

D.2.b Vertical Alignment

The vertical alignment of the roadway on a crossing is an important factor in safe vehicle operation. The intersection of the tracks and the roadway should constitute an even plane. All tracks should, preferably, be at the same elevation, thus allowing a smooth roadway through the crossing. Where the railroad is on a curve with superelevation, the vertical alignment of the roadway shall coincide with the grade established by the tracks.

Vertical curvature on the crossing should be avoided. This is necessary to limit vertical motion of the vehicle.

The vertical alignment of the approach roadway should be adjusted when rail elevations are raised to prevent abrupt changes in grade and entrapment of low clearance vehicles

The roadway approach to crossing should also coincide with the grade established by the tracks. This profile grade, preferably zero, should be extended a reasonable distance (at least two times the design speed in feet) on each side of the crossing. Where vertical curves are required to approach this section, they should be as gentle as possible. The length of these vertical curves shall be of sufficient length to provide the required sight distance.

D.3 Highway Cross Section

Preserving the continuity of the highway cross section through a grade crossing is important to prevent distractions and to avoid hazards at an already dangerous location.

D.3.a Pavement

The full width of all travel lanes shall be continued through grade crossings. The crown of the pavement shall be transitioned gradually to meet the cross sectional grade of the tracks. This pavement cross slope transition shall be in conformance with the requirements for superelevation runoff. The lateral and longitudinal pavement slopes should be designed to direct drainage away from the tracks.

D.3.b Shoulders

All shoulders shall be carried through rail-highway grade crossings without interruption.

The use of full-width paved shoulders is required at all new crossings to maintain a stable surface for emergency maneuvers. The shoulders should be paved a minimum distance of 50 feet on each side of the crossing, measured from the outside rail. It is desirable to pave 100 feet on either side to permit bicycles to exit the travel lane, slow for their crossing, and then make an adequate search before selecting a gap for a return to the travel lane. See **Chapter 3, Table 3 – 11 Shoulder Widths for Rural Highways** for further information on shoulder width.

D.3.c Medians

It is recommended that the full median width on divided highways should be continued through the crossing. The median should be contoured to provide a smooth transition on the tracks.

A raised median is the ideal deterrent to discourage motorists from driving around the gates to cross the tracks or making a U-turn prior to the tracks. Flush medians should have channelization devices as a deterrent. Railroad signals and gate assemblies should be installed in the median only when gate arms of 36 feet will not adequately span the approach roadway.

Figure 7 – 2 Flush Median Channelization Devices



Alexander Street, SR 39A, Plant City, FL 1

D.3.d Sidewalks and Shared Use Paths

To provide an accessible route for pedestrians at grade rail-highway crossings, new or existing sidewalks and shared use paths shall be continued across the rail crossing. The surface of the crossing shall be:

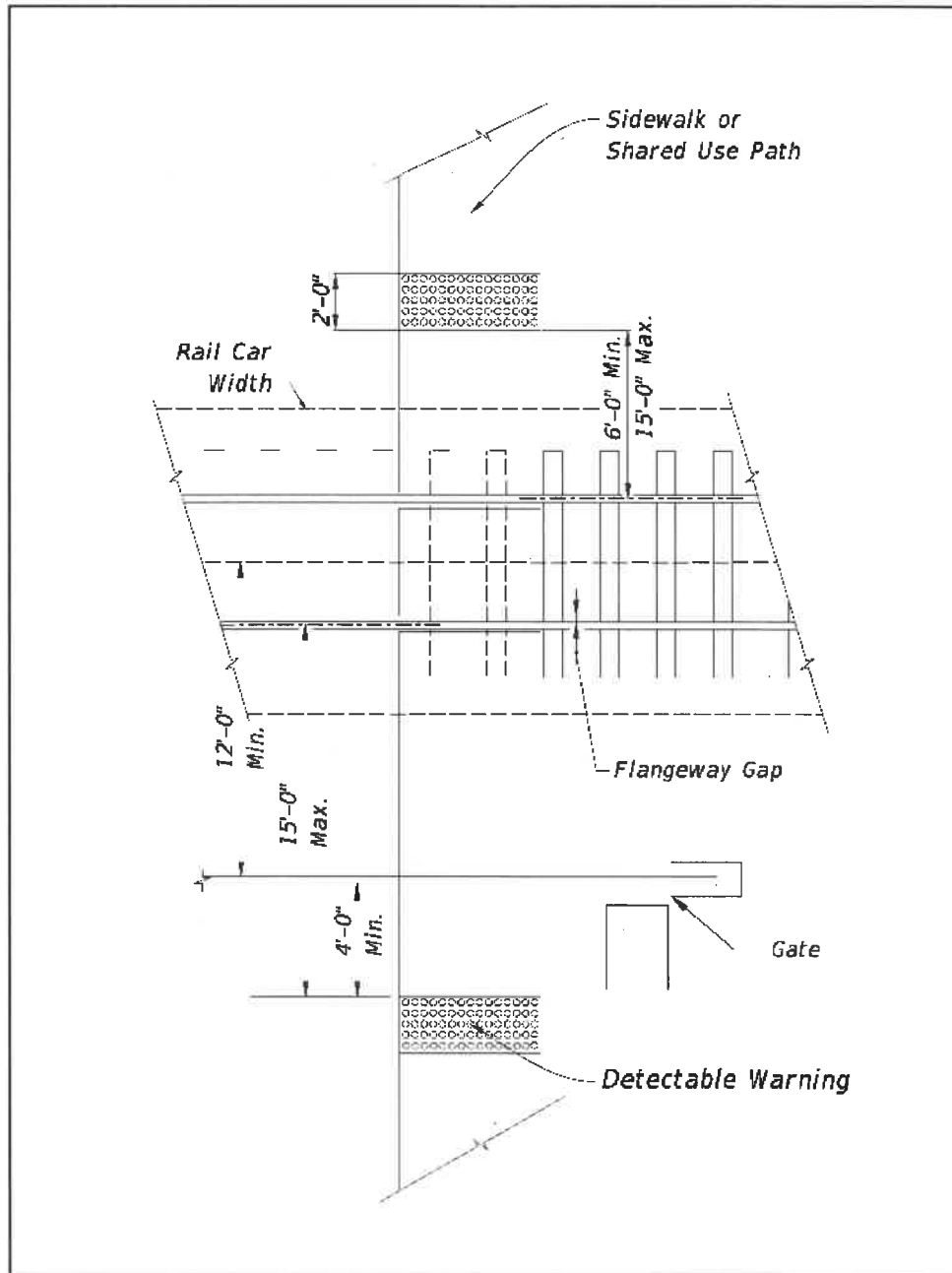
- firm, stable and slip resistant,
- level and flush with the top of rail at the outer edges of the rails, and
- area between the rails align with the top of rail.

Detectable warnings shall be placed on each side of the rail-highway crossing, extend 2.0 feet in the direction of pedestrian travel and the full width across the sidewalk or shared use path, as shown in Figure 7 – 3 Pedestrian Crossings.

