the impacts of rebuilding needed for ADA compliance.
- 9.** When relocating a bus stop, will it be visible to bus drivers? Yes.
- 10.** How do you provide transit drivers clear directions to understanding the construction zone? That's usually up to the transit agency and/or pre-construction communication.
- 11.** How do you notify pedestrians and riders of the new stop locations and access points? That's usually up to the transit agency and/or pre-construction communication and public notification of construction.
- 12.** What happens if the construction zone is near or in front of an area with high passenger activity? Monitor for operation.

- 13.** If possible, can construction be done at night or weekends to reduce the impact on transit riders? If not, can it be done during periods of low traffic volumes? Not usually, but it's really up to the construction contractor's willingness to cooperate within the contract documents.
- 14.** What are the decisions taken to relocate and re-design bus stop placement during design and construction? Depends on transit agency's input, and impact, and user volume.
- 15.** What efforts are used to maintain existing transit service? Try to keep open or arrange for use during construction.
- 16.** Do you consider the level of service that is needed and what can be realistically provided? Yes.
- 17.** Have you consider short-term and long-term impacts? Yes, but rely on the transit agency's input and needs.
- 18.** What are the considerations you use for safety, accessibility, and visibility of stops during construction? Based on the transit's criteria, engineering/industry judgment/practice, and feasibility.
- 19.** Any comments on the approval process? Get everyone involved early and have reasonable expectations.
- 20.** Do you have any other comments or suggestions regarding this project? No.

## 12/2/2013 – Jacqueline Hriljac Responses from Palm Tran:

1) We attended a preliminary meeting to know... who, when, where and for how long. When we know the people involved in the project, we provide them with our requirements:

It is Palm Tran's desire and a Federal requirement that all bus stops that are part of any reconstruction be made ADA accessible. We need 2 weeks' notice of any bus stop or street closure. No more than two consecutive bus stops should be closed at one time. Palm Tran request the site plan, also start/finish date. A meeting on site to review the area confirms location and makes a plan for the route affected.

The goal is always making the operation as safe it possible and low impact for all the parts involved in the project (riders, construction people etc.).

We discuss with the contractor the better option to maintain what bus stops in service, in what area; that means keep the bus stop separate from the construction area. They need provide in case is needed a temporarily location following ADA requirements (Firm and stable surface etc.).

2) Our Transit Design Manual –Transit Infrastructure Punch List.

Statewide Transit Facility Standards, Criteria, and Guidelines. Final report January 2011

2008 Accessing Transit Design Handbook for Florida Bus Passenger Facilities Version 3.

FDOT District 4 "Transit Guidelines (version 3)

2010 ADA Standards for Accessible Design

3) The Marketing DPT make "Costumer Notices" and placed on buses and we can attach "Costumer Notices" to bus stop signs to.

4) If the bus stop will be affected with big machinery working around the area and the location will be block with materials and people working, we can determine the location is not safe for people standing there. Then we can bag the bus stop sign or removed the bus stop sign witch ever is needed. If the next bus stop will be affected to; at same time the next step is found immediately after of the affect area a safe location for a temporarily bus stop. Check on the manual for how to establish a bus stop.

5) The contractor shall provide the boarding @ alighting area with a firm stable surface.

The Boarding and alighting area shall provide a **clear length** of 96 inches (2440 mm) minimum, measured perpendicular to the curb or vehicle edge, and a **clear width** of 60 inches (1525 mm) minimum, measured parallel to the vehicle roadway. Boarding and alighting area shall be connected to streets, sidewalks, or pedestrian paths by an **accessible route** consisting of the following components:

- a) Walking surfaces with a running slope not steeper than 1:20,
- b) Walking surface with a cross slope not steeper than 1:48,
- c) Walking surface with a minimum clear width of 36 inches (915 mm),

- d) Walking surface with a minimum 60 inch (1525 mm) passing space at minimum intervals of 200 feet (61 m),
- e) Walking surface 180 degree turn with a minimum 48 inch (1220 mm) clear width,

Reference Federal ADA of 1990, as amended, and all regulations issued related thereto, including but not limited to 49 CFR Part 37, Appendix A. Minimum ADA BUS STOP requirements as outlined in paragraph 810.2

**6)** The bus stop (sign) is in place before the construction start, the bus stop will stay if the bus stop can be separate with barriers from the construction area with enough space for people waiting safely for the bus and the accessible route can be maintained (or create if needed) separated to and free of obstruction); and the bus can safety access the bus stop. If you are looking for a temporarily bus stop, you look for the same attributes plus more that can help. Like, existing traffic light, signals at the area.

