### G.1.b Midblock Crosswalks

Midblock crosswalks facilitate crossings to places that people want to go but that are not well served by the existing sidewalk or path network. These pedestrian crossings commonly occur at schools, parks, museums, waterfronts, and other destinations. Designers should study both existing and projected pedestrian volumes in assessing warrants for midblock crossings to account for latent demand.

Midblock crossings are located according to a number of factors including pedestrian volume, traffic volume, roadway width, traffic speed and type, desired paths for pedestrians, land use, and to accommodate transit connectivity. Midblock crossings should not be installed where sight distance or sight lines are limited for either the motorist or pedestrian.

Midblock crossings should be marked and signed in accordance with the ***MUTCD***. See Figure 8 – 6 Raised Midblock Crosswalks for an example of a midblock crosswalk.

**Figure 8 – 6 Raised Midblock Crosswalk**

Suwannee Street, Tallahassee, Florida

Crosswalks may be supplemented with Pedestrian Hybrid Beacons (PHB) or Rectangular Rapid Flashing Beacons (RRFBs). Illumination should be evaluated if night-time pedestrian activity is expected. See ***Chapter 6 – Lighting*** for further information.

A PHB is a special type of beacon used to warn and control traffic at an unsignalized location to assist pedestrians in crossing a street or highway at a marked crosswalk. ***Chapter 4F. Pedestrian Hybrid Beacons, MUTCD*** provides additional information regarding their installation. See Figure 8 – 7 Pedestrian Hybrid Beacon for an example of a pedestrian hybrid beacon.

## Figure 8 – 7 Pedestrian Hybrid Beacon (PHB)

16th Street South, St. Petersburg, Florida

The RRFB uses rectangular-shaped high-intensity LED-based indications, flashes rapidly in a wig-wag "flickering" flash pattern, and is mounted immediately between the crossing sign and the sign's supplemental arrow plaque. Use of PHBs should be limited to locations with the most critical safety concerns, such as pedestrian and school crosswalks across uncontrolled approaches.

The use of RRFBs requires interim approval from FHWA. The ***MUTCD*** provides further information on obtaining ***interim approval*** for the use of ***RRFBs.*** See Figure 8 – 8 Pedestrian Median Refuge with Rectangular Rapid Flashing Beacon for an example of a Rectangular Rapid Flashing Beacon (RRFB).

## Figure 8 – 8 Pedestrian Median Refuge with Rectangular Rapid Flashing Beacons (RRFB)


4th Street North, St. Petersburg, Florida

### G.2 Curb Ramps and Blended Transitions

A continuous accessible pedestrian route, including curb ramps and blended transitions is needed along pedestrian networks. Blended transitions are raised pedestrian street crossings, depressed corners, or similar connections between pedestrian access routes at the level of the sidewalk or shared use path and level of the pedestrian street crossing that have a grade of 5% or less. Blended transitions can be used when geometrics and allocated space doesn't allow for separated curb ramps.

Curb ramps shall be provided at all intersections with curb (***Section 336.045 (3), Florida Statutes)***. Each crossing should have separate curb ramps, perpendicular with the curb, and landing within the crosswalk. Include sidewalk curb ramps at the following locations:

- At curbed returns for intersections and turnouts.
- On curbed roadways between intersections where a crosswalk has been established, such as midblock crossings and side streets.

Relocate or adjust pull boxes, manholes and other types of existing surface features to meet the ADA requirements for nonslip top surfaces, ¼ inch height protrusion, and slopes flush with the surrounding surface.

On sidewalks, the curb ramp width shall be a minimum of 4 feet; curb ramp widths equal to crosswalk widths are encouraged. For shared use paths, the curb ramp shall be at least as wide as the approaching width of the path. Curb ramp slopes shall not exceed 1:12 and shall have a firm, stable, slip resistant surface texture.

Curb ramps should be in line with the crossing. At intersections where more than one road is crossed, provide separate curb ramps at both ends of each crossing. Two ramps per corner are preferred to minimize the problems with entry angle and to decrease the delay to pedestrians entering and exiting the roadway.

Crossings are required to meet the same grade and cross slope requirements as sidewalks. Where criteria for maximum cross slope of the crossing cannot be met, provide the minimum attainable cross slope. When following the profile grade of the roadway, curb ramps are not required to exceed 15 feet in length.

Curb ramps whose sides have returned curbs on the outside edges provide useful directional cues when they are aligned with the pedestrian street crossing and are protected from cross travel by a buffer area or landscaping.

Provide transition slopes (flared sides) where a pedestrian circulation path crosses the curb ramp. The maximum slope of transition slopes is 1:10, measured parallel with and adjacent to the curb line.

A turning space at least 4 feet by 4 feet wide shall be provided at the top of the curb ramp and shall be permitted to overlap other turning spaces and clear spaces. Where the turning space is constrained at the back-of-sidewalk, the

turning space shall be at least 4 feet by 5 feet. The 5-foot dimension shall be provided in the direction of the ramp run.

When altering an existing pedestrian facility and conditions preclude the accommodation of a curb ramp slope of 1:12, provide a slope from 1:12 to 1:10 with a maximum rise of 6 inches.

Further information on curb ramps, landings and blended transitions is provided in the FDOT ***Standard Plans***.

### G.3 Detectable Warnings

Install detectable warnings to cover the full width of the walking surface and 2 feet in length. They are required on sidewalks and shared use paths at the following locations:

- Curb ramps and blended transitions at street crossings
- Cut-through pedestrian refuge islands or medians six feet wide or greater
- Pedestrian at-grade rail crossings
- Commercial driveways with a stop sign, yield sign or traffic signal
- Boarding and alighting areas adjacent to the roadway at bus stops where there is an at-grade connection to the roadway
- Edges of rail boarding platforms not protected by screens or guards

Detectable warnings are not required where sidewalk intersects urban flared turnouts or sidewalks that run continuously through driveways. Do not place detectable warnings on transition slopes or over grade breaks.

The detectable warning systems on the Department's ***Approved Product List (APL)*** are designed to work with concrete surfaces. In areas where the pedestrian facility has an asphalt surface, such as a shared use path, specify an appropriate detectable warning system. In these cases, consider including a short section of concrete that will accommodate any system.

Further information on detectable warnings are provided in the FDOT ***Standard Plans***.

## G.4 Curb Extensions

Curb extensions (a.k.a., bulb-outs) may be used in conjunction with on-street parking at intersections or midblock locations where there is a crosswalk, provided there is adequate width for existing traffic movements. Curb extensions shorten the crossing distance, and provide additional space at intersections, allowing pedestrians to see and be seen before entering a crosswalk. The design of curb extensions must take into consideration the needs of transit vehicles, drainage, and bicyclists.

## G.5 Pedestrian Signals

Signs, signals, and markings should be utilized to provide the necessary information and direction for pedestrians. All directions and regulations should be clear, consistent, and logical, and should, at a minimum, conform to the requirements given in the ***MUTCD***. The installation of accessible pedestrian signals that include audible and/or vibro-tactile, and visual signals should be considered.

Where pedestrian facilities are provided or planned, include provisions (e.g., conduit, conductors, signal cables, push button pedestals, curb ramps) needed for future installation of Accessible Pedestrian Signal (APS) devices on all new and reconstructed signalized intersections and signalized crossing locations.

Provide a level landing at the base of all pedestrian pushbutton locations. The landing must provide a clear area of 30 inches by 48 inches (in either direction) directly in front of and centered on, the pedestrian pushbutton to allow persons using a wheeled mobility device to actuate the button while remaining stationary.

## G.6 Sight Distance

The general requirements for sight distances for the driver are given in ***Chapter 3 - Geometric Design***.

Stopping sight distances greater than the minimum should be provided at all pedestrian crossings. These sight distances should include a clear view of the pedestrian approach pathway. Where parallel pedestrian pathways are within the roadside recovery area, or where casual pedestrian crossings are likely, the normal required stopping sight distance should also include a clear view of the entire roadside recovery area.

Sight distances shall be based upon a driver's eye and object height as discussed in ***Chapter 3 – Geometric Design***. Due to the small size of some pedestrians (particularly children), they are generally easy to confuse with other background objects.

Parking shall be prohibited where it would interfere with the required sight distance. Particular care should be exercised to ensure ample mutual sight distances are provided at all intersections and driveways.

## G.7 Rail Crossings

Roadways, sidewalks, and shared use paths at grade may cross light rail, street car rail, passenger rail, and freight railroads. Special design considerations are needed for these pedestrian intersections so that pedestrians are warned of the crossing and potential presence of a train. In addition, these crossings have specific accessibility requirements relating to surface continuity which must be met. See ***Chapter 7 – Rail-Highway Crossings*** for further information. The ***Federal Railroad Administration*** may impose additional requirements for the design and construction of rail crossings.

## H LIGHTING

Lighting of the roadway itself is not only important for the safety of vehicular traffic, but also valuable for the protection of pedestrians. Vehicle headlamps often do not provide sufficient lighting to achieve the required stopping sight distance. Since this requirement is of vital importance at any potential pedestrian crossing point, lighting of the crossing should be considered. Lighting a street or highway is also valuable in improving the pedestrian's view of oncoming vehicles. At intersections or other locations with vehicle turning maneuvers, vehicle headlights may not be readily visible to the pedestrian.

Lighting shall be provided in pedestrian underpasses and should be considered on pedestrian overpasses. All pedestrian lighting shall be vandal resistant. The installation of daytime lighting is warranted when underpass user visibility requirements are not met with sunlight. Pedestrian underpass and overpass lighting should conform to the general lighting requirements given in the American Association of State Highway and Transportation Officials (AASHTO) Roadway Lighting Design Guide.

The general requirements for lighting on streets and highways are given in ***Chapter 6 – Lighting***. Pathways adjacent to a street or highway should not be illuminated to a level more than twice that of the roadway itself.

In general, lighting should be considered as warranted when it is necessary, at night, to provide the mutual sight distance capabilities described in the preceding ***Chapter 3 – Geometric Design***. Locations with significant night time pedestrian traffic that should be considered for lighting of the roadway and adjacent pedestrian facilities include the following:

- Any street or highway that meets the warranting criteria given in ***Chapter 6 – Lighting***
- Streets and highways with speed limits more than 40 mph that do not have adequate pedestrian conflict elimination
- Sections of highway with minimal separation of parallel pedestrian pathways
- Intersections, access and decision points, and areas adjacent to changes in alignment or cross sections
- Areas adjacent to pedestrian generators
- Transit stops and other mass transit transfer locations
- Parking facilities

- Entertainment districts, sports/recreation complexes, schools, and other activity centers generating night travel
- Pedestrian crossings
- Any location where improvement of night time sight distance will reduce the hazard of vehicle-pedestrian conflicts

See ***Chapter 6 – Lighting*** for further information on lighting of pedestrian facilities and shared use paths.

## I REFERENCES FOR INFORMATIONAL PURPOSES

- Florida Department of Transportation Transit Facility Design
  ***https://www.fdot.gov/fdottransit/transitofficehome/transitplanning.shtm/newtransitfacilitiesdesign.shtm***
- USDOT/FHWA ADA Standards for Accessible Design (ADAAG)
  ***http://www.access-board.gov/guidelines-and-standards/buildings-and-sites/about-the-ada-standards/ada-standards***
- 2006 Americans with Disabilities Act Standards for Transportation Facilities
  ***https://www.access-board.gov/files/ada/ADAdotstandards.pdf***
- 2012 Florida Accessibility Code for Building Construction
  ***http://floridabuilding.org/fbc/committees/accessibility/aac/Changes_to_Law/Florida_Accessibility_Code_2012_ICC_FINAL.pdf***
- ***AASHTO – Guide for the Planning, Design, and Operation of Pedestrian Facilities***
  ***https://store.transportation.org/***
- AASHTO – Roadway Lighting Design Guide
  ***https://store.transportation.org/***
- NACTO Urban Streets Design Guide
  ***https://nacto.org/publication/urban-street-design-guide/***
- ***Designing Walkable Urban Thoroughfares (CNU and ITE)***
  ***https://www.cnu.org/our-projects/cnu-ite-manual***
- FHWA Policy Memo for Flexibility in Pedestrian and Bicycle Facility Design
  ***https://nacto.org/wp-content/uploads/2013/09/design_flexibility_memorandum_092013.pdf***
- AASHTO Load and Resistance Factor Design (LRFD) Bridge Design Specifications, 6$^{h}$ Edition, (2012) with 2013 Interim Revisions
  ***https://store.transportation.org/***
- Federal Railroad Administration General Manual - Policies, Procedures, and General Technical Bulletins (July 2014)
  ***https://railroads.dot.gov/about-fra/about-fra***

# CHAPTER 9

## BICYCLE FACILITIES

## TABLES



## FIGURES

# CHAPTER 9

# BICYCLE FACILITIES

## A INTRODUCTION

Bicycle facilities shall be given full consideration in the planning and development of transportation facilities, including the incorporation of such facilities into state, regional, and local transportation plans, and programs under the assumption that transportation facilities will be used by cyclists. Bicycle facilities should be established in conjunction with the construction, reconstruction, or other change of any transportation facility and special emphasis should be given to projects in or within 1 mile of an urban area. The provision for bicycle facilities is also desirable for resurfacing, restoration & rehabilitation (RRR) projects.

Bicycle and pedestrian facilities are not required to be established:

1. Where their establishment would be contrary to public safety.
2. When the cost would be excessively disproportionate to the need or probable use; or
3. Where other available means or factors indicate an absence of need.

Appropriately designed and located bicycle facilities play an important role in supporting bicycle travel. Bicyclists shall be considered in all phases of transportation planning, design, construction, and maintenance activities. Emphasis should be given to new construction, reconstruction, intersection improvement, and transit projects. Bicycle facilities can include bicycle lanes, paved shoulders, wide curb lanes, shared lanes, shared use paths, and bicycle parking facilities.

In addition to the design criteria provided in this chapter, shared use paths and structures that include provisions for pedestrians shall be designed to be accessible to persons with disabilities. For more information on accessible design requirements, see Chapter 8 – Pedestrian Facilities.

## B ON-STREET FACILITIES

Provisions for bicycle traffic should be incorporated in the original roadway design. All roadways, except where bicycle use is prohibited by law, should be designed, constructed, and maintained under the assumption they will be used by bicyclists. Roadway conditions should be favorable for bicycling, with smooth pavement and limited

changes in elevation along edge lines. Drainage inlets and utility covers that cannot be moved out of the travel way shall be designed flush with grade, well seated, and make use of bicycle-compatible grates and covers.

Railroad grade crossings on a diagonal can cause steering difficulties for bicyclists. Crossings for bicycle facilities should be perpendicular to the rail. This can be accomplished with a widened shoulder or bicycle lane, or separate path. Consideration shall be given to improving the smoothness of the crossing and reducing the width and depth of the flangeway opening. Flangeway fillers can be used on heavy rail lines to minimize the size of the opening adjacent to the rail.

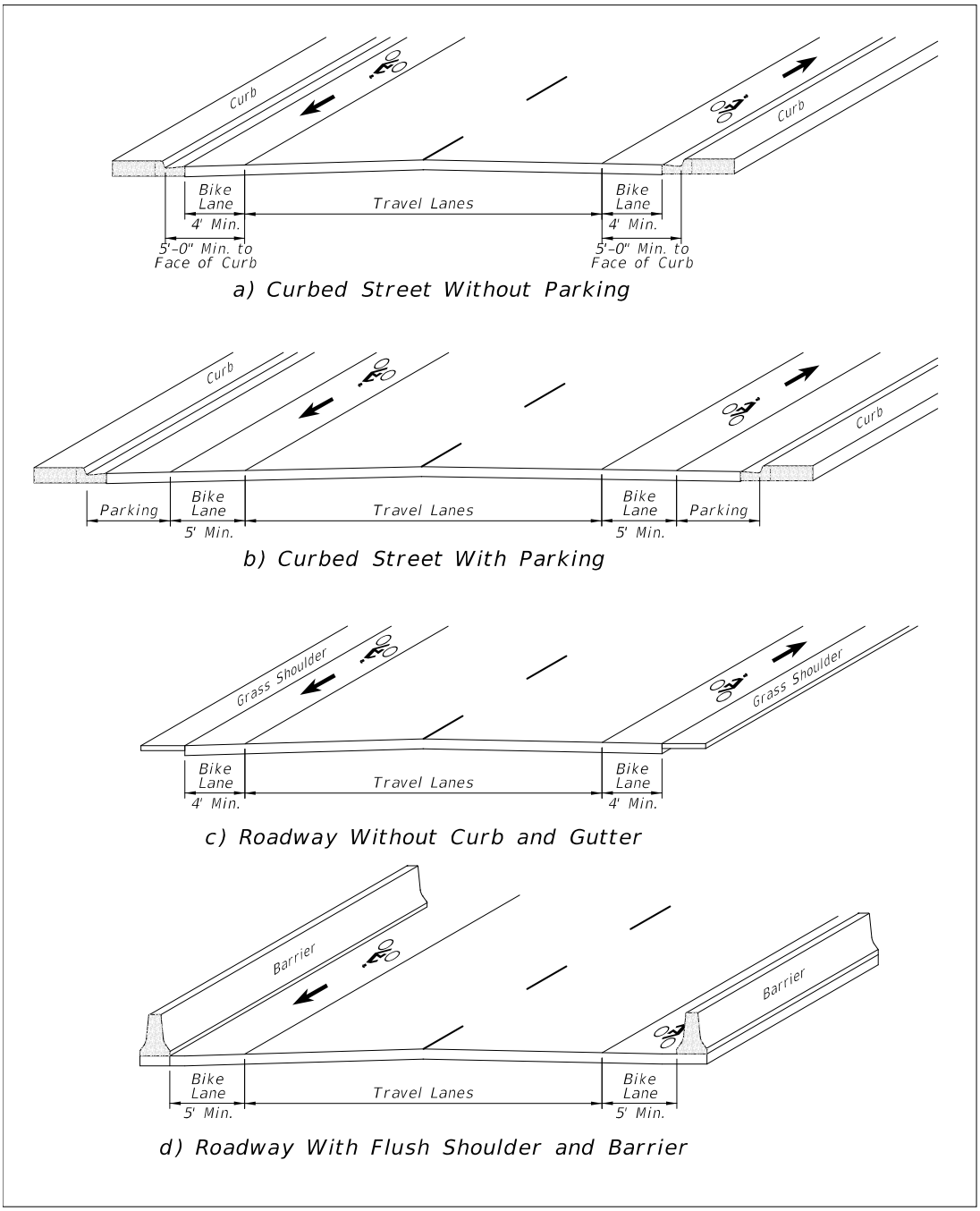
Bicycle lanes, paved shoulders, wide curb lanes, or shared lanes should be included to the fullest extent feasible. The appropriate selection of a bicycle facility depends on many factors, including motor vehicle and bicycle traffic characteristics, adjacent land use and expected growth patterns. All new or reconstructed arterial and collector roadways, in and within one mile of an urban area, should include bicycle lanes.

Rumble strips used in a traffic lane to alert operators to conditions ahead (e.g., stop signs, traffic signals or curves) should provide clear space (free of rumble strips) for bicyclists. This clear space may be a paved shoulder or if no paved shoulder is present, a minimum of 1.5 feet of clear space at the outermost portion of the lane.

## B.1 Bicycle Lanes

Bicycle lanes delineate available roadway space for preferential use by bicyclists, providing more predictable movements by motorists and bicyclists. Bicycle lanes also help increase the total capacity of highways carrying mixed bicycle and motor vehicle traffic. Bicycle lanes shall have a minimum functional width of 4 feet. At least 1-foot additional width is needed when the bicycle lane is adjacent to a curb or other barrier, on-street parking is present, there is substantial truck traffic (>10%), or posted speeds exceed 50 mph. Minimum bicycle lane widths are illustrated in Figure 9 – 1 Minimum Widths for Bicycle Lanes. The 4-foot bicycle lane shown in the flush shoulder typical section assumes the grass portion of the shoulder provides emergency maneuvering room.

## Figure 9 – 1 Minimum Widths for Bicycle Lanes



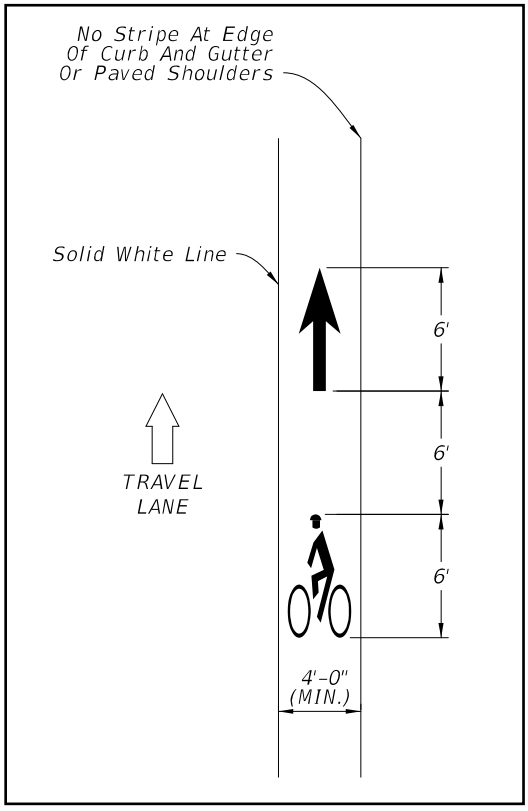
Bicycle lanes are one-way facilities and carry bicycle traffic in the same direction as the adjacent motor vehicle traffic. A bicycle lane should be delineated from the travel lanes with a solid white line and be marked with the bicycle symbol and arrow as shown in Figure 9 – 2 Detail of Bicycle Lane Markings. The dimensions for each pavement marking is 72" long, separated by 72".

The recommended placement of bicycle lane markings is:

a) At the beginning of a bicycle lane, on the far side of major intersections, and prior to and within the bicycle lane between a through lane and turn lane.

b) Along the roadway as needed to provide a maximum spacing of 1,320 for posted speeds less than or equal to 45 mph, 2,640 feet for a posted speed of 50 mph or greater.

**Figure 9 – 2 Detail of Bicycle Lane Markings**



If used, bike lane signs and plaques should be placed in advance of the upstream end of the bicycle lane, at the downstream end of the bicycle lane, and at periodic intervals based upon prevailing speed of bicycle and other traffic, block length, and distances from adjacent intersections, and other considerations. They should only be used in conjunction with marked bicycle lanes. Bike lane signs are not required.

**Figure 9 – 3 Bicycle Lanes**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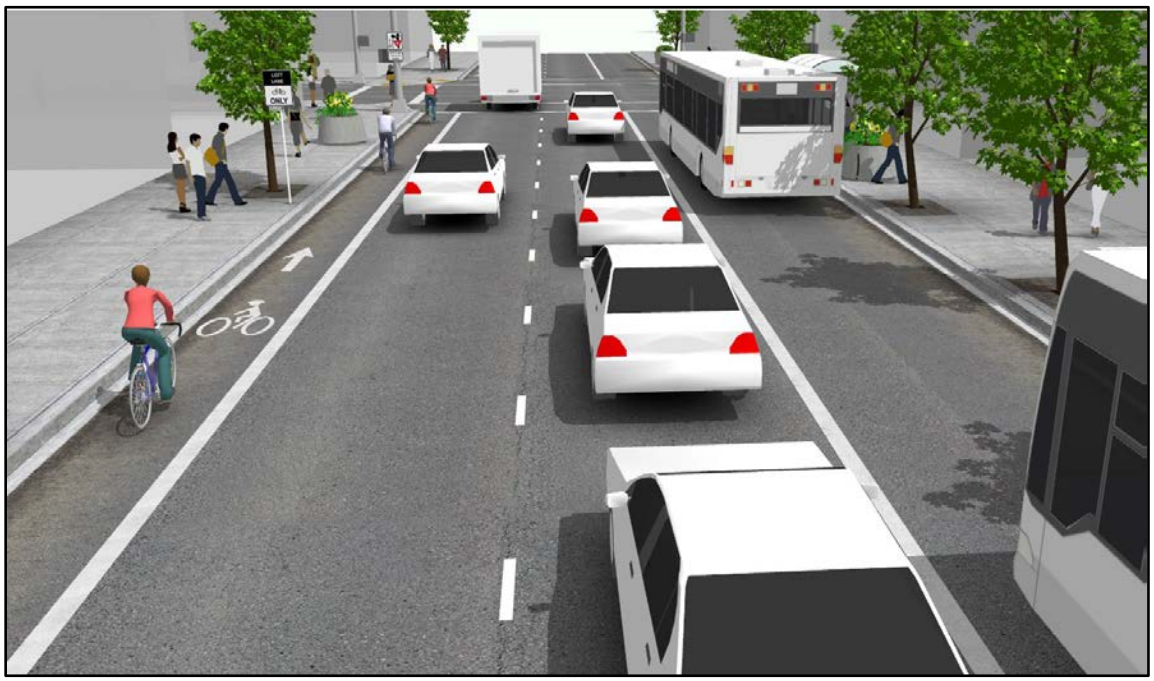
A through bicycle lane shall not be positioned to the right of a right turn only lane or to the left of a left turn only lane. For new construction, reconstruction, and traffic operations projects, where bicycle lanes are provided between the through lane and right turn lane, bus bay or parking lane they shall be a minimum of 5 feet wide. For bicycle lanes adjacent to parking lanes, if the parking volume is substantial or the turnover is high a width of 6-7 feet is desirable to avoid opening vehicle doors.

On one-way streets, bicycle lanes should generally be placed on the right side of the street. A bicycle lane on the left side of the street can be considered when a bicycle lane on the left will substantially decrease the number of conflicts, such as those caused by frequent bus traffic, heavy right turning movements, high-turnover parking lanes, or if there are a significant number of left turning bicyclists. See Figure 9 – 4 Left Side Bicycle Lanes for an illustration.

**Figure 9 – 4 Left Side Bicycle Lanes**



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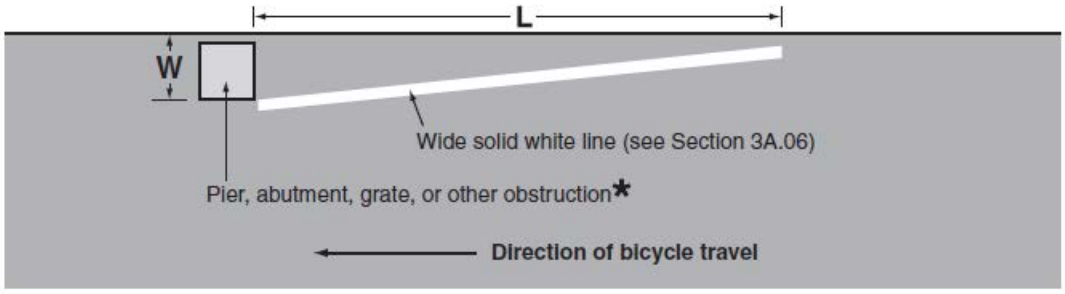
Bicycle lanes shall not be provided on the circular roadway of a roundabout, and shall be transitioned prior to the roundabout in accordance with the MUTCD.

Existing drainage inlets, grates and utility covers shall be evaluated as to whether they present an obstruction to bicyclists, and should be relocated out of the cyclist's path of travel. Drainage inlets, grates and utility covers to remain should be adjusted to be flush with the adjacent pavement surface, utilize a grate recommended for bicycle travel, and may be marked as an obstruction.

Advance warning of an inlet or other obstruction may be provided as shown in the ***MUTCD, Part 9***. Additional information on appropriate drainage inlets in or near pedestrian and bicycle facilities can be found in the FDOT's ***Drainage Manual, Section 3.7.4 Inlet Placement, (2022).***

**Figure 9 – 5 Example of Obstruction Pavement Markings**




**B - Obstruction at edge of path or roadway**

L = WS, where W is the offset in feet and S is bicycle approach speed in mph

* Provide an additional foot of offset for a raised obstruction and use the formula L = (W+1) S for the taper length

Traffic signals should be responsive to bicyclists. Regular maintenance of bicycle lanes should be a priority, since bicyclists are unable to use a lane with potholes, debris, or broken glass.

In conjunction with resurfacing projects, the roadway width shall be redistributed when practical to provide for bicycle facilities. The types of bicycle facilities considered for implementation include buffered bicycle lanes, bicycle lanes, wide outside lanes, and shared lanes. Lane widths on urban multilane roadways and two-lane curb and gutter roadways may be reduced as shown in Table 9 – 1 Lane Widths to provide for bicycle facilities.

**Table 9 – 1 Lane Widths Urban Multilane orTwo-Lane with Curb and Gutter**

| Design Year AADT | Design Speed (mph) | Minimum Thru Lane (ft.) | Minimum Turn Lane (ft.) | Minimum Parking Lane (ft.) |
|---|---|---|---|---|
| ALL | ALL | 10 [1] | 9 [2] | 7 [3] |

1. 11 ft. where either of the following conditions exist:
   a) Trucks are >10% of Design Year Traffic.
   b) Design Speed is 40 mph or greater.
2. 10 ft. for 2 Way Left Turn Lanes.
3. A minimum width of 7 ft. measured from face of curb may be left in place. Otherwise provide 8 ft. minimum, measured from face of curb.

Various configurations of bicycle lanes on curb and gutter and flush shoulder typical sections are illustrated in Figures 9 – 6 to 9 – 23.