The edge of the detectable warning nearest the rail crossing shall be 6.0 to 15.0 feet from the centerline of the nearest rail. Where pedestrian gates are provided, detectable warnings shall be placed a minimum of 4.0 feet from the side of the gates opposite the rail, and within 15.0 feet of the centerline of the nearest rail.

If traffic control signals are in operation at a crossing that is used by pedestrians or bicyclists, an audible device such as a bell shall also be provided and operated in conjunction with the traffic control signals. See [MUTCD, Chapters 8B and 8C](#) for further information and to determine if additional signals, signs, or pedestrian gates should be included. See [MUTCD, Chapter 8D](#) for additional information on designing crossings for shared use paths.

Figure 7 – 3 Pedestrian Crossings

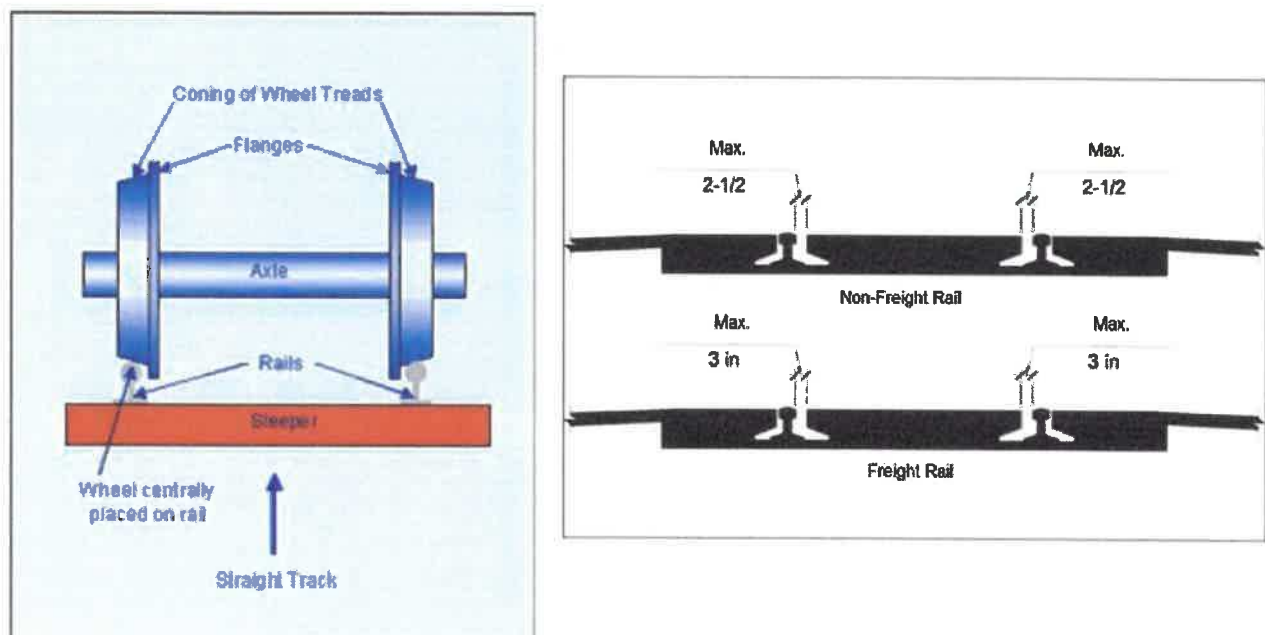


Note: Pedestrian gates may be installed on the outside of the sidewalk/shared use path or in the utility strip.

Flangeway gaps are necessary to allow the passage of train wheel flanges; however, they pose a potential hazard to pedestrians who use wheelchairs because the gaps can entrap the wheelchair casters. Flangeway gaps at pedestrian at-grade rail crossings shall be 2 1/2" maximum on non-freight rail track and 3" maximum on freight rail track.

Figure 7 – 4 Flangeways and Flangeway Gaps illustrates where the flanges are located on the wheel, how they interact with the rails, and the maximum gap allowed.

Figure 7 – 4 Flangeways and Flangeway Gaps



See **Chapter 8 – Pedestrian Facilities** and **Chapter 9 – Bicycle Facilities** for further information on designing sidewalks and shared use paths. The [2006 Americans with Disabilities Act – Standards for Transportation Facilities](#) and the [2017 Florida Accessibility Code](#) impose additional requirements for the design and construction of pedestrian facilities.

D.3.e Roadside Clear Zone

Although it is often not practical to maintain the full width of the roadside clear zone, the maximum clear area feasible should be provided. This clear zone shall conform to the requirements for slope and change in grade for roadside clear zones.

D.3.f Auxiliary Lanes

Auxiliary lanes are permitted but not encouraged at signalized rail-highway grade crossings that have a large volume of bus or truck traffic required to stop at all times. These additional lanes should be restricted for the use of these stopping vehicles. The approaches to these auxiliary lanes shall be designed as storage for deceleration lanes. The exits shall be designed as acceleration lanes.

D.4 Roadside Design

The general requirements for roadside design given in **Chapter 3 – Geometric Design** and **Chapter 4 – Roadside Design**, should be followed at rail-highway grade crossings. Supports for traffic control devices may be required within the roadside recovery area. Due to the structural requirements and the necessity for continuous operation, the use of a breakaway design is not recommended. The use of a guardrail or other longitudinal barrier is also not recommended, because an out of control vehicle would tend to be directed into the crossing.

In order to reduce the hazard to errant vehicles, all support structures should be placed as far from the traveled way as practicable.

D.5 Vertical Clearance

Minimum vertical clearances for grade separated rail-highway crossings are shown in Table 7 – 2 Minimum Vertical Clearances for New Bridges. Minimum vertical clearance is the least distance between the bottom of the superstructure and the top of the highest rail utilized anywhere within the horizontal clearance zone.

Table 7 – 2 Minimum Vertical Clearances for New Bridges

Facility Type	Clearance
Railroad over Roadway	16'-6"
Roadway over Railroad ¹	23'-6"
Pedestrian over Railroad ¹	23'-6"