**7)** Cost born by FDOT, PBC, or Municipality. (On Accessing Transit Design Handbook for Florida check on appendix /K page-146.

**8)** Negotiations with contractor and or governmental authority

**9)** The sign mark the Bus stop; the sign must be visible and must follow the rules. You will found locations that will make these rules hard to accomplish. You can found the rules on the manuals that we mentioned in the questions #2 and in accordance with MUTCD.

**10)** With “Drivers Notice” that show maps with the area affect describing the route they must fallow when they approach to the area; can be placed on the board usually the Transit Company have a designated board for this notices and other information they used to communicate different topics to the employs. On the street, the contractor will make prevision to signaling the area.

**11)** Proper used of the signage (example: bus stop sign) and other pedestrian guidance (example: fencing barriers) are necessary to ensure that and accessible circulation path is maintained.

**12)** The concept is the same you must provide a safety location between the construction area for the public, if you cannot ensure that, you must temporarily close the bus stop and establish a temporarily bus stop a near is possible to reduce the inconvenience for the public. A detour can be planned to. Evaluate all aspects in advance to better decide the best way to minimize the impact for all the parties.

**13)** Yes, some construction is done in night or weekends.

**14)** You can moved a bus stop if you can improved the original location, with better location or better amenities or more safety .Only if will by a benefits for the public, and the service and with consideration of what is existing at the area.

**15)** All efforts, meet with contractor make requirements to improve what is needed for the construction area affected. Sometimes detours

**16)** Yes we collect AVAIL data and we are available to know how many people used our stops.

**17)** Yes, and we used the data we have available to take decision.

**18)** Consideration to improve the accessibility during construction Traffic Signals, Sign Post, Barriers, Pavement Marking, Walking Surface, Pedestrian Crossing, Street Light, safe distances for arriving or departing buses, bike lanes if they are at the area.

**19)** I not have very much knowledge about permits , but maybe will by a challenge if you need to install many signs for maybe an extended route and you need place the signs on a certain date and you don't know if you will have the approvals on time.

**20)** In the beginning is hard for a person who not has experience on Construction or Transit choose a safety location for buses and people without guide. There is a punch list for establish a bus stop, but in the beginning people don't realize they can used some important information from that list to establish the bus stop on the construction area to. A separate punch list for construction I think can help a lot. Training videos showing different situations that are common in areas of construction and how to solve them.

## **2/6/2014 – Arethia Douglas Responses from BCT:**

- 1.** Before construction starts, how do you plan the accessibility and safety of transit riders? During the pre-construction meeting a temporary bus stop location is selected outside of the construction area.
- 2.** What documents/manuals/reports do you use as guideline? FDOT Specifications and Guidelines are followed.
- 3.** How do you inform transit riders of temporary closure and/or relocation of bus stops before construction starts? Decals are placed on the affected bus stop
- 4.** If bus stop spacing is affected during construction, how do you plan for this? Stops are temporarily relocated to avoid the spacing issue
- 5.** If a sidewalk is included in the construction phase, how do you accommodate people with disabilities? A temporary access is provided
- 6.** How do you determine where the stop will be located during construction and how passengers will access the stop? A pre-construction meeting is held and a location identified for the bus stop and access determined.
- 7.** If a bus stop needs to be relocated as a result of a new construction, how do you determine the cost of removing and relocating the bus stop? Bus stop relocation is included in the Bid or in the cost of the project.
- 8.** How do you minimize the costs of construction near or on transit stops? By designing the most efficient improvement that meets the guidelines.
- 9.** When relocating a bus stop, will it be visible to bus drivers? YES
- 10.** How do you provide transit drivers clear directions to understanding the construction zone? All work is done under an approved MOT, which is set up when construction is ongoing.
- 11.** How do you notify pedestrians and riders of the new stop locations and access points? No formal notification in place
- 12.** What happens if the construction zone is near or in front of an area with high passenger activity? Stop is temporarily relocated and contractor is asked to provide adequate workers to ensure safety at all times
- 13.** If possible, can construction be done at night or weekends to reduce the impact on transit riders? If not, can it be done during periods of low traffic volumes? Work is done during the allowable hours as per the approved MOT
- 14.** What are the decisions taken to relocate and re-design bus stop placement during design and construction? Bus stops are only relocated if designing and construction is not feasible ta the existing location.
- 15.** What efforts are used to maintain existing transit service? Bus stops are rarely moved so as to maintain the existing service