**Figure 9 – 6 Bicycle Lane Markings**

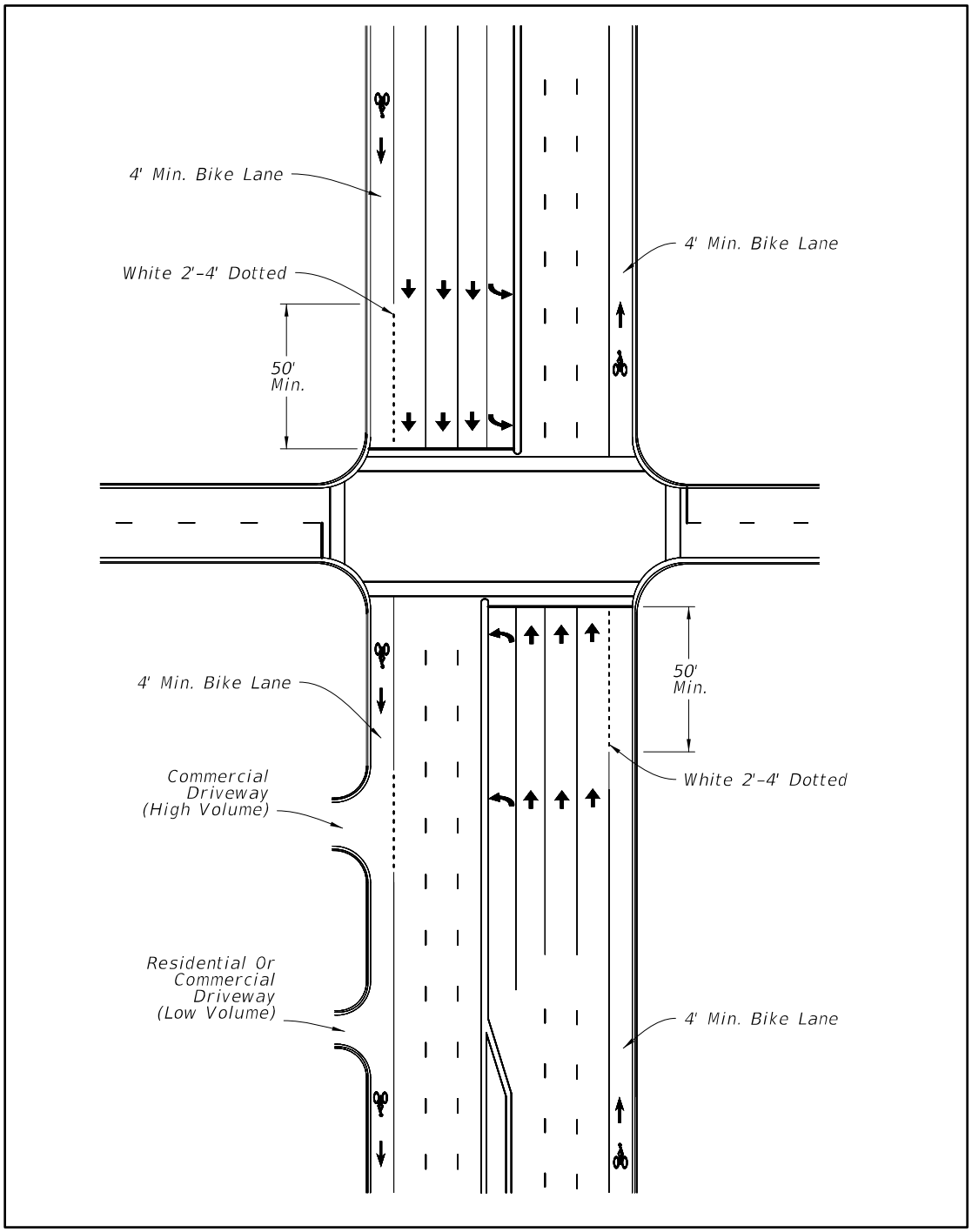


**Figure 9 – 7 Bicycle Lanes with Separate Right Turn Lane (Curb and Gutter)**

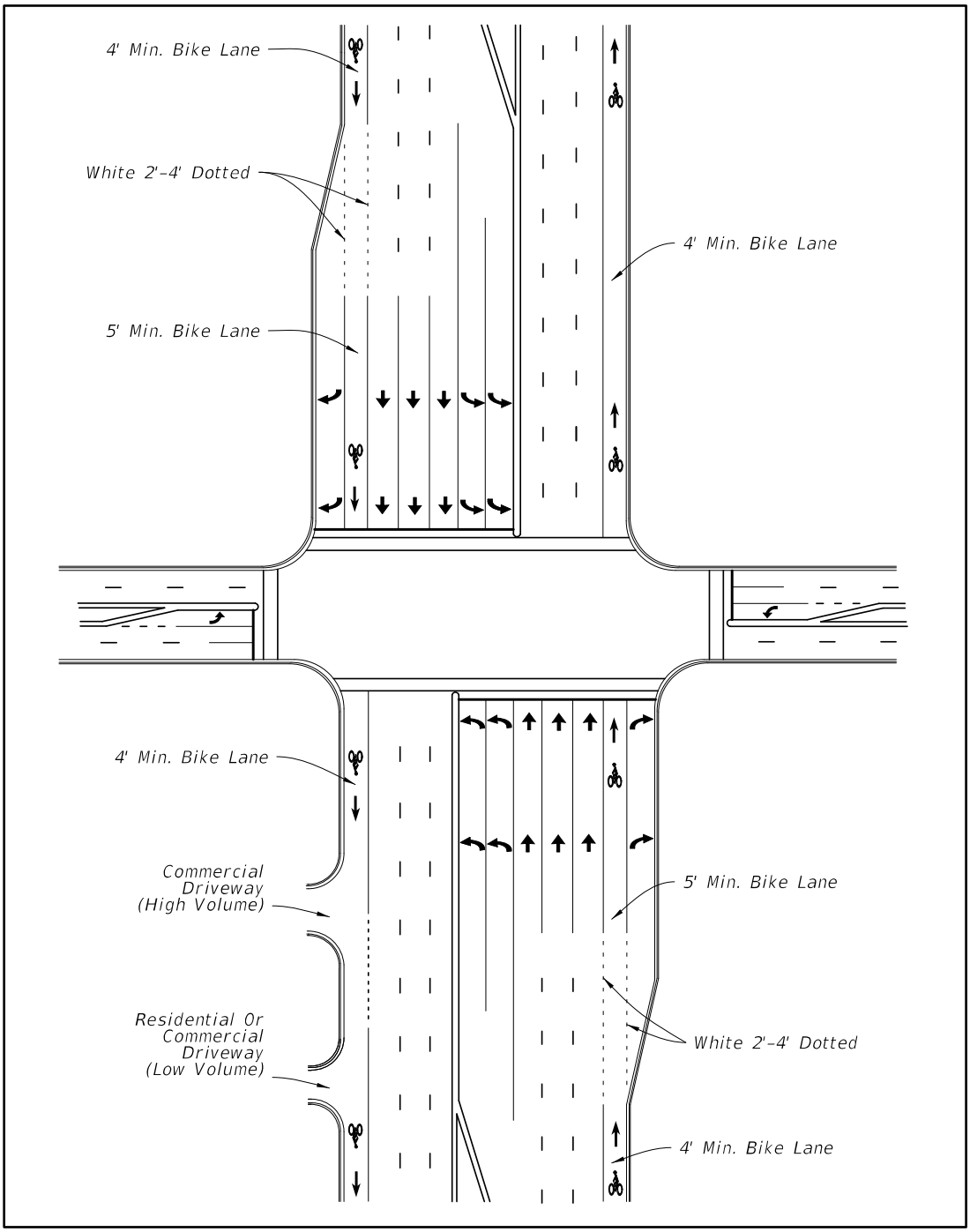


**Figure 9 – 8 Bicycle Lanes with On Street Parking, No Right Turn Lane (Curb and Gutter)**

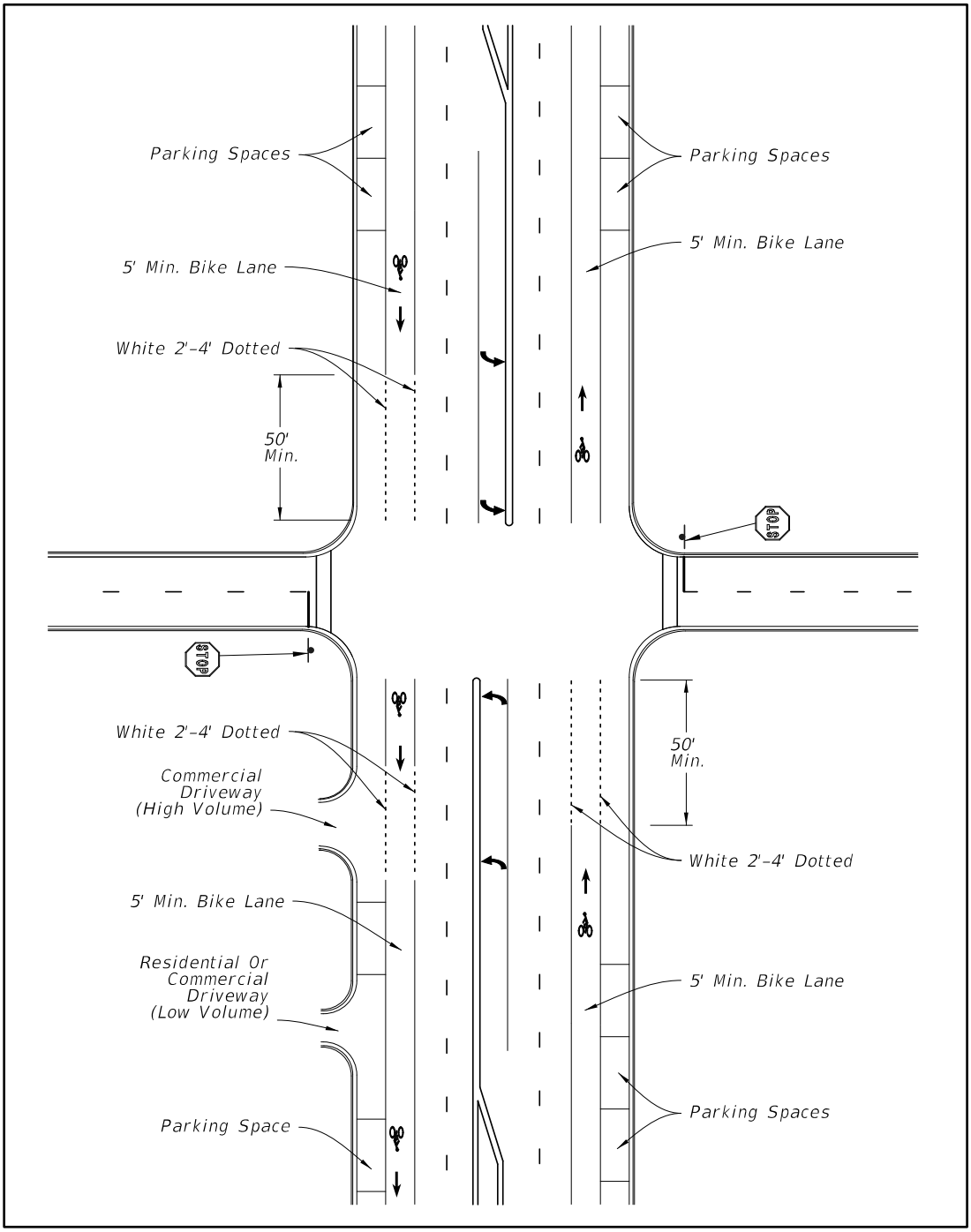


**Figure 9 – 9 Bicycle Lane with Right Turn Drop Lane (Curb and Gutter)**

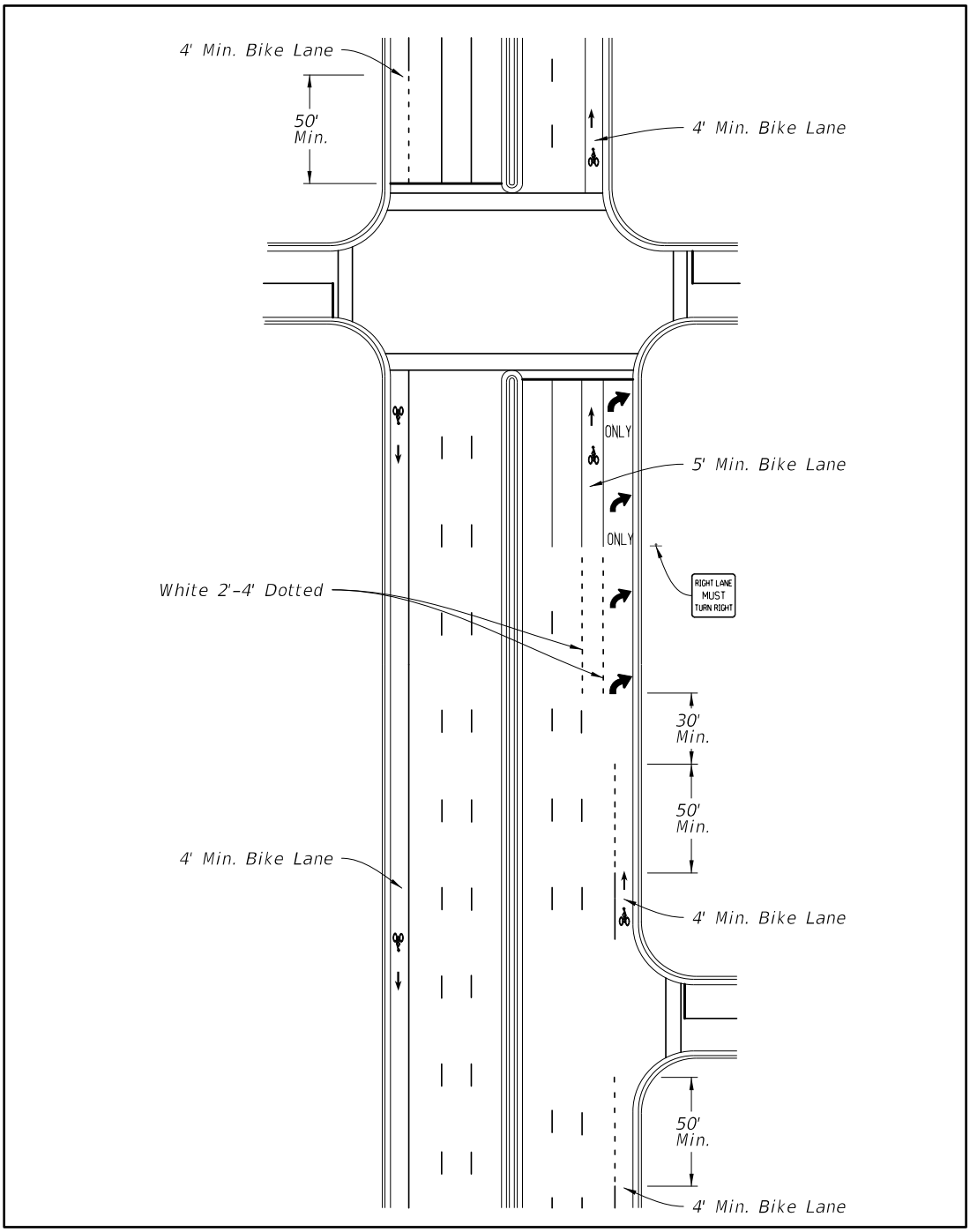


**Figure 9 – 10 "Tee" Intersection with Bicycle Lane, Separate Right and Left Turn Lanes (Curb and Gutter)**

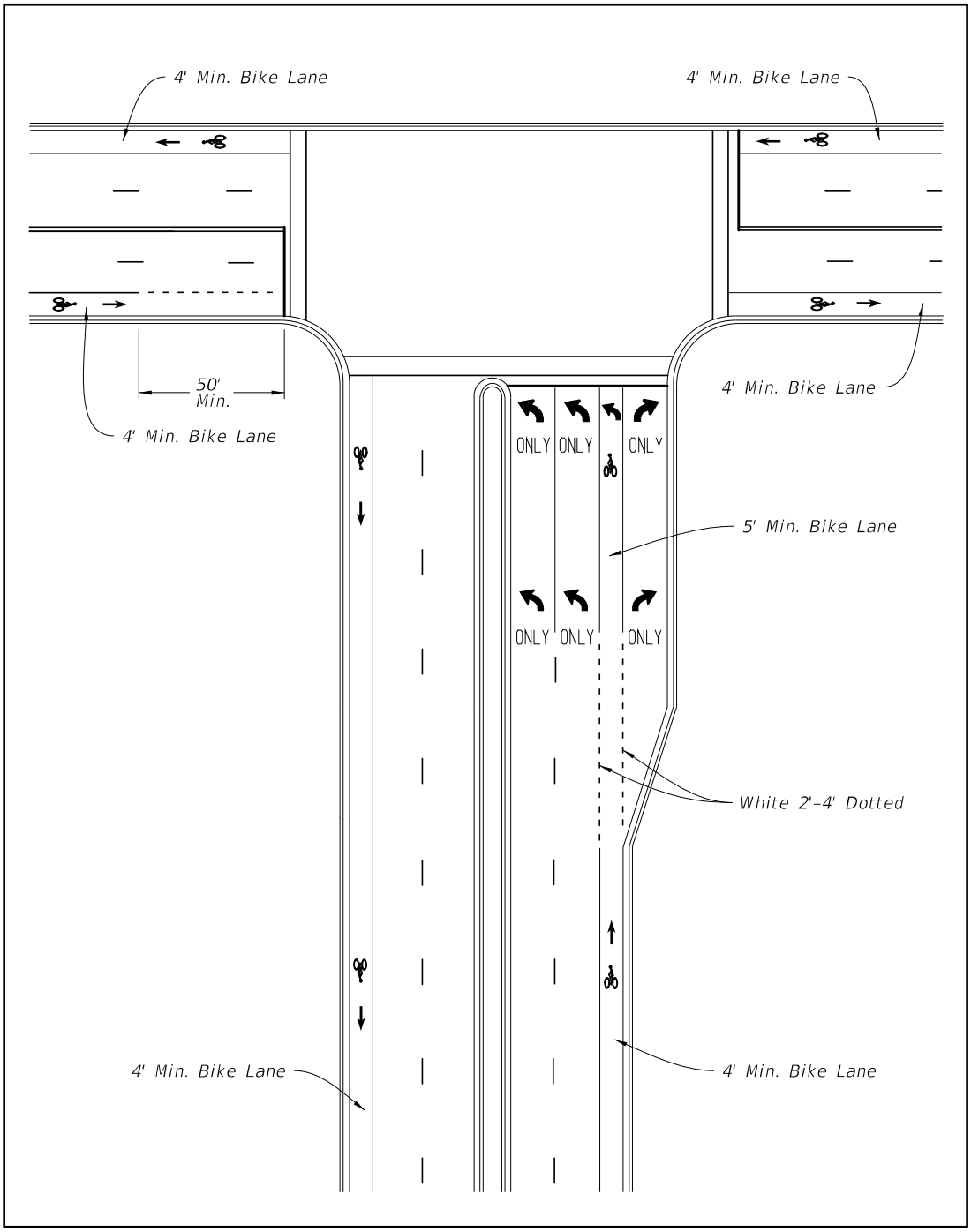


**Figure 9 – 11 "Tee" Intersection with Bicycle Lanes, Left Turn Lane and Right Turn Drop Lane (Curb and Gutter)**

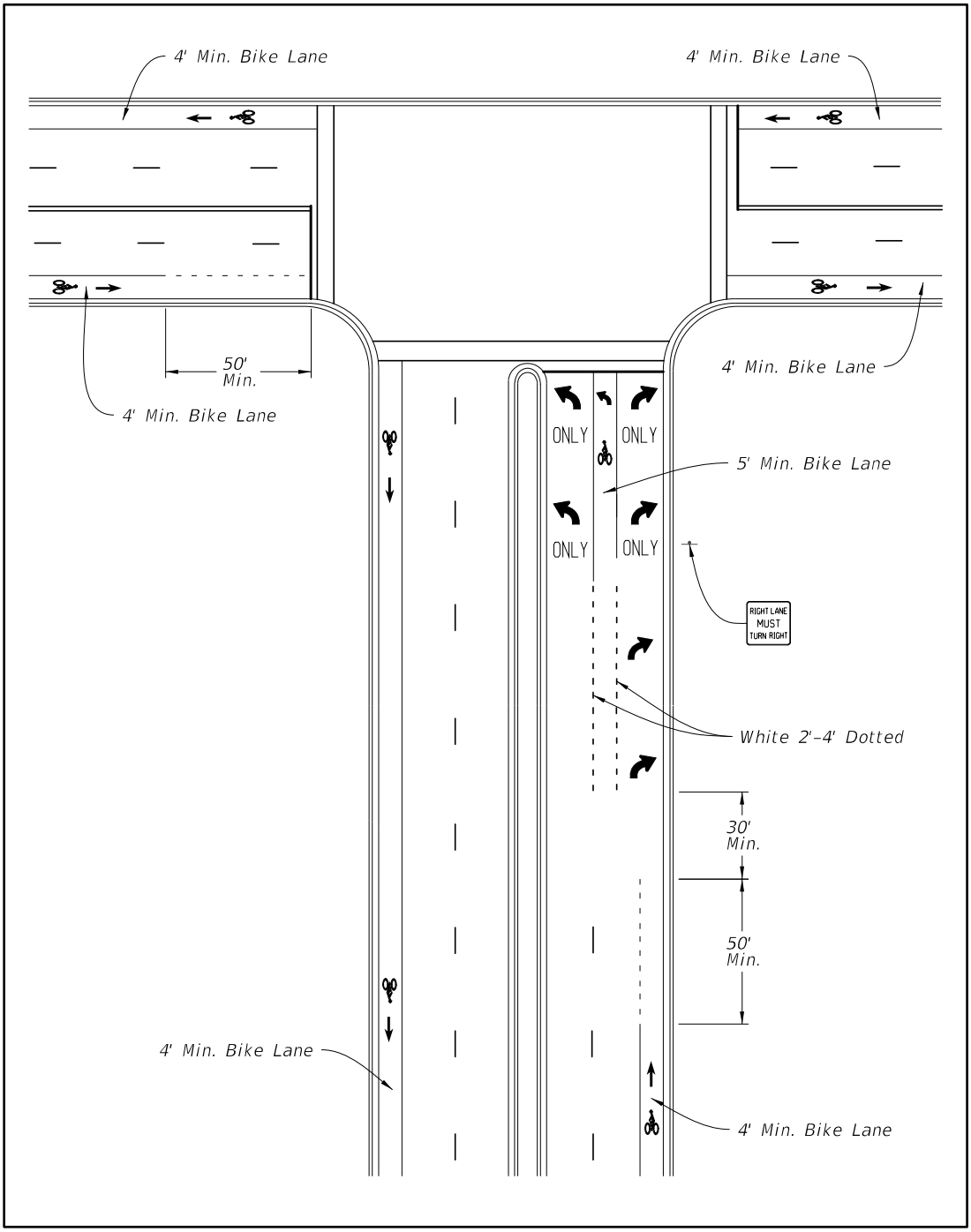


**Figure 9 – 12 Bicycle Lanes with No Right Turn Lane (Flush Shoulder)**

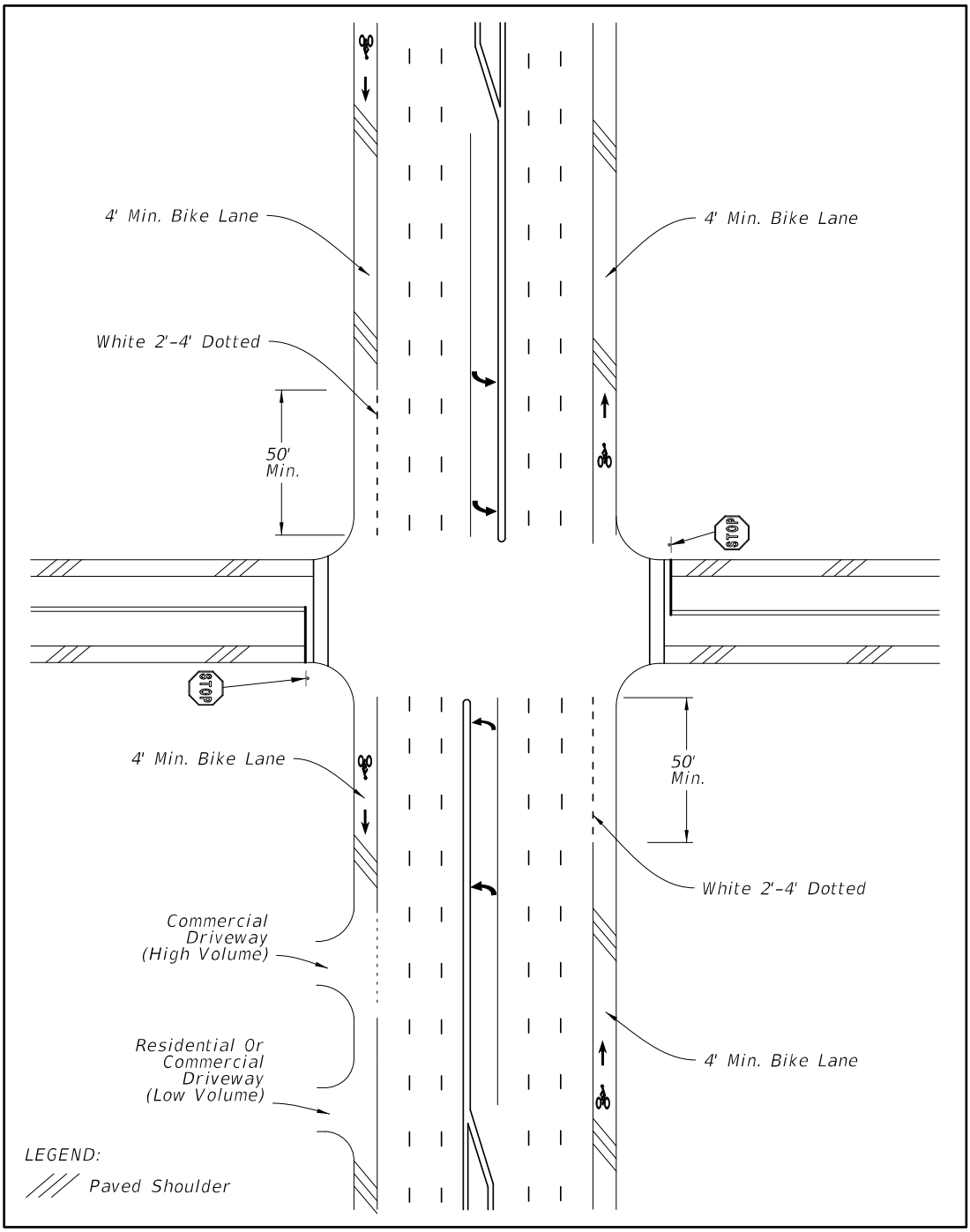


**Figure 9 – 13 Bicycle Lane with Separate Right Turn Lane (Flush Shoulder)**

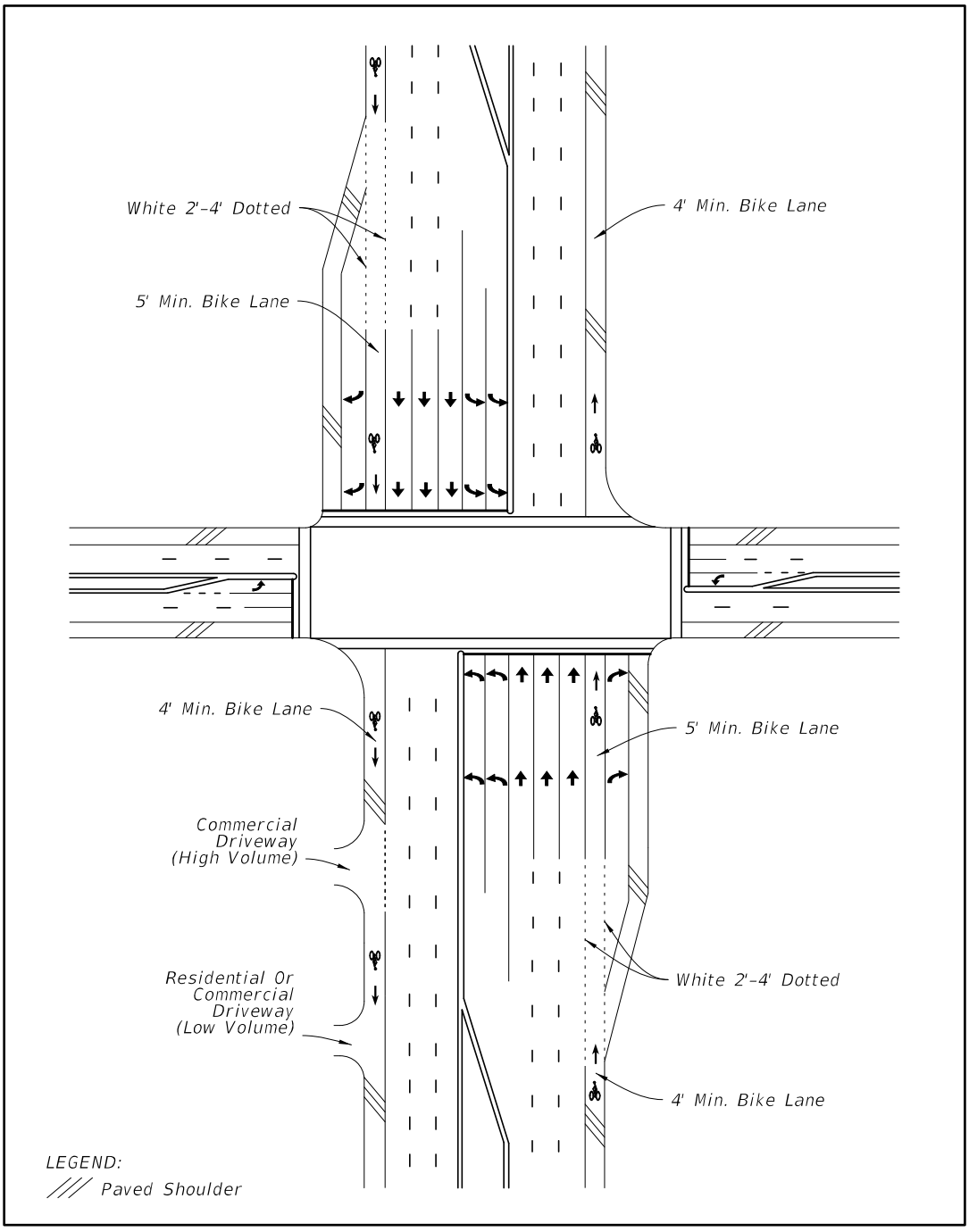


**Figure 9 – 14 Bicycle Lanes with Bus Bay, No Right Turn Lane (Curb and Gutter)**

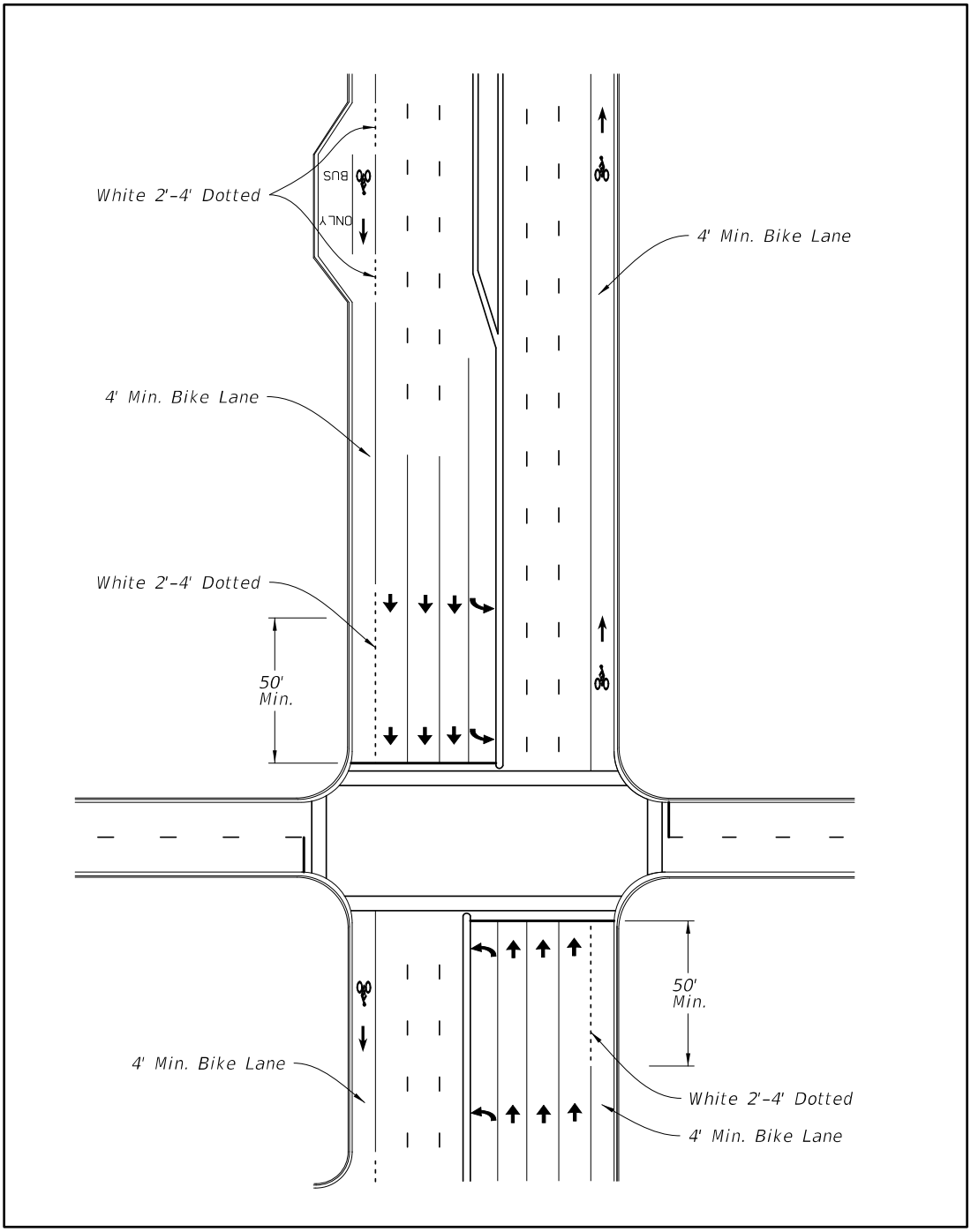
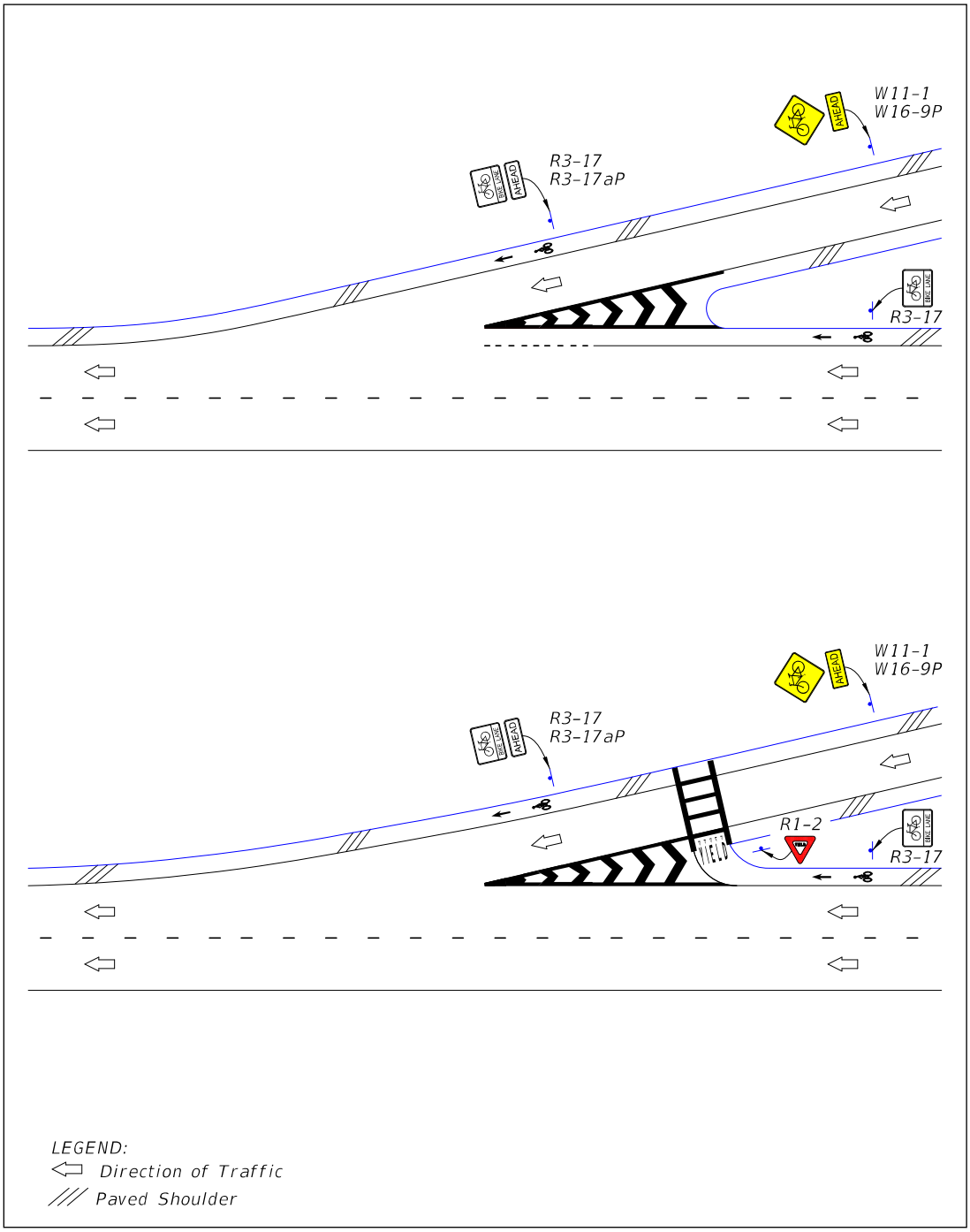


**Figure 9 – 15 Bicycle Lanes on Interchange Ramps (Flush Shoulder)**



## B.2 Buffered Bicycle Lanes

Buffered bicycle lanes are bicycle lanes separated from either the adjacent travel lane or parking lane with a marked buffer area. They provide greater shy distance between motor vehicles and bicyclists and encourage bicyclists to ride outside of the "door zone" of parked cars. Typical applications include streets with high travel speeds, high traffic volumes, high amounts of truck or transit traffic, or where there are underutilized travel lanes or extra pavement width.

The bicycle lane symbol and arrow markings shall be used, along with longitudinal lines to create the buffer. There are several options for marking the buffer area, including a wide solid double line (crossing prohibited), wide solid single line (crossing discouraged) or wide dotted single line (crossing permitted to make right hand turn). Where the buffer space is wider than 4 feet and crossing the buffer is prohibited, chevron markings should be placed in the buffer area.

At an intersection approach, the buffer striping should transition to a wide dotted stripe using a 2/4 skip pattern. The transition should begin 150 feet in advance of an intersection to provide sufficient distance for an automobile or truck to merge into the bicycle lane before turning right. Figures 9 – 16, 17 and 18 provide examples of buffered bicycle lanes. ***Chapter 3D. Markings for Preferential Lanes of the MUTCD*** provides additional information on the striping of buffered bicycle lanes.