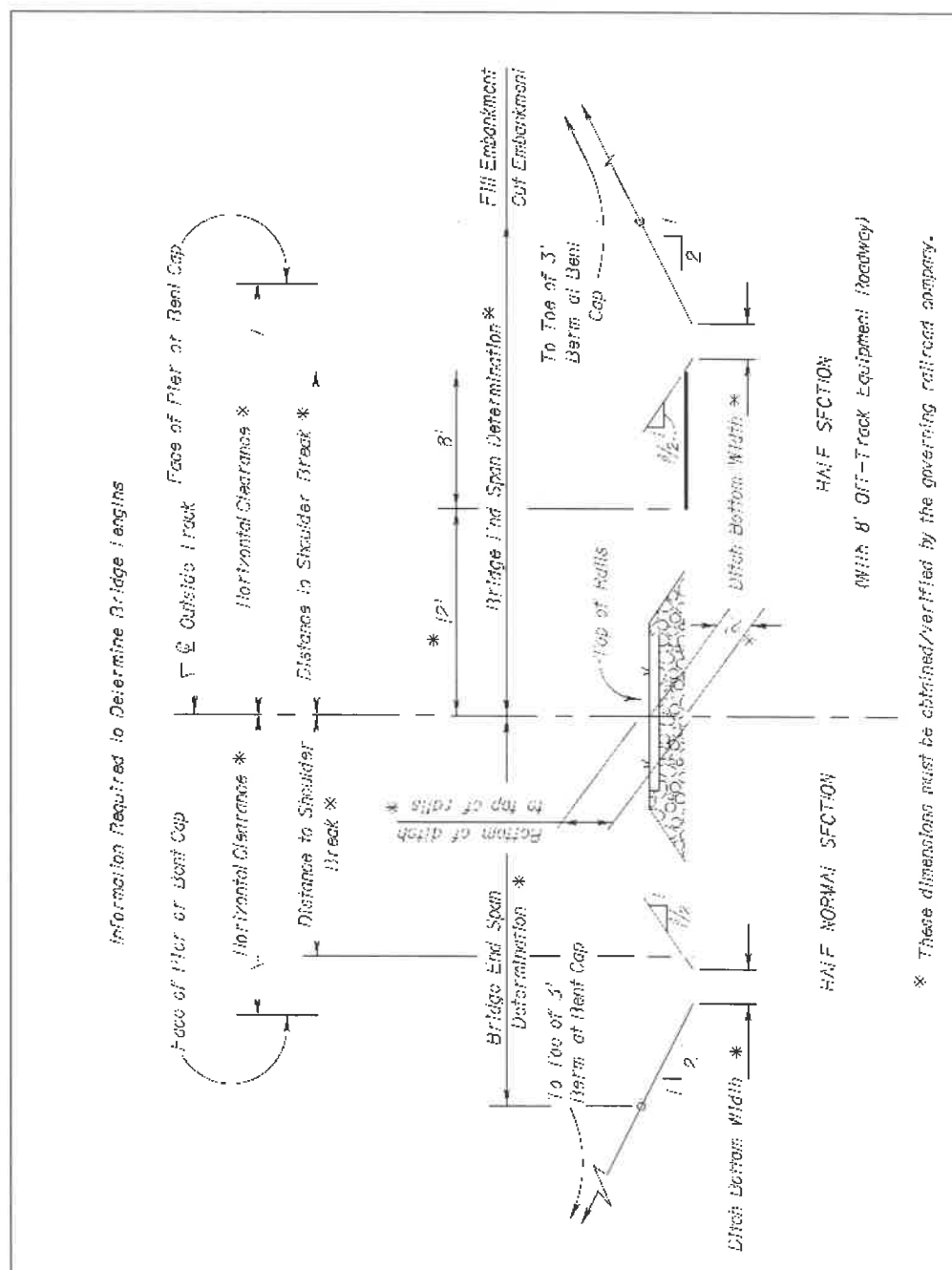
1. Over High Speed Rail Systems, see the latest version of [American Railway Engineering and Maintenance-of-Way Association \(AREMA\)](#) guidelines, or the design office of the high-speed rail line of interest for specific guidelines and specifications. Over Electrified Railroad, the minimum vertical clearance shall be 24 feet 3 inches. (See [Department Topic No. 000-725-003: South Florida Rail Corridor Clearance.](#))

For any construction affecting existing bridge clearances (e.g., bridge widenings or resurfacing) vertical clearances less than 16' - 0" shall be maintained or increased. If reducing the design vertical bridge clearance to a value between 16' - 0" and 16' - 2", the design vertical clearance dimension in the plans shall be stated as a minimum.

D.6 Horizontal Clearance

Horizontal clearances shall be measured in accordance with Figure 7 – 5 Track Section. The governing railroad company occasionally may accept a waiver from normal clearance requirements if justified; i.e., for designs involving widening or replacement of existing overpasses. The [Department's District Rail Coordinator](#) should be consulted if such action is being considered for FDOT owned rail corridors. For other rail crossings, coordinate with the owner of the rail corridor.

Figure 7 – 5 Track Section



The minimum horizontal clearances measured from the centerline of outermost existing or proposed tracks to the face of pier cap, bent cap, or any other adjacent structure are shown in Table 7 – 3 Horizontal Clearances for Railroads but must be adjusted for certain physical features and obstructions such as track geometry and physical obstructions.

Table 7 – 3 Horizontal Clearances for Railroads

Minimum Clearance Requirements	Normal Section ¹	With 8' Required Clearance for Off-Track ²	Temporary Falsework Opening
With Crash Walls	18 ft.	22 ft.	10 ft.
Without Crash Walls	25 ft.	25 ft.	N/A

¹ Any proposed structure over the South Florida Rail Corridor shall be designed and constructed to provide a horizontal clear span of a minimum of 100 feet but not less than 25 feet from the center line of the outermost existing or proposed tracks. (See [Department Topic No. 000-725-003-j: South Florida Rail Corridor Clearance.](#))

² The additional 8 ft. horizontal clearance for off-track equipment shall be provided only when specifically requested in writing by the railroad.

D.6.a Adjustments for Track Geometry

When the track is on a curve, the minimum horizontal clearance shall be increased at a rate of 1.5 inches for each degree of curvature. When the track is superelevated, clearances on the inside of the curve will be increased by 3.5 inches horizontally per inch of superelevation. For extremely short radius curves, the [AREMA](#) requirements shall be consulted to assure proper clearance.

D.6.b Adjustments for Physical Obstructions

Columns or piles should be kept out of the ditch to prevent obstruction of drainage. Horizontal clearance should be provided to avoid the need for crash walls unless extenuating circumstances dictate otherwise.

Figure 7 – 5 Track Sections shows horizontal dimensions from the centerline of track to the points of intersection of a horizontal plane at the rail elevation with the embankment slope. These criteria may be used to establish the preliminary bridge length, which normally is also the length of bridge eligible for FHWA participation; however, surrounding topography, hydraulic conditions, and economic or structural considerations may warrant a decrease or an increase of these dimensions. These dimensions must be coordinated with the governing railroad company.

The [*Department's Structures Design Guidelines, Section 2.6.7*](#) provide additional information on the design of structures over or adjacent to railroad and light rail tracks.

D.7 Access Control

The general criteria for access control in ***Chapter 3 – Geometric Design*** for streets and highways should be maintained in the vicinity of rail-highway grade crossings. Private driveways should not be permitted within 150 feet, nor intersections within 300 feet, of any grade crossing.

D.8 Parking

No parking shall be permitted within the required clear area for the sight distance visibility triangle.