- 16.** Do you consider the level of service that is needed and what can be realistically provided?  
Yes. With cost and feasibility been considered
- 17.** Have you consider short-term and long-term impacts? YES
- 18.** What are the considerations you use for safety, accessibility, and visibility of stops during construction? Relocation of bus stops to an area safely outside of the construction zone.
- 19.** Any comments on the approval process? NO
- 20.** Do you have any other comments or suggestions regarding this project? NO

## **2/7/2014 – Kevin Hoyt Responses from Manatee County Public Works:**

- 1.** Before construction starts, how do you plan the accessibility and safety of transit riders? We plan for using well-lit areas as well as tying into sidewalks or accessibility areas.
- 2.** What documents/manuals/reports do you use as guideline? We have designed typical for bus stop improvements.
- 3.** How do you inform transit riders of temporary closure and/or relocation of bus stops before construction starts?\_We place information to the web site as well as placing notices on bus stop poles. These notices are installed two weeks prior to construction.
- 4.** If bus stop spacing is affected during construction, how do you plan for this?\_We use temporary locations nearest to each bus stop.
- 5.** If a sidewalk is included in the construction phase, how do you accommodate people with disabilities?\_We use FDOT index 660
- 6.** How do you determine where the stop will be located during construction and how passengers will access the stop? If you have working APC you would use this software. Automated Passenger Counters
- 7.** If a bus stop needs to be relocated as a result of a new construction, how do you determine the cost of removing and relocating the bus stop?\_Relocating bus stops are done with house staff personnel
- 8.** How do you minimize the costs of construction near or on transit stops? You tie into the closest curb to sidewalk area
- 9.** When relocating a bus stop, will it be visible to bus drivers? Yes
- 10.** How do you provide transit drivers clear directions to understanding the construction zone? It's all in FDOT Index 660
- 11.** How do you notify pedestrians and riders of the new stop locations and access points? Signage displayed on website and bus stop poles
- 12.** What happens if the construction zone is near or in front of an area with high passenger activity?\_You provide proper MOT maintenance of traffic
- 13.** If possible, can construction be done at night or weekends to reduce the impact on transit riders? If not, can it be done during periods of low traffic volumes? Depending on contract you have with vendor, but night time construction costs twice the amount due to plant opening fee's as well as overtime for contractors
- 14.** What are the decisions taken to relocate and re-design bus stop placement during design and construction?\_Safety and location
- 15.** What efforts are used to maintain existing transit service? All efforts

**16.** Do you consider the level of service that is needed and what can be realistically provided?  
Yes

**17.** Have you consider short-term and long-term impacts? Yes

**18.** What are the considerations you use for safety, accessibility, and visibility of stops during construction? These aren't so much as considerations but common sense while construction is taken place for any kind. MOT is planned and required by FDOT, when using the proper index codes these are all accomplished.

**19.** Any comments on the approval process? No

**20.** Do you have any other comments or suggestions regarding this project? No

## **2/19/2014 – Jim Lewis Responses from Bergmann Associates**

- 1.** Before construction starts, how do you plan the accessibility and safety of transit riders? We contact Palm Tran in Palm Beach County and review bus stop locations compared to MOT Plans and contract schedule and coordinate a workable plan to maintain or relocate access for public transit.
- 2.** What documents/manuals/reports do you use as guideline? We use MUTCD chapter 6, FDOT Design Standards section 600, the contract MOT plans and FDOT form 700-010-08 MOT review form
- 3.** How do you inform transit riders of temporary closure and/or relocation of bus stops before construction starts? Each week the FDOT PIO officer issues a weekly traffic report and we put a written message on existing bus stop signs to direct a changed location or closure.
- 4.** If bus stop spacing is affected during construction, how do you plan for this? We try to keep as many stops as originally available or we notify citizens as noted in item 3 above.
- 5.** If a sidewalk is included in the construction phase, how do you accommodate people with disabilities? We maintain an alternative route if necessary with permanent or temporary ADA access.
- 6.** How do you determine where the stop will be located during construction and how passengers will access the stop? We ask the transit authority to work with us on this issue.
- 7.** If a bus stop needs to be relocated as a result of a new construction, how do you determine the cost of removing and relocating the bus stop? We've not ever been charged for relocation.
- 8.** How do you minimize the costs of construction near or on transit stops? Please see item 7.
- 9.** When relocating a bus stop, will it be visible to bus drivers? Yes and when coordinating with the transit authority we ask them to notify their drivers of changes approved by the authority.
- 10.** How do you provide transit drivers clear directions to understanding the construction zone? See Item 9. Also we try to maintain clear path for all motorists through the construction zone or if a detour is necessary.
- 11.** How do you notify pedestrians and riders of the new stop locations and access points? Please see item 3 and item 4.
- 12.** What happens if the construction zone is near or in front of an area with high passenger activity? We attempt to provide a safe area for people to congregate
- 13.** If possible, can construction be done at night or weekends to reduce the impact on transit riders? If not, can it be done during periods of low traffic volumes? Night and weekends are not necessarily convenient or safe for residents and business owners – when they are, night and weekend work is usually specified in the plans. In some cases periods of high traffic volume are excluded from permissible working hours.