**Figure 9 – 16 Buffered Bicycle Lane Adjacent to On-Street Parking**

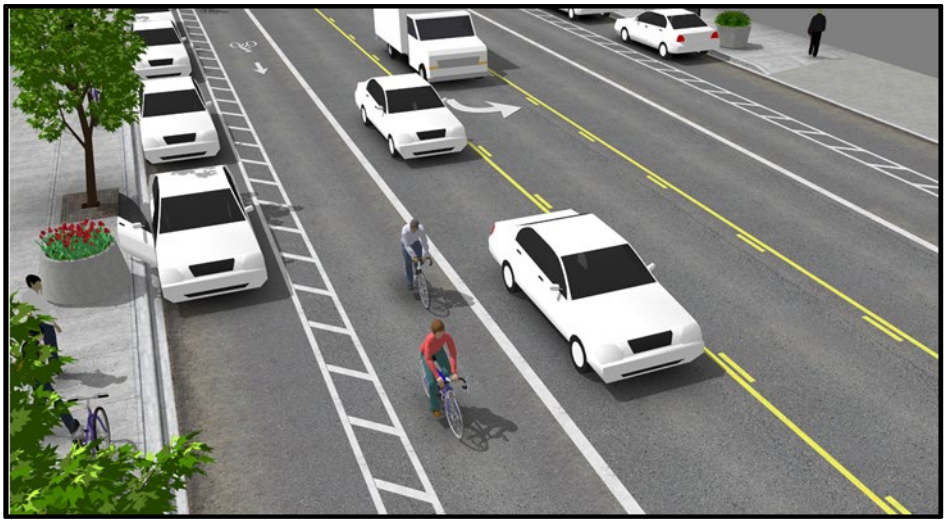


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**Figure 9 – 17 Buffered Bicycle Lane Markings**

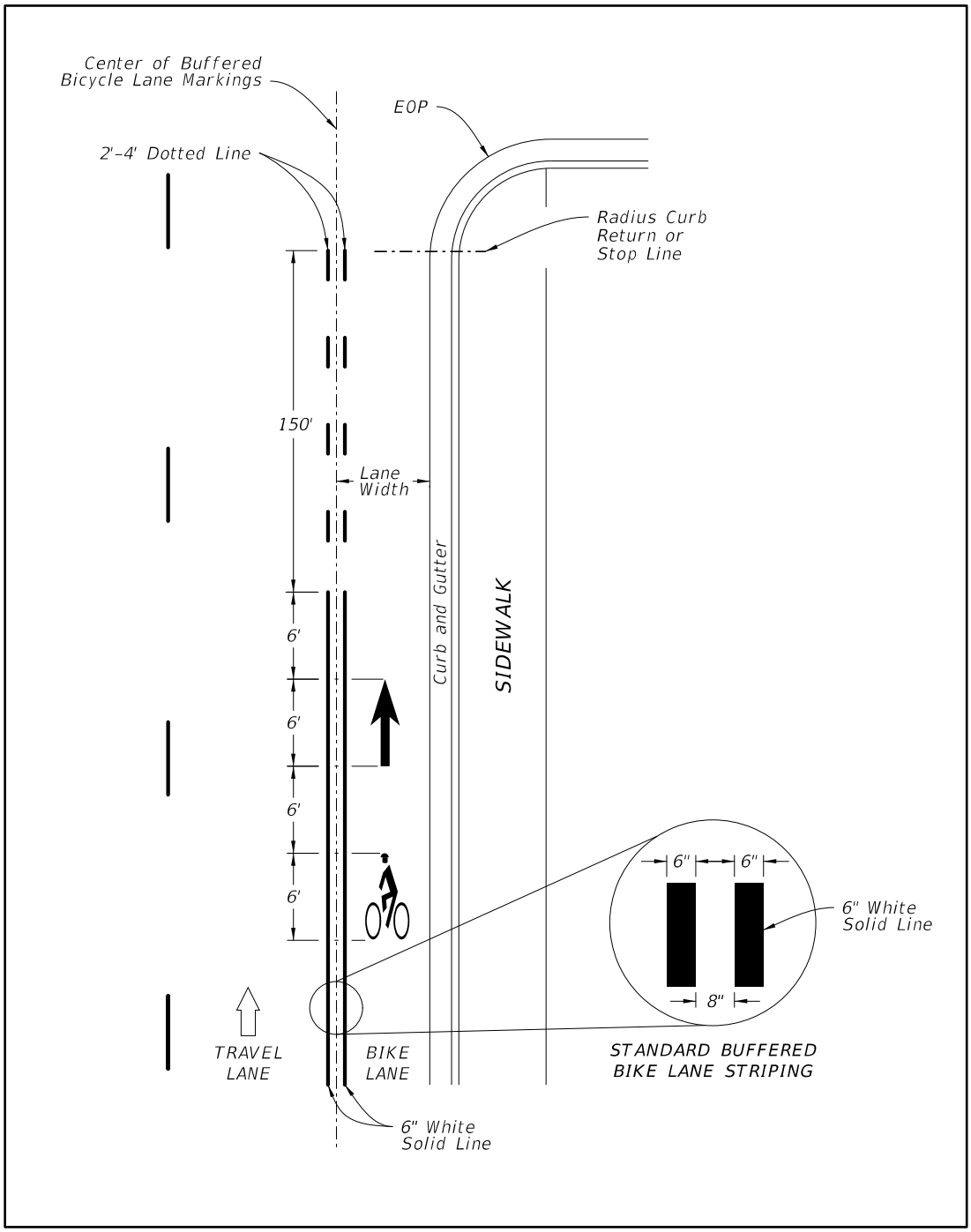
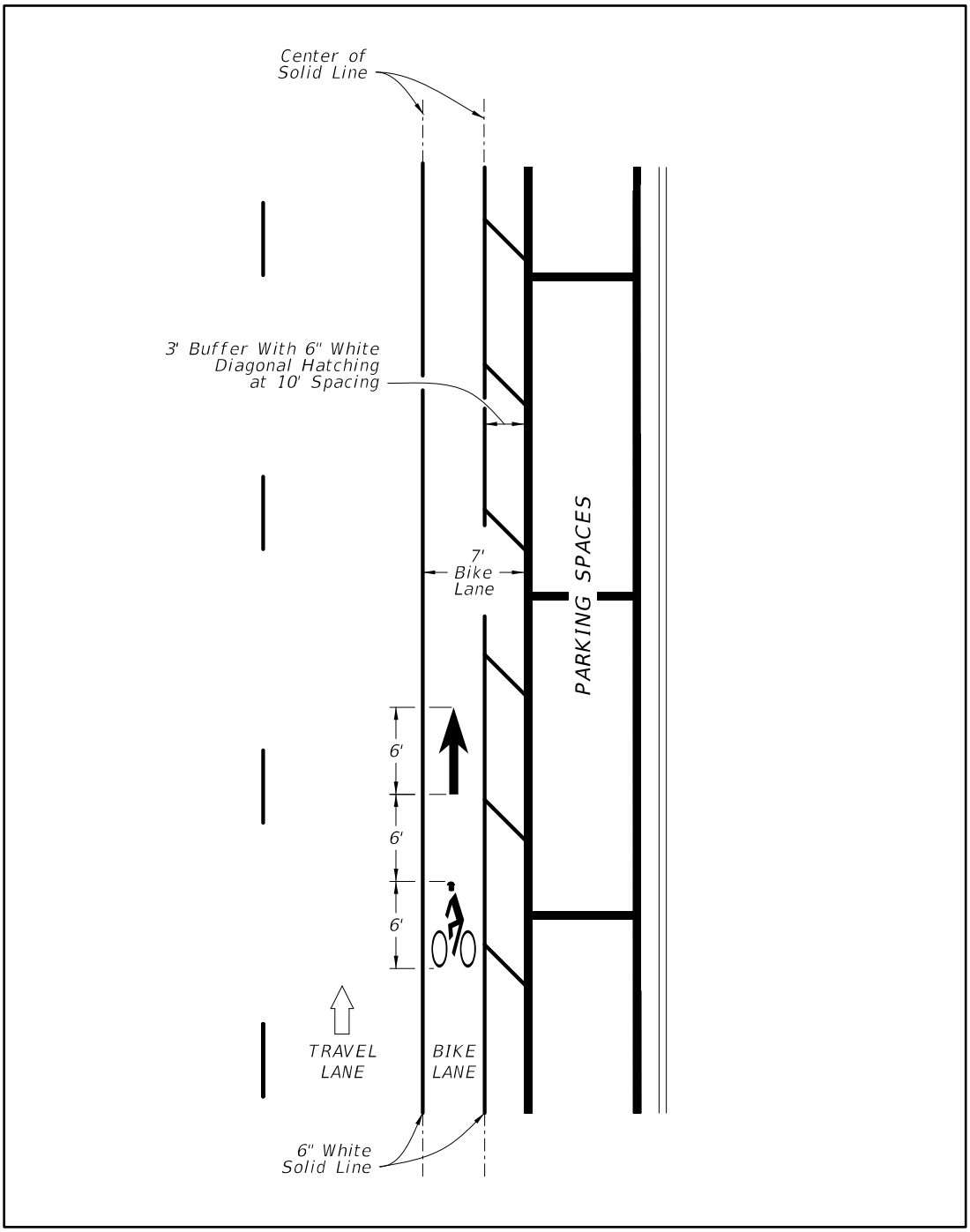


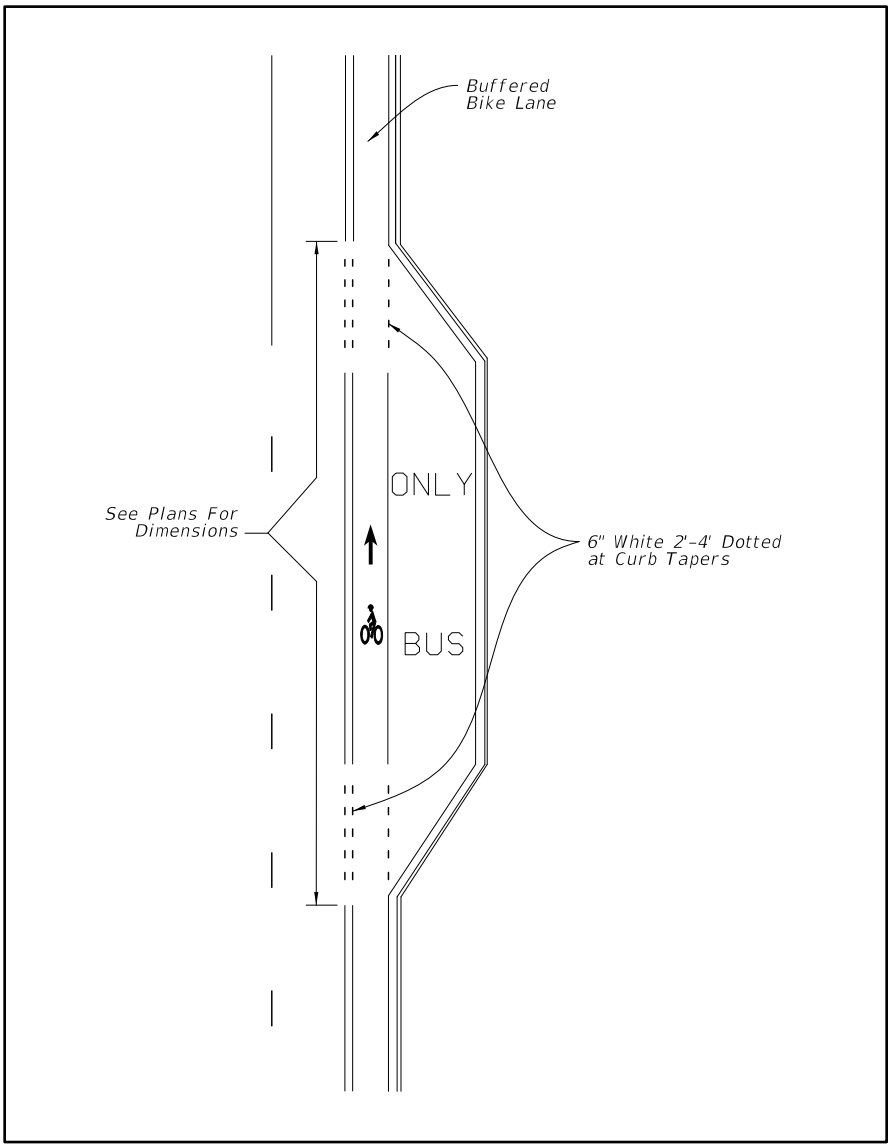
**Figure 9 – 18 Buffered Bicycle Lane Markings with On-Street Parking**



## B.3 Bicycle Lane with Bus Bay

When a bus bay is provided on roadways with bicycle lanes, the bicycle lane shall be continued adjacent to the bus bay. Figure 9 – 19 Buffered Bicycle Lane with Bus Bay Marking provides an example of a buffered bicycle lane with a bus bay.

**Figure 9 – 19 Buffered Bicycle Lane with Bus Bay Marking (Curb and Gutter)**



## B.4 Separated Bicycle Lanes

Separated bicycle lanes use a combination of horizontal separation (buffer distance) and vertical separation (e.g., flex posts, parked cars, medians, traffic separators, or curbs) to separate people bicycling from motor vehicle traffic. The combination of lateral separation distance and vertical separation elements (such as flexible delineators, curbs or height differences, or vehicle parking) can improve the comfort level of bicycling. They may be designed to support either one-way or two-way traffic. The amount of separation tends to increase as adjacent motor vehicle traffic volumes and speed increase.

Required features of a separated bicycle lane include:

- Is a preferential use lane, signed and marked as required by the ***MUTCD***. Include the bicycle lane symbol and arrow markings at the beginning of the lane and at periodic intervals.
- A horizontal separation is required, vertical elements may be added when required or desired.
- Types of vertical elements include changes in elevation, tubular markers, or similar type of lane delineator, raised medians, traffic separators, on-street parking, and rigid barriers (with appropriate end treatments). For posted speeds of 40 to 45 mph, raised medians, traffic separators or rigid barriers are required.
- The widths of separation are:
  1. A minimum of 3 feet separation is required if adjacent to on-street parking.
  2. If adjacent to travel lanes:
     - Posted speeds of 35 mph or less – a 6 feet minimum separation is preferred, 3 feet minimum (unless using tubular markers or similar type of lane delineator or raised median; then 2 feet minimum).
     - Posted speeds of 40 to 45 mph – an 8 feet minimum separation is preferred, 3 feet minimum.
- For one-way separated bicycle lanes, 7 feet is the preferred width, 6 feet is the minimum allowed. For two-way separated bicycle lanes, 12 feet is the preferred width, 10 feet is the minimum allowed.
- Separation is maintained between bicycle and motorized vehicle traffic through intersections.
- Conflict points are minimal and mitigated through pavement markings, color or

other treatment.

For additional information on planning and designing separated bike lanes, please see ***FHWA's Separated Bike Lane Planning and Design Guide***.

## B.5 Green Colored Bicycle Lanes

The Federal Highway Administration (FHWA) has issued an ***Interim Approval*** for the use of green colored pavement in bicycle lanes and in extensions of bicycle lanes through intersections and other traffic conflict areas. Colored pavements shall not replace or be used in lieu of required markings for bike lanes as defined in the ***MUTCD***, but shall only supplement such markings. Traffic conflict areas include where the:

- bicycle lane crosses a right turn lane,
- traffic in a right turn lane crosses a bike lane, or
- bicycle lane is adjacent to a dedicated bus bay.

The Interim Approval may be found at the following website and provides further information on how to submit a written request to use green colored pavement:

***http://mutcd.fhwa.dot.gov/res-interim_approvals.htm***

The effectiveness of green colored pavement is maximized if the treatment is used only where the path of bicyclists and other road users cross and yielding must occur. Because colored pavements are addressed in the 2009 MUTCD, they are a traffic control device whose need should be demonstrated before they are used. A need for this treatment can be demonstrated by either of the following:

1. A history of 3 or more motor vehicle-bicycle crashes exists at or adjacent to the traffic conflict area over the most recent three-year period, or
2. A government agency has observed and documented conflicts (failure of the motor vehicle to yield to the bicyclist) between cyclists and motor vehicles at an average rate of two per peak hour. The documentation for conflicts shall include observations from a minimum of two separate data collection periods, conducted on different days in a one month period, and include at least one weekday and one weekend count period during peak bicycle travel times. Each period should be at least 2 hours in duration. Peak times vary by region and surrounding land use, but are typically:

    - Weekday, 11:00 AM to 1:00 PM

- Weekday, 5:00 PM to 7:00 PM
- Saturday, 8:00 AM to 2:00 PM

When used in conjunction with white skip lines, such as when extending a bike lane across a right turn lane or access to a bus bay, the transverse colored marking shall match the 2'-4' white skip line pattern of the bike lane extension. The green colored pavement should begin as a solid pattern 50 feet in advance of the skip striping, match the 2' 4' skip through the conflict area, and then resume the solid color for 50' after the conflict area, unless such an extent is interrupted by a stop bar or an intersection curb radius. Details of each installation and associated pavement markings shall be shown in the plans. Figures 9 – 20, 21, 22 and 23 illustrate how the green portion of the bicycle lane may be marked.

Materials permitted to color the bike lane green shall be non-reflective and fall within the color parameters defined by FHWA in their interim approval. Materials which have been tested to meet these requirements can be found in the FDOT's ***Product Application and Tracking System (PATH)*** which includes products on both the FDOT's ***Approved Product List (APL), Specification 523, Patterned Pavement*** or the FDOT's ***Innovative Products List (IPL), Dev-714 Green-Colored Pavement Markings***.

**Figure 9 – 20 Green Bicycle Lane with Separate Right Turn Lane**

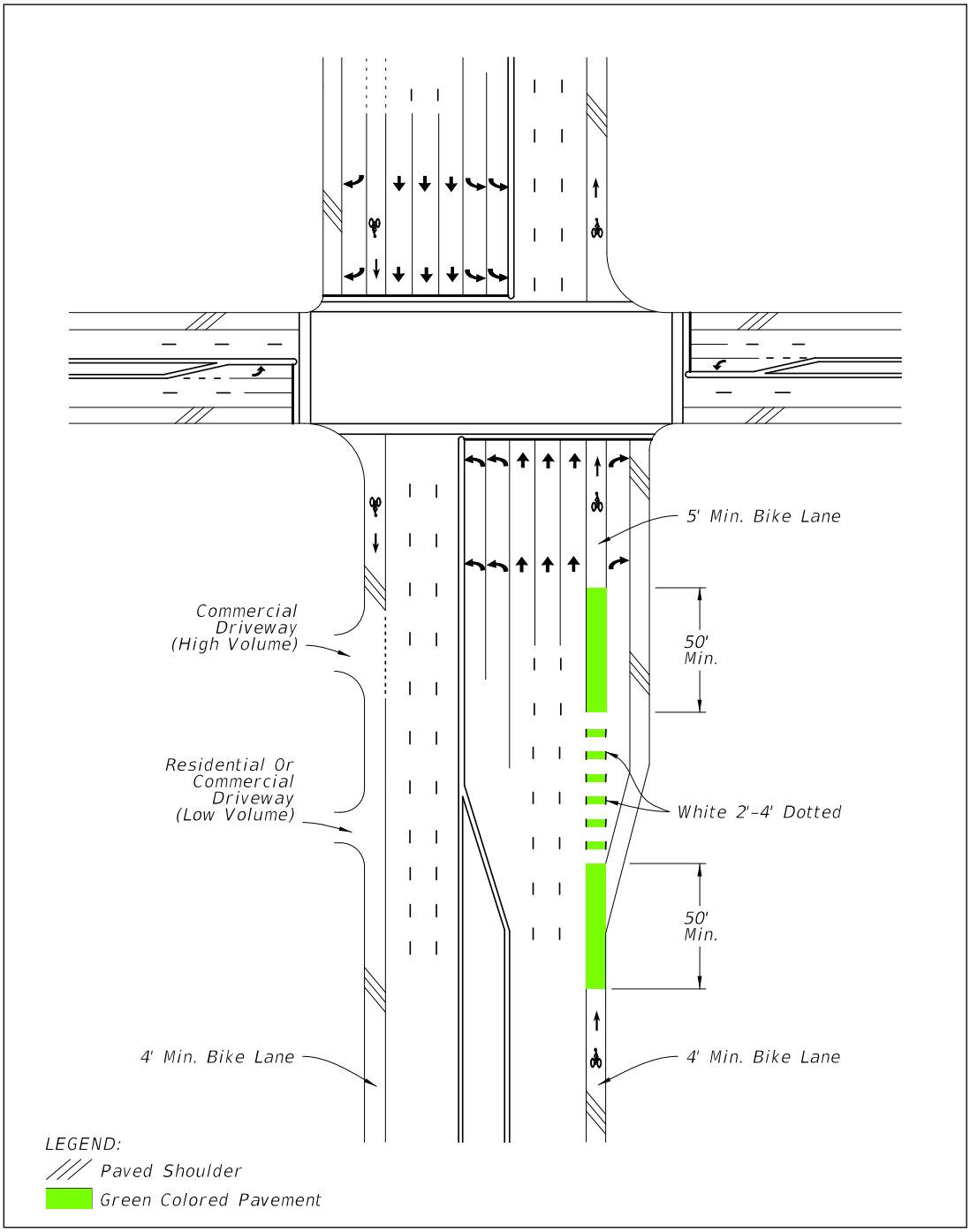
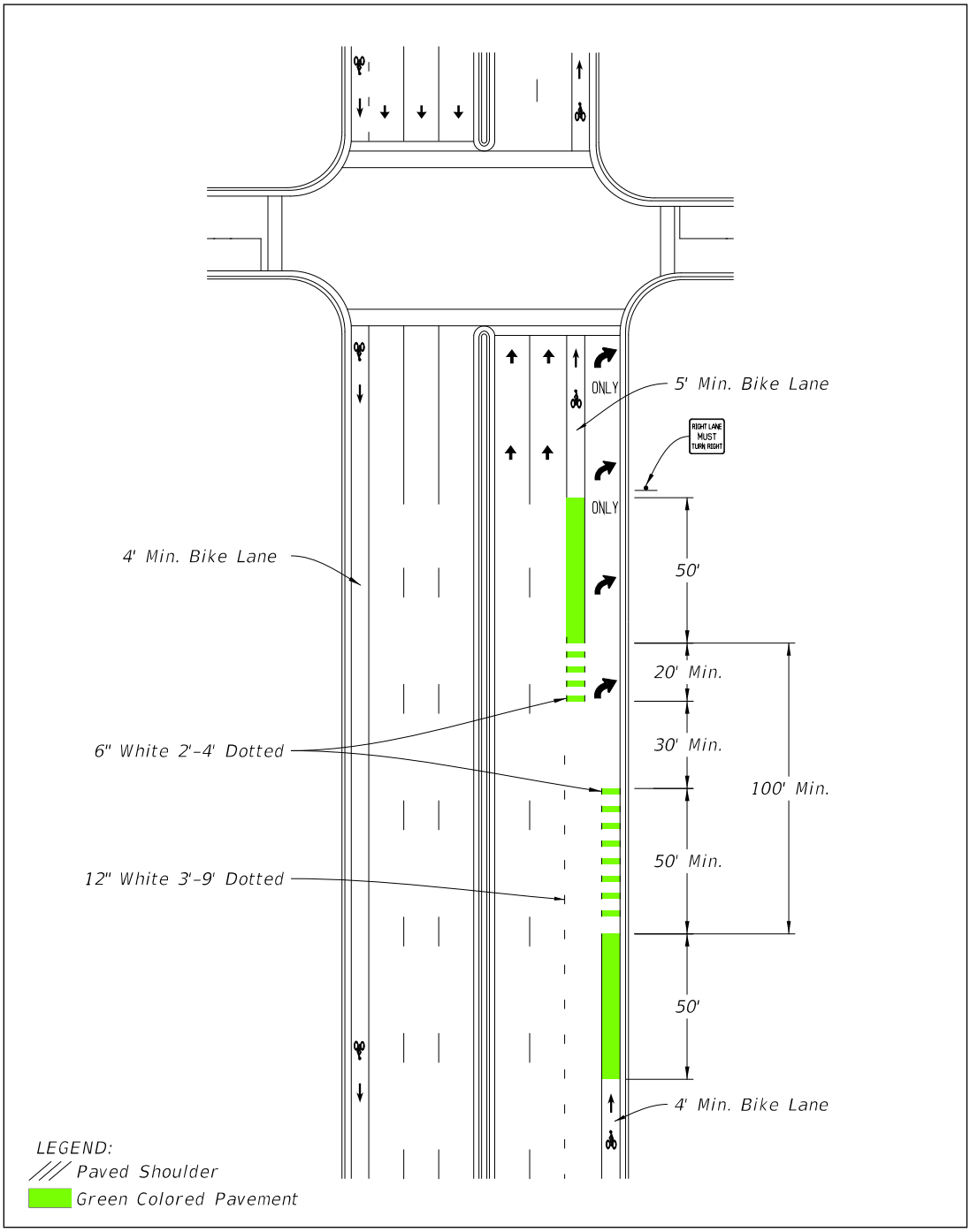


**Figure 9 – 21 Green Bicycle Lane with Right Turn Drop Lane**



## Figure 9 – 22 Green Bicycle Lane with Channelized Right Turn Lane

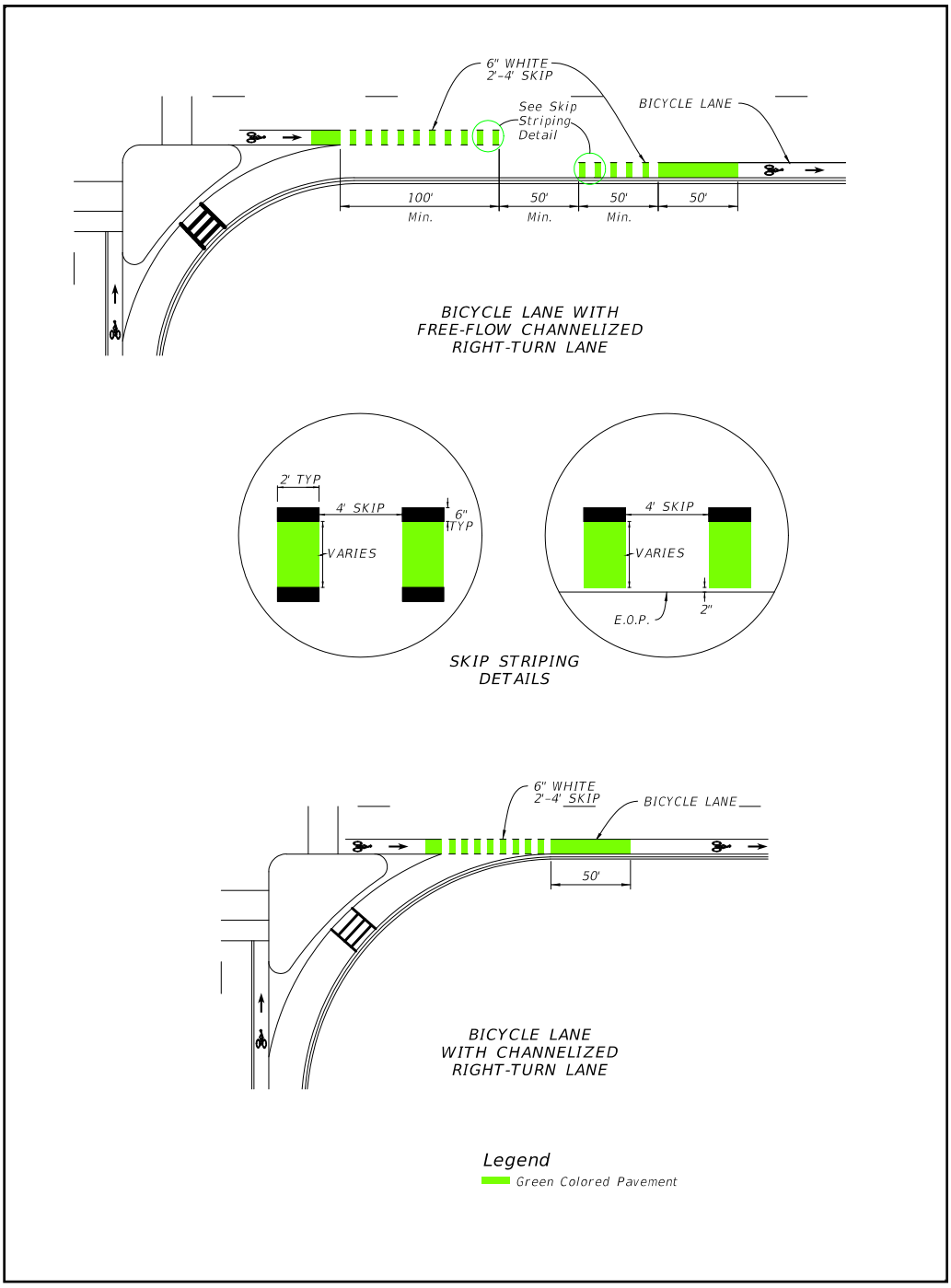
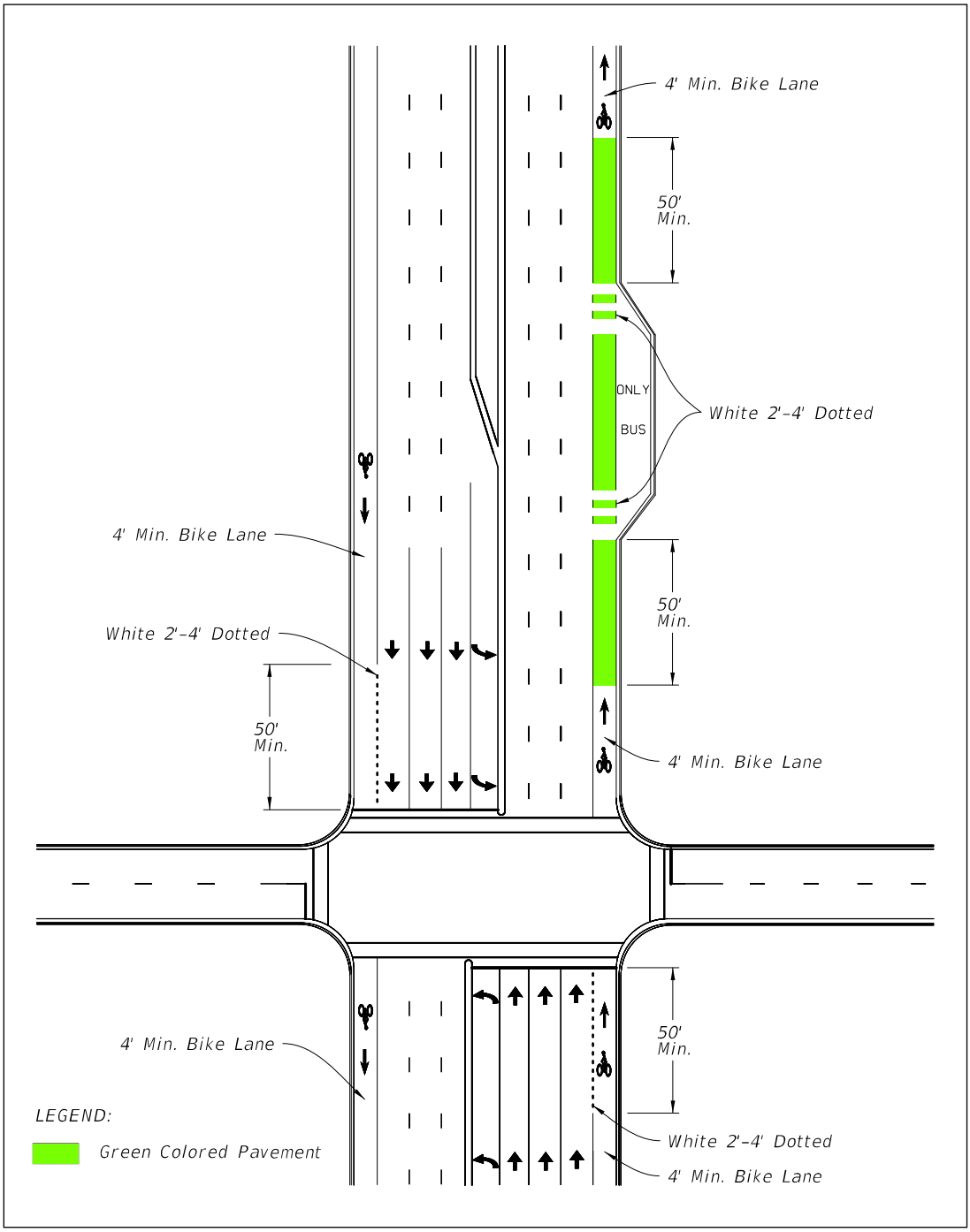


**Figure 9 – 23 Green Bicycle Lane with Bus Bay**



## B.6 Paved Shoulders

A paved shoulder is a portion of the roadway which has been delineated by edge line striping. Adding, widening or improving paved shoulders often can be an acceptable way to accommodate bicyclists. However, when a shoulder is intended to serve as a bicycle facility and is adjacent to a curb, guardrail or other roadside barrier, a minimum 5-foot clear width between the traveled way and the face of the barrier is required. Additional shoulder width is desirable if the posted speed exceed 50 mph, or the percentage of trucks, buses, or recreational vehicles is high (>10%).

Ground-in rumble strips should not be included in paved shoulders if a minimum clear width of 4 feet outside of the rumble strip cannot be provided.

## B.7 Wide Outside Lanes

Wide outside lanes on curbed roadways are through lanes that provide a minimum of 14 feet in width, which allows most motor vehicles to pass cyclists safely within the travel lane. Bicycle lanes are preferred for arterial and collector roadways, however, in some conditions, such as resurfacing projects, wide outside lanes may be the only practical option for a bicycle facility.

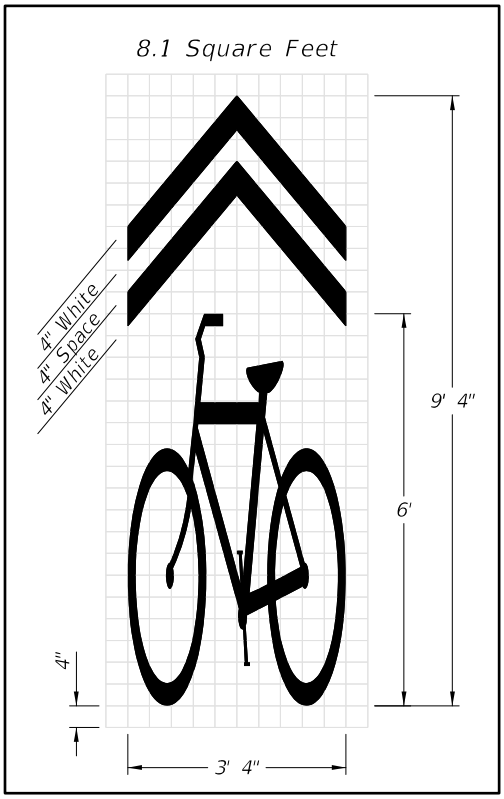
## B.8 Shared Lane Markings

The shared lane marking is an optional pavement marking for roadways where bicyclists and motor vehicles are intended to share the lane and no bicycle lane or paved shoulder exists or is feasible. Shared lane markings should be limited to roadways with a posted speed of 35 mph or less. They are not intended to be placed on every roadway without bicycle facilities or on shared use paths.

Shared lane markings provide guidance to cyclists on their lateral positioning, especially on roadways with on-street parking or lanes that are too narrow to share side by side with a motor vehicle. They also help to discourage wrong way riding and encourage safer passing of bicyclists by motorists. Shared lane markings may be used to identify an alternate route as part of an approved temporary traffic control plan. Figure 9 – 24 provides the dimensions for shared lane markings.

Shared lane markings should be placed as follows:

**Figure 9 – 24 Shared Lane Marking**




- If used on a roadway without on-street parking that has an outside travel lane that is 14 feet wide or less, the Shared Lane Markings should be centered in the travel lane (Figure 9 – 25).
- If used on a roadway with on-street parking, the Shared Lane Markings should be centered in the travel lane (Figure 9 – 26).
- Shared Lane Markings should be placed immediately after an intersection and spaced at intervals not greater than 250 feet thereafter.