D.9 Traffic Control Devices

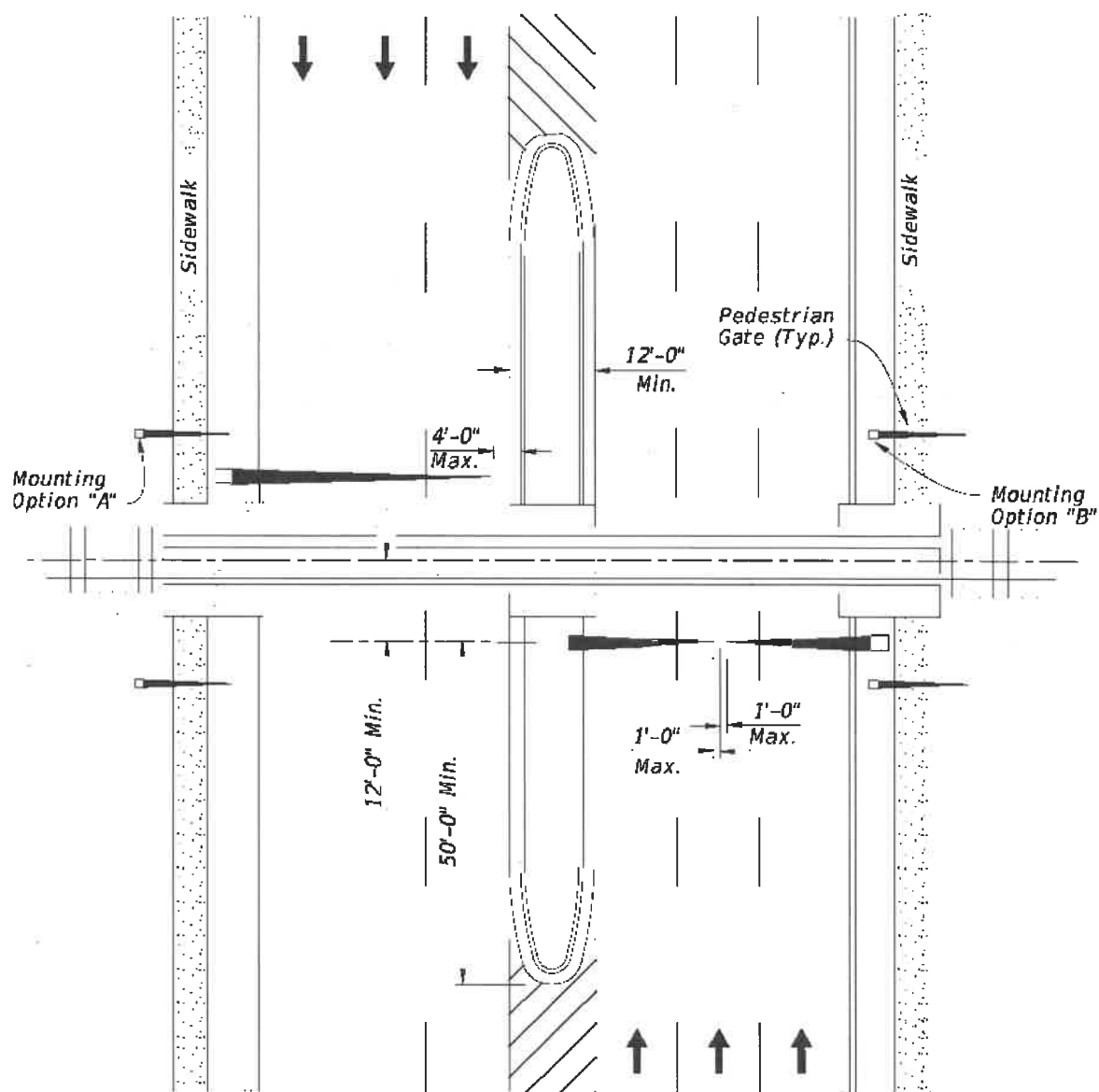
The proper use of adequate advance warning and traffic control devices is essential for all grade crossings. Advance warning should include pavement markings and two or more signs on each approach. Each new crossing should be equipped with train-activated flashing signals.

Automatic gates, when used, should ideally extend across all lanes, but shall at least block one-half of the inside travel lane. It is desirable to include crossing arms across sidewalks and shared use paths.

Traffic control devices shall meet the requirements of the [*MUTCD*](#). See Section E of this chapter for additional requirements for traffic control devices in Quiet Zones.

Figure 7 – 6 Median Signal Gates for Multilane Curbed Sections provides an example of gate installation when a median is present.

Figure 7 – 6 Median Signal Gates for Multilane Curbed Sections



D.10 Rail-Highway Grade Crossing Surface

Each crossing surface should be compatible with highway user requirements and railroad operations at the site. When installing a new rail-highway crossing or reworking an existing at-grade crossing, welded rail should be placed the entire width from shoulder point to shoulder point. Surfaces should be selected to be as maintenance free as possible.

D.11 Roadway Lighting

The use of roadway lighting at grade crossings should be considered to provide additional awareness to the driver. Illumination of the tracks can also be a beneficial safety aid.

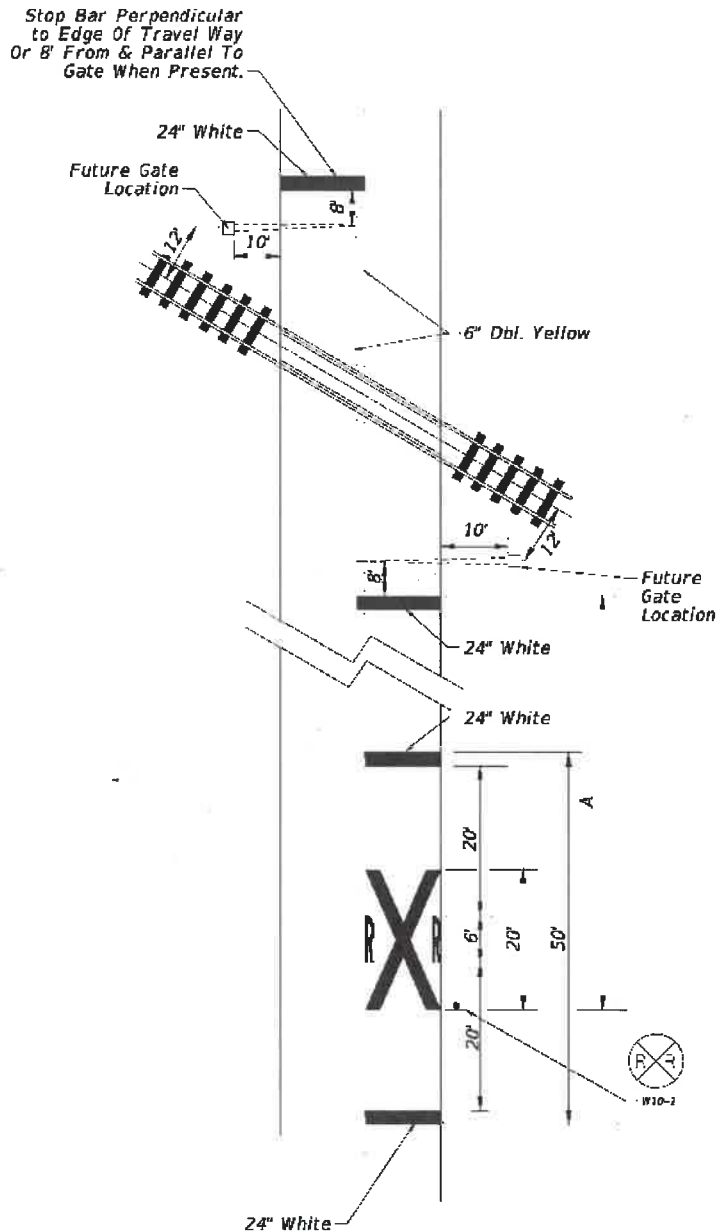
D.12 Crossing Configuration

Recommended layouts for grade crossings are shown in Figures 7 – 7 Passive Rail-Highway Grade Crossing Configuration and 7 – 8 Active Rail-Highway Grade Crossing Configuration. The distance “A” in the Figures is determined by speed and shown in the [*MUTCD, Table 2C – 4. Guidelines for the Advance Placement of Warning Signs*](#). Although the design of each grade crossing must be "tailored" to fit the existing situation, the principles given in this section should be followed in the design of all crossings. Additional information on the design of rail-highway crossings can be found in the Department's [*Design Standards, Index 17881 and 17882*](#).