- 14.** What are the decisions taken to relocate and re-design bus stop placement during design and construction? Please see the previous answers.
- 15.** What efforts are used to maintain existing transit service? All efforts possible.
- 16.** Do you consider the level of service that is needed and what can be realistically provided? That's up to the transit authority and we attempt to accommodate their normal level of service.
- 17.** Have you consider short-term and long-term impacts? Yes.
- 18.** What are the considerations you use for safety, accessibility, and visibility of stops during construction? We try to maintain the same level of safety, accessibility and visibility as in non-construction areas or we ask the transit authority to move the stop.
- 19.** Any comments on the approval process? On our most recent project in Riviera Beach we attempted to use an ADA accessible ramp and FDOT was very concerned about crash testing. All of the materials used to construct the ramp/stops were of un-pressure treated lumber with less than 2X4 thickness. MOT reviewers at the State Construction Office level found these installations unacceptable. We believe that they are being evaluated by FIU at this time. Hopefully a suitable device can come from our efforts in the future.
- 20.** Do you have any other comments or suggestions regarding this project? No

### **3/10/2014 – Dan Rodriguez Responses from HART**

Just so that we are clear, nearly all projects requiring substantial MOT or lane and street closures are done by the owners of the right of way.

**1. Before construction starts, how do you plan the accessibility and safety of transit riders?**

It is the responsibility of the Department/County/City or project owner to ensure that the contractor awarded the project is aware that there is transit present and that the project creates the least amount of impact as possible.

**2. What documents/manuals/reports do you use as guideline?**

Current FDOT standards for pedestrian MOT should suffice

**3. How do you inform transit riders of temporary closure and/or relocation of bus stops before construction starts?**

It is the responsibility of the Department/County/City or project owner to ensure that the contractor awarded the project notifies the Transit Authority with sufficient time, that the Authority will notice the bus stops affected and place notices on the buses on that route.

**4. If bus stop spacing is affected during construction, how do you plan for this?**

Working with the contractor the Authority's maintenance department provides temporary signage that can be moved easily.

**5. If a sidewalk is included in the construction phase, how do you accommodate people with disabilities?**

That is the responsibility of the Department/County/City or project owner contractor to provide a safe passage through or around the work area with proper signage.

**6. How do you determine where the stop will be located during construction and how passengers will access the stop?**

Stop location is determined by what trip generators are at that location, preferably stops are placed far side of intersection, but depending on intersection characteristics may be located near side or even mid-block if necessary.

**7. If a bus stop needs to be relocated as a result of a new construction, how do you determine the cost of removing and relocating the bus stop?**

Cost of relocating the stop is quite minimal especially if it is only relocating the bus stop sign, which can be done by the contractor since they would have an open sunshine ticket for their work zone. Now if a shelter would have to be removed temporarily during construction then the Authority or the Authority's shelter advertiser would remove it at its (their) expense, with the hope that a new pad would be placed elsewhere for the placement of that shelter later during the project closeout.

**8. How do you minimize the costs of construction near or on transit stops?**

By making decisions early so that it can be planned accordingly. If new construction of a bus stop is required, that it be included as part of the project by the project owner, so that the

construction can benefit from the economies of scale, and existing mobilization and MOT expenses.