**Figure 9 – 25 Shared Lane Marking Placement
(No Designated Parking, Lane Width ≤ 14 Feet)**

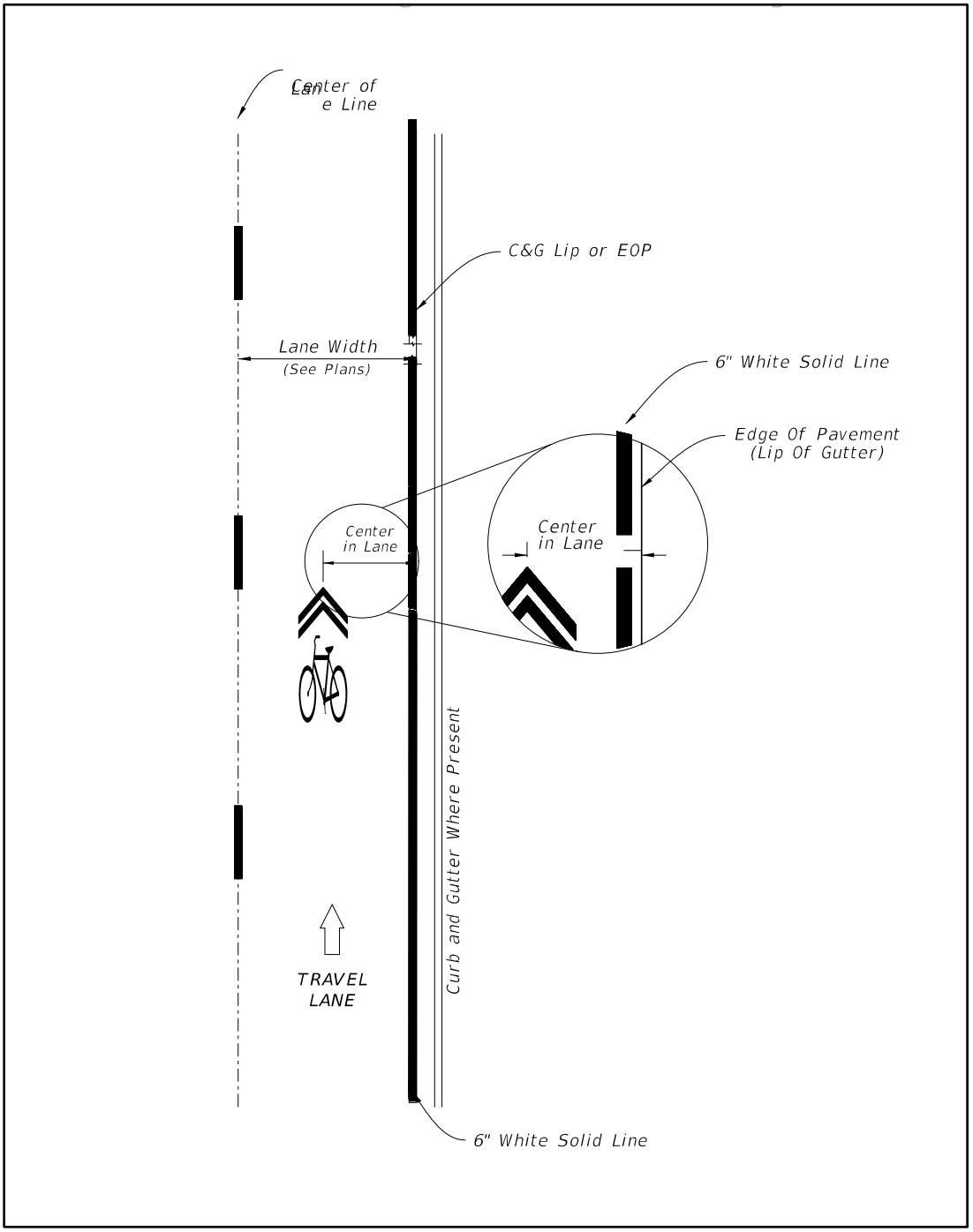
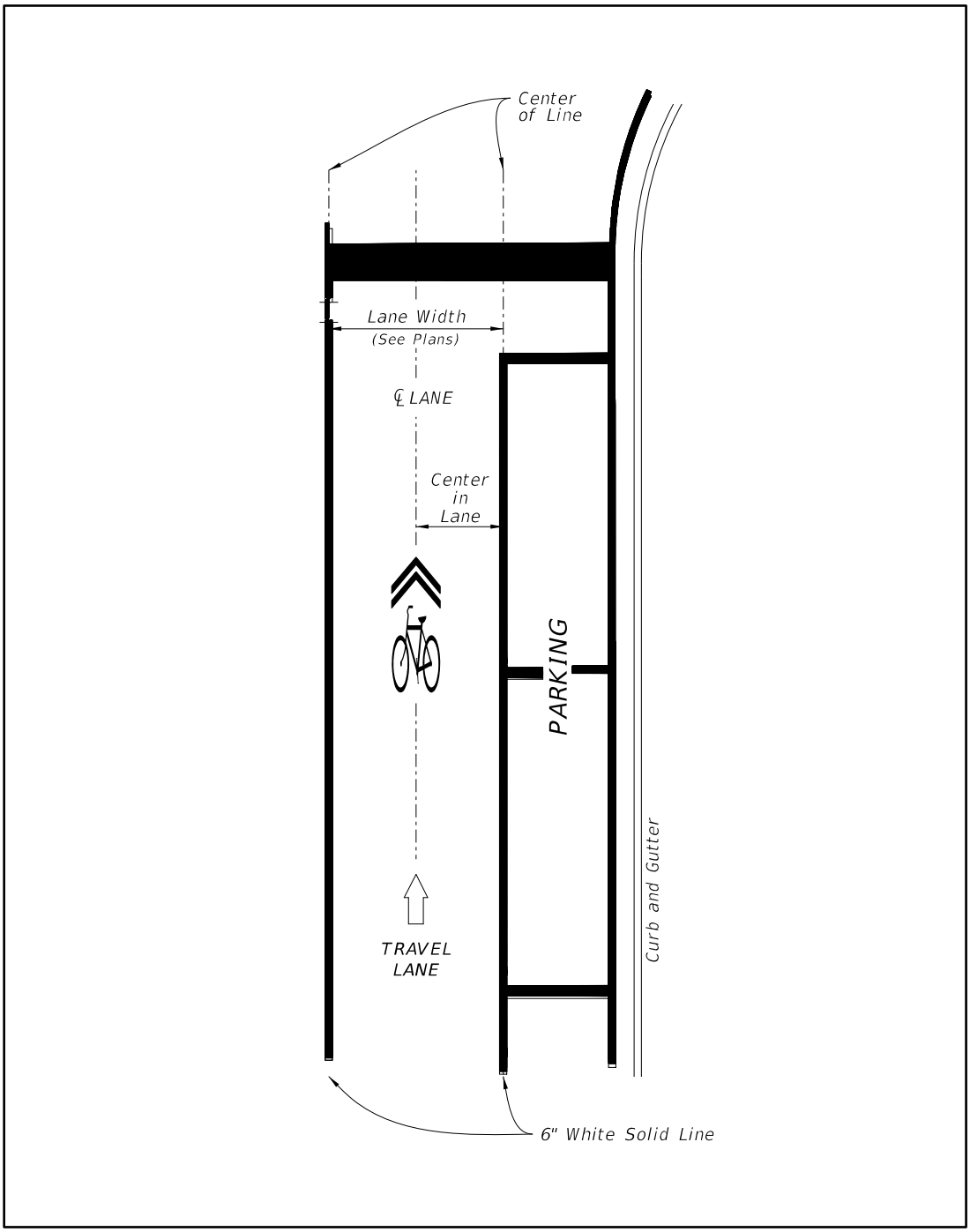


**Figure 9 – 26 Shared Lane Marking Placement (With On-Street Parking)**



### B.9 Bicycles May Use Full Lane Sign

The Bicycle May Use Full Lane sign (R4-11) may be used on roadways where no bicycle lanes or adjacent shoulders useable by bicyclists are present and where travel lanes are less than 14' wide. The ***MUTCD*** provides additional information on the use of the sign.

## C SHARED USE PATHS

Shared use paths are paved facilities physically separated from motorized vehicular traffic by an open space or barrier and either within the highway right of way or an independent right of way, with minimal cross flow by motor vehicles. They are used by bicyclists, pedestrians, runners, skaters, and in some cases equestrians. The bicycle's operating characteristics will govern the design of shared use paths, along with requirements for accessibility since they also serve as pedestrian facilities.

In addition to the design criteria provided in this manual, the following documents provide criteria and guidance in the design of shared use paths:

- ***United States Department of Transportation ADA Standards for Transportation Facilities (2006)*** and as required by ***49 C.F.R 37.41 or 37.43.***
- ***United States Department of Justice ADA Standards (2010)*** as required by ***28 C.F.R 35 (title II) and 36 (title III).***
- ***Public Rights-of-Way Accessibility Guidelines (PROWAG)*** provides additional information for the design of pedestrian facilities.

The ***2020 Florida Building Code, Accessibility, 7th Edition*** as required by ***61G20-4.002*** contains ADA requirements for accessibility to sites, facilities, buildings, and elements by people with disabilities.

Shared use paths serve a variety of purposes. They can provide a school age child, a recreational cyclist, or a person with a disability an alternative to busy roadways. Shared use paths can be located along former rail corridors, the banks of rivers or canals, and through parks and forests. Shared use paths can also provide access to areas otherwise served only by limited access highways. For transportation purposes, they should be thought of as an extension of the roadway network for non-motorized users. The inclusion of a shared use path should not be considered as an alternative to providing on-

street facilities, but, rather, as a supplement.

For additional information on shared use path design, refer to the ***AASHTO Guide for the Development of Bicycle Facilities (2012, 4th Edition).***

### C.1 Width and Clearance

The useable width and horizontal clearance for a shared use path are primary design considerations. The minimum paved width for a two-way path is 10 feet. Typically, widths range from 10 to 14 feet, with the wider values applicable to areas with high use or a wider variety of users, on steep grades, through curves, or used by larger maintenance vehicles.

In very rare circumstances, a reduced width of 8 feet may be used where the following conditions prevail:

- Bicycle traffic is expected to be low, even on peak days or during peak hours.
- Pedestrian use of the facility is not expected to be more than occasional.
- Horizontal and vertical alignments provide frequent, well-designed passing and resting opportunities.
- The path will not be regularly subjected to maintenance vehicle loading conditions that would cause pavement edge damage.

In addition, a path width of 8 feet may be used for a short distance due to a physical constraint such as an environmental feature, bridge abutment, utility structure, or fence.

A minimum 2 foot wide graded, clear area with a maximum 1:6 slope shall be maintained adjacent to both sides of the path; however, 3 feet or more is desirable to provide clearance from trees, poles, walls, fences, guardrails, or other lateral obstructions. See Chapter 8, Section D Barrier Separation and Chapter 4 – Roadside Design, Figure 4 – 8 Location of Guardrail for information on when and how longitudinal barriers should be utilized,

Where the path is adjacent to canals, ditches, or slopes steeper than 1:3, a wider separation should be considered. A minimum 5 foot separation from the edge of the path pavement to the top of the slope is desirable. Depending on the height of embankment and condition at the bottom, a physical barrier, such as a railing

or chain link fence may need to be provided.

Where the clear area adjacent to the shared use path is less than 5 feet wide, physical barriers or rails are recommended in the following situations:

- Slopes 1:3 or steeper, with a drop of 6 feet or greater.
- Slopes 1:3 or steeper, adjacent to a parallel body of water or other substantial obstacle
- Slopes 1:2 or steeper, with a drop of 4 feet or greater; and
- Slopes 1:1 or steeper, with a drop of 1 foot or greater.

The ***AASHTO Guide for the Development of Bicycle Facilities (2012, 4th Edition)*** provides additional information on the design of barriers or railings.

The desirable vertical clearance to obstructions is 10 feet. Fixed objects should not be permitted to protrude within the vertical or horizontal clearance of a shared use path. The recommended minimum vertical clearance that can be used in constrained areas is 8 feet. In some situations, vertical clearance greater than 10 feet may be needed to permit passage of maintenance and emergency vehicles.

### C.2 Separation Between Shared Use Paths and Roadways

When shared use paths are located adjacent to a roadway, a separation shall be provided. This demonstrates to both path users and motorists that the shared use path is a separate facility.

The minimum distance between a path and roadway shall be 5 feet. On roadways with curb, the distance is measured from the face of curb to the nearest edge of the path. On roadways with flush shoulders, this separation is measured from the:

- Paved shoulder - outside edge of the paved shoulder to the inside edge of the path
- Unpaved shoulders - outside edge of the traveled way to the inside edge of the path
- Where the separation is less than 5 feet, a physical barrier or railing should be provided between the path and the roadway.

A barrier or railing between the path and adjacent highway should not impair sight distance at intersections, and should be designed to limit the potential for injury to errant motorists or bicyclists. The barrier or railing need not be of size and strength to redirect errant motorists toward the roadway, unless other conditions indicate the need for a crashworthy barrier.

Barriers or railings at the outside of a structure or steep fill embankment that not only define the edge of the path but also prevent bicyclists from falling over the rail to a substantially lower elevation should be a minimum of 42" high. Barriers at other locations that serve only to separate the area for motor vehicles from the path should generally have a minimum height equivalent to the height of a standard guard rail.

When a path is placed along a high-speed highway, a separation greater than 5 feet is desirable.

### C.3 Design Speed

For paths in relatively flat areas (grades less than or equal to 4%), a design speed of 18 mph shall be used. When a sustained downgrade greater than 4% exists, refer to the ***AASHTO Guide for the Development of Bicycle Facilities (2012, 4th Edition)*** for further guidance,

### C.4 Horizontal Alignment

The typical adult bicyclist is the design user for horizontal alignment. Please refer to the ***AASHTO Guide for the Development of Bicycle Facilities (2012, 4th Edition)*** for further information on determining the minimum radius of curves on shared use paths.

Shared use paths should be transitioned as necessary towards the roadway at intersections to provide a more functional crossing location that also meets driver expectation.

### C.5 Accessibility

Since nearly all shared use paths are intended to be used by pedestrians, they fall under the accessibility requirements of the Americans with Disabilities Act.

Where a shared use path is contained within a street or highway right of way, the grade of the shared use path shall not exceed the general grade established for

the adjacent street or highway. Where a shared use path is not contained within a street or highway right of way, the grade of the shared use path shall be 5 percent maximum.

Where compliance with the maximum grade requirements for shared use paths is not practicable due to existing terrain or infrastructure, right-of-way availability, a notable natural feature, or similar existing physical constraints, compliance is required to the extent practicable.

The cross slope of a shared use path shall be 2% maximum.

Pull boxes, manholes (and other utility covers), and other types of existing surface features in the location of a proposed curb ramp or detectable warning should be relocated when feasible. When relocation is not feasible, the feature shall be adjusted to meet the ADA requirements for surfaces (including the provision of a nonslip top surface, and adjustment to be flush with and at the same slope as the adjacent surface).

The detectable warning systems are designed to work with concrete surfaces. In areas where the path has an asphalt surface, the engineer must specify an appropriate detectable warning system. In these cases, consider including a short section of concrete that will accommodate any system.

If curb ramps or blended transitions are included in the path design, they shall be parallel to and the full width of the approaching path width. Shared use path crossings shall meet the same grade and cross slope requirements as sidewalks where the grade should not exceed 5%, and the maximum cross slope shall be no more than 2%.

Project design shall include an evaluation of existing driveways to determine if it is feasible to upgrade nonconforming driveway turnouts to meet maximum cross slope criteria. Nonconforming driveways are not required to be upgraded if it is not feasible within the scope of the project.

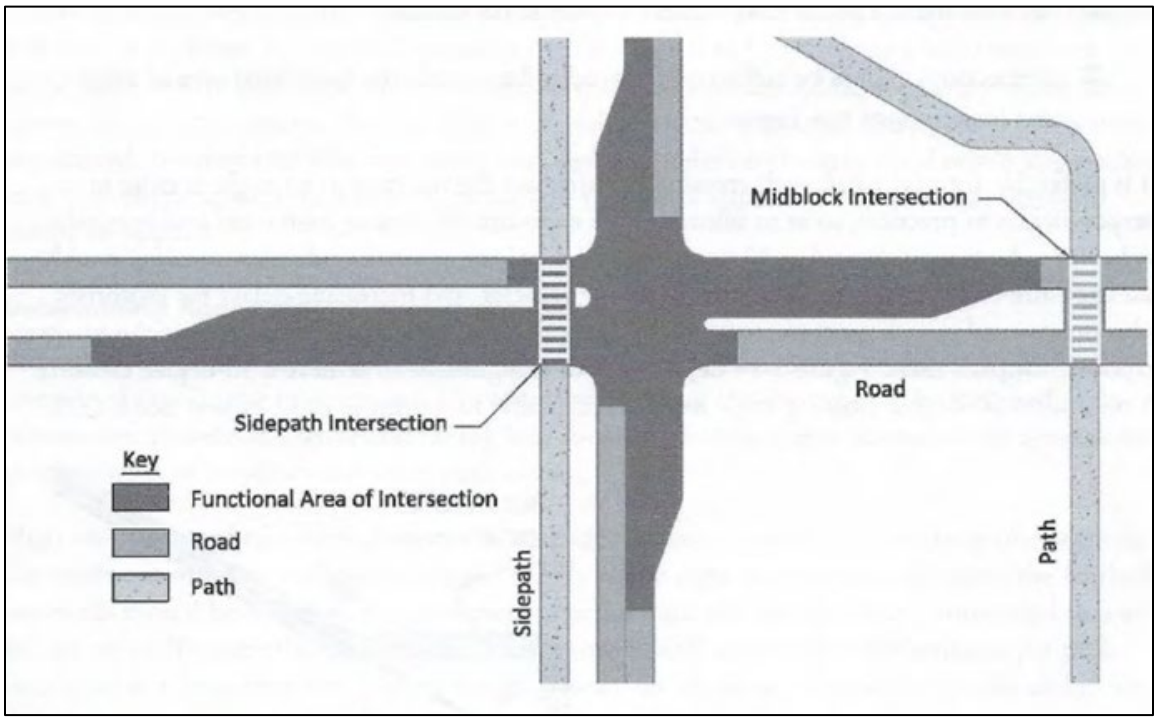
***Chapter 8 – Pedestrian Facilities*** provides additional information regarding accessible design of shared use paths.

## C.6 Shared Use Path – Roadway Intersections

Shared use path crossings fall into three basic categories:

- Grade Separated Crossings – Crossings consisting of either a bridge over the roadway or an underpass beneath the roadway.
- Sidepath/Intersection Crossings – Crossings that are located within the functional area of an intersection of two or more roadways and the path is running parallel with the roadway. Sidepath crossings are typically parallel to one of the intersecting roadways. See Figure 9 – 27 Mid-Block and Sidepath Crossings Relative to Intersection Functional Area.
- Midblock Crossings – Crossings that are located outside the functional area of an intersection. See Figure 9 – 27 Mid-Block and Sidepath Crossings Relative to Intersection Functional Area.

**Figure 9 – 27 Mid-Block and Sidepath Crossings Relative to Intersection Functional Area**




Source: 2012 AASHTO Guide to Bicycle Facilities

### C.6.a Grade Separated Crossings

Grade separated crossings involve considerable expense but may be warranted in certain locations. The need for a grade separated crossing should be based on an engineering analysis to assess existing and future path user characteristics and volume, motor vehicle traffic volume and speed, opportunity for improved at-grade crossings in close proximity, feasibility of accessible design, consistency with existing and future surrounding land use and activities, and long term maintenance costs and responsibility. For further information on conducting such an analysis, see the ***AASHTO Guide to Bicycle Facilities, 4th Edition Section 5.2.10*** and the discussion of grade-separated crossings in the ***AASHTO Guide for the Planning, Design, and Operation of Pedestrian Facilities***.

### C.6.b Sidepath Crossings

Sidepath crossings have unique operational and design challenges. One key factor that must be addressed is intersection sight distance. Given their proximity to motor vehicle intersections, sidepath intersection sight distance requirements must consider both what is needed for the drivers of motor vehicles crossing in each direction as well as bicyclists and pedestrians.

In cases where a shared use path is located parallel to and within the roadway corridor, the traffic control on the sidepath shall be consistent with that on the parallel roadway. The path shall be aligned to allow the placement of the stop bar on side streets a minimum of 4 feet in advance of the crosswalk, and crosswalks shall be marked. The crosswalk width shall be equal to or greater than the approach width of the path.

Where a shared use path is located parallel to a high speed roadway and crossing an access or exit ramp or lane, moving the crossing away from the intersection to a midblock location may be considered. This allows for motorists to first enter or exit the high speed roadway and then turn attention to the pathway crossing. When this is done, care should be taken to insure the midblock location is clearly outside the functional area of the intersection and designed accordingly.

See the ***AASHTO Guide to Bicycle Facilities, 4th Edition, Sections 5.2.2 and 5.3.4*** which covers these operational issues in detail and provides several factors to be considered for proper design for further information.

### C.6.c Midblock Shared Use Path Crossings

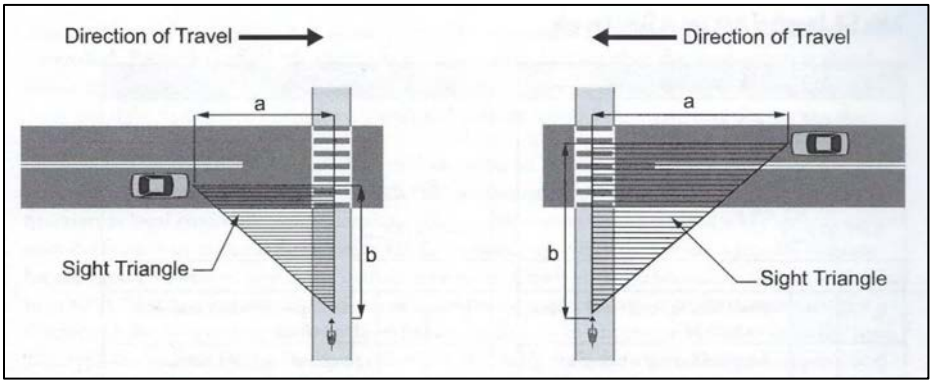
The design of a midblock shared use path crossing is similar in many ways to designing a multi-leg intersection. As with sidepath crossings, a key design element is intersection sight distance. The basic criteria for establishing intersection sight distance for shared use path crossings is based on the same methodology presented in the ***AASHTO Greenbook*** for conventional intersections but with adjustments to account for the design vehicle and design speed of the shared use path. As with conventional intersections, the dimensions of the clear sight triangle are dependent on the type of traffic control.

The ***AASHTO Guide to Bicycle Facilities, 4th Edition Section 5.3.2*** provides additional information on the details and methodology for the proper design of midblock crossings including several examples.

#### C.6.c.1 Intersections with Yield Control

The ***AASHTO Guide to Bicycle Facilities*** indicates that it is preferable to provide shared use path intersection sight distance based on yield control for all midblock crossings. See Figure 9 – 28 Yield Sight Triangles and Table 9 – 2 Formulas for Lengths of Roadway and Path Legs – Yield Condition and the formulas to compute the lengths of the roadway leg (a) and path leg (b) for yield control. Table 9 – 3 Intersection Sight Distance Calculated Lengths of Roadway and Path Lengths provides calculated sight distance values based on Figure 9 – 28 and Table 9 – 2 for a range of roadway design speeds and a shared use path design speed of 18 mph.

**Figure 9 – 28 Yield Sight Triangles**



## Table 9 – 2 Formulas for Lengths of Roadway and Path Legs – Yield Condition

| Length of Roadway Leg (a) | |
|---|---|
| $t_a = \frac{S}{1.47\ V_{path}}$<br>$t_g = t_a + \frac{w + L_a}{1.47\ V_{path}}$<br>$a = 1.47\ V_{road}\ t_g$ | |
| $t_g$ | = Travel time to reach and clear the path (s) |
| a | = length of leg sight triangle along the path approach (ft) |
| $t_a$ | = Travel time to reach the road from the decision point for a path user that does not stop (s) |
| w | = Width of the intersection to be crossed (ft) |
| $L_a$ | = Typical bicycle length = 6 ft (see AASHTO Guide for other design users) |
| $V_{path}$ | = Design speed of the path (mph) |
| $V_{road}$ | = Design speed of the road (mph) |
| S | = Stopping sight distance for the path user traveling at design speed. |

| Length of Path Leg (b) | |
|---|---|
| $t_a = \frac{1.47\ V_e\ -\ 1.47\ V_b}{a_i}$<br>$t_g = t_a + \frac{w + L_a}{0.88\ V_{road}}$<br>$b = 1.47\ V_{path}\ t_g$ | |
| $t_g$ | = Travel time to reach and clear the path (s) |
| b | = Length of leg sight triangle along the path approach (ft) |
| $t_a$ | = Travel time to reach the path from the decision point for a motorist that does not stop (s). |
| $V_e$ | = Speed at which the motorist would enter the intersection after deceleration (mph) (assumed 0.60 x road design speed) |
| $V_b$ | = Speed of which braking by the motorist begins (mph) (same as road design speed) |
| $a_i$ | = Motorist deceleration rate (ft/s$^2$) on intersection approach when braking to a stop not initiated (assume 5.0 ft/s$^2$) |
| w | = Width of intersection to be crossed. |
| $L_a$ | = Length of the design vehicle (ft) |
| $V_{path}$ | = Design speed of the path |
| $V_{road}$ | = Design speed of the road (mph) |

## Table 9 – 3 Intersection Sight Distance Calculated Lengths of Roadway and Path Lengths

| Roadway Design Speed (mph) | Length of Roadway Leg a (feet) | | Length of Path Leg b (feet) |
|---|---|---|---|
| | Length for Crossing 2 Roadway Traffic Lanes | Additional Length for each Additional Traffic Lane Crossed | |
| 20 | 182 | 13 | 109 |
| 25 | 228 | 17 | 115 |
| 30 | 273 | 20 | 124 |
| 35 | 319 | 23 | 136 |
| :40 | 364 | 27 | 148 |
| 45 | 410 | 30 | 161 |
| 50 | 456 | 33 | 174 |
| 55 | 501 | 37 | 188 |
| 60 | 547 | 40 | 202 |

**Notes:**

1. Above lengths a and b based on:
   - Design Speed of Path = 18 mph
   - Stopping Sight Distance for path user = 134 feet
   - Shared Use Path Width at Roadway Crossing = 12 feet
   - Path Design Vehicle Length = 6 feet (bicycle)
   - Road Width = 2 traffic lanes @ 12 feet each = 24 feet
   - Roadway Design Vehicle Length = 19 feet (passenger vehicle)
   - Roadway Approach Grade ≤ 3.0%
   - Path Approach Grade = 0.0%

   For other design conditions see AASHTO Guide to Bicycle Facilities.
2. The line of sight is measured 2.7 feet above the surface of the path and roadway.

#### C.6.c.2 Intersections with Signal Control or Stop Control

Where intersection sight distance based on yield control cannot be provided, signal control or stop control should be considered. For midblock crossings with signal control or stop control on either the roadway or the path, the roadway and path approaches shall provide the minimum stopping sight distance to obey the control and execute a stop before entering the intersection. An unobstructed view of a path user located at the stopped position on the path should be visible to the motorist and vice versa. The ***AASHTO Guide for the Development of Bicycle Facilities*** provides additional details for the proper design of signal control and stop control intersections.

### C.7 Structures

The minimum clear width on structures shall be the same as the approach width of the shared use path, plus a minimum 2 foot wide clear area on each side should be provided. Access by emergency, patrol and maintenance vehicles should be considered in establishing the design clearances of structures on shared use paths. Where practical, a path vertical clearance of 10 feet (on the structure) is desirable for adequate vertical shy distance.

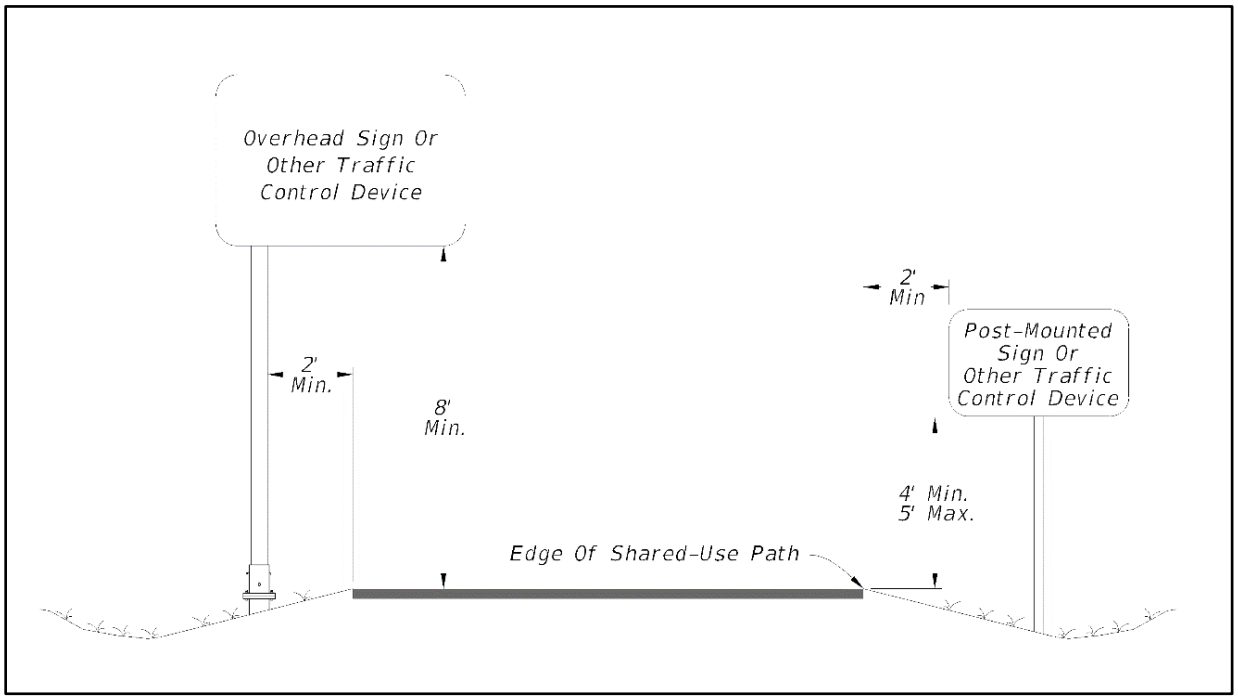
Where compliance with the requirement for a maximum running slope of 5% is not practicable due to existing terrain or infrastructure, right-of-way availability, a notable natural feature, or similar existing physical constraints, compliance is required to the extent practicable.

Ramps on new structures that are part of a shared use path and serve as the accessible route shall have a running slope between 5% minimum and 8.3% maximum. The cross slope of ramp runs shall be 2% maximum.. Landings are required at the top and the bottom of each ramp run.

### C.8 Pavement Markings and Signage

The MUTCD regulates the design and use of all traffic control devices on shared use paths. Figure 9 – 29 Sign Placement on Shared Use Paths provides the minimum criteria for the placement of signs along or over a shared use path. The maximum height from the outside edge of the path to the bottom elevation of a sign is five feet. Signs on shared use paths should follow the dimensions provided in ***Table 9B-1 Bicycle Sign and Plaque Sizes, MUTCD***. Guidance on the placement of stop or yield lines and crosswalks on roadways intersecting with shared use paths is provided in the ***MUTCD, Part 3***.

**Figure 9 – 29 Sign Placement on Shared Use Paths**




## D RAILROAD CROSSINGS

Railroad-highway grade crossings should ideally be at a right angle to the rails. This can be accomplished either as a separate path or a widened shoulder. The greater the crossing deviated from this ideal crossing angle, the greater is the potential for a bicyclist's front wheel to be trapped in the flangeway, causing loss of steering control. If the crossing angle is less than approximately 45 degrees, an additional paved shoulder of sufficient width should be provided to permit the bicyclist to cross the track at a safer angle, preferable perpendicularly. Where this is not possible, and where train speeds are low, commercially available compressible flangeway fillers may enhance bicyclist operation. It is also important that the roadway approach be at the same elevation as the rails. For more information, see Figure 4 – 28 Correction for Skewed Railroad Grade Crossing – Separate Pathway in the ***AASHTO Guide for the Development of Bicycle Facilities***.

## E STRUCTURES

All new bridges over roadways and shared use paths shall be designed to meet the vertical clearance standards specified in ***Chapter 3, Section C.7.j.4.(b)***, and ***Chapter 17, Section C.3.b.***

All bridges that include provisions for pedestrians shall provide pedestrian accommodations and design considerations that meet the provisions of the ADA.

Bridges over roadways should be covered or screened to reduce the likelihood of objects being dropped or thrown below. If the bridge is enclosed, the visual tunnel effect may require widening the bridge to provide a feeling of security for all bridge users. The area adjacent to overpasses may be fenced to prevent unsafe crossings and to channel pedestrians to the vertical separation structure.

## F REFERENCES FOR INFORMATIONAL PURPOSES

- USDOT/FHWA ADA Standards for Accessible Design (ADAAG)
  ***https://www.fhwa.dot.gov/programadmin/pedestrians.cfm***
- AASHTO – Guide for the Development of Bicycle Facilities, 2012, 4th Edition
  ***https://store.transportation.org/Common/DownloadContentFiles?id=1096***
- NACTO Urban Streets Design Guide
  ***http://nacto.org/usdg***
- FHWA Policy Memo for Flexibility in Pedestrian and Bicycle Facility Design
  ***https://www.fhwa.dot.gov/environment/bicycle_pedestrian/guidance/***
- Drainage Handbooks, Florida Department of Transportation,
  ***https://www.fdot.gov/roadway/drainage/manualsandhandbooks.shtm***
- Manual on Uniform Traffic Control Devices, May 2012
  ***http://mutcd.fhwa.dot.gov/pdfs/2009r1r2/pdf_index.htm***
- NACTO, Urban Bikeway Design Guide
  ***https://nacto.org/publication/urban-bikeway-design-guide/cycle-tracks/***

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# CHAPTER 10

## MAINTENANCE AND RESURFACING



## FIGURES

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# CHAPTER 10

# MAINTENANCE AND RESURFACING

## A INTRODUCTION

In order to provide for the safe and efficient movement of all modes of traffic, it is essential to maintain all aspects of the road and right of way at the highest reasonable level of safety. Improvements consistent with upgrading safety standards or accommodating changes in traffic are also required to maintain the facility in a quality condition. Maintenance and resurfacing are costly operations; therefore, every effort should be made to provide the maximum safety benefit from each operation. The fact that a major portion of the maintenance effort is necessary to merely preserve the economic investment in a facility should not be considered as justification for sacrificing the requirements for maintaining or improving the safety characteristics of a street or highway.

## B MAINTENANCE

### B.1 Objectives

The major objectives of a maintenance program include the following:

- Maintain all highway features and components in the best possible condition.
- Improve sub-standard features, with the ultimate goal to at least meet minimum standards.
- Provide for minimum disruptions and hazards to traffic during maintenance operations.
- Location and reporting of inadequate safety features.

### B.2 Policy

Each highway agency responsible for maintenance shall develop and maintain a program of highway maintenance for the entire highway network under its jurisdiction. This program should include the following activities:

- Identify needs
- Establish priorities

- Establish procedures
- Establish and maintain a regular program of maintenance for all aspects

The program should be regularly evaluated and suitably modified to promote the maintenance of streets and highways that result in the best practicable condition.

## B.3 Identification of Needs

The identification of maintenance needs is the first stage in the development of a successful maintenance program, and is required when any portion of the highway system is in a sub-standard condition. Action is also required to correct any situation which is hazardous or may become hazardous in the near future. This may be accomplished by both regular inspection of the highway network and proper analysis of crash records.

### B.3.a Inspection

Periodic and systematic inspection of the entire highway network under each agency's jurisdiction is required to identify situations requiring improvements, and corrections or repairs. These inspections should be conducted by maintenance or traffic operations personnel, or other qualified personnel who are trained in the aspects of highway maintenance requirements.

### B.3.b Crash Records

A regular program of crash investigations, record keeping, and analysis should be established to provide information for recommended highway modification and corrective maintenance requirements. Cooperation among maintenance, traffic operations, and police agencies is required, and activities of these agencies should be coordinated in accordance with the guidelines set forth in the ***National Highway Traffic Safety Administration (NHTSA) Program Guideline No. 21 (II), Identification and Surveillance of Crash Locations***. Inspection of the highway network and analysis of crash records should be utilized to provide feedback for modification of design and construction procedures.

## B.4 Establishment of Priorities

The maintenance activities determined to be necessary by the identification program should be carried out on a priority basis. The establishment of priorities

should be based, to a large extent, upon the objective of promoting highway safety. A high priority should be given to the improvement or correction of situations that may result in fatal or serious crashes. Preservation of highway investment and promotion of efficient traffic operations are important maintenance objectives. Every effort should be made to ensure the highest safety payoff from the maintenance dollar.

## B.5 Establishment of Procedures

Standard procedures and methods for maintenance operations should be established for efficient, rapid, and safe completion of the required work. All maintenance work shall be conducted in accordance with the Standards set forth in ***Chapter 11 – Work Zone Safety***. Each maintenance agency should develop its own Maintenance Manual or utilize the Maintenance Manuals of the FDOT. Such manuals should specify the methods, procedures, equipment, personnel qualifications, and other aspects of the work necessary to ensure successful completion of maintenance operations. Procedures should be developed for emergency, routine, and special operations.

### B.5.a Emergency Maintenance

Emergency maintenance operations are those required to immediately restore the highway to a safe condition. Emergency maintenance work should be carried out by personnel who are specially trained and qualified. Work units, which should be available on a twenty-four hour basis, should be connected with the emergency response communications system. Emergency operations would include the following:

1. The removal of debris from crashes, cargo spillage, or other causes. This activity should be conducted in accordance with the guidelines set forth in the ***NHTSA Program Guideline No. 16, Debris Hazard Control and Cleanup***.
2. Replacement of inoperative traffic control devices.
3. Repair or replacement of damaged highway safety components such as lighting, traffic control devices, redirection devices, and energy absorbing devices.
4. Repair or correction of any situation that provides an immediate or unexpected hazard to the public.
5. Assistance in any activity during emergency response operations.