Passive rail-highway grade crossings include traffic control devices that provide static messages of warning, guidance, and, in some instances, mandatory action for the driver. (Source: [*FHWA Railroad-Highway Grade Crossing Handbook*](#))

Active rail-highway grade crossings include traffic control devices that give advance notice of the approach of a train. (Source: [*FHWA Railroad-Highway Grade Crossing Handbook*](#))

Figure 7 – 7 Passive Rail-Highway Grade Crossing Configuration



Note: The distance "A" is determined by speed and shown in the [MUTCD, Table 2C – 4. Guidelines for the Advance Placement of Warning Signs.](#)

[illegible]

Rail-Highway Crossings

E QUIET ZONES

Quiet Zone means a segment of a rail line that includes public rail-highway crossings at which locomotive horns are not routinely sounded. The Federal Railroad Administration (FRA) has established guidelines the applying jurisdiction must follow for approval of quiet zones. Applying entities can go to the [FRA's website](#) and the [Code of Federal Regulations \(CFR\), Title 49, Subtitle B, Chapter II, Part 222](#) for further information on the process for approval of Quiet Zones.

Coordinate with the [Department's District Rail Coordinator](#) to determine if crossings are located within designated Quiet Zones for State owned rail corridors or crossings of state highways. State owned rail corridors include the [Central Florida Rail Corridor](#) and [South Florida Rail Corridor](#). For other rail crossings, coordinate with the local government who maintains the crossing roadway, sidewalk or shared use path to determine if the location has been approved by the FRA for a Quiet Zone.

For a crossing within a Quiet Zone that requires supplemental safety measures, approved supplemental safety measures include:

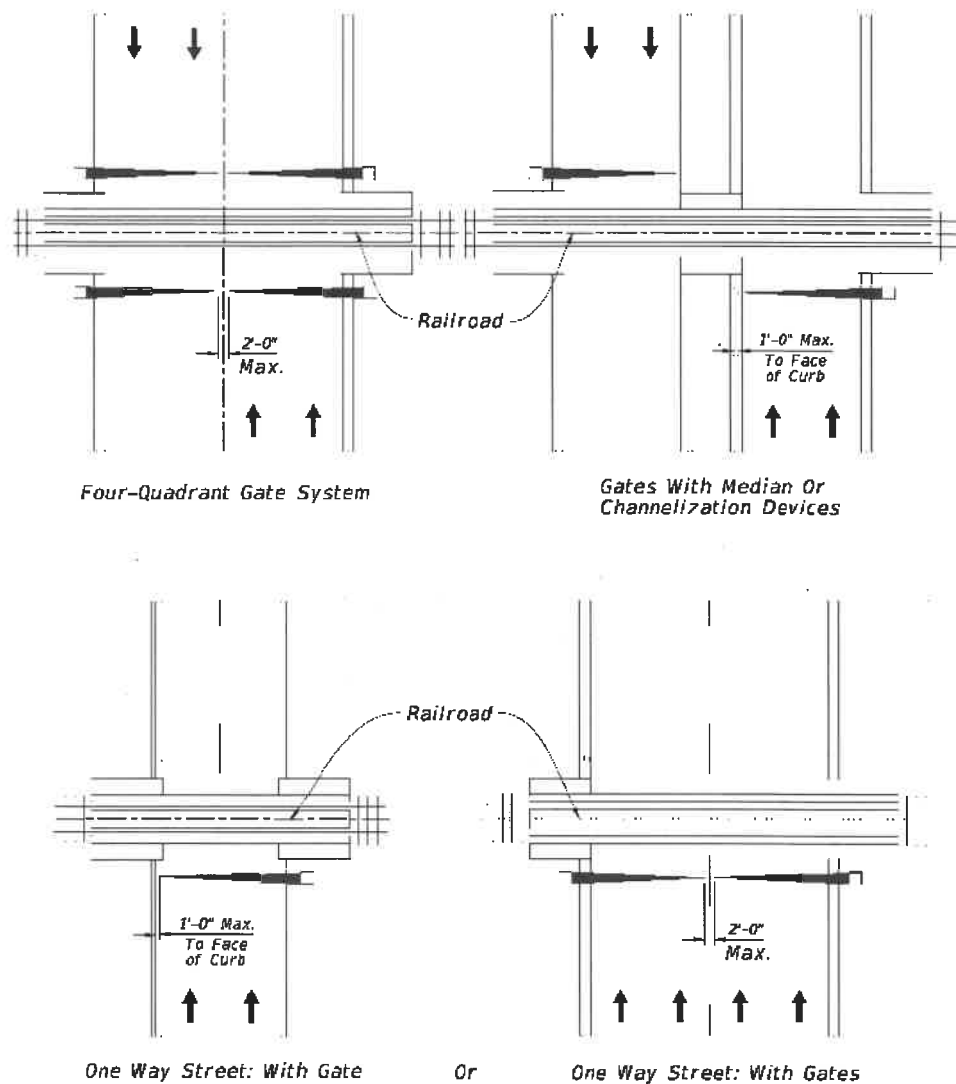
- Temporary closure of a public railroad-highway-rail grade crossing;
- Four-quadrant gate systems;
- Gates with medians or channelization devices;
- One way street with gate(s); and
- Permanent closure of a public highway-rail grade crossing.

The [CFR, Title 49, Chapter II, Part 222, Appendix A, Approved Supplemental Safety Measures](#) provides additional information on the design of Quiet Zones to meet federal approval. The **CFR** also requires that any traffic control device and its application where used as part of a Quiet Zone shall comply with all applicable provisions of the **MUTCD**. See [MUTCD, Part 8, Traffic Control for Railroad and Light Rail Transit Grade Crossings](#) for further information. Pedestrian gates, audible device, and detectable warnings are required when a sidewalk or shared use path is present or proposed.

For Quiet Zones that cross state owned rail corridors, the Department's [Design Manual, Chapter 220 Railroads](#) provides additional design criteria.

Figure 7 – 9 Gate Configurations for Quiet Zones illustrates the maximum gap allowed for gates at rail-highway crossings within Quiet Zones, based upon *CFR, Title 49, Chapter II, Part 222*.