**9.** When relocating a bus stop, will it be visible to bus drivers?

Yes, the authority places bright orange bags over the stops not in use and places standard bus stop signs at the temporary stops during construction.

**10.** How do you provide transit drivers clear directions to understanding the construction zone?

A notice is placed in the drivers' room as well as flyer placed in the drivers mailboxes that normally serve that route.

**11.** How do you notify pedestrians and riders of the new stop locations and access points?

The old stops have flyers with removal dates and stop relocation directions. Announcements are made to patrons on effected routes.

**12.** What happens if the construction zone is near or in front of an area with high passenger activity?

The Authority would expect the contractor to provide access to this stop or relocate it to a very ADA accessible point nearby.

**13.** If possible, can construction be done at night or weekends to reduce the impact on transit riders? If not, can it be done during periods of low traffic volumes?

The Authority would prefer that construction on Transit routes be done during off peak hours, so that very little disruption occurs during high volume times.

**14.** What are the decisions taken to relocate and re-design bus stop placement during design and construction?

Spacing, ridership, and existing as well potential future trip generators.

**15.** What efforts are used to maintain existing transit service?

Every possible effort is to maintain the route on its current route and service to be kept close to normal conditions as possible.

**16.** Do you consider the level of service that is needed and what can be realistically provided?

In this case, routes will most likely be existing, so level of service would have already been predetermined for some time.

**17.** Have you consider short-term and long-term impacts?

Both short and long-term impact are considered, that is why the Transit Authority has to be involved in the approval of the MOT because they need to minimize the impact to patrons as much as possible.

**18.** What are the considerations you use for safety, accessibility, and visibility of stops during construction?

Safe and clearly visible stop locations during construction are the utmost importance. The contractor is responsible for the right of way during construction, which would include boarding and alighting areas at bus stops either at existing locations or at relocated areas.

**19.** Any comments on the approval process?

MOT should be approved by the Transit Authority's operation department for access and stop locations.

**20.** Do you have any other comments or suggestions regarding this project?

No

# **Appendix C:**

## **MOT Checklist**

## MOT CHECKLIST

To assist with bus stops issues in highway construction work zones, the following checklist can be used during the construction process to verify that key elements are not ignored.

Check	Description
<input type="checkbox"/>	Check that all bus stops and transit issues are clearly been identified early enough in the coordination process.
<input type="checkbox"/>	Verify that safe access is being provided to bus stops during construction.
<input type="checkbox"/>	Review the guidelines in the TTC documents, drawings, and notes (TTC Plan Development Topic #625-000-007).
<input type="checkbox"/>	Evaluate the conditions of the bus stop for the accessibility to all, including people with disabilities, during construction.
<input type="checkbox"/>	Assess the impacts of road conditions that may restrict the proper movement of transit vehicles.
<input type="checkbox"/>	If a transit stop or route needs to be relocated or re-routed, appropriate notifications needs to be sent to the public with sufficient time.
<input type="checkbox"/>	Conditions that are beyond recommended standards or non-compliant need to be reported to the leading agency. Particular attention must be paid to missing transit elements, hazardous conditions, and ADA issues.
<input type="checkbox"/>	Recommend a safe and accessible path to and from the bus stop.
<input type="checkbox"/>	Temporary bus stops should be located in a safe location.
<input type="checkbox"/>	Crosswalks and stops located in dangerous construction zones with high transit patronage should be protected to ensure the safety of transit riders. Crosswalks must be clearly marked and provide a safe pathway to transit riders.
<input type="checkbox"/>	Construction zones that include bus stops need to consider passenger loading and waiting areas with an accessible sidewalk or pedestrian path.
<input type="checkbox"/>	Avoid locating a stop close to areas with standing water due to poor drainage.
<input type="checkbox"/>	Ensure that a safe environment is being provided for transit riders and transit operations.
<input type="checkbox"/>	Bus stop signs must be visible and clear of obstructions to assist passengers and bus operators.
<input type="checkbox"/>	Bus stop signs must provide route information for that particular location and display transit information such as telephone number and web site.
<input type="checkbox"/>	Where needed, provide lighting at bus stops for security reasons.
<input type="checkbox"/>	Avoid placing temporary stops in conflict with businesses or residential driveways.
<input type="checkbox"/>	Collaboration between the contractor and transit agency is important for the relocation of bus stops and other transit elements during construction.
<input type="checkbox"/>	Verify that TCP documents comply with all ADA requirements.