### B.5.b Routine Maintenance

Routine maintenance operations are those that may be predicted and planned in advance. These operations, which may be preventive or corrective in nature, should be conducted on a regularly scheduled basis using standard procedures. Proper scheduling of these operations should be utilized to provide minimum disruptions and hazards to the driving public. Routine maintenance may include operations such as:

1. Cleaning and debris removal from the pavement, shoulders, and roadside clear zones.
2. Mowing and other vegetation control operations to provide a smooth recovery area and to maintain proper sight distance.
3. Cleaning and inspection of gutters, ditches, and other drainage structures.
4. Structural inspection and preventive maintenance on bridges and other structures.
5. Cleaning, replacement, and maintenance of roadway lighting fixtures.
6. Replacement and maintenance of traffic control devices.
7. Inspection and maintenance of redirection and energy absorbing devices (***Chapter 4 – Roadside Design***).
8. Inspection and maintenance of emergency response communication systems and access facilities.
9. Inspection and maintenance of pavement and shoulders, with particular emphasis on maintaining shoulders flush with the pavement (***Chapter 5 – Pavement Design and Construction***).
10. Inspection and maintenance of all highway components and safety features.
11. Inspection and maintenance of pedestrian pavements, crossings, etc., with particular emphasis on sidewalk cracks, joint separations, accumulated debris, adjacent landscape materials, etc.).
12. Thin pavement overlay that is intended to preserve the pavement, retard its future deterioration and maintain its functional condition.

### B.5.c Special Maintenance

Special maintenance operations are defined as those projects that are

neither urgent nor routine in nature, but are occasionally required to improve or maintain a street or highway in a quality condition. Since these projects can be planned in advance of the initiation of any work, procedures that provide for efficient, rapid, and safe operations can be developed. To avoid continuing disruptions of traffic, the quality and durability of these improvements, corrections, and repairs should be maintained at the highest practicable level. Special maintenance should include the upgrading of the highway safety features, as well as the repair or replacement of damaged or deteriorated highway components. These operations should be designed to upgrade or maintain the street or highway in accordance with the Standards presented in this Manual.

### B.5.d Pavement Maintenance

The primary purpose of pavement maintenance is to ensure the pavement characteristics prescribed in ***Chapter 5 – Pavement Design And Construction***, are reasonably maintained. Each agency with responsibility for maintenance of streets and highways shall establish a meaningful pavement maintenance system (including shoulders and drainage structures) for the entire system under its jurisdiction. This program should include:

1. A process that monitors the serviceability of the existing streets and highways and identifies the pavement sections that are inadequate.

2. A systematic plan of maintenance activities designed to correct structural deficiencies and to prevent rapid deterioration.

3. A preservation program, with assigned priorities, designed to resurface, reconstruct, or replace pavements when they are no longer structurally serviceable.

Pavement maintenance requires a substantial portion of the total maintenance budget for streets and highways. It is necessary to ensure highway safety. The reduction of hydroplaning and splashing is essential for promoting safe and efficient operation during wet weather conditions. The elimination of driving discomfort, and vehicle damage caused by deteriorated pavements, provides additional economic justification for maintaining the pavement in a fully serviceable condition.

It is recognized that a comprehensive preservation program is expensive. Adequate financing is required to successfully carry out these activities.

The establishment of appropriate budget priorities and careful planning can assist in developing and conducting a pavement maintenance and preservation program that will, within a reasonable number of years, bring substandard pavements up to the required level of serviceability and will maintain the adequacy of the entire system.

## C RESURFACING

In addition to the design criteria provided in this chapter, the ***United States Department of Transportation ADA Standards for Transportation Facilities (2006)*** as required by ***49 C.F.R 37.41 or 37.43, United States Department of Justice ADA Standards (2010)*** as required by ***28 C.F.R 35 (title II) and 36 (title III)*** and the ***2020 Florida Building Code, Accessibility, 7th Edition*** as required by ***61G20-4.002*** contains ADA requirements for accessibility in the public right of way, for transportation facilities, and for sites, facilities, buildings, and elements by people with disabilities.

The ***Public Rights-of-Way Accessibility Guidelines*** ***(PROWAG)*** provides additional information for the design of pedestrian facilities.

### C.1 Accessibility Requirements

If new sidewalk and driveway construction or reconstruction is included on resurfacing projects they shall be designed to meet the requirements of ***Section C.7.d*** of ***Chapter 3 – Geometric Design*** and ***Chapter 9 – Pedestrian Facilities***. Project design should include an evaluation of existing driveways to determine if it is feasible to upgrade nonconforming driveways.

Existing detectable warnings and curb ramps shall be brought into compliance. This includes installing new detectable warnings for both flush shoulder and curbed roadway connections and signalized driveways where none exist or do not meet current requirements. New curb ramps shall be provided on curbed roadways where none exist and existing substandard curb ramps shall be replaced. Existing ramps not meeting detectable warning requirements which otherwise comply with orientation, slope and width criteria shall be retrofitted with detectable warnings.

Where existing right of way is inadequate or conflicts occur with existing features that cannot be practicably relocated or adjusted (e.g. driveways, drainage inlets, signal poles, pull boxes, utility poles, etc.), pedestrian accessibility shall be provided to the maximum extent feasible, with appropriate documentation signed and sealed by a Professional Engineer (EOR). Other than meeting detectable warning and curb ramp requirements, existing sidewalks and driveways are not required to be upgraded for the sole purpose of meeting requirements for accessibility unless included in the project scope.

### C.2 Railroad-Highway Grade Crossing Near or Within Project Limits

Federal-aid projects must be reviewed to determine if a railroad-highway grade

crossing is within the limits of or near the terminus of the project. If such railroad-highway grade crossing exists, the project must be upgraded to meet the requirements of the ***Manual on Uniform Traffic Control Devices (2009 Edition with Revision Numbers 1 and 2, May 2012) (MUTCD)*** in accordance with ***Title 23, United States Code (U.S.C), Chapter 1, Section 109(e)*** and ***23 C.F.R. 646.214(b)*****.** Please refer to Section C of ***Chapter 7 – Rail-Highway Crossings*** for further information.

## C.3 Safety Improvements

Local agencies should strive to upgrade the safety of their facilities during scheduled maintenance intervals especially during pavement resurfacing projects. Particular attention should be paid to improving pedestrian and bicyclist safety using strategies such as crosswalks and bicycle facilities. Investments should also be made in improved guardrail end treatments and bridge-end transitions on high speed facilities.

### C.3.a Pavement Safety Edge

Many low-cost strategies exist to improve the long-term safety of streets and highways. One such strategy is the pavement Safety Edge. The Safety Edge provides a higher probability of a vehicle returning safely to the travel lane when it drifts off the pavement. It is a wedge-shaped transition of the structural pavement to the unpaved shoulder. The wedge shape eliminates tire scrubbing against the pavement edge and improves vehicle stability as it crosses a drop-off.

The Safety Edge is particularly effective when providing a smooth transition from pavement to shoulder when vertical drop-offs exceed 2 inches. Construction of the Safety Edge typically includes initially pulling the unpaved shoulder for pavement structural course, and then backfilling onto the Safety Edge with installation of sod or turf. The Safety Edge is very effective in mitigating the severity of road-departure crashes should the unpaved shoulder erode away between maintenance intervals.

A Safety Edge treatment should be provided adjacent to the travel lane on roadways:

- without curb or paved shoulders,
- with a posted speed of 45 mph or greater, and
- a history of lane departure crashes.

Details for the Safety Edge are included in Figures 10 – 1 Two Lane Road with Safety Edge and 10 – 2 Safety Edge Detail (No Paved Shoulder).

Additional information on Safety Edge can be found at ***FHWA's Office of Safety – Safety Edge***, including a Design and Construction Guide, Guide Specification, Safety Evaluation Tech Brief and Case Studies. ***FHWA's Crash Modification Factors Clearinghouse*** also provides information on the performance of safety edge. The FDOT has a ***Developmental Specification for Safety Edge – Dev330SE*** on the FDOT's web site which may be used if approved by the agency having jurisdiction.

**Figure 10 – 1 Two Lane Road with Safety Edge**

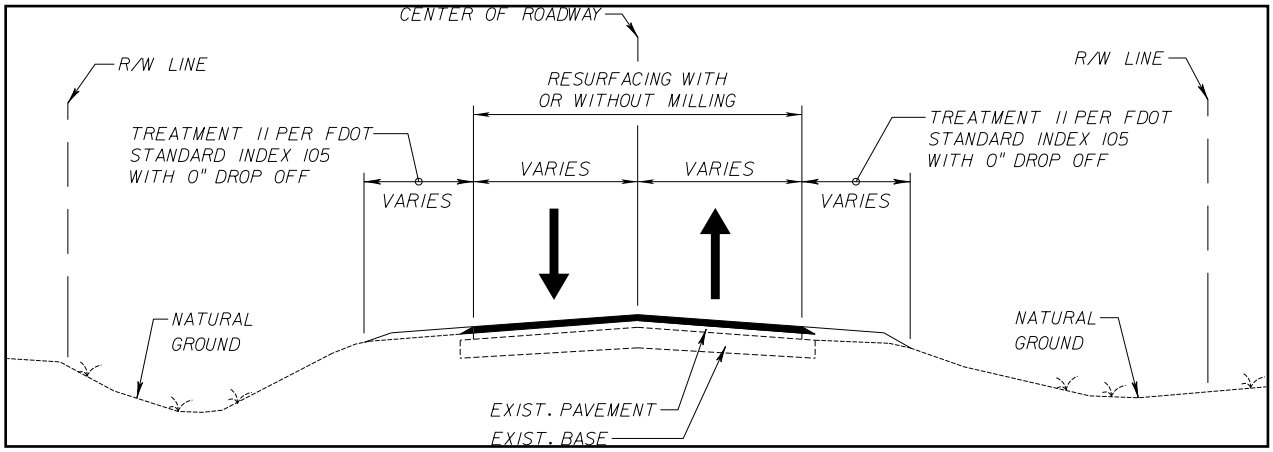
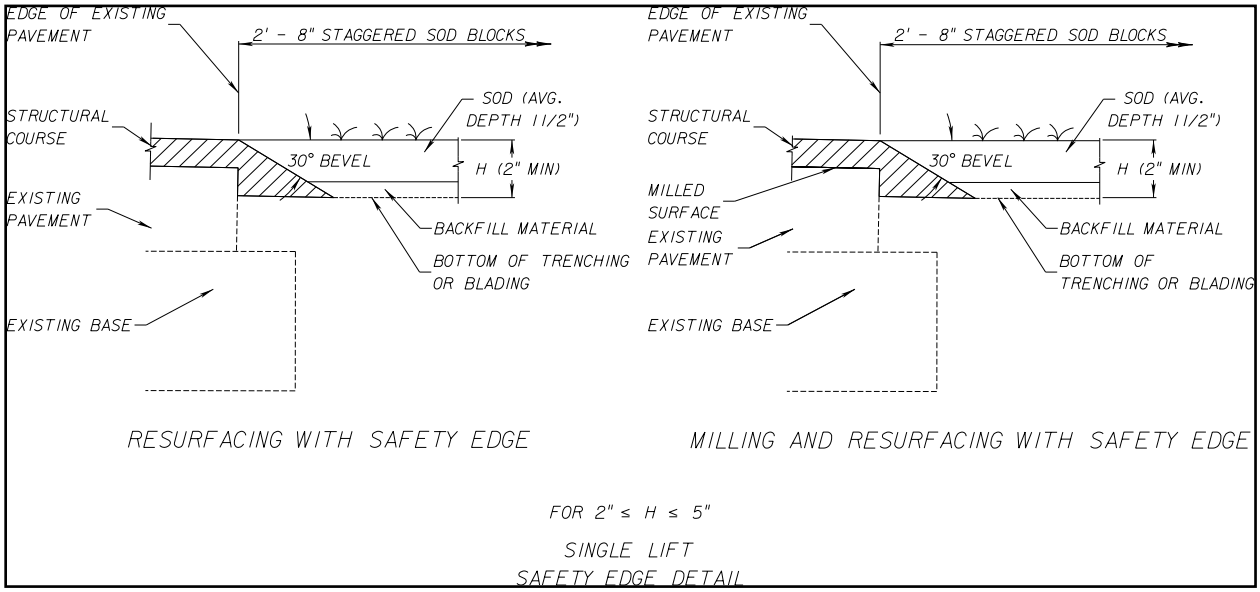


**Figure 10 – 2 Safety Edge Detail (No Paved Shoulders)**




## C.4 Federal Aid Project Requirements

The following are the minimum requirements that a local highway resurfacing project scope must contain for federal-aid assistance including projects in the Local Agency Program (LAP):

1. Rework shoulders to be flush with the pavement and establish turf along the pavement edge.

2. Upgrade or replace existing roadside hardware (guardrail) as necessary for compliance with Federal criteria for 3R projects (as summarized in the ***FDOT Design Manual, Chapter 215 Roadside Safety)***.

3. Meet the ***Manual on Uniform Traffic Control Devices (2009 Edition with Revision Numbers 1 and 2, May 2012) (MUTCD)*** standards for signing and pavement marking.

4. Construct or reconstruct, as appropriate, curb cuts and ramps to meet current accessibility requirements.

5. Upgrade the safety of the project by mitigating the impact of crashes involving vehicles, bicycles, and pedestrians.

   Note: The local agency may contact the FDOT District Safety Office and

determine locations within the project with crash rates higher than average for similar facility type. The local agency may then identify the causes of the crashes from a review of crash report data provided by the FDOT District Safety Office. Based on this analysis, the local agency may then specify the appropriate crash mitigation measures (additional guardrail, signing, vibratory/audible pavement marking, designated crosswalks or other prudent safety-enhancing strategies).

6. Upgrade railroad crossings to meet the ***Manual on Uniform Traffic Control Devices (2009 Edition with Revision Numbers 1 and 2, May 2012) (MUTCD)*** requirements in accordance with ***Title 23, United States Code (U.S.C), Chapter 1, Section 109(e)*** and ***23 C.F.R. 646.214(b).*** Please refer to ***Section C*** of ***Chapter 7 – Rail-Highway Crossings*** for further information.

## D REFERENCES FOR INFORMATIONAL PURPOSES

The following is a list of publications that may be referenced for further guidance:

- FHWA Pavement Preservation Definitions, HIAM-20, September 12, 2005, ***http://www.fhwa.dot.gov/pavement/preservation/091205.cfm***
- NCHRP Synthesis 417: Geometric Design Practices for Resurfacing, Restoration, and Rehabilitation, ***https://www.trb.org/Publications/Blurbs/165650.aspx***
- FHWA Center for Accelerating Innovation – Safety Edge ***https://www.fhwa.dot.gov/innovation/everydaycounts/edc-1/safetyedge.cfm***

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# CHAPTER 11

## WORK ZONE SAFETY AND MOBILITY

# TABLES



# FIGURES

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# CHAPTER 11

# WORK ZONE SAFETY AND MOBILITY

## A INTRODUCTION

Construction, maintenance, and utility work, along with traffic incident management, are operations that may create highway safety and mobility challenges. The changes to normal traffic flow and the introduction of unexpected travelling conditions at many work zones may generate hazardous situations and serious traffic conflicts. A comprehensive plan for work zone safety is required to minimize the risks and effects of these operations. These comprehensive plans are known as transportation management plans. Any activity within a street, highway or shared use path corridor shall follow the requirements of this chapter.

The general objective of a transportation management plan is to protect workers, traffic incident responders, pedestrians, bicyclists, and motorists during work zone operations. This may be achieved by meeting the following:

- Provide adequate advance warning and information about upcoming work zones
- Promote the use of the appropriate traffic control and protection devices
- Provide pedestrians, bicyclists, and motorists clear information to understand how to navigate through or around the work zone
- Provide accessible and continuous routes for pedestrians through, in, and/or around construction or maintenance work zones at least to the same level of accessibility that existed prior to the project
- Reduce the consequences of an out-of-control vehicle
- Provide safe access and storage for equipment and material
- Promote the speedy completion of projects (including thorough cleanup of the site)

## B REGULATORY REQUIREMENTS

Each agency with responsibilities for construction, maintenance, utility, or traffic incident management, or any roadwork operations on streets and highways shall develop and maintain a program of work zone safety, as set forth in the ***Manual on Uniform Traffic Control Devices, 2009 Edition (MUTCD)***, *and* adopted by ***Rule 14 – 15.010, F.A.C.*** Additional requirements related to all highway construction projects financed in whole or in part with federal-aid highway funds are provided in ***Title 23 Code of Federal Regulations (CFR) 630 Subpart J***, more commonly known as the ***Work Zone Safety and Mobility Rule***, and ***Temporary Traffic Control Devices Rule (Subpart K)***,

When an existing pedestrian facility is in place, an accessible and continuous route for pedestrians through, in, and/or around construction or maintenance work zones must be provided, in compliance with the ***2006 Americans with Disabilities Act Standards for Transportation Facilities*** as required by ***49 C.F.R 37.41 – Construction of Transportation Facilities by Public Entities*** or ***37.43 - Alteration of Transportation Facilities by Public Entities***. The ***2017 Florida Accessibility Code*** also includes requirements that apply to work zones, as required by ***F.A.C. 61G20-4.002***.

## C TRANSPORTATION MANAGEMENT PLAN

A Transportation Management Plan (TMP) lays out a set of strategies for managing work zone impacts of a project. The TMP helps to expand mitigation of work zone impacts beyond traffic safety and control to also address mobility for all users. The scope and content of the TMP required for a project are based on the work zone policies, expected work zone impacts of the project, and whether a project is determined to be significant. For all projects, the TMP will contain a Temporary Traffic Control Plan (TTCP) that addresses traffic safety and control through the work zone and is consistent with the provisions under Part 6 of the ***MUTCD.***

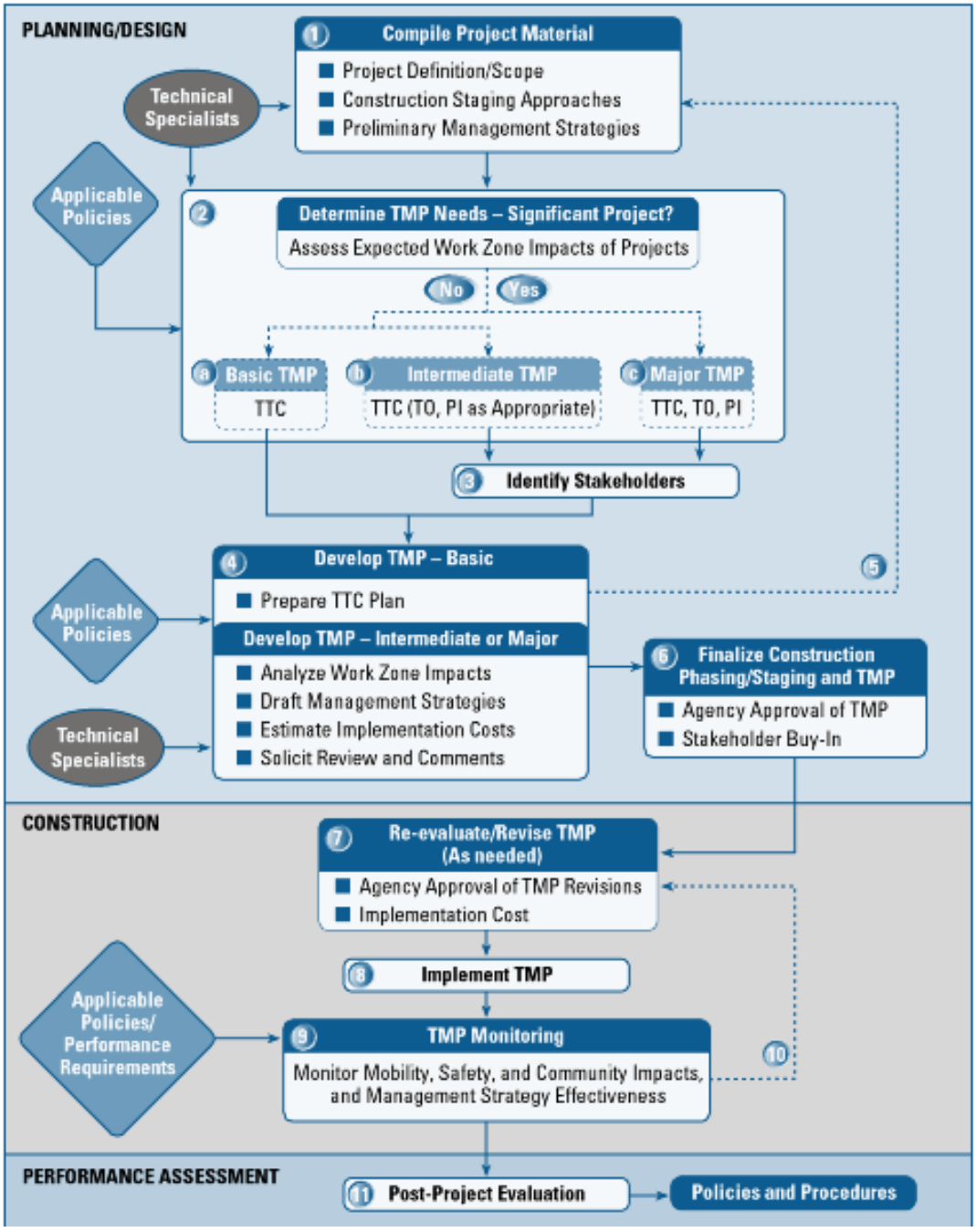
If a project is expected to be significant, the TMP for that project must also contain both transportation operations and public information components. The Transportation Operations Plan (TOP) addresses operations and management of the transportation system in the work zone impact area. Examples of TOP strategies include travel demand management, signal retiming, use of Intelligent Transportation Systems (ITS), speed enforcement, and traffic incident management.

The Public Information Plan (PIP) addresses communication with the public and concerned stakeholders, both before and during the project, about the project, what to expect in and around the work zone, and available travel alternatives. Examples of PIP strategies include using brochures, web sites, radio, and/or variable message signs to disseminate this information both pre-trip and in-route.

A significant project is defined as one that alone or in combination with other concurrent projects nearby is anticipated to cause sustained work zone impacts that are greater than what is considered tolerable based on policy or engineering judgement.

Figure 11 – 1 TMP Development provides an overview of the steps taken in developing a Transportation Management Plan. Further information on developing TMPs for projects can be found on ***FHWA's Work Zone Management*** web page.

**Figure 11 – 1 TMP Development**




Source: FHWA Figure 6.1 Transportation Management Plans

# D TEMPORARY TRAFFIC CONTROL PLAN (TTCP)

The achievement of work zone safety requires careful and complete planning prior to the initiation of any work. The planning objective is to develop a comprehensive Temporary Traffic Control Plan (TTCP) that includes the following considerations:

- Type of Operation
- Nature of Work Zone
- TTCP Details
- Work Scheduling
- Coordination

## D.1 Type of Operation

The type of operation may be further classified as routine, unplanned, or planned operations.
Routine operations would involve projects such as mowing, street cleaning, and preventive maintenance operations conducted on a regularly scheduled basis.
Unplanned operations require prompt, efficient action to restore the facility to a safe condition. These include traffic incident management such as clearing vehicle crash or storm debris, addressing hazardous materials spills, repairing or replacing damaged safety components and restoring inoperative traffic control devices.
Planned operations are scheduled projects, neither routine nor time-sensitive in nature, that are occasionally required to maintain or upgrade a street, highway, sidewalk, or path.

## D.2 Nature of the Work Zone

The development of the TTCP for work zone safety should include consideration of the following factors:

- Length of the project
- Duration and complexity of the work
- Hazards that may be created (e.g., long term drop-offs)
- Necessity for storing equipment or material in the facility right of way
- Traffic characteristics and patterns
- Effects on nearby businesses and residences, especially when detouring

- Site conditions that may be confusing or distracting
- Limitations on sight distance
- Decreased visibility associated with nighttime operations
- Reasonableness of detour length and complexity

## D.3 TTCP Details

Plans should include protection at work zones when work is in progress and when operations have been halted (such as during the night, special events or restrictions, holidays). The TTCP should include provisions for the following:

- Work zone traffic signs
- Channelizing devices
- Temporary barriers (see ***Chapter 4 – Roadside Design***)
- The usage of flaggers or temporary traffic signals
- Access and accommodations for pedestrians, bicyclists, and transit users
- Lane widths (see ***Section D.6 Number and Width of Travel Lanes, Bike Lanes, Sidewalks, and Shared Use Paths***)
- Drop-off hazards (see ***Chapter 4 – Roadside Design***)
- Above ground hazards (see ***Chapter 4 – Roadside Design***)
- Clear zone (see ***Chapter 4 – Roadside Design***)
- Sight distance (intersection, stopping)
- Temporary drainage
- Work zone speed
- Lane closure restrictions
- Bus stops, boarding and alighting areas, shelters, lighting
- Traffic control officers and law enforcement
- Adequate work zone space for construction vehicles, workers and materials
- Night safety (see ***Chapter 6 – Lighting***)
- Traffic control and protective devices – including short term transverse rumble strips and temporary raised rumble strip sets (see ***Section D.3.1 Short Term***

***Transverse Rumble Strips, Section, D.3.2 Temporary Raised Rumble Strip Sets,*** and ***Chapter 18 – Signing and Marking***)

- Detours, including for pedestrians and bicyclists
- Special events

### D.3.a Short Term Transverse Rumble Strips

In locations with existing raised rumble strip sets (e.g., intersections, approaches to horizontal curves, toll plazas), maintain or replace the raised rumble strip sets throughout construction. Provide short-term raised rumble strip sets when existing raised rumble strip sets are removed for construction activities, until the permanent raised rumble strip sets are installed. Short-term raised rumble strip sets must be installed prior to opening the road to traffic; therefore, quantities may include multiple applications due to construction phasing. The ***FDOT's Standard Plans, Index 546-001*** and ***Standard Specifications, Section 546*** provide additional information on short term raised rumble strips.

**Example of Transverse Rumble Strips**

### D.3.b Temporary Raised Rumble Strip Sets

Temporary raised rumble strip sets are used to warn vehicular traffic of the upcoming work zone. They may be used to supplement the required signs, channelizing devices, and flagging operations in the work zone. They are most often used when both of the following conditions occur:

- Lane closure on a two-lane, two-way roadway
- Existing posted speed prior to construction is 55 mph or greater

The FDOT's ***Standard Plans, Index 102-603*** provide additional information on temporary raised rumble strips.

## D.4 Work Scheduling

Proper work scheduling and sequencing of operations will promote efficiency, but also improve the safety aspects. Where feasible, routine operations and special projects should be conducted during periods of low traffic volume to reduce conflicts. Projects that may be carried out concurrently at the same site should be scheduled simultaneously to eliminate successive disruptions of traffic.

Major projects that impede or restrict traffic flow should be coordinated and sequenced with similar projects in adjacent areas, to produce a minimum of disruption to orderly traffic flow in the overall network. The scheduling of work at a given location should include consideration of traffic generation (including special events), as well as traffic restrictions by work activities on the surrounding network.

## D.5 Coordination

To ensure safe and efficient roadwork operations, the TTCP should be developed and executed in cooperation with interested individuals and agencies, which may include the following:

- Transportation agencies
- Police and sheriff's departments
- Emergency responders
- Contractors
- Utilities

- Building departments
- Mass transit providers
- Traffic generators
- Residents and businesses
- Neighboring jurisdictions
- School Boards
- Postal Services
- Media
- Trash and recycling pick ups

### D.6 Number and Width of Travel Lanes, Bike Lanes, Sidewalks, and Shared Use Paths

The number and width of travel lanes, sidewalks, shared use paths, and bike lanes should be maintained through work zones. The minimum widths for work zone travel lanes, sidewalks, shared use paths, and bike lanes shall be as follows:

- Freeways – 11 feet
- Arterials – 10 feet except on transit or truck routes, where a minimum width outside through lane of 10.5 feet is required
- Collectors – 10 feet
- Local – 10 feet, or to match existing lane widths if less than 10 feet
- Sidewalks – 5 feet
- Shared Use Paths – 8 feet
- Bike Lanes – 4 feet plus 1'offset from barrier or curb

Do not allow traffic control and warning devices to encroach on travel lanes, bike lanes, paved shoulders, sidewalks, and shared use paths open for travel.

## D.7 Clear Zones, Above-Ground Hazards, Drop-Offs, and Temporary Barriers

When above-ground hazards or drop-offs occur within the clear zone or adjacent to pedestrian facilities due to construction or maintenance activities, protection devices may be needed. See ***Chapter 4 – Roadside Design*** for requirements.

## D.8 Work Affecting Pedestrian and Bicycle Facilities

### D.8.a Pedestrian Facilities

When an accessible sidewalk or shared use path is temporarily closed to pedestrians by construction, alterations, maintenance operations, or other conditions, an alternate pedestrian access route complying with Sections 6D.01, 6D.02, and 6G.05 of the ***MUTCD*** shall be provided. Where provided, pedestrian barricades and channelizing devices shall comply with sections 6F.63, 6F.68, and 6F.71 of the ***MUTCD***. The temporary sidewalk or shared use paths shall maintain the same level of accessibility as the existing facility or greater. Minimize diversions and detour lengths.

For a temporary sidewalk, provide a minimum width of 5 feet. In constrained conditions, a minimum sidewalk width of 4 feet may be provided, with a 5’ x 5’ passing section at least every 200 feet. For a temporary shared use path, provide a minimum width of 8 feet. Both sidewalks and shared use paths shall have a maximum cross slope of 0.02 and running slope of 5%. If the temporary sidewalk or shared use path is contained within a street or highway right of way the maximum running slope shall not exceed the general grade established for the adjacent street or highway.

When temporary sidewalks or shared use paths intersect with streets or driveways, ensure that all curb ramps or blended transitions meet ADA requirements. Detectable warnings shall be provided at intersections with all streets and signalized or stop sign controlled driveways. Detectable warnings are not required for curb ramps or blended transitions diverting pedestrian traffic into a closed lane.

See ***Chapter 8 – Pedestrian Facilities*** and ***Chapter 9 – Bicycle Facilities*** for further information. Additional information on designing accessible sidewalks and shared use paths can be found on the ***United States Access Board’s*** web page, including the ***(Proposed) Public Rights-of-Way Accessibility Guidelines (PROWAG)***.

### D.8.b Bicycle Facilities

The continuity of a bicycle facility should be maintained through the work zone. Continuity through the work zone is particularly important where bicyclists have been traveling on a shoulder, bike lane, or shared-use path prior to the work zone and adjacent to a lane having a posted speed limit ≥ 35 miles per hour. If a bicycle lane, paved shoulder, or shared use path on a roadway having a speed limit of 35 mph or higher is closed a separate bicycle facility or detour route should be provided. To maintain room for bicycle lanes, paved shoulders, or a shared use path through the work zone on a multi-lane roadway, one or more travel lanes could be closed.

On roadways where bicyclists currently share lanes with motor vehicle traffic, the TTCP and typical applications for general traffic will usually be adequate for bicyclists as well.

If a bicycle facility detour is unavoidable, it should be as short and direct as practical, using roadways where conditions are appropriate for bicycling. On-road bicyclists should not be directed onto a sidewalk unless no practical alternative is available (such as might be the case on a bridge in the course of a rehabilitation project or roadway with environmental or right of way constraints). If directing cyclists onto a sidewalk; sidewalks should be widened to be at least 6 feet, 7 feet when back of curb.

If a portion of a bicycle facility is to be closed due to construction activities and the detoured facility follows a complex path not in the original corridor, then a full detour plan should be developed and implemented. The TTCP for the detour of the bicycle facility should include all necessary advance warning (W21 series) signs, detour (W4-9 series) signs, and any other TTCP devices necessary to guide bicyclists along the detour route.

If an on-street bicycle facility had a wide outside through travel lane (lanes having a width of at least 14 feet) prior to construction, and construction activities reduce the lane width to less than 14 feet through the work zone, then the Bicycles May Use Full Lane (R4-11) sign and Shared Lane Marking should be used.

Additional requirements for providing for and managing bicycle travel in work zones is found in ***Part 6 of the MUTCD***. The minimum TTC sign and plaque sizes for shared-use paths shall conform to those shown in ***Table 9B-1 Bicycle Facility Sign and Plaque Minimum Sizes of the MUTCD***. The minimum TTC sign and plaque sizes for on-street bicycle facilities shall conform to ***Chapter 6F of the MUTCD***.

## D.9 Typical Application Examples

The following figures provide examples of typical applications. Typical applications should be used to develop a site-specific TTCP. Examples are provided for the following scenarios:

Figure 11 – 2 Two-Lane Roadway Lane (Closure Using Flaggers)

Figure 11 – 3 Multi-Lane Roadway Lane (Single Lane Closure)

Figure 11 – 4 Sidewalk/Shared Use Path Diversion (Temporary Sidewalk/Shared Use Path)

Figure 11 – 5 Sidewalk/Shared Use Path Detour (Closure with Reroute)

Figure 11 – 6 Bicycle Lane Closure Without Detour

Figure 11 – 7 Bicycle Lane Closure With On-Road Detour

Figure 11 – 8 Shared Use Path Closure with a Diversion

Figure 11 – 9 On-Road Detour for Shared Use Path

Figure 11 – 10 Paved Shoulder Closure with Bicycle Diversion onto Temporary Path

The recommended spacing for work zone details in the Figures below are provided in Tables 11 – 1 Work Zone Sign Spacing “X”, Table 11 – 2 Taper Length “L”, Table 11 – 3 Buffer Length “U”, and Table 11 – 4 Channelizing Device Spacing. The ***MUTCD*** provides additional information; for work zone sign spacing see ***Table 6H-3***; for taper length see ***Table 6H-4***, and for buffer length, see ***Table 6C-2.*** Provide pavement markings in accordance with ***Section 6F-78*** of the ***MUTCD***. The FDOT’s ***Standard Plans*** provides additional information and modifications of typical applications found in the ***MUTCD***.