Figure 7 – 9 Gate Configuration for Quiet Zones



F HIGH SPEED RAIL

The establishment of high-speed rail service is governed by **49 U.S. Code 26106 – High-Speed Rail Corridor Development**.

The [High-Speed Rail \(HSR\) Strategic Plan](#) divides potential operations into four categories or generic descriptions:

- HSR – Express. Frequent express service between major population centers 200 - 600 miles apart, with few intermediate stops. Top speeds of at least 150 mph on completely grade-separated, dedicated rights-of-way (with the possible exception of some shared track in terminal areas). Intended to relieve air and highway capacity constraints.
- HSR – Regional. Relatively frequent service between major and moderate population centers 100 - 500 miles apart, with some intermediate stops. Top speeds of 110 - 150 mph, grade-separated, with some dedicated and some shared track (using positive train control (PTC) technology). Intended to relieve highway and, to some extent, air capacity constraints.
- Emerging HSR. Developing corridors of 100 - 500 miles, with strong potential for future HSR Regional and/or Express service. Top speeds of up to 80 - 110 mph on primarily shared track (eventually using PTC technology), with advanced grade crossing protection or separation. Intended to develop the passenger rail market and provide some relief to other modes.
- Conventional Rail. Traditional intercity passenger rail services of more than 100 miles with as little as 1 to as many as 7 - 12 daily frequencies; may or may not have strong potential for future high-speed rail service. Top speeds of up to 79 mph generally on shared track. Intended to provide travel options and to develop the passenger rail market for further development in the future.

Further information on the implementation of high-speed rail service can be found on the Federal Railroad Administration's website [High Speed Rail Overview](#).

G MAINTENANCE AND RECONSTRUCTION

The inspection and maintenance of all features of rail-highway grade crossings shall be an integral part of each highway agency's and railroad company's regular maintenance program (***Chapter 10 – Maintenance And Resurfacing***). Items that should be given a high priority in this program include: pavement stability and skid resistance, clear sight distance, and all traffic control and protective devices.

The improvement of all substandard or hazardous conditions at existing grade crossings is extremely important and should be incorporated into the regular highway reconstruction program. The objective of this reconstruction program should be to upgrade each crossing to meet these standards. The priorities for reconstruction should be based upon the guidelines set forth by the Department.

H REFERENCES

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

- Federal Highway Administration Railroad-Highway Grade Crossing Handbook, Revised Second Edition, August 2007
http://safety.fhwa.dot.gov/xings/com_roaduser/07010/
- Code of Federal Regulations (CFR), Title 49 Transportation, Part 222, Use of Locomotive Horns at Public Highway-Rail Grade Crossings
http://www.ecfr.gov/cgi-bin/text-idx?tpl=/ecfrbrowse/Title49/49cfr222_main_02.tpl
- The Train Horn Rule and Quiet Zones
<https://www.fra.dot.gov/Page/P0104>
- MUTCD, Part 8, Traffic Control for Railroad and Light Rail Transit Grade Crossings
<http://mutcd.fhwa.dot.gov/pdfs/2009r1r2/part8.pdf>
- The American Railway Engineering and Maintenance-of-Way Association (AREMA)
<https://www.arema.org/>
- Florida Administrative Code, (Rule 14-57: Railroad Safety and Clearance Standards, and Public Railroad-Highway Grade Crossings
[https://www.flrules.org/gateway/RuleNo.asp?title=RAILROAD SAFETY AND CLEARANCE STANDARDS, AND PUBLIC RAILROAD-HIGHWAY GRADE CROSSINGS&ID=14-57.011](https://www.flrules.org/gateway/RuleNo.asp?title=RAILROAD%20SAFETY%20AND%20CLEARANCE%20STANDARDS,%20AND%20PUBLIC%20RAILROAD-HIGHWAY%20GRADE%20CROSSINGS&ID=14-57.011)
- Florida Department of Transportation Rail Contacts
<http://www.dot.state.fl.us/rail/contacts.shtm>

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CHAPTER 8

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CHAPTER 8

PEDESTRIAN FACILITIES

A INTRODUCTION

Pedestrian 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 pedestrians. Pedestrian facilities should be considered in conjunction with the construction, reconstruction, or other significant improvement of any transportation facility. Special emphasis should be given to projects in or within 1 mile of an urban area.

In addition to the design criteria provided in this chapter, the 2006 Americans with Disabilities Act Standards for Transportation Facilities as required by 49 C.F.R 37.41 or 37.43 and the 2017 Florida Accessibility Code for Building Construction as required by 61G20-4.002 impose additional requirements for the design and construction of pedestrian facilities. Examples of pedestrian facilities include sidewalks, shared use paths, over and under passes, curb ramps, median refuges, and crosswalks.

Each highway agency responsible for a system of streets and highways should establish and maintain a program for implementing pedestrian facilities, and for maintaining existing pedestrian facilities.

B TYPES OF PEDESTRIAN FACILITIES

There are several ways in which pedestrians can be accommodated in the public right of way

B.1 Sidewalks

Sidewalks are walkways parallel to the roadway and designed for use by pedestrians. Sidewalks should be provided along both sides of roadways that are in or within one mile of an urban area. If sidewalks are constructed on the approaches to bridges, they should be continued across the structure. If continuous sidewalks are constructed on only one side of the street, pedestrians should be provided access to facilities and services located on the opposite side

of the street. Newly constructed, reconstructed, or altered sidewalks shall be accessible to and usable by persons with disabilities.

The minimum width of a sidewalk shall be 5 feet on both curb and gutter and flush shoulder roadways. The minimum separation for a 5-foot sidewalk from the back of curb is 2 feet. If the sidewalk is located adjacent to the curb, the minimum width of sidewalk is 6 feet. For sidewalks, not adjacent to the curb, at least a 1-foot wide graded area should be provided on both sides, flush with the sidewalk and having a maximum 1:6 slope. Wider sidewalks should be considered in Central Business Districts and in areas where heavy two-way pedestrian traffic is expected.

A 5-foot wide (minimum) sidewalk that connects a transit stop or facility with an existing sidewalk or shared use path shall be included to comply with ADA accessibility standards. **Chapter 13 – Transit** provides illustrations of the connection between the sidewalk and transit facility.

Particular attention shall be given to pedestrian accommodations at the termini of each project. If full accommodations cannot be provided due to the limited scope or phasing of a roadway project or an existing sidewalk is not present at the termini, an extension of the sidewalk to the next appropriate pedestrian crossing or access point should be considered. If pedestrian facilities are provided, they shall be connected with facilities (e.g. sidewalks, shared use path, and crosswalks on the adjoining projects).

For new construction and reconstructed roadways, grades on sidewalks or shared use paths shall not exceed 5%, unless accessible ramps and landings are provided. However, in a roadway right of way, the grade of sidewalks or shared use paths is permitted to equal the general grade established for the adjacent street or highway. There should be enough sidewalk or path cross slope to allow for adequate drainage, however the maximum shall be no more than 2% to comply with ADA requirements.