**Table 11 – 1 Work Zone Sign Spacing "X"**

| Road Type | Min. Spacing (feet) |
|---|---|
| Arterials and collectors with Work Zone Speed ≤ 40 mph | 200 |
| Arterials and collectors with Work Zone Speed ≥ 45 mph | 500 |
| Freeways/Limited Access Roadways | 1,500 |

**Table 11 – 2 Taper Length "L"**

| Work Zone Speed (mph) | Min. Length (feet) |
|---|---|
| ≤ 40 | $L = WS^2/60$ |
| ≥ 45 | $L = WS$ |
| Note: Where W = width of offset in feet<br>S = speed in mph | |

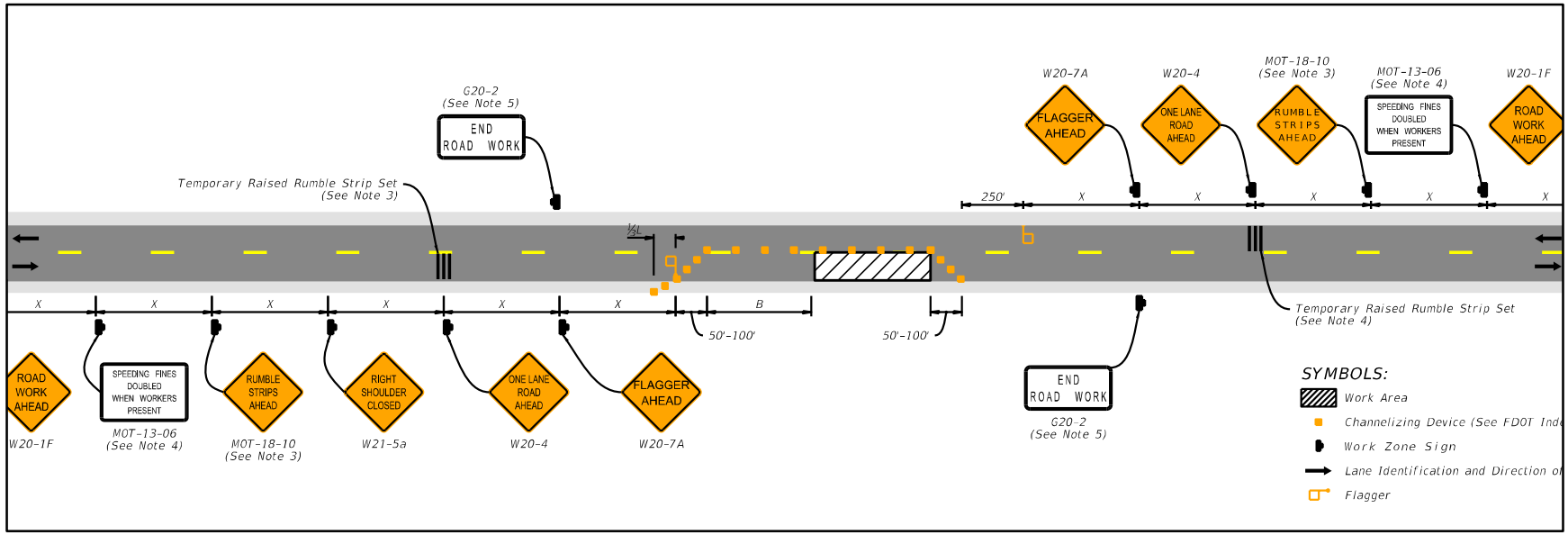
**Table 11 – 3 Buffer Length "U"**

| Work Zone Speed (mph) | Min. Length (feet) |
|---|---|
| 25 | 155 |
| 30 | 200 |
| 35 | 250 |
| 40 | 305 |
| 45 | 360 |
| 50 | 425 |
| 55 | 495 |
| 60 | 570 |
| 65 | 645 |
| 70 | 730 |
| Note: When Buffer Length "U" cannot be attained due to geometric constraints, use the greatest length possible, but not less than 155 feet. | |

**Table 11 – 4 Channelizing Device Spacing**

| Speed (mph) | Max. Distance Between Devices (feet) | | | |
|---|---|---|---|---|
| | Tubular Markers | | Vertical Panels or Opposing Traffic Lane Divider | |
| | Taper | Tangent | Taper | Tangent |
| 25 | 25 | 50 | 25 | 50 |
| 30 to 45 | 25 | 50 | 30 | 50 |
| 50 to 70 | 25 | 50 | 50 | 100 |

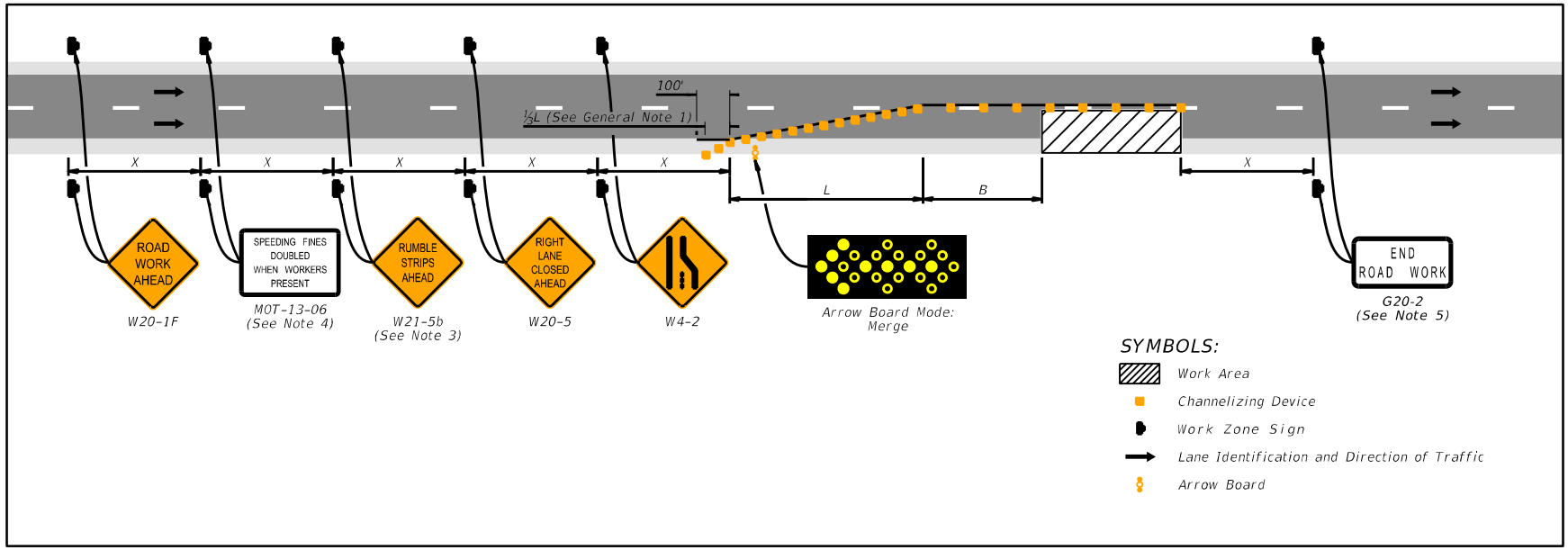
## Figure 11 – 2 Two-Lane Roadway, Single Lane Closure Using Flaggers




Notes:

1. X = Work Zone Sign Spacing, L = Taper Length, U = Buffer Length, see Table 11 – 1, 11 – 2, and 11 – 3 of this chapter and the MUTCD.
2. See Table 11 – 4 for the required spacing of channelizing devices.
3. If temporary rumble strips are used, include “Rumble Strips Ahead” signs and associated sign spacing distance.
4. “Speeding Fines Doubled When Workers Present” signs may be used,
5. “End Road Work” signs may be included when the work zone is in place for greater than 24 hours.
6. Temporary Pavement Markings are required for work zones greater than 24 hours in duration.
7. For general sign codes refer to FHWA Standards for Highway Signs and Markings. For special signs beginning with MOT-xx, FDOT’s Special Sign Details in the ***Standard Plans*** provide additional information.

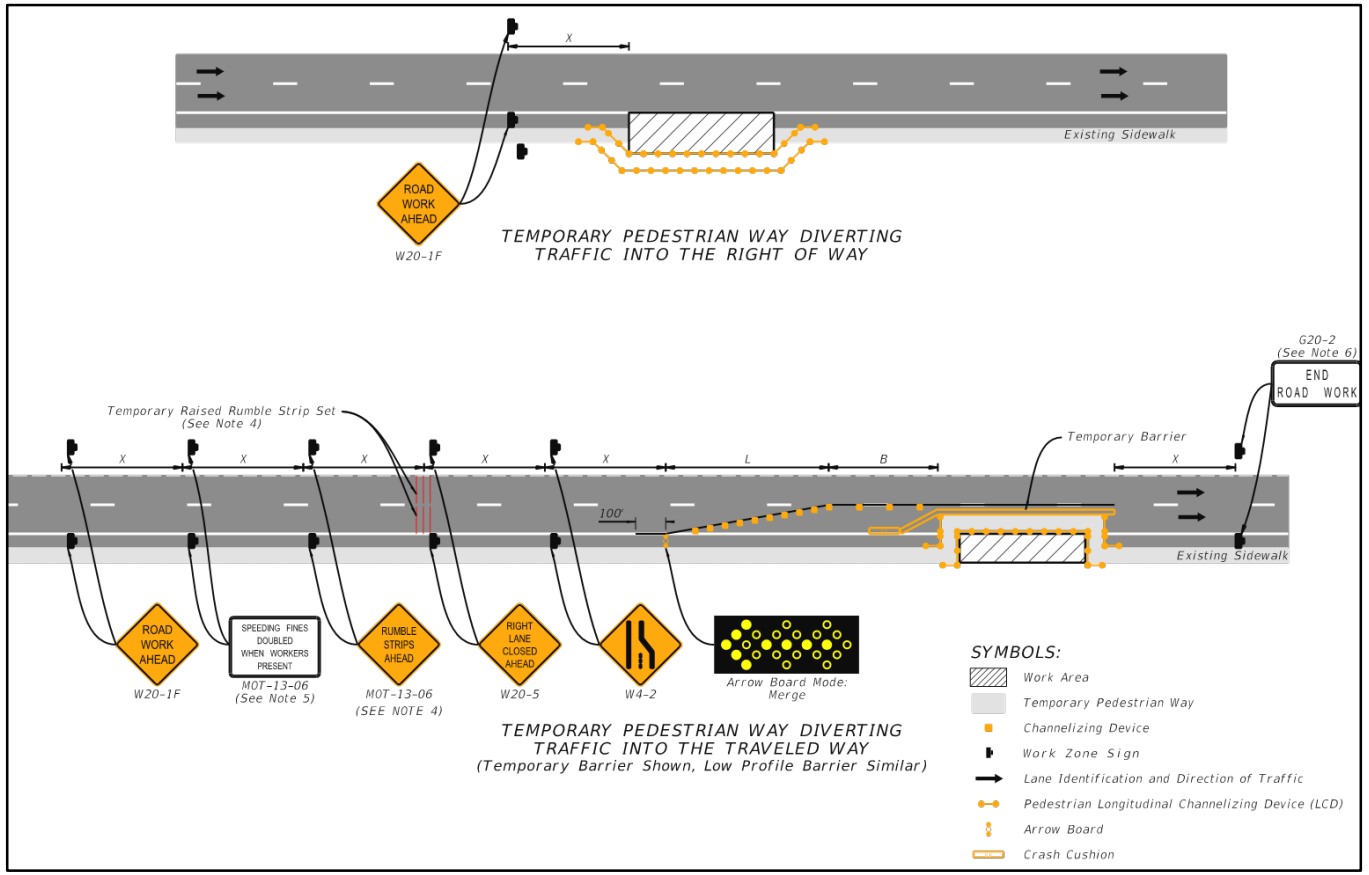
## Figure 11 – 3 Multi-Lane Roadway, Single Lane Closure




Notes:

1. X = Work Zone Sign Spacing, L = Taper Length, U = Buffer Length, see Table 11 – 1, 11 – 2, and 11 – 3 of this chapter and the MUTCD.
2. See Table 11 – 4 for the required spacing of channelizing devices.
3. If temporary rumble strips are used, include “Rumble Strips Ahead” signs and associated sign spacing distance.
4. “Speeding Fines Doubled When Workers Present” signs may be used,
5. “End Road Work” signs may be included when the work zone is in place for greater than 24 hours
6. Temporary Pavement Markings are required for work zones greater than 24 hours in duration.
7. For general sign codes refer to FHWA Standards for Highway Signs and Markings. For special signs beginning with MOT-xx, FDOT’s Special Sign Details in the Standard Plans provide additional information.

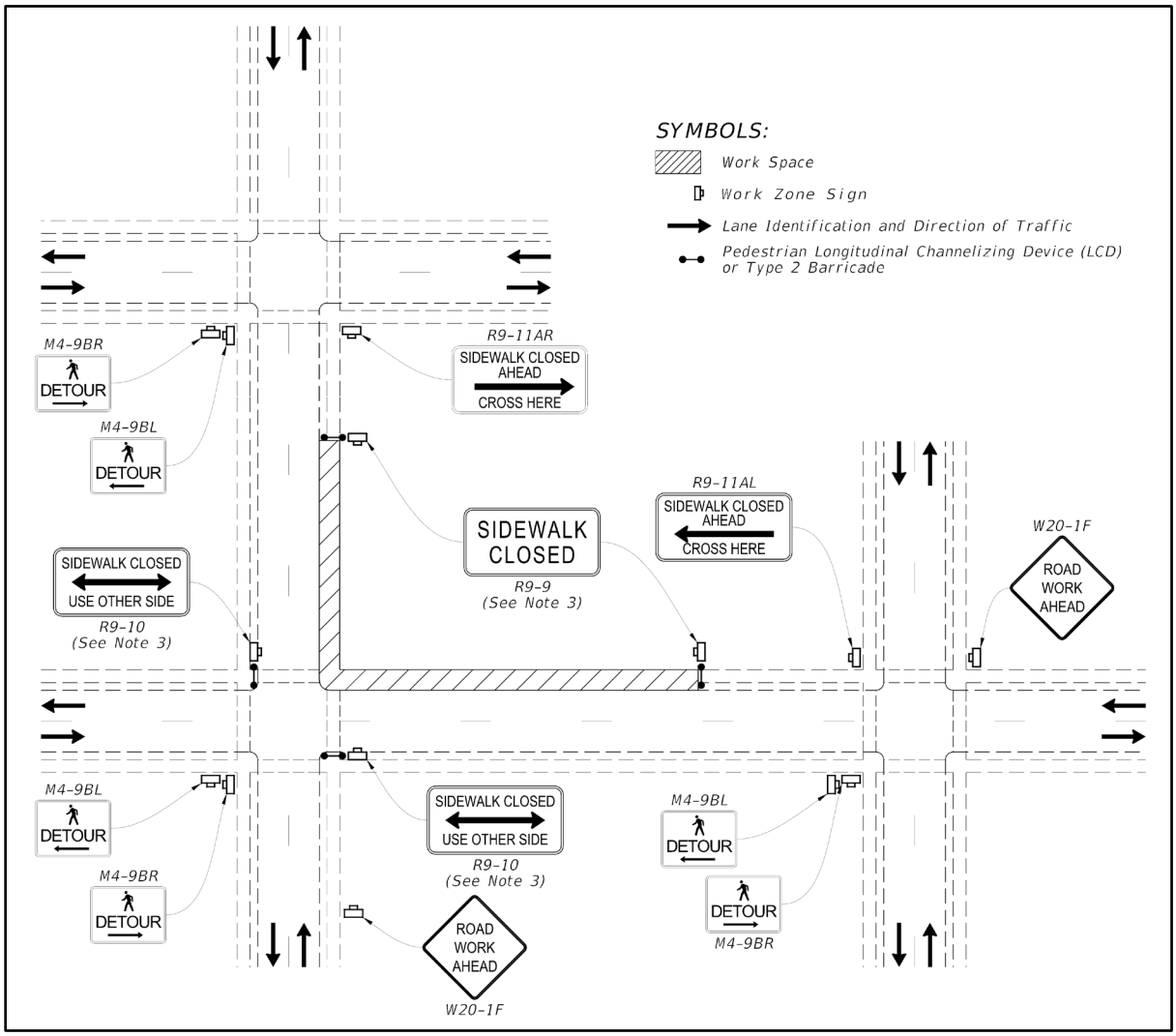
**Figure 11 – 4 Sidewalk/Shared Use Path Diversion (Temporary Sidewalk/Shared Use Path)**




Notes: See following page.

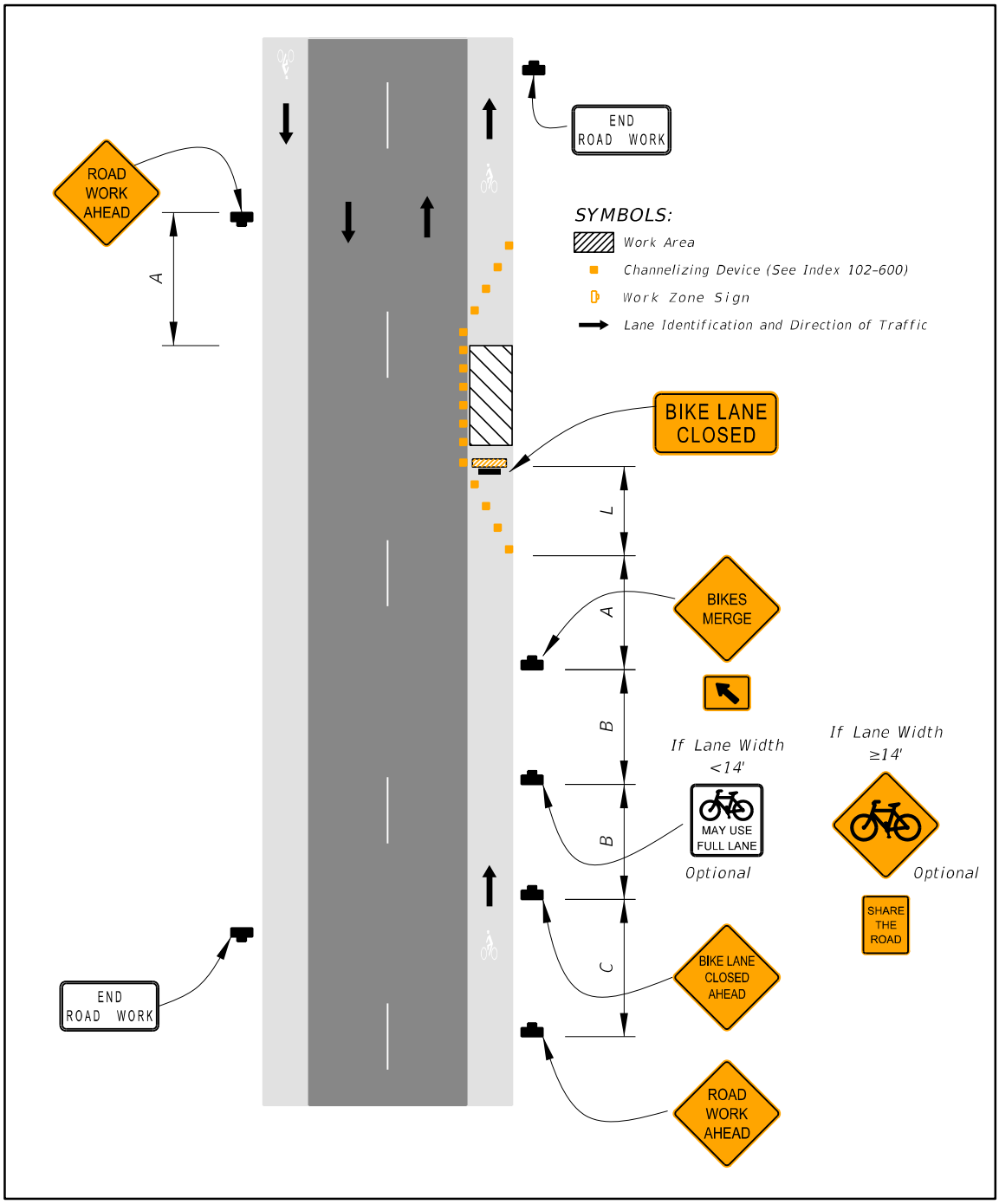
1. X = Work Zone Sign Spacing, L = Taper Length, U = Buffer Length, see Table 11 – 1, 11 – 2, and 11 – 3 of this chapter and the MUTCD.
2. See Table 11 – 4 for the required spacing of channelizing devices.
3. Temporary sidewalks and shared use paths shall have a maximum cross-slope of .02. Provide curb ramps or blended transitions with detectable warnings.
4. If temporary rumble strips are used, include “Rumble Strips Ahead” signs and associated sign spacing distance.
5. “Speeding Fines Doubled When Workers Present” signs may be used.
6. “End Road Work” signs may be included when the work zone is in place for greater than 24 hours.
7. Temporary Pavement Markings are required for work zones greater than 24 hours in duration.
8. For general sign codes refer to FHWA Standards for Highway Signs and Markings. For special signs beginning with MOT-xx, FDOT’s Special Sign Details in the ***Standard Plans*** provide additional information.

**Figure 11 – 5 Sidewalk/Shared Use Path Detour (Closure with Reroute)**




Notes:
1. Cover or deactivate pedestrian traffic signal display(s) controlling closed crosswalks.
2. Place pedestrian longitudinal channelizing devices (LCD) across the full width of the closed crosswalk.
3. "Sidewalk Closed" signs (R9-xx) may be mounted on pedestrian LCDs in accordance with the manufacturer's instructions.

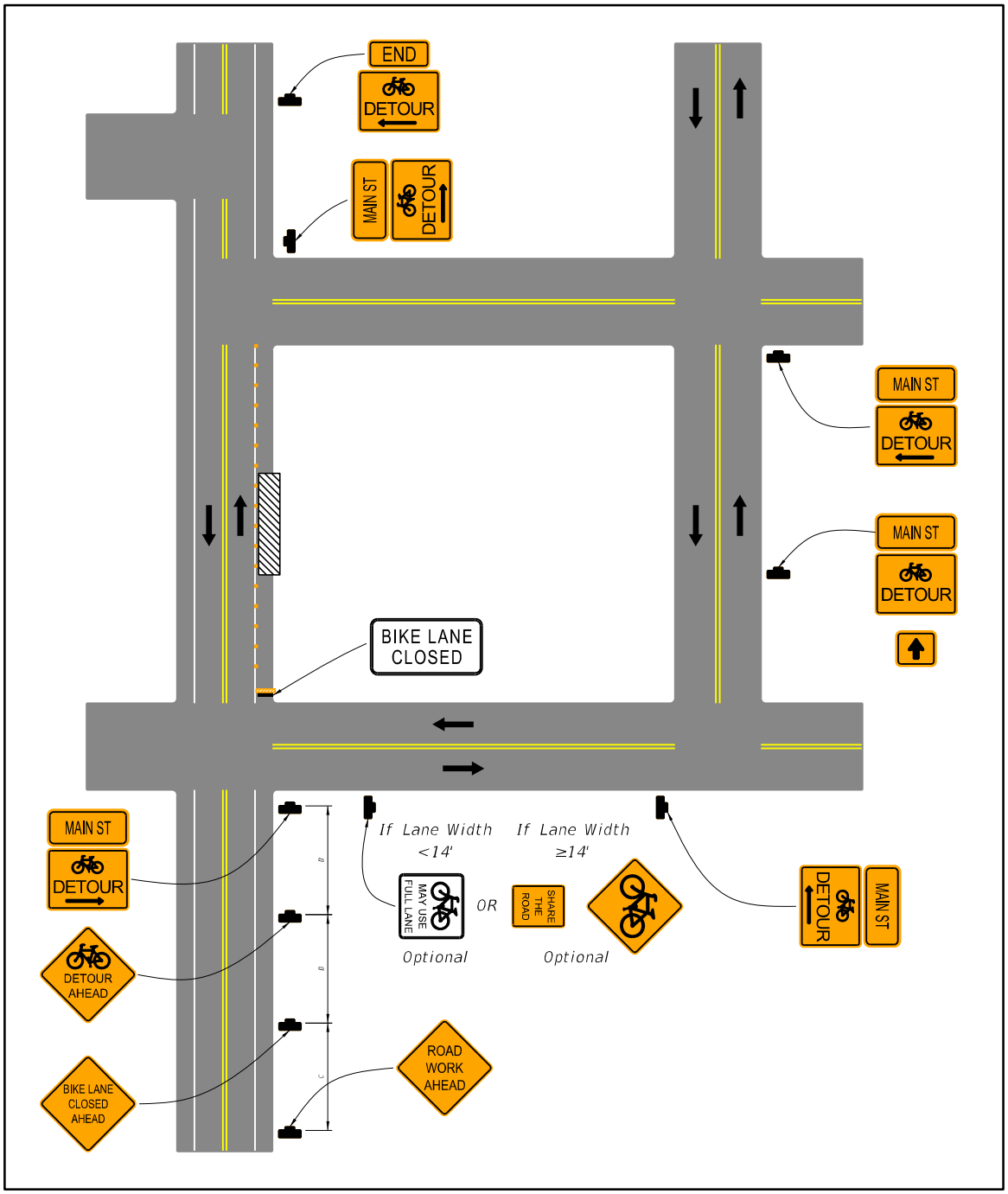
**Figure 11 – 6 Bicycle Lane Closure Without Detour**




Notes: See following page.

1. See Table 6H-3 Meaning of Letter Codes of the MUTCD for the distances A, B and C between signs.
2. See Table 6-H-4 Formulas of the MUTCD for Determining Taper Length for the distance L. Speeds shall be posted speeds.
3. See Table 11 – 4 for the required spacing of channelizing devices.
4. If the posted speed limit is ≤ 35 mph, and the outside through travel lane is < 14 feet wide, then Bicycles May Use Full Lane (R4-11) signs should be used.
5. If the posted speed limit is ≤ 35 mph, and the outside through travel lane is ≥ 14 feet wide throughout the work zone, then Bicycle Warning (W11-1) signs in association with SHARE THE ROAD (W16-1) plaques should be used.

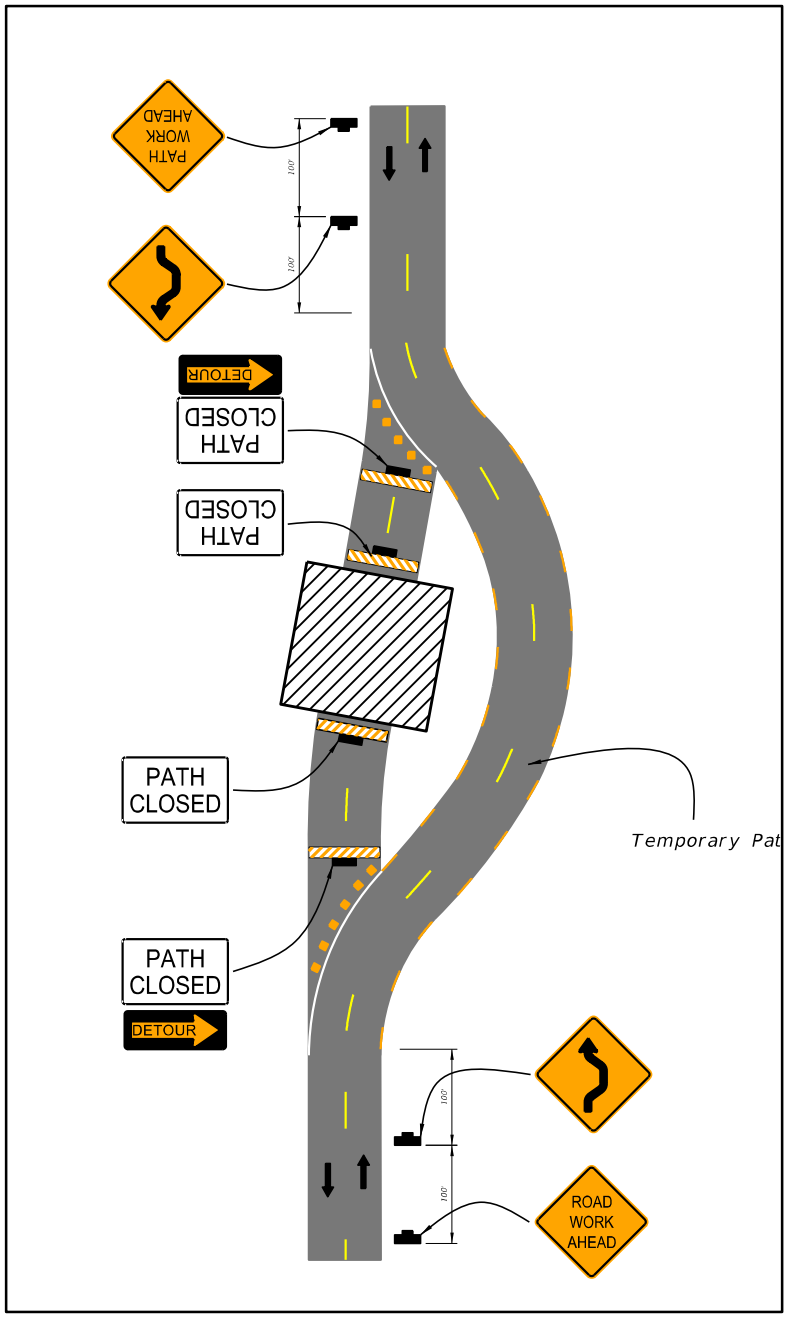
**Figure 11 – 7 Bicycle Lane Closure with On-Road Detour**




Notes: See following page.

1. See Table 6H-3 Meaning of Letter Codes of the MUTCD for the distances A, B and C between signs.
2. If the posted speed limit is ≤ 40 mph, and the outside through travel lane is < 14 feet wide, then Bicycles May Use Full Lane (R4-11) signs should be used.
3. See Table 11 – 4 for the required spacing of channelizing devices.
4. If the posted speed limit is ≤ 40 mph, and the outside through travel lane is ≥ 14 feet wide throughout the work zone, then Bicycle Warning (W11-1) signs in association with SHARE THE ROAD (W16-1) plaques should be used.
5. A Street Name sign or Bike Route Name sign should be mounted with the Bike Detour sign. Where used, the Street Name sign or Bike Route Name sign shall be placed above the Bike Detour sign. The Street Name sign or Bike Route Name sign may be either white on green or black on orange.

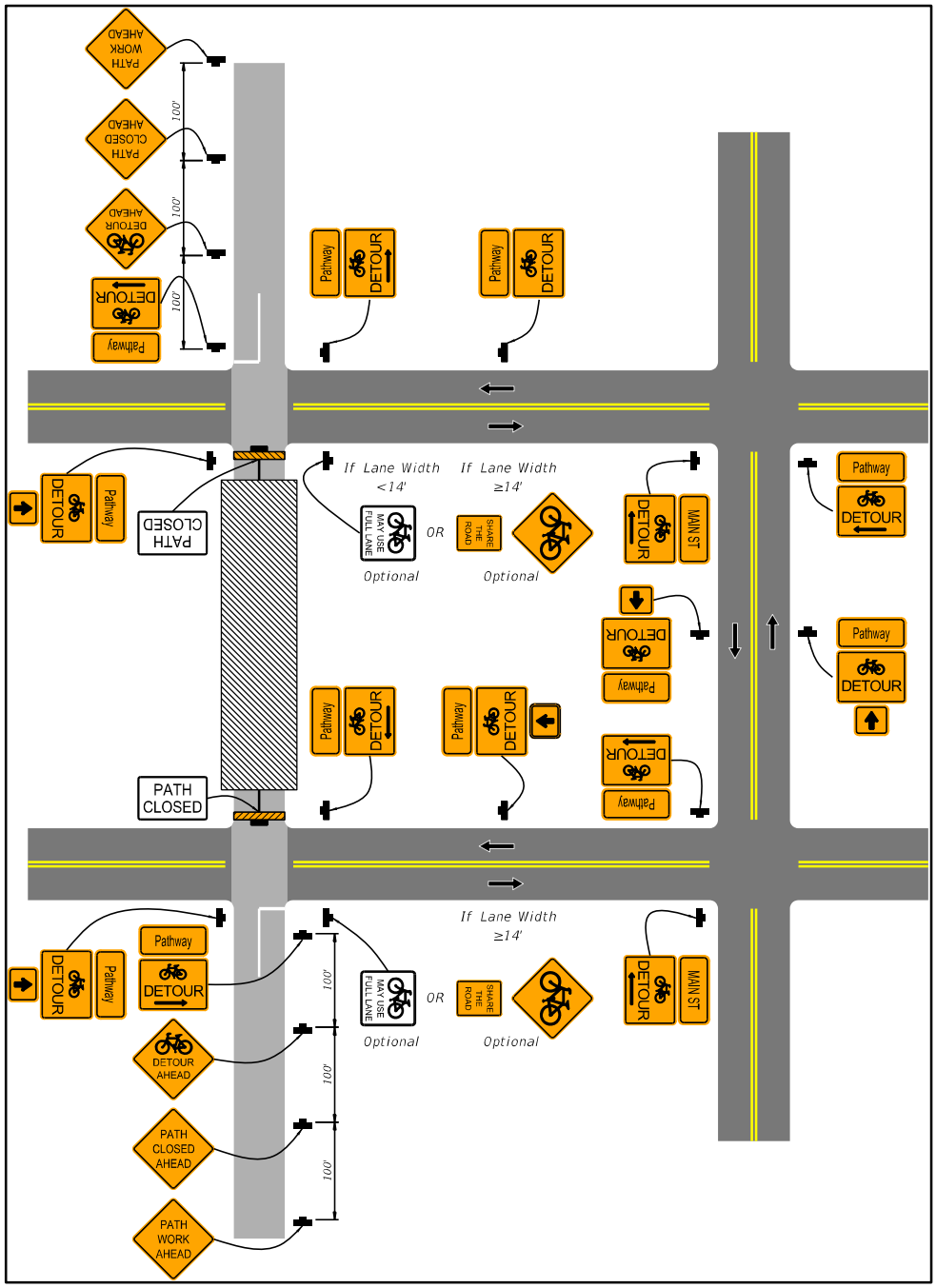
**Figure 11 – 8 Shared Use Path Closure with a Diversion**




Notes:

1. See MUTCD Table 6H-2 Meaning of Symbols on Typical Application Diagrams.
2. See Table 11 – 4 for the required spacing of channelizing devices.

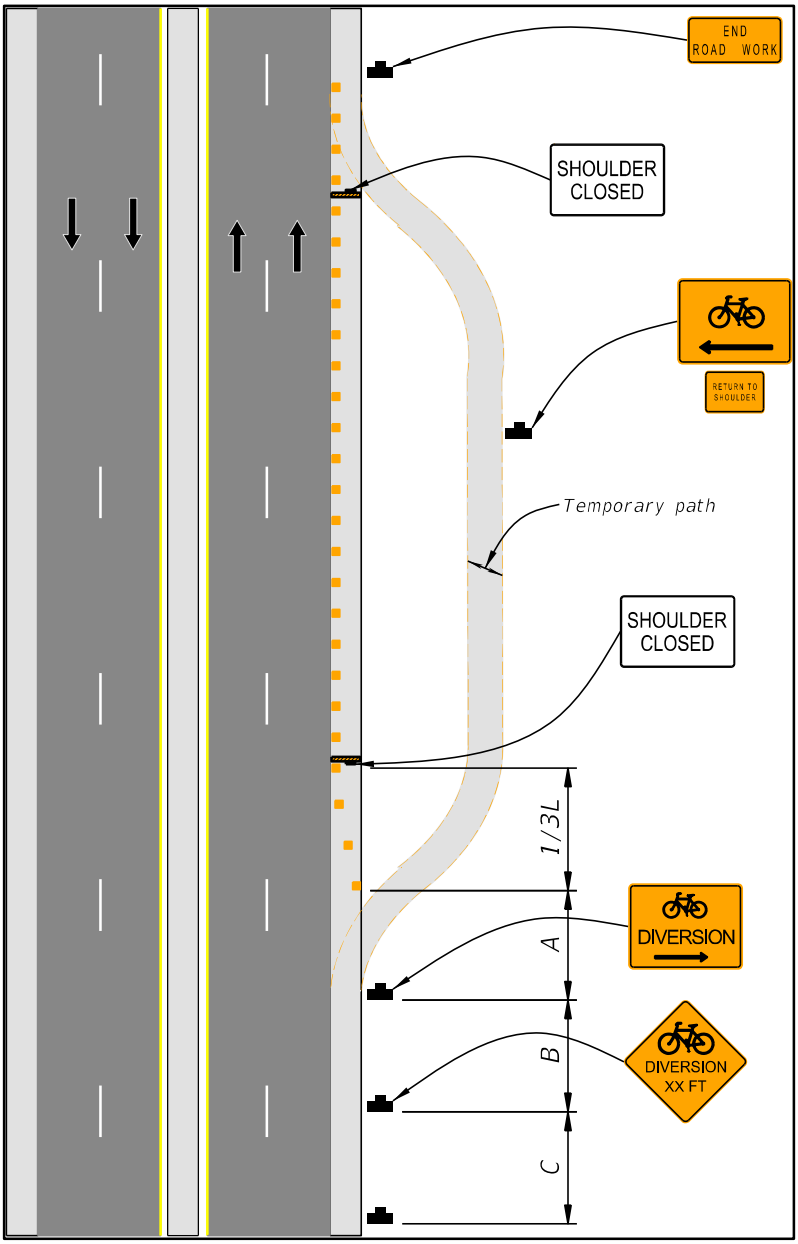
**Figure 11 – 9 On-Road Detour for Shared Use Path**




Notes:

1. See MUTCD Table 6H-2 and 6H-3 for the meaning of the symbols and letter codes used.

**Figure 11 – 10 Paved Shoulder Closure with Bicycle Diversion onto Temporary Path**




Notes:
1. See Table 6H-3 Meaning of Letter Codes of the MUTCD for the distances A, B and C between signs.
2. See Table 6-H-4 Formulas of the MUTCD for Determining Taper Length for the distance L. Speeds shall be posted speeds.
3. See Table 11 – 4 for the required spacing of channelizing devices.

# E TRANSPORTATION OPERATIONS PLAN

The Transportation Operations Plan (TOP) addresses operations and management of the transportation system in the work zone impact area. Management of construction, maintenance, and emergency response operations shall support the TTCP.

## E.1 Contracts and Permits

The general work zone layout; planned detours, traffic control and protection procedures; occupational safety and health requirements; and specific traffic control devices required should be incorporated in the contract plans and specifications.

### E.1.a Utilities

New utility installations in public rights of way are prohibited unless a permit by the appropriate agency with jurisdiction over the facility is issued. Permits for routine maintenance (e.g., deteriorated pole/equipment replacement), minor alterations (e.g., changes in cable, wire, or transformer size), service drops, or emergency work will be determined by the agency with jurisdiction over the facility. ***Occupational Safety and Health Administration (OSHA)*** regulations for work zone safety should be reviewed prior to any construction by utility companies involving encroachment into the transportation facility right of way by workers, equipment, or material.

### E.1.b Wildlife Sensitive Lighting

If lighting is provided in a work zone along coastal roadways where sea turtles may be affected, see ***Section J*** of ***Chapter 6*** **– Lighting** for requirements and further information. In addition to the resources in ***Chapter 6***, coordinate with the local agencies for additional guidance with providing lighting in work zones.

## E.2 Inspection and Supervision

A regular program of inspection and supervision of all construction and maintenance projects shall be established and executed.

## F PUBLIC INFORMATION PLAN

During construction, the Public Involvement Plan (PIP) serves a public information role, informing people about work zone limits, sidewalk, shared use path or travel lane closures, median changes, detours, business access impacts, work hours, and grand openings. A major function is to provide up-to-date information and solicit concerns to minimize the disruption to residents, businesses, and the traveling public during the construction phase.

Some agencies may hold pre-construction open houses, which can either be formal meetings held in enclosed spaces or informal activities conducted within the project corridor.

Below is a summary of activities which could be included in a PIP:

- Determine need for a project specific public information officer (prior to scope for construction engineering and inspection)
- Handoff meeting from design to construction (after letting)
- Mass mailing of project information flyer/brochure (two to four weeks prior to construction)
- Project information meeting/open house (two to four weeks prior to construction)
- Presentations to other local governments, community groups, or general public as needed
- Construction notices included in weekly traffic report (one week prior and throughout construction)

In addition to traditional public information meetings, some projects may benefit from other methods such as one-on-one meetings, an up-to-date project website, and social media. Variable message signs (VMS) are routinely used to communicate lane closures and changes in access.

All reasonable effort should be made to inform the public of the location, duration, and nature of impending work. Transit agencies should be given advance notice of planned operations so they can make adjustments in service or routes if needed, and coordinate with passengers.

## G EVALUATION OF PROGRAM

The entire program for work zone safety should be periodically evaluated and revised to provide the safest practicable environment for workers, pedestrians, bicyclists, and motorists during operations.

# CHAPTER 12

## CONSTRUCTION

# CHAPTER 12

# CONSTRUCTION

## A INTRODUCTION

The purpose of this chapter is to establish guidelines for field procedures, as they pertain to control of construction projects, supervision, and contract administration. All construction projects require an inspection process to administer the contract, to certify the project has been constructed within reasonable conformance with the plans/specifications, and the materials which were incorporated into the project were properly tested/certified.

All construction projects require:

- An inspection procedure to administer the contract
- Certification

The Engineer of Record (EOR) is a Professional Engineer registered in the State of Florida that develops the criteria and concept for the project, performs the analysis, and is responsible for the preparation of the Plans and Specifications. The Maintaining Authority's Engineer of Record may be in-house staff or a consultant.

The Construction Engineer (CE) is a Professional Engineer registered in the State of Florida that supervises the construction of the project. The Maintaining Authority's Construction Engineer or Designee may assign in-house staff or a consultant to act on their behalf.

## B OBJECTIVES

Construction of street and highway facilities is the result of the effort of the engineer, the contractor, and the owner. Minimum construction standards shall be followed to provide for proper implementation of the design. The following general objectives for roadway construction should be followed to ensure proper construction:

- All construction performed and all materials utilized shall be in reasonably close conformity with the construction plans and contract documents.
- The responsibilities and obligations of the owner, engineer, and contractor should be clearly defined.

- A safe working environment shall be provided in accordance with ***Chapter 11 – Work Zone Safety and Mobility***.
- Adequate procedures through established methods of sampling and testing shall be implemented to provide for the control and placement of materials.

## C CONTROL OF THE WORK

### C.1 Plans and Contract Documents

The Contractor will be furnished an appropriate number of copies of the plans and special provisions as required for the particular project. The Contractor shall have available at the work site, at all times, one copy each of the plans (including relevant Design Standards), Specifications, and Special Provisions.

#### C.1.a Plans

The plans furnished consist of general drawings showing such details which are necessary to give a comprehensive idea of the construction contemplated. Roadway plans will show, in general, alignment, profile grades, typical cross sections, and general cross sections as necessary. Structure plans, in general, will show in detail all dimensions of the work contemplated.

#### C.1.b Alterations in Plans

No changes shall be made on any plan or drawing after it is approved by the EOR, except as authorized in writing by the EOR. Minor changes may be approved by the Construction Engineer in consultation with the EOR.

All authorized alterations affecting the requirements and information given on the approved plans shall be in writing.

#### C.1.c Working Drawings (for Structures)

##### C.1.c.1 General

The Contractor shall furnish such working, shop, and erection drawings, as may be required, to complete the structure in compliance with the design shown on the plans.

### C.1.c.2 Submission of Working, Shop, and Erection Drawings

All working, shop, and erection drawings prepared by the Contractor or his agents (subcontractor, fabricator, supplier, etc.) shall be reviewed, dated, stamped, approved, and signed by the Contractor prior to submission to the EOR for review. The Contractor's signed approval of drawings submitted shall confirm he/she has verified the work requirements, field measurements, construction criteria, sequence of assembly and erection, access and clearances, catalog numbers, and other similar data. Each series of drawings shall indicate the specification section and page or drawing number of the contract plans to which the submission applies. The Contractor shall indicate on the working, shop, and erections drawings all deviations from the contract drawings and shall itemize all deviations in his letter of transmittal.

### C.1.c.3 Responsibility for Accuracy of Working Drawings

It is understood that approval by the EOR of the Contractor's working drawings does not relieve the Contractor of any responsibility for accuracy of dimensions and details, or for conformity of dimensions and details. The Contractor shall be responsible for agreement and conformity of his working drawings with the approved plans and specifications.

## C.2 Coordination of Plans, Specifications, and Special Provisions

The specifications, plans, special provisions, and all supplemental documents are integral parts of the contract, and a requirement occurring in one is as binding as though occurring in all. They are to be complementary and to describe and provide for a complete work.

In cases of discrepancy, the governing order of the documents shall be as follows:

- Special Provisions
- Plans
- Standard Drawings
- Specifications

## C.3 Conformity of Work with Plans

All work performed and all materials furnished shall be in reasonably close conformity with the lines, grades, cross sections, dimensions, and material requirements, including tolerances, shown on the plans or indicated in the specifications.

In the event the CE finds the materials or the finished product in which the materials are used not within reasonably close conformity with the plans and specifications, but reasonably acceptable work has been produced, he/she shall then make a determination if the work shall be accepted and remain in place. In this event, the CE will document the basis of acceptance by contract modification which will provide for an appropriate adjustment in the contract price for such work or materials as he deems necessary to conform to his determination based on engineering judgment.

In the event the CE finds the materials, or the finished product in which the materials are used, or the work performed, are not in reasonably close conformity with the plans and specifications and have resulted in an inferior or unsatisfactory product, the work or materials shall be removed and replaced or otherwise corrected by and at the expense of the Contractor.

## C.4 Conformity of Work Shown in Regulatory Permits

All work shall be accomplished in accordance with special conditions of the

regulatory permits.

## C.5 Authority of the Construction Engineer

All work shall be performed to the satisfaction of the CE.

## C.6 Engineering and Layout

### C.6.a Control Points Furnished

Horizontal and vertical control points are required at appropriate intervals along the line of the project to facilitate the proper layout of the work. The Contractor shall preserve all control points furnished.

### C.6.b Layout of Work

Utilizing the control points furnished, all horizontal and vertical controls shall be established as necessary to construct the work in conformance with the plans and specifications. The work shall include performing all calculations required and setting all stakes needed, such as grade stakes, offset stakes, reference point stakes, slope stakes, and other reference marks or points necessary to provide lines and grades for construction of all roadway, bridge, and miscellaneous items.

### C.6.c Personnel, Equipment, and Record Requirements

The Contractor shall employ only competent personnel and utilize only suitable equipment in performing layout work.

Adequate field notes and records shall be kept as layout work is accomplished. These field notes and records shall be available for review by the CE as the work progresses and copies shall be furnished to the CE at the time of completion of the project. Any inspection or checking of the Contractor's field notes or layout work by the CE, and the acceptance of all or any part thereof, shall not relieve the Contractor of his responsibility to achieve the lines, grades, and dimensions shown in the plans and specifications.

## C.7 Contractor's Supervision

### C.7.a Prosecution of Work

The Contractor shall give the work the constant attention necessary to assure the scheduled progress and shall cooperate fully with the CE and with other contractors at work in the vicinity.

### C.7.b Contractor's Superintendent

The Contractor shall at all times have on the work site, as his/her agent, a competent superintendent capable of thoroughly interpreting the plans and specifications and thoroughly experienced in the type of work being performed, and who shall receive the instructions from the CE or his/her authorized representatives. The superintendent shall have full authority to execute the orders or directions of the CE and to supply promptly any materials, tools, equipment, labor, and incidentals which may be required. Such superintendence shall be furnished regardless of the amount of work sublet.

### C.7.c Supervision for Emergencies

The Contractor shall have a responsible person available at or reasonably near the work site on a twenty-four hour basis, seven days a week, in order that he/she may be contacted in emergencies and in cases where immediate action must be taken to maintain traffic or to handle any other problems that might arise. The Contractor shall be responsible for initiating, installing, and maintaining all traffic control devices as described in ***Chapter 11 – Work Zone Safety and Mobility*** and in the plans.

## C.8 General Inspection Requirements

### C.8.a Cooperation by Contractor

No work shall be done nor materials used without suitable supervision or inspection by the CE. The Contractor shall furnish the CE with every reasonable facility for ascertaining whether the work performed and materials used are in accordance with the requirements and intent of the plans and specifications.

#### C.8.b Failure of Construction Engineer to Reject Work During Construction

If, during or prior to construction operations, the CE should fail to reject defective work or materials, whether from lack of discovery of such defect or for any reason, such initial failure to reject shall in no way prevent his/her later rejection when such defect is discovered.

#### C.8.c Qualifications for Services for FDOT Administered Projects

For projects administered by a local government that are wholly or partially funded by the FDOT, there are limitations on who may perform design, and Construction Engineering and Inspection services (CEI). See ***F.S. 337.14 (7) Application for qualification; certificate of qualification; restrictions, request for hearing*** for more information.

### C.9 Final Construction Inspection Maintenance until Final Acceptance

The Contractor shall maintain all work in first-class condition until it has been completed as a whole and has been accepted by the CE. When all materials have been furnished, all work has been performed, and the construction contemplated by the contract has been satisfactorily completed, the CE will make the final inspection.

## D CONTROL OF MATERIALS

### D.1 Source of Supply and Quality Requirements

#### D.1.a Only Approved Materials to be Used

Only materials conforming to the requirements of the specifications and approved by the Engineer shall be used in the work. Any materials proposed for use may be inspected or tested at any time during their preparation and use. No material which, after approval, has in any way become unfit for use, shall be used in the work.

### D.2 Inspection and Tests at Source of Supply

#### D.2.a General

The CE may undertake the inspection of materials at the source of supply.

### D.2.b Cooperation by Contractor

The Contractor shall assure the CE has free entry at all times to such parts of the plant as concern the manufacture or production of the materials ordered, and shall bear all costs incurred in providing all reasonable facilities to assist in determining whether the material furnished complies with the requirements of the specifications.

## D.3 Control by Samples and Tests

### D.3.a Materials to be Tested, Samples

The CE may require any or all materials to be subjected to tests by means of samples or otherwise, at production points, after delivery, or both, as he/she may determine.

### D.3.b Applicable Standards

Methods of sampling and testing materials shall conform to the CE's requirements and should be in accordance with ***Florida Sampling and Testing Methods (FSTM)*** so far as covered therein. Otherwise, they should be in accordance with Standards of AASHTO, ASTM, or other criteria as specifically designated by the CE. Where an AASHTO, ASTM, or other non-Florida Method is designated, but a Florida Method which is similar exists, sampling and testing should be in accordance with the Florida Method.

Whenever in these Specifications, FSTM, AASHTO, ASTM, or other standards are referenced without identification of the specific time of issuance, the reference should be construed to mean the most current issuance, including interims or addendums thereto, at the time of advertisement for bids for a project.

## D.4 Quality Control System

### D.4.a General Requirements

The Contractor shall furnish and maintain a quality control system that will provide reasonable assurance that all materials and products submitted for acceptance conform to the contract requirements, whether manufactured or processed by the Contractor or procured from suppliers or subcontractors.

The Contractor shall perform or have performed the inspection and tests required to substantiate product conformance to contract requirements and shall also perform or have performed all inspections and tests otherwise required by the contract.

### D.4.b Documentation

The Contractor shall maintain adequate records of all inspections and tests. The records shall indicate the nature and number of tests made, the number and type of deficiencies found, the quantities approved and rejected, and the nature of corrective action taken, as appropriate.

### D.4.c Corrective Actions

The Contractor shall take prompt action to correct any errors, equipment malfunctions, process changes, or other assignable causes which have resulted or could result in the submission of materials, products, and completed construction which do not conform to the requirements of the specifications.

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# CHAPTER 13

## PUBLIC TRANSIT

# FIGURES

# CHAPTER 13

# PUBLIC TRANSIT

## A INTRODUCTION

All modes of transportation (autos, trucks, transit vehicles, rails, aircraft, water craft, bicyclists, and pedestrians) shall be considered when planning, designing, and constructing the surface transportation system. Where there is a demand for highways to serve vehicles, there could also be a demand for public transit or public transportation. Public transit should be considered in all phases of a project, including planning, preliminary design and engineering, design, construction, and maintenance. Coordination with the appropriate public transit provider(s) will help determine the need for transit related infrastructure on a project-by-project basis. The integration of public transit street side facilities along with pedestrian and bicycle facilities furthers the implementation of this goal.

Planning and designing for public transit is important because it is an integral part of the overall surface transportation system. Public transit is defined as passenger transportation service, local or regional in nature, which is available to any person. It operates on established schedules along designated routes or lines with specific stops and is designed to move relatively large numbers of people at one time. Public transit includes bus, light rail, street cars, bus rapid transit and paratransit.

With rising levels of congestion resulting in the use of new strategies to effectively and efficiently manage mobility, there is an increased demand for accessible and user friendly public transit. New strategies include increased emphasis on public transit and new emphasis on Transportation System Management (TSM), as well as Transportation Demand Management (TDM). TSM is the use of low cost capital improvements to increase the efficiency of roadways and transit services such as retiming traffic signals or predestinating traffic flow. TDM focuses on people reducing the number of personal vehicle trips, especially during peak periods. TDM includes the promotion of alternatives to the single occupant vehicle, including public transportation, carpooling, vanpooling, bicycling, walking, and telecommuting, as well as other methods for reducing peak hour travel.

Federal and State legislation provide the stimulus for planning, designing, and constructing a fully integrated transportation system benefiting the traveling public and the environment. Examples of legislation include ***Fixing America's Surface Transportation Act (FAST Act)***, ***Americans with Disabilities Act of 1990 (ADA)***, and

***Clean Air Act Amendment of 1990 (CAAA)***. In response to this legislation, the surface transportation system should provide for concurrent use by automobiles, public transit and rail, bicycles, and pedestrians.

## B OBJECTIVE

There are several methods to efficiently develop a coordinated surface transportation system. Coordination among agencies is necessary during the planning and design stages to:

- incorporate transit needs and during the construction phase for re-routing bus (and complementary pedestrian) movements, and
- for actual transit agency specific requirements (e.g., bus stop sign replacement, shelter installations, etc.).

For planning purposes, the state and local Transportation Improvement Program (TIP) should be referenced. Additionally, individual transit authorities have ten-year Transit Development Plans (TDPs) that are updated annually. The TDP can be used as a guide for planned transit needs along existing and new transportation corridors so transit consideration and transit enhancements can be incorporated where appropriate.

# C TRANSIT COMPONENTS

## C.1 Boarding and Alighting (B&A) Areas

Boarding and Alighting (B&A) areas help to create an accessible bus stop by providing a raised platform that is compatible with a bus that kneels or extends a ramp. A B&A area has a firm, stable and slip-resistant surface with a minimum clear length of 8.0 feet (measured perpendicular to the curb or roadway edge), and a minimum clear width of 5.0 feet (measured parallel to the roadway). Firm, stable, and slip resistant B&A areas are required if amenities such as benches or shelters are added to a bus stop. B&A areas are not required at bus stops on flush shoulder roadways where only a bus stop sign is provided. Coordinate with the appropriate public transit provider(s) to determine compatibility with equipment and transit vehicles.

The slope of the B&A area parallel to the roadway shall to the extent practicable, be the same as the roadway. For water drainage, a maximum slope of 2% perpendicular to the roadway is allowed. Benches and other site amenities shall not be placed on the B&A area. The B&A area can be located either within or outside the shelter, and shall be connected to streets, sidewalks, or pedestrian circulation paths by an accessible route.

On flush shoulder roadways, a B&A area may be constructed at the shoulder point (or edge of shoulder pavement on roadways with a design speed of 45 mph or less) as shown in Figures 13 – 1 and 13 – 2 Boarding and Alighting Area for Flush Shoulder Roadways. A Type “E” curb (5” curb height) should be used.

A sidewalk and/or ramp provided with the B&A area shall be a minimum of 5 feet in width, and the ramp shall not exceed a slope of 1:12. A detectable warning is required where a sidewalk associated with a B&A area connects to the roadway at grade. Except for the area adjacent to the 5” curb, the areas surrounding the B&A area shall be flush with the adjacent shoulder and side slopes and designed to be traversable by errant vehicles. On the upstream side of the platform, a maximum slope of 1:12 should be provided, and may be grass or a hardened surface. The B&A area (and ramp and level landing if needed) should be constructed with 6” thick concrete.

**Figure 13 – 1 Boarding and Alighting Area for Flush Shoulder Roadways with Connection to the Roadway**

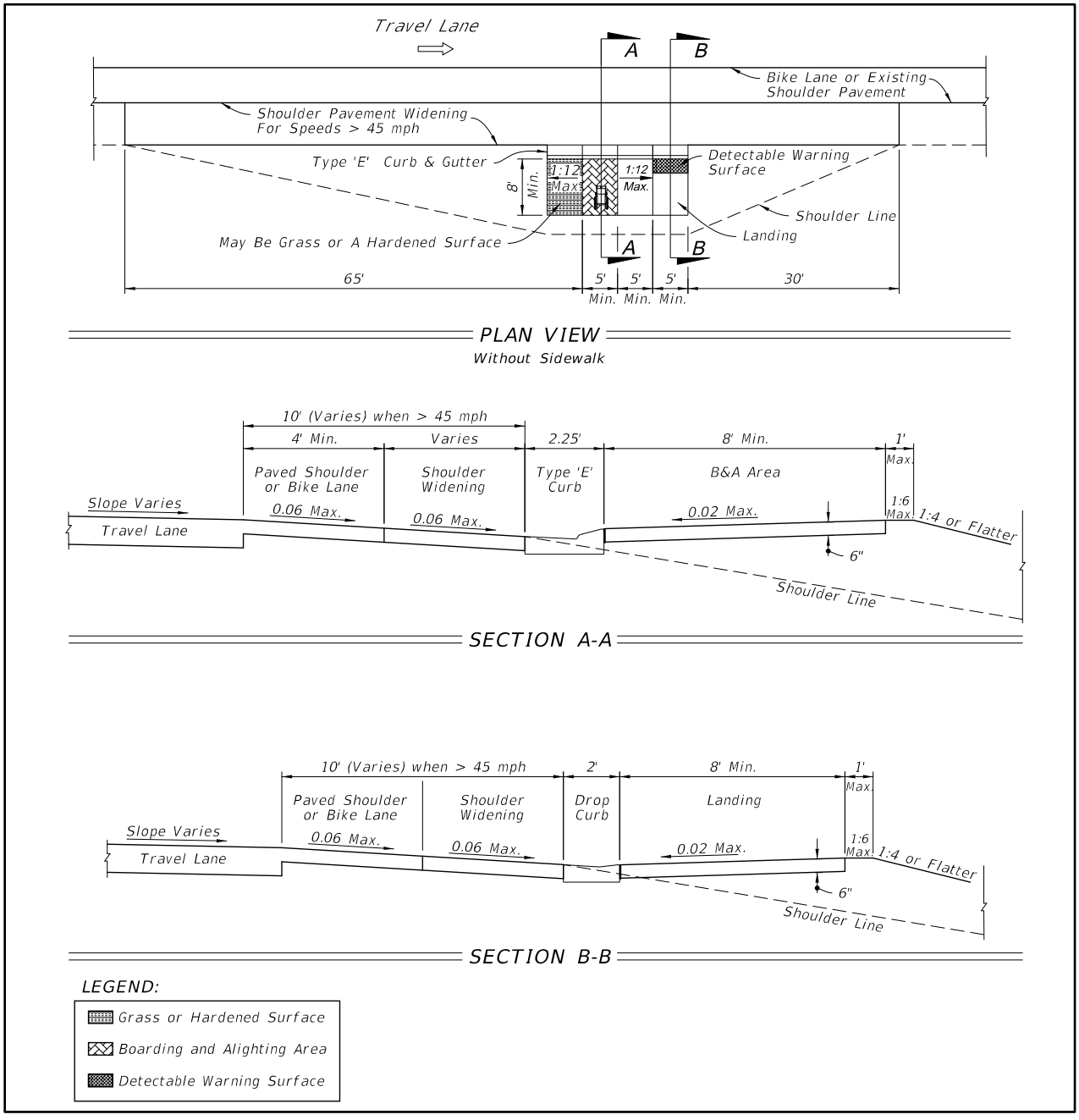
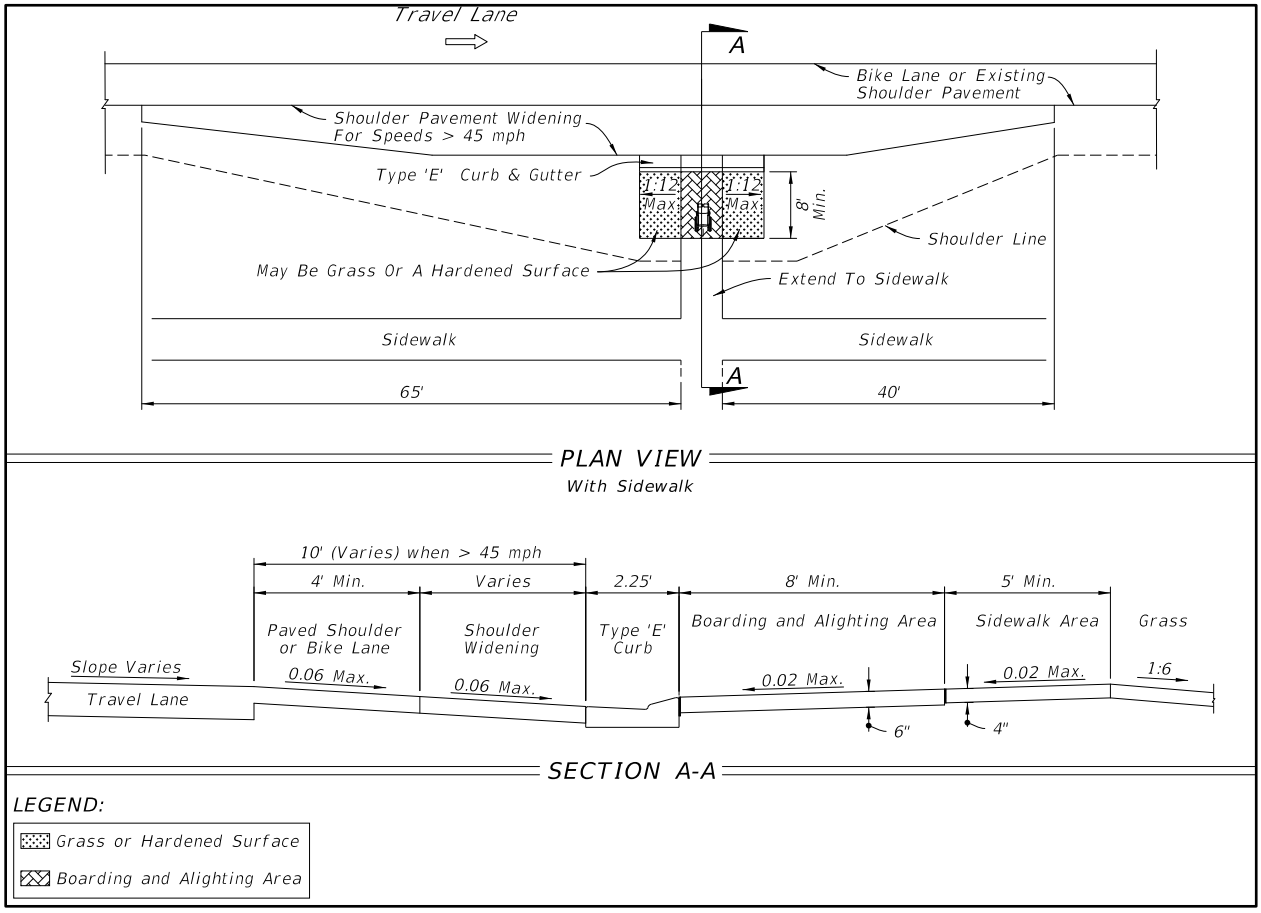


**Figure 13 – 2 Boarding and Alighting Area for Flush Shoulder Roadways with Connection to the Sidewalk**

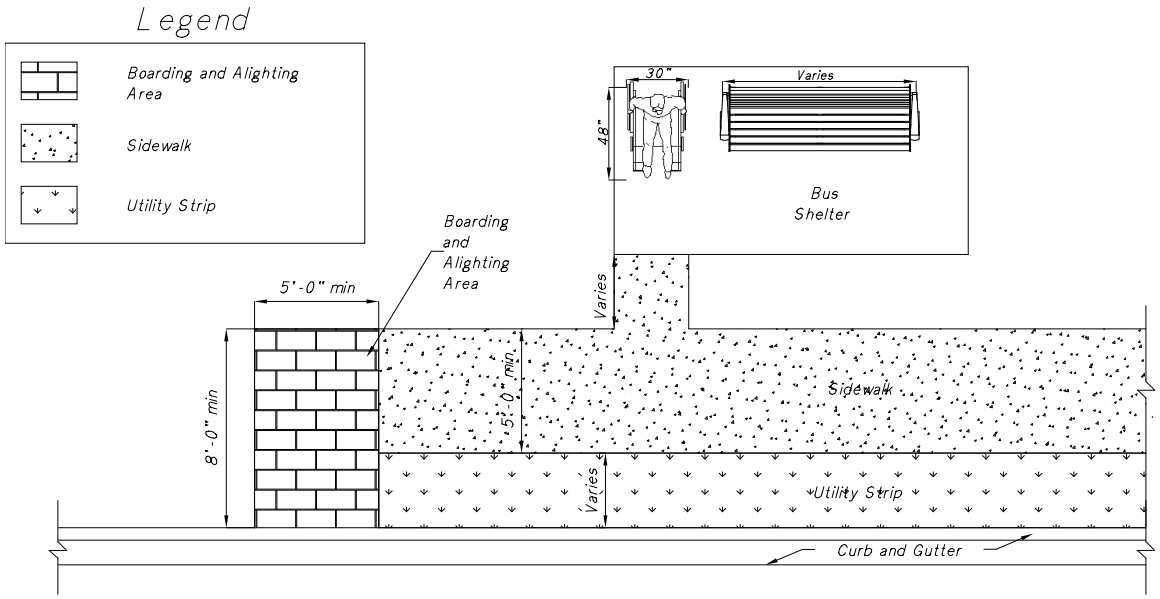


## C.2 Shelters

Every public transit system has different needs with regards to shelters and corresponding amenities (e.g., benches, information kiosks, leaning posts, trash receptacles, etc.). Shelter foundation and associated pad size vary from stop to stop based on right of way availability, line of sight, and facility usage. New or replaced bus shelters shall be installed or positioned to provide an accessible route from the public way (sidewalk or roadway) to reach a location that has a minimum clear floor area of 30 inches by 48 inches, entirely within the perimeter of the shelter.

Shelters shall be connected by an accessible route to a B&A area. Coordinate with the appropriate public transit provider(s). Where feasible, shelters should provide a location for a bicycle rack. Shelters should be installed at locations where demand warrants installation and in accordance with clear zone criteria in ***Chapter 3 – Geometric Design, Section C.10.e*** Bus Benches and Transit Shelters and ***Chapter 4 – Roadside Design***, Table 4 – 2 Lateral Offset of this Manual.

**Figure 13 – 3 Bus Shelter Location**



### C.3 Benches

If a bench is provided, it should be on an accessible route, out of the path of travel on a sidewalk. Benches shall have an adjacent firm, stable and slip-resistant surface at least 30 inches wide and 48 inches deep to allow a user of a wheelchair to sit next to the bench, permitting the user shoulder-to-shoulder seating with a companion. Connection between the bench, sidewalk and/or bus B&A area shall be provided. Coordinate with the local public transit provider(s).

### C.4 Stops and Station Areas

Transit stops should be located so that there is a level and stable surface for boarding vehicles. Locating transit stops at signalized intersections increases the usability for pedestrians with disabilities.

### C.5 Bus Bays (Pullout or Turnout Bays)

Bus bays for transit vehicles may be necessary (e.g., extended dwell time, layover needs, safety reasons, high volumes or speed of traffic.). Bus bays can be designed for one or more buses. Coordinate with the local public transit provider(s) to determine the need for bus bays. When possible, bus bays should be located on the far side of a signalized intersection. The traffic signal will create the critical gap needed for bus re-entry into traffic. There are several publications available which provide additional design information for transit system applications. The FDOT District Public Transportation Office(s) maintains a library of these publications.

## D PUBLIC TRANSIT FACILITIES

When a project includes a public transit route, curb-side and street-side transit facilities for bus stops should be considered in the roadway design process. Transit facilities shall comply with ***Chapter 14-20, Florida Administrative Code***.

The “Accessing Transit: Design Handbook for Florida Bus Passenger Facilities” provides guidance relating to provisions for curb-side and street-side facilities.

### D.1. Curb-Side Facilities

Curb-side facilities are the most common, simple, and convenient form of facilities at a bus stop. These include bus stop signs, shelters, bus stop B&A areas, benches, bike racks, leaning rails, and shelter lighting. “Accessing Transit”

provides additional details and guidelines for each type of transit facility. Coordinate with the appropriate public transit provider(s) to determine the appropriate type and placement of amenities.

## D.2 Street-Side Facilities

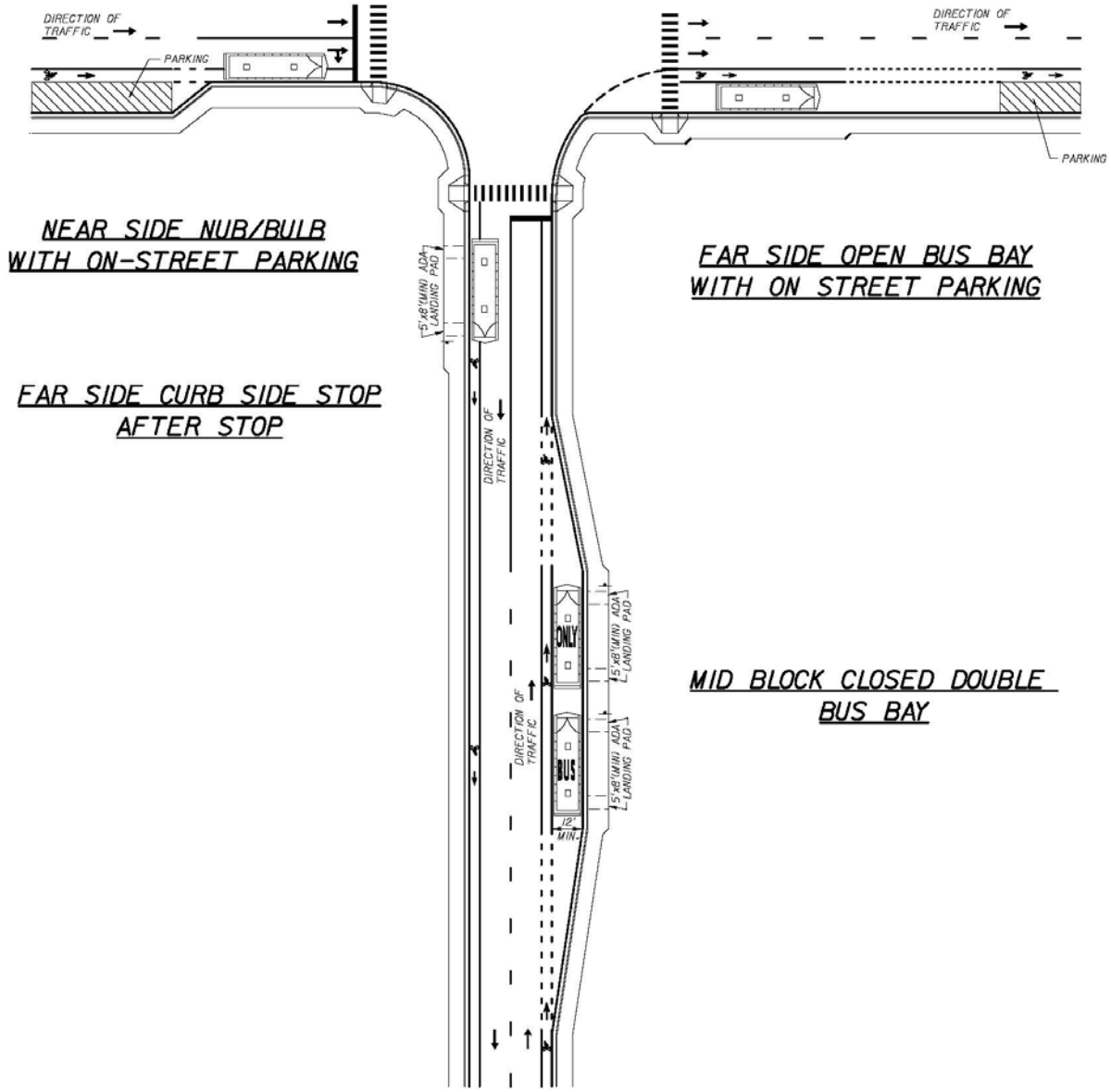
Bus stop locations can be categorized as far side, near side and mid-block stops. Bus stops may be designed with a bus bay or pullout to allow buses to pick up and discharge passengers in an area outside of the travel lane. This design feature allows traffic to flow freely without the obstruction of stopped buses. Far side bus stops and bays are preferred. See ***Accessing Transit, Version 3 (2013)*** and ***Accessing Transit Update (2017)*** for a more detailed discussion of the location of the bus stop or bay.

Bus bays can be closed-ended, open-ended, or nubs/bulbs, and can be positioned near-side, far-side, or mid-block in relation to an intersection, as illustrated in Figure 13 – 3 Bus Shelter Location. The total length of the bus bay should allow room for an entrance taper, a stopping area, and an exit taper as a minimum. However, in some cases it may be appropriate to consider providing acceleration and deceleration lanes depending on the volume and speed of the through traffic. This decision should be based upon site specific conditions. “Accessing Transit” provides detailed bus bay dimensions for consideration with various right of way and access conditions.

## D.3 Bus Stop Lighting

Lighting design for bus stops should meet the same criteria for minimum illumination levels, uniformity ratios and max-to-min ratios that are being applied to the adjoining roadway based on ***Chapter 6 – Lighting*** of this Manual. If lighting is not provided for the adjoining roadway, coordinate with the transit agency to determine if lighting should be provided for the bus stop area, particularly when night transit services are provided. A decision to install lighting for the adjoining bus stop area may include illumination of the bus bay pavement area. The use of solar panel lighting for bus stops is another option that should be considered.