Where existing physical constraints make it impracticable for altered elements, spaces, or facilities to fully comply with the requirements for new construction, compliance is required to the extent practicable within the scope of the project. Existing physical constraints include, but are not limited to, underlying terrain, right-of-way availability, underground structures, adjacent developed facilities, drainage, or the presence of a notable natural or historic feature. The location of new poles or relocated poles shall provide at least 48" minimum unobstructed sidewalk width.

Evaluate existing driveways and turnouts for compliance to ADA requirements. Nonconforming driveways are not required to be upgraded if it is not feasible within the scope of the project.

Additional information on designing accessible pedestrian facilities is provided by the United States Access Board at the following web site:

[*Proposed Guidelines for Pedestrian Facilities in the Public Right-of-Way*](#)

Edge drop-offs should be avoided. When drop-offs cannot be avoided, they should be shielded as discussed in Section F, Drop-Off Hazards for Pedestrians.

For additional information concerning the design of sidewalks, refer to **Section C.7.d of Chapter 3 – Geometric Design**.

B.2 Shared Use Paths

Paths are usually set back from the roadway and separated by a green area, ditch, swales or trees. Shared use paths are intended for the use by both pedestrians and bicyclists and shall be accessible. For additional information concerning the design of shared-use paths, refer to **Chapter 9 – Bicycle Facilities**.

B.3 Shared Streets

Shared uses of a street for people walking, bicycling and driving are referred to as shared streets. These are usually specially designed spaces such as pedestrian streets which are local urban streets with extremely low vehicle speed.

B.4 Shoulders

Highway shoulders are not intended for frequent use by pedestrians, but do accommodate occasional pedestrian traffic. Highway shoulders often have cross slopes which exceed 2%; consequently they are not considered or expected to fully meet ADA criteria.

C MINIMIZING CONFLICTS

The planning and design of new streets and highways shall include provisions that support pedestrian travel and minimize vehicle-pedestrian conflicts. These may include:

- Sidewalks and/or shared use paths parallel to the roadway
- Marked pedestrian crossings
- Raised median or refuge islands
- Pedestrian signal features such as pedestrian signal heads and detectors
- Transit stops and shelters

In some situations it may be possible to eliminate a vehicle-pedestrian conflict through close coordination with the planning of pedestrian facilities and activity outside of the highway right of way. Care should be exercised to ensure the elimination of a given conflict point does not transfer the problem to a different location. Any effort to minimize or eliminate conflict points must consider the mobility needs of the pedestrian. The desired travel path should not be severed and the number of required crossing points and/or walking distances should not be significantly increased. Some crossings should be redesigned rather than eliminated or relocated.

C.1 General Needs

Minimizing vehicle-pedestrian conflicts can be accomplished by providing adequate horizontal, physical, or vertical (primarily for crossings) separation between the roadway and the pedestrian facility.

C.2 Horizontal Separation

The development of independent systems for pedestrian and motor vehicular traffic is the preferred method for providing adequate horizontal separation.

C.2.a General Criteria

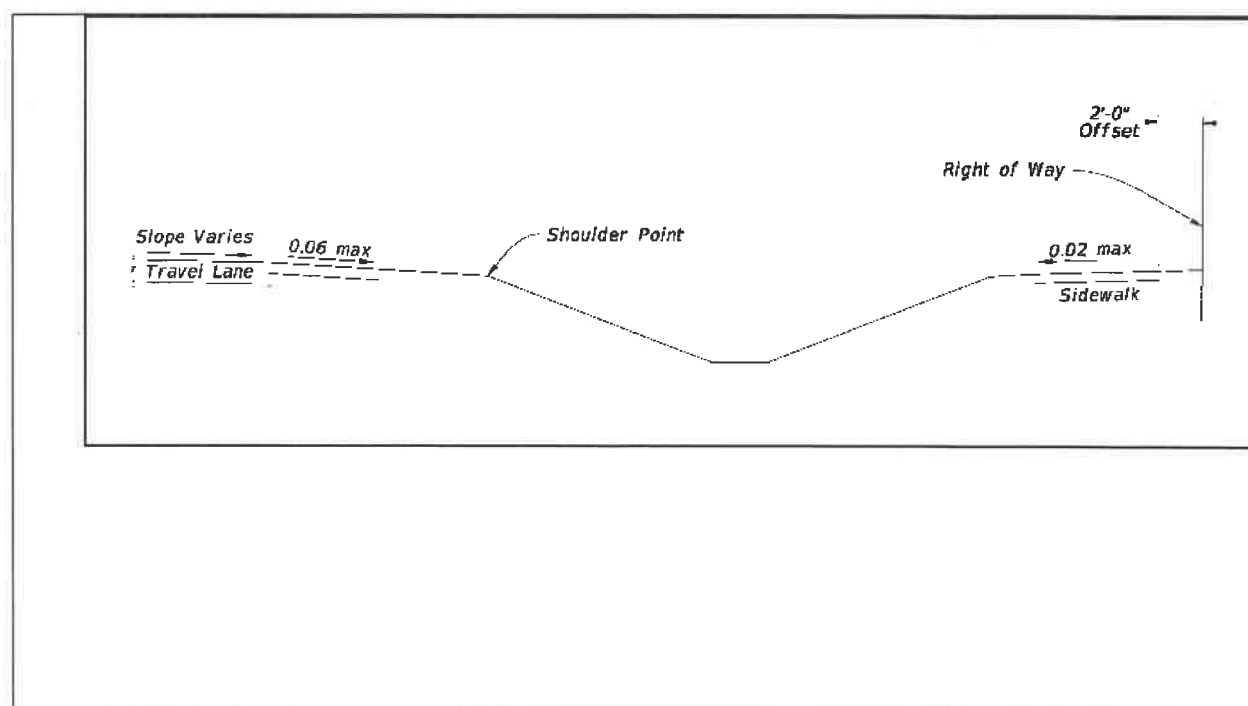
New sidewalks should be placed as far from the roadway as practical in the following sequence of desirability:

1. As near the right of way line as possible. (ideally, 3 feet of width should be provided behind the sidewalk for above ground utilities)
2. Outside of the clear zone.
3. Sufficiently off-set from the curb to allow for the placement of street trees, signs, utilities, parking meters, benches or other street furniture outside of the sidewalk in urban locations (e.g. town center, business or entertainment district).
4. Five feet from the shoulder point on flush shoulder roadways.
5. At the grass shoulder point of flush shoulder roadways.

Figure 8 – 1 Shoulder Point with Sidewalk provides an illustration of the location of the shoulder point.

On arterial or collector roadways, sidewalks shall not be constructed contiguous to the roadway pavement, unless a curb or other barrier is provided. Nearing intersections, the sidewalk should be transitioned as necessary to provide a more functional crossing location that also meets driver expectation. Further guidance on the placement of stop or yield lines and crosswalks is provided in the [MUTCD, Part 3.](#)

Figure 8 – 1 Shoulder Point with Sidewalk



C.2.b Buffer Widths

Providing a buffer can improve pedestrian safety and enhance the overall walking experience. Buffer width is defined as the space between the sidewalk and the edge of traveled way. On-street parking or bike lanes can also act as an additional buffer. The planting strip or buffer strip should be 6 feet where practical to eliminate the need to narrow or reroute sidewalks around driveways. With this wider buffer strip, the sidewalk is placed far enough back so that the driveway slope does not have to encroach into the sidewalk.

C.3 Other Considerations

When designing urban highways, the following measures may be considered to help increase the safe and efficient operation of the highway for pedestrians:

- Use narrower lanes and introduce raised medians to provide pedestrian refuge areas
- Provide pedestrian signal features and detectors
- Prohibit right turn on red
- Control, reduce, or eliminate left and/or right turns
- Prohibit free flow right turn movements
- Reduce the number of lanes

D BARRIER SEPARATION

Barriers may be used to assist in the separation of motor vehicular and pedestrian traffic.

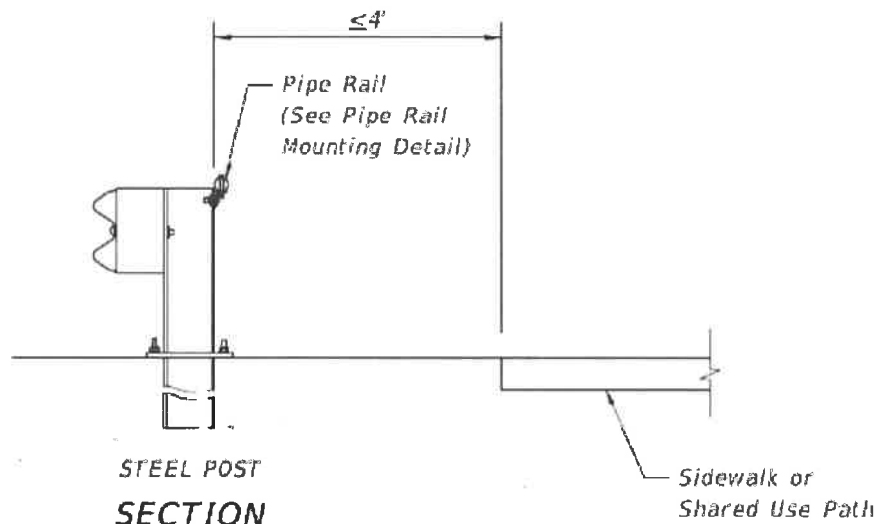
D.1 Longitudinal Barriers

Longitudinal barriers such as guardrails, rigid barriers, and bridge railings are designed primarily to redirect errant vehicles away from roadside hazards. These barriers can also be used to provide valuable protection of pedestrian facilities from out of control vehicles.

Where adequate horizontal separation is not feasible, or where there is a significant hazard from out of control vehicles, longitudinal barriers may be utilized. If electing to use barriers, special consideration should be made to ensure proper sight distance near driveways and intersections is maintained. See Chapter 4, Figure 4 – 8 Location of Guardrail for information on the correct placement of a sidewalk in conjunction with a guardrail.

When a sidewalk or shared use path is within 4 feet of the back of a guardrail with steel posts, a pipe rail should be installed on the back of the post. For a guardrail with timber posts, the bolt ends should be trimmed flush with the post or recessed. See Figure 8 – 2 Guardrail with Pipe Rail Detail for an illustration of when a pipe rail is needed. Additional information on the design of guardrails adjacent to a sidewalk or shared use path can be found in the Department's [Standard Plans, Index 536-001](#).

Figure 8 – 2 Guardrail with Pipe Rail Detail



D.2 Fencing, Pedestrian Channelization Devices or Landscaping

Fencing, pedestrian channelization devices or landscaping may be used to discourage pedestrian access to the roadway and aid in channeling pedestrian traffic to the proper crossing points. These should not be considered a substitute for longitudinal barriers, but may be used in conjunction with redirection devices.

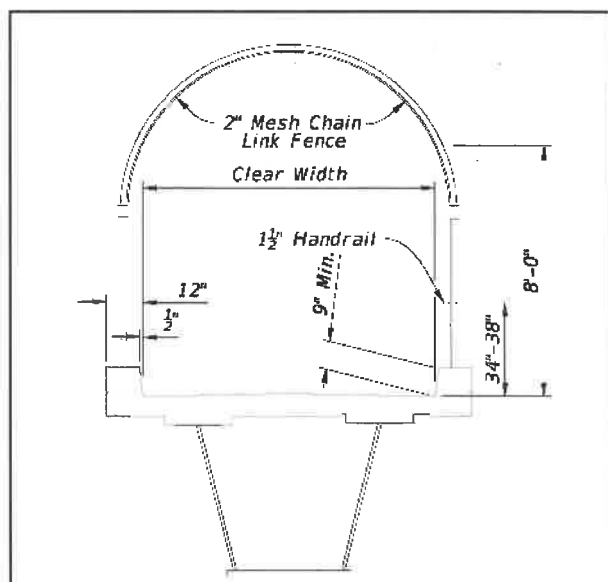
E GRADE SEPARATION

Grade separation may be selectively utilized to support the crossing of large pedestrian volumes across highways where the traffic volume on the roadway is at or near capacity or where speeds are high. Overpasses or underpasses may be justified at major pedestrian generators such as schools, shopping centers, sports and amusement facilities, transit centers, commercial buildings, parks and playgrounds, hospitals, and parking facilities.

The minimum clear width of any stand-alone pedestrian overpass or underpass on a pedestrian accessible route is 8 feet. However, if the contiguous sidewalk or path is greater than 8 feet wide, the clear width of the overpass or underpass should match that width. The minimum clear height of a pedestrian overpass or underpass is 8 feet. See Figure 8 – 3 Pedestrian Bridge Typical Section for an example of a pedestrian bridge typical section.

The [*FDOT Structures Manual - Volume 1 - Structures Design Guidelines \(SDG\), Section 10*](#) provide additional guidance on engineered steel and concrete pedestrian bridges.

Figure 8 – 3 Pedestrian Bridge Typical Section



Notes: 1. Pedestrian handrails may be required. See the [*2006 Americans with Disabilities Act Standards for Transportation Facilities*](#).

2. Other superstructure configurations may be used provided an 8 ft. minimum headroom is maintained.

E.1 Overpasses

Pedestrian overpasses are typically bridge structures over major roadways or railroads. Overpasses should provide elevator access if they are not designed to provide accessible ramps with compliant slopes, level landings, and handrails on both sides. Bridges over roadways should be covered or screened to reduce the likelihood of objects being dropped or thrown below. The area adjacent to overpasses may be fenced to prevent unsafe crossings and to channel pedestrians to the overpass structure.

E.2 Underpasses

Pedestrian underpasses or tunnels perform the same function as overpasses. Their use is convenient when the roadway is elevated above the surrounding terrain.

Underpasses should be adequately maintained to reduce potential problems in lighting, cleaning, policing, and flooding and to maximize safety. The area adjacent to underpasses may be fenced to prevent unsafe crossings and to channel pedestrians to the underpass structure.

F DROP-OFF HAZARDS FOR PEDESTRIANS