**Figure 13 – 4 Bus Stop Locations**



## E REFERENCES FOR INFORMATIONAL PURPOSES

The following is a list of publications that may be referenced for further guidance:

- FDOT's Accessing Transit, Design Handbook for Florida Bus Passenger Facilities, Version III, 2013
  ***http://www.fdot.gov/transit/***

- TCRP Report 155 – Track Design Handbook for Light Rail Transit, Second Edition
  ***http://onlinepubs.trb.org/onlinepubs/tcrp/tcrp_rpt_155.pdf***

- Central Florida Commuter Rail Transit Project, Design Criteria – Phase 2 South RFP
  ***https://corporate.sunrail.com/wp-content/uploads/2015/06/P2S-RFP-Design-Criteria-06-15-15.pdf***

- Transit facilities shall comply with Chapter 14-20, Florida Administrative Code, Private Use of Right of Way
  ***https://www.flrules.org/gateway/ChapterHome.asp?Chapter=14-20***

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# CHAPTER 14

## DESIGN EXCEPTIONS AND VARIATIONS



## EXHIBITS

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# CHAPTER 14

# DESIGN EXCEPTIONS AND VARIATIONS

## A GENERAL

Uniform minimum standards for design, construction, and maintenance for streets and highways are contained in this Manual and meet or exceed the minimum values established by AASHTO. Consequently, the values given govern the design process. When it becomes necessary to deviate from the Manual's criteria, early documentation and approval are required.

Design Exceptions are required when existing or proposed design elements are below both the criteria in this Manual and AASHTO's new construction criteria for the following Controlling Design Elements.

For projects using safety funds and developed to improve specific safety problems, only the elements identified under the scope of work for the safety improvement project are subject to these approval processes. Existing non-compliant features, within the limits of a safety improvement project do not require approval to remain if the project does not create a non-compliant condition. The Safety Study must identify all applicable Design Exceptions and Variations required based on the proposed scope. For these projects, all applicable Design Exceptions and Variations must be approved prior to the beginning of the design phase.

For drainage projects, only elements identified in the scope of services for the drainage project are subject to these approval processes. The existing features, within the limits of the drainage project that do not meet design criteria, do not require approval to remain (if the project does not create a nonconforming condition).

For landscape-only projects, intersection sight distance Design Variations may be processed by the Responsible Landscape Architect of Record. For design projects with landscaping, intersection sight distance Design Variations must be processed by a Professional Engineer. In cases where intersection sight distance falls below stopping sight distance, a Design Exception for stopping sight distance must be processed by the respective professional.

Maintenance Resurfacing, Ride Only (a.k.a., Ride Rehabilitation) and Skid Hazard Projects do not require Design Exceptions or Variations other than for accessible curb ramp or blended transition requirements. If compliance with accessible curb ramp or

blended transition requirements is determined to be technically infeasible, documentation as a Design Variation is required.

The 10 Controlling Design Elements for high speed (Design Speed ≥ 50 mph) roadways are:

- Design Speed
- Lane Width
- Shoulder Width
- Horizontal Curve Radius
- Superelevation Rate
- Stopping Sight Distance
- Maximum Grade
- Cross Slope
- Vertical Clearance
- Design Loading Structural Capacity

The 2 Controlling Design Elements for low speed (Design Speed < 50 mph) roadways are:

- Design Speed
- Design Loading Structural Capacity

When proposed design elements other than the Controlling Elements do not meet the criteria contained in this Manual, sufficient detail and justification of such deviations must be documented by the Responsible Professional Engineer as a Design Variation and submitted to the municipality or county.

This chapter provides the process for documentation and approval of Design Exceptions and Variations. The approved Design Exception or Variation submittal should be included in the project file to clearly document the action taken and the approval given.

## B RECOMMENDATIONS FOR APPROVAL

Design Exceptions and Variations are recommended by the Professional Engineer responsible for the project design element (Responsible Professional Engineer). All Design Exceptions and Variations require approval from the Maintaining Authority's Professional Engineer or Designee.

For additional information on the process to be followed for a Design Exception or Variation that involves a state facility or located on the National Highway System (NHS), please see the ***FDOT Design Manual, Chapter 122 Design Exceptions and Design***

***Variations*.**

## C COORDINATION

In order to allow time to research alternatives and begin analysis and documentation activities, it is critical that Design Exceptions and Variations be identified as early in the process as possible. This is preferably done during the planning phases of projects or as soon as possible during initial design.

When the need for a Design Exception or Variation has been determined, the Responsible Professional Engineer must coordinate with the Maintaining Authority's Professional Engineer or Designee and FDOT (if applicable), to obtain conceptual concurrence and provide any requested documentation.

FDOT will be involved only if the proposed design on the local (Non-State Highway System (SHS)) roadway is part of an FDOT project. For example, an FDOT project for a roadway on the SHS includes work on the adjacent local roads, or an FDOT project is exclusively on a local (Non-SHS) roadway. In these cases, the FDOT District Design Engineer will be listed for "concurrence" in the Design Exception or Variation request letter.

## D JUSTIFICATION FOR APPROVAL

Sufficient detail and explanation must be given in order for the Maintaining Authority's Professional Engineer or Designee to approve the request for a Design Exception or Variation. The 10 Controlling Design Elements are considered to have significant effects on safety and the strongest case possible must be made if the designer is not able to meet these requirements. All deviations below the minimum criteria and standards in this Manual must be uniquely identified, located, and justified.

A strong case can be made if it can be shown that:

- The required criteria are not applicable to the site specific conditions.
- The project can be as safe by not following the criteria.
- The environmental or community needs prohibit meeting criteria.

Most often a case is made by showing the required criteria are impractical and the proposed design wisely balances all design impacts. The impacts required for documentation are:

- Safety and Operational performance
- Level of Service
- Right of Way impacts
- Community impacts
- Environmental impacts
- Costs
- Usability by all modes of transportation
- Long term and cumulative effects on adjacent sections of roadway

A case should not be made based solely on the basis that:

- Money can be saved.
- Time can be saved.
- The proposed design is similar to other designs.

## E DOCUMENTATION FOR APPROVAL OF DESIGN EXCEPTIONS

Supporting documentation that is generated during the approval process is to accompany each submittal. Design Exceptions should include the following documentation:

1. Submittal/Approval Letter (Example shown in Exhibit 14-A)

2. Project Description:

    a) General project information, location map, existing roadway characteristics, project limits (mileposts), county section number, work mix, objectives, and obstacles.

    b) Associated or future limitations that exist as a result of public or legal commitments.

3. Project Schedule and Lifespan:

    a) Letting date and other important production dates associated with the project.

    b) Discussion of whether the deficiency is a temporary or permanent condition.

    c) Future work planned or programmed to address the condition.

4. Exception Description:

    a) Specific design criteria that will not be met (AASHTO, Florida Greenbook) and a detailed explanation of why the criteria or standard cannot be complied with or is not applicable.

    b) Proposed value for the project or location and why it is appropriate.

    c) Plan view, plan sheet, or aerial photo of the location, showing right of way lines and parcel lines of adjacent property.

    d) Photo of the area of the deficiency.

    e) Typical section or cross-section.

    f) Milepost or station location.

5. Alternative Designs Considered:

    a) Meeting AASHTO or Florida Greenbook criteria, partial correction, and the no-build (existing) condition.

6. Impacts of the Exception:

   a) Safety Performance:

      • Anticipated impact on safety, long and short term effects and of any anticipated cumulative effects.

      • Summary of the most recent 5-year crash history including any pertinent crash reports.

   b) Operational Performance:

      • Description of the anticipated impact on operations (long and short term effects) and any anticipated cumulative effects.

      • Summary of the amount and character of traffic using the facility.

      • Compatibility of the design with adjacent sections of roadway.

      • Effects on capacity and Level of Service (proposed criteria vs. AASHTO)

   c) Right-of-way

   d) Community

   e) Environment

   f) Usability by all modes of transportation

7. Anticipated Costs:

   a) Description of the anticipated costs (design, right of way, construction, maintenance).

8. Mitigation Measures:

   a) Practical mitigation measures or alternatives that were considered and any selected treatments implemented on the project.

9. Summary and Conclusions

When preparing a Design Exception, the Responsible Professional Engineer should consider potential mitigation strategies that may reduce the adverse impacts to highway safety and traffic operations. Please refer to the ***FHWA Mitigation Strategies for Design Exceptions*** ***(July 2007)*** for examples of mitigation strategies. The ***Highway Safety Manual (HSM)*** and ***Highway Capacity Manual*** provide information on quantifying and evaluating highway safety performance.

**Benefit/Cost Analysis:**

Calculate a benefit/cost analysis which estimates the cost effectiveness of correcting or mitigating a substandard design element. The "benefit" is the expected reduction in future crash costs and the "cost" is the direct construction and maintenance costs associated with the design. These costs are calculated and annualized so that direct comparison of alternate designs can be made.

A benefit/cost ratio equal to or greater than 1.0 indicates it may be cost effective to implement a particular design; however, the final decision is a management decision which considers all factors and applies sound engineering judgement. Key factors in the analysis are:

a) Evaluation of crashes by type and cause

b) Estimate of crash costs (based on property damage and severity of injuries)

c) Selection of a crash reduction factor based on proposed mitigation strategy

d) Selection of a discount rate (typically 4% for roadway projects)

e) Estimate of construction and maintenance costs

f) Selection of service life of the improvements

NOTE: The ***FDOT Design Manual, Chapter 122 Design Exceptions and Design Variations*** provides guidance for the benefit/cost analysis, and may be used. FDOT provides a useful tool, called ***Benefit Cost Analysis Spreadsheet Tool*** (BCAnalysis.xlsm), to aid in determining the benefit/cost ratio.

**Conclusion and Recommendation:**

a) The cumulative effect of other deviations from design criteria

b) Safety mitigating measures considered and provided

c) Summarize specific course of action

## F DOCUMENTATION FOR APPROVAL OF DESIGN VARIATIONS

When proposed design elements other than the Controlling Elements do not meet the criteria contained in this Manual, sufficient detail and justification of such deviations must be documented by the Responsible Professional Engineer as a Design Variation and submitted to the municipality or county. The documentation, submittal and approval requirements for Design Variations are similar to that for Design Exceptions described in this chapter.

Design Variations should include:

a) Design criteria versus proposed criteria.

b) Reason the design criteria are not appropriate.

c) Justification for the proposed criteria.

d) Review and evaluation of the most recent 5 years of crash history where appropriate.

e) Background information which documents or justifies the request.

## G FINAL PROCESSING OF DESIGN EXCEPTIONS AND VARIATIONS

After receiving conceptual approval from the designated Professional Engineer representative of the municipality or county, the documentation justifying the Design Exception or Variation shall be signed and sealed by the Responsible Professional Engineer and delivered to the municipality or county. ***Exhibit 14-A Sample Request Letter for Design Exception or Variation*** provides an example of an appropriate format and should be included with the signed and sealed supporting documents. The Design Exception or Variation will be reviewed for completeness and adherence to the requirements of this Chapter.

If the Design Exception satisfies all requirements, the acknowledgment of receipt will be signed by the Maintaining Authority's Professional Engineer or Designee, and, if applicable, forwarded to the FDOT District Design Engineer for concurrence.

When all signatures are obtained, the Design Exception or Variation will be returned to the Responsible Professional Engineer. The original will be retained by the municipality or County and a copy kept by the FDOT, if applicable.

## Exhibit 14-A Sample Request Letter for Design Exception or Variation

TO: _____ DATE: _____

SUBJECT: **DESIGN EXCEPTION or ☐ DESIGN VARIATION**

Local road number or street name: _____
Project description (limits): _____
Type construction (new, rehabilitation, adding lanes, resurfacing, etc.) _____
Design Speed _____
State and/or Federal road number (if applicable): _____
FDOT Financial Project ID No. (if applicable): _____

DESIGN EXCEPTION OR VARIATION FOR THE FOLLOWING ELEMENT:

| | | |
|---|---|---|
| ( ) Design Speed | ( ) Stopping Sight Distance | ( ) Other (explain): |
| ( ) Lane Width | ( ) Maximum Grade | _____ |
| ( ) Shoulder Width | ( ) Cross Slope | _____ |
| ( ) Horizontal Curve Radius | ( ) Vertical Clearance | |
| ( ) Superelevation Rate | ( ) Design Loading Structural Capacity | |

Include a brief statement concerning the project and items of concern.

Attach all supporting documentation to this exhibit in accordance with Chapter 14**.**

Recommended by: _____
(Responsible Professional Engineer)

Approval: _____
(Maintaining Authority's Professional Engineer or Designee)

Concurrence: _____
FDOT (if applicable)

Concurrence: _____
FHWA (if applicable)

# CHAPTER 15

## TRAFFIC CALMING

# TABLES



# FIGURES

# CHAPTER 15

# TRAFFIC CALMING

## A INTRODUCTION

As Florida continues to grow, more and more of the major highways in its communities are becoming congested. This has caused many drivers to seek less crowded local residential streets as alternatives to get to their destinations. In many cases, this has meant the use of local residential streets as bypasses. The increase in traffic intrusion, volume, and speeds on residential streets has degraded the livability standards of various neighborhoods in Florida and as a result many residents complain about their environment (noise, air pollution), livability (quality of life, traffic intrusion, excessive volume, and speed of traffic), safety (as well as safety of their children, pets, and property) and physical characteristics (absence of sidewalks, etc.). This chapter provides some guidance to Florida roadway planners, designers, and traffic engineers on how to address concerns about maintaining or enhancing the quality of life in residential neighborhoods by balancing the need for safety for all roadway users and adjacent property owners of the street network and maintaining the integrity of the highways networks as a whole.

## B PLANNING CRITERIA

Traffic calming is the combination of mainly physical measures that reduce the negative effects of motor vehicle use, alter driver behavior, and improve conditions for non-motorized street users.

Communities undertaking a traffic calming program shall have a procedure for planning which neighborhoods and roadways qualify for participation in the program. Specifics of these methods shall be developed by the local jurisdictions. The methods will likely vary from locality to locality. However, some issues should be addressed in all communities:

- Through the public involvement process, adjacent residents and road users who are impacted by the situation should be included in identifying the concern(s).
- The need for traffic-calming measures should be confirmed by appropriate studies (license plate survey, speed, volume, crash analyses) studied.
- Once the concerns are clearly identified and confirmed by traffic studies, and documented, it will provide the focus for possible solution, prioritizing, and development of appropriate traffic calming measures. It will also help determine the best approach to address the concerns.
- When developing traffic calming measures, in addition to the affected property owners, emergency response, transit, school, and sanitation officials and any other entities impacted by the installation of such devices should be included in the review process.

Traffic calming may not be the appropriate method in all cases to address vehicle speeds, volumes, and safety. Alternative solutions or educational tools may be considered, as well as coordinated effort with law enforcement.

The application of traffic calming measures should consider possible network and access issues. A system impact analysis should be performed as part of the development process. Vehicular and pedestrian counts, speed data, and crash history of the streets under evaluation should be reviewed. Storm water and environmental impacts also need to be addressed, as well as facility type, urban and rural design factors, and driveway densities.

Design details for each traffic calming measure may vary depending on local conditions. Factors to be considered include both horizontal and vertical deflection, ease of use, emergency vehicle accessibility, ease of maintenance, and facility type. Operational considerations and geometrics are critical factors to consider as well. A list of references and resources to consider in providing more detailed design factors and information can be found at the end of this section. It may be desirable to begin with less restrictive measures and progress to more restrictive ones in stages.

Listed below are some "Do's" and "Don'ts" of the planning process for traffic calming which may be helpful in working through the design process.

**Do's and Don’ts of the Planning Process**

**Do the following:**

- Install temporary traffic calming features and monitor them for a period of time before installing the permanent features. Testing features on site prior to permanent installation will relieve resident anxiety about the impact on their own driving patterns and driving behaviors will adjust to the new route circumstances.
- Have an organized program including public involvement. Plans and policies should be approved and supported by the local government. Emphasize the selected treatments(s) will be initially in a “test” mode, with permanency pending the outcome measurement. Be able to describe what is being done to keep traffic off residential streets.
- Channel public resources by prioritizing traffic calming request according to documentable criteria, setting thresholds of volume, speed, etc., to merit treatment.
- Involve the local service agencies, including fire, police, and emergency medical services personnel, from the start.
- Consult with fire department and EMS personnel to develop the preferred design, particularly with speed humps and traffic circles. Set up traffic circles with cones and have fire trucks and other emergency vehicles drive around them; this will help determine what radius is best for the vehicles used in a given area. The same process can be used in the design of speed humps.
- Review traffic patterns in the neighborhood as a whole. Avoid solving the problem on one neighborhood street by just shifting the traffic to another neighborhood street.
- Consider appropriate landscape treatments as part of the traffic calming design and implementation.

- Make certain that all signing, pavement markings, and channelization is in accordance with the ***Manual on Uniform Traffic Control Devices (MUTCD), the AASHTO Policy on Geometric Design of Highways and Streets***, and ***Roundabouts: An Informational Guide, Second Edition, National Cooperative Highway Research Program (NCHRP 672)***.
- Check sight distances for vehicles, pedestrians, and bicyclists. Sight distance should be consistent with the dimensions shown in ***Chapter 3 – Geometric Design*** *or* ***Chapter 16 – Residential Street Design.***
- Become familiar with the traffic calming features used in other communities and assemble references so that residents can be directed where to see them.
- Decide on a safe design speed beforehand and in consultation with neighborhood residents.
- Check sight distances by visiting the site before and after installation. Do parked cars obstruct sight distances? Do landscaping or other features obstruct sight distance?
- Review the illumination at night. Are additional street lights needed? Does landscaping block the light? Is there a shadow on one side of a median or traffic circle that might hide pedestrians from view?
- Review the channelization during the day and night. Is it a clear approach from all directions? Can it be seen at night? Watch the traffic: Is the driving public confused by the signing and channelization? Make adjustments as needed.
- Review the site for utility conflicts. Is there a fire hydrant? Does it need to be moved? Are there existing utilities in the way?
- Check the storm water drainage. Will the storm drain system need to be moved or revised? Can the runoff flow through or around the device?
- Review on-street parking. Will parked cars block the access of emergency vehicles through or around the proposed neighborhood traffic control devices? Add additional no parking zones where needed. Additional enforcement of parking restrictions may be required to keep the traveled path clear.
- Include weekends in traffic counts, as residential streets may have unique travel patterns and high use periods.

**Don't do the following:**

- Install neighborhood traffic calming features without a well-engineered program supported by the local government and public.
- Install neighborhood traffic calming features on arterial streets (See Section 1.C.2 for a discussion of roadway classifications). Typically, physical devices are not installed on streets with volumes greater than 3,000 vehicles per day, or with posted or operating speeds of greater than 30 MPH.
- Install neighborhood traffic calming features on streets without curbs unless supplemental features or other design considerations are included to keep vehicles within the traveled way.
- Install neighborhood traffic calming features on street with grades of greater than 10 percent.
- Install neighborhood traffic calming features on major truck routes.
- Install neighborhood traffic calming features on primary emergency routes. Contact local fire, emergency service, and police departments to determine these routes. Secondary access routes should be considered on a case-by-case basis.
- Install neighborhood traffic calming features on curving or winding roads with limited sight distance, unless reduced speed limits and adequate warning signs are used in conjunction with the devices.
- Place neighborhood traffic calming features in front of driveways.
- Neglect to check for conflicting utilities or drainage considerations.
- Install physical features on adjacent parallel routes, unless feasible design alternatives have been agreed upon, as this prevents or hinders emergency response.

# C INAPPROPRIATE TRAFFIC CALMING TREATMENTS

## C.1 Stop Signs

Unwarranted stop signs should not be used for traffic calming for the following reasons:

- Increase midblock speeds along the street because of drivers trying to make up for lost time
- Increase noise because of quick accelerations and decelerations
- Increase pollution
- Reduce drivers' expectation of a uniform flow
- Relocate the problem
- Cause disrespect for stop signs by drivers and bicyclists

Stop signs shall be used only when warranted per the ***MUTCD***.

## C.2 Speed Bumps

Speed bumps shall not be used on public streets. Speed bumps are severe treatments 3 to 6 inches high and 1 to 2 feet long that slow drivers to speeds of less than 10 mph. Due to their abrupt rise and required low speed they can be a hazard to motorists and bicyclists. Speed *humps*, as described in Section D under vertical deflection, should not be confused with speed *bumps*.

## C.3 Other Inappropriate Treatments

There are some other treatments that have been shown to be ineffective at reducing the speed and volume of traffic on local roadways. While a temporary improvement may result, long-term improvement is not likely; consequently, their use is discouraged. These treatments include the following:

- Novelty signs -While signs such as CHILDREN AT PLAY, SENIORS CROSS HERE and SLOW DEAF CHILD may make an infrequent roadway user aware of a specific local population, most regular users of the roadway are unaffected by the signs.
- Odd speed limit - NEIGHBORHOOD SPEED LIMIT 23 MPH and other odd speed limit signs place a high dependence on police to monitor speeders and

are not consistent with the national practice required by the ***MUTCD*** of posting speeds limits in 5 mph increments.

- Crosswalks – Standard crosswalks marked only with signs and pavement markings do not affect motorists' speeds and should not be used by themselves as traffic calming treatments.
- Bicycle lanes – Standard bicycle lanes are not traffic calming treatments. They can be used to provide space for bicyclists between the sidewalk and travel lanes but should not be used by themselves for traffic calming.
- Speed trailers – While speed trailers can be used as part of a traffic calming program for educational awareness, they have no lasting effect on motorists' behavior.
- Reduced speed limit signs – Reduced speed limits without physical traffic calming measures do not slow drivers and should not be used for traffic calming.
- Rumble strips – These applications have high maintenance requirements and can cause severe noise problems. Also, they can be an obstacle to bicyclists.

## D APPROPRIATE TRAFFIC CALMING TREATMENTS

The following sections describe some of the available traffic calming strategies. This list is not exhaustive, nor do the treatments necessarily fall exclusively into only one category.

In a typical traffic calming plan various types of treatments will be used. These plans will be based upon neighborhood preferences combined with engineering judgment.

Design details for traffic calming treatments will vary with application. Specific designs will need to be determined based upon the objective of the installations.

## D.1 Vertical Treatments

Vertical treatments are those that depend upon a change in vertical alignment to cause drivers to slow down. When properly used, these treatments can be effective in reducing speeds and crashes. However, consideration should be given to impacts on emergency responders, buses, and, to some extent, bicyclists, and motorcyclists.

Traffic calming features that alter the vertical alignment should not be installed near fire hydrants or mailboxes.

Information on signing and pavement markings for vertical deflections can be found in the ***Manual on Uniform Traffic Control Devices (MUTCD)***.

**Table 15 – 1 Vertical Treatments**

| Treatment | Description | Effect | Concerns | Cost |
|---|---|---|---|---|
| Raised Intersection | A raised plateau where roads intersect. Plateau is generally 4 inches above surrounding street. | Slows vehicles entering intersection and improves pedestrian safety. | Increases difficulty of making a turn. | Medium to High |
| Raised Crosswalk | Raised pedestrian crossing used in mid-block locations. Crosswalks installed on flat-top portion of speed table. See Figure 15 - 1 | Reduces speed and is an effective pedestrian amenity makes pedestrians more visible. | May be a problem for emergency vehicles and vehicles with trailers. | Low to Medium |
| Speed Humps | Speed humps are parabolic, curved, or sinusoidal in profile, 3 to 4 inches in height and to 14 feet long. Comfortable speeds limited to 15 to 20 mph. See Figure 15 - 2. | Reduces speed. | May cause delays for emergency vehicles and impact patient comfort. May have greater impacts on longer wheelbase cars. | Low |
| Speed Tables | Speed tables are flat-topped speed humps, also 3 to 4 inches high but with a sloped approach taper on each side of a flat top. They are generally 20 to 24 feet long. Comfortable speeds limited to 20 to 25 mph. | Reduces speed. | May cause delays for emergency vehicles and impact patient comfort. | Low |
| Speed Cushions/ Pillows | Signed speed humps as described above. | Reduces speed. | May not slow all vehicles. | Low |

**Figure 15 – 1 Raised Crosswalk**

Suwannee Street, Tallahassee, Florida

**Figure 15 – 2 Speed Hump**

Inside Loop Road, Orange County, Florida

## D.2 Horizontal Treatments

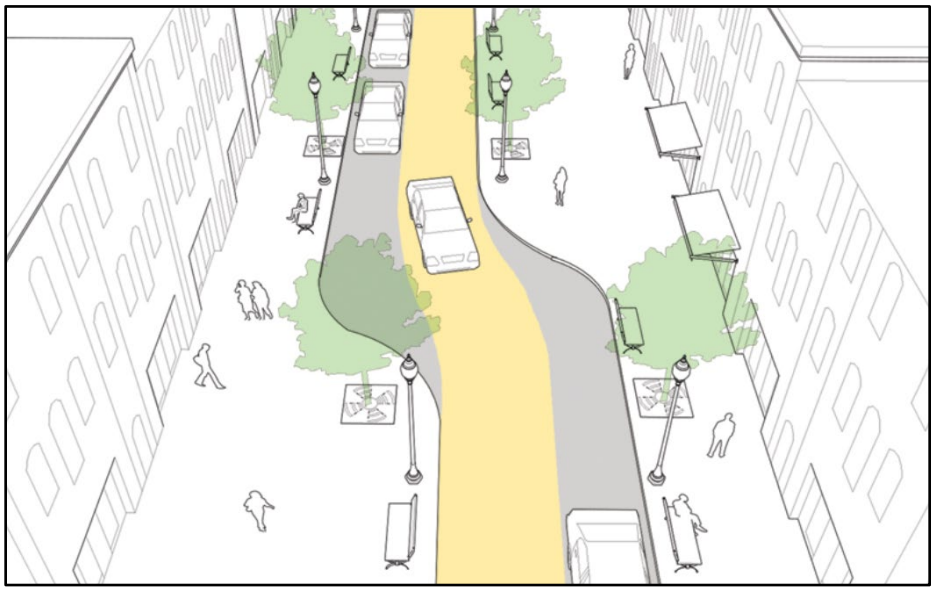
Horizontal deflection treatments are often more expensive than vertical deflection treatments. However, they have less of an impact on emergency responders and large vehicles with multiple axles. They generally do not create problems for bicyclists and motorcyclists. Because pavement area is usually reduced, additional landscaping may be possible, making horizontal deflection treatments useful as part of neighborhood beautification projects.

Information on striping and signing roundabouts can be found in the ***MUTCD***.

**Table 15 – 2 Horizontal Treatments**

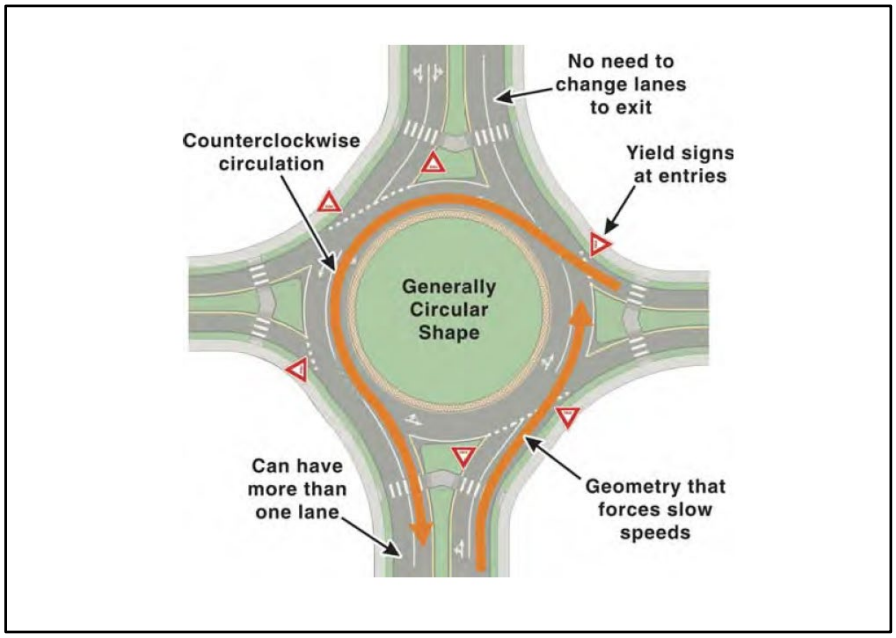
| Treatment | Description | Effect | Concerns | Cost |
|---|---|---|---|---|
| Angled Slow Point | Angled deviation to deter the path of travel so that the street is not a straight line | Reduces speed and pedestrian crossing distance. | Landscaping must be controlled to maintain visibility. Conflicts may occur with opposing drivers. | Medium to High |
| Chicanes | Mainline deviation to deter the path of travel so that the street is not a straight line. See Figure 15 - 3. | Reduces speed and pedestrian crossing distance. | A chicane design may warrant additional signing and striping to ensure that drivers are aware of a slight bend in the roadway. Increases the area possible for landscaping. | Medium to High |
| Mini-Circles | A raised circular island in the center of an existing intersection, typically 15 to 20 feet in diameter. May have mountable truck apron to accommodate large vehicles. | Reduces speed and both the number and severity of crashes. | May restrict larger vehicles. May cause some confusion when not signed properly. Some communities have documented increased crashes when mini-circles replaced all-way stop intersections. | Low to Medium |
| Roundabouts | A circular intersection with specific design and traffic control features, including yield control of all entering traffic, channelized approaches, geometric curvature. May be appropriate at locations as an alternative to a traffic signal. See Figure 15 - 4. | Reduces vehicle speeds and reinforces a change in the driving environment in transition areas. | May require more space at the intersection itself than other intersection treatments. While Roundabouts have sometimes been considered traffic calming features, they are primarily traffic control measures. | High |

**Figure 15 – 3 Chicanes**



NACTO Urban Street Design Guide, National Association of City Transportation Officials

**Figure 15 – 4 Key Roundabout Characteristics**




NCHRP Report 672: Roundabouts: An Informational Guide, Second Edition

## D.3 Neighborhood Entry Control

Neighborhood entry control treatments include partial street closures and gateway type tools. They are used to reduce speeds and volume at neighborhood access points and may be used in conjunction with neighborhood beautification or enhancement projects and residential area identification.

**Table 15 – 3 Neighborhood Entry Control**

| Treatment | Description | Effect | Concerns | Cost |
|---|---|---|---|---|
| Chokers | Midblock reduction of the street to a single travel lane for both directions. | Reduces speed and volume. | Costs increase if drainage needs to be rebuilt. | Medium to High |
| Gateway Treatment or Entrance Features | Treatment to a street that includes a sign, banner, landscaping, and roadway narrowing or other structure that helps to communicate a sense of neighborhood identity. | Reduces entry speed and pedestrian crossing distance. Discourages intrusion by cut through vehicles and identifies the area as residential. | Maintenance responsibility. May lose some on street parking. | Medium to High |
| Curb Extensions or Bulb-outs | Realignment of curb at intersection or mid-point of a block to decrease pavement width. See Figure 15 - 5. | Visually and physically narrows the roadway, shortens pedestrian crossing distance, increases space for plantings, street furniture. | May impact sight distance, parking, and drainage. | Medium to High |
| Midblock Median, Slow Point | An island or barrier in the center of a street that separate traffic. | Provides refuge for pedestrians and cyclists. | Landscaping may impede sight distance. | Varies |
| Lane Narrowing | Street physically narrowed to expand sidewalks and landscaping areas. Could include median, on street parking etc. | Improved pedestrian safety. | May create conflict with opposing drivers in narrow lanes. | Medium to High |
| One-Way In or One-Way Out Channelization | Intersection reduction of the street to single travel lane with channelization. Also called half road closure. | Reduces speed and traffic. | Costs increase if drainage must be rebuilt. Transfers additional vehicles to other ingress/egress points. | Medium to High |
| Textured Pavement | A change in pavement texture, and color (e.g., asphalt to brick), that helps make drivers aware of a change in driving environment. | Enhances pedestrian crossings, bike lanes, or on street parking. | Increase maintenance. May increase noise. | Low to Medium |

**Figure 15 – 5 Curb Extension or Bulb Out**

First and Lee Streets, Ft. Myers, Florida

## D.4 Diverters

A diverter consists of an island or curbed closure, which prevents certain movements at intersections, and reduces speeds and volumes. By diverting motorists within a neighborhood, they can significantly reduce cut through traffic.

Diverters must be planned with care because they will impact the people who live in the neighborhood more than anyone else. Trip lengths increase, creating inconvenience to residents. Emergency responders must also be considered when diverting traffic.

Bicyclists and pedestrians should be provided access through traffic diverters.

**Table 15 – 4 Diverters**

| Treatment | Description | Effect | Concerns | Cost |
|---|---|---|---|---|
| Diagonal Diverters | Barrier placed diagonally across an intersection, interrupting traffic flow forcing drivers to make turns. | Eliminates through traffic. | May inhibit access by emergency vehicles and residents and increase trip lengths. | Medium |
| Forced Turn Barrier/Diverters | Small traffic islands installed at inter-sections to restrict specific turning movements. | Reduces cut through traffic. | Could impact emergency vehicles response time. | Low to Medium |
| Road Closures, Cul-de-sac | One or more legs of the intersection closed to traffic. | Eliminates through traffic improving safety for all street users. | May increase volumes on other streets in the area. Access restriction may cause concerns for emergency responders. Additional right of way for proper turnaround at dead ends may be required. | Low to Medium |
| Median Closures | Small median islands installed at cross streets to prevent through movements and restrict left turns. | Reduces cut through traffic. | Could impact emergency vehicle responses, inhibit access, and increase trip lengths or transfer volumes to other streets. | Low to Medium |

## D.5 Other Treatments

These treatments are most effective when used in combination with other physical traffic calming features, and should be used as supplements.

**Table 15 – 5 Other Treatments**

| Treatment | Description | Effect | Concerns | Cost |
|---|---|---|---|---|
| Pavement Markings | Highlighting various area of road to increase driver's awareness of certain conditions such as bike lanes or crosswalks. See Figure 15 - 6. | Inexpensive and may reduce speed. | May not be as effective as a structure such as curb. | Low |
| Traversable Barriers | A barrier placed across any portion of a street that is traversable by pedestrians, bicycles, and emergency vehicles but not motor vehicles. | Eliminates cut-through traffic. | Inconvenience to some residents. | Medium |
| Colored Bike Lanes or Shoulders | A bike lane or shoulder painted, covered with a surface treatment, or constructed of a pigmented pavement designed to contrast with the adjacent pavement. | Visually narrows the roadway and may reduce speeds. | May not be effective on roadways with 12 foot lanes. | Low to medium |

**Figure 15 – 6 Bicycle Lane, Advance Yield Bar, and Crosswalk**


Franklin Blvd, Tallahassee, Florida

## E REFERENCES FOR INFORMATIONAL PURPOSES

The publications listed below are additional sources, of information related to topics presented in this chapter. Search the Internet Web for up-to-date resources using "traffic+calming" as key words.

- Speed Management Safety, FHWA
  ***https://safety.fhwa.dot.gov/speedmgt/***

- Traffic Calming Measures - Institute of Transportation Engineers
  ***https://www.ite.org/technical-resources/traffic-calming/traffic-calming-measures/***

- Canadian Guide to Traffic Calming - Second Edition (2018), Transportation Association of Canada
  ***https://www.tac-atc.ca/en/publications/ptm-trafcalm18-e***

- Primer on Traffic Calming, Canadian Institute of Transportation Engineers and Transportation Association of Canada, January 2018
  ***http://www.tac-atc.ca/sites/default/files/site/doc/Bookstore/traffic_calming_-_second_edition.pdf***

- National Cooperative Highway Research Program (NCHRP) Report 672, Roundabouts: An Informational Guide, Second Edition, (2010)
  ***http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_672.pdf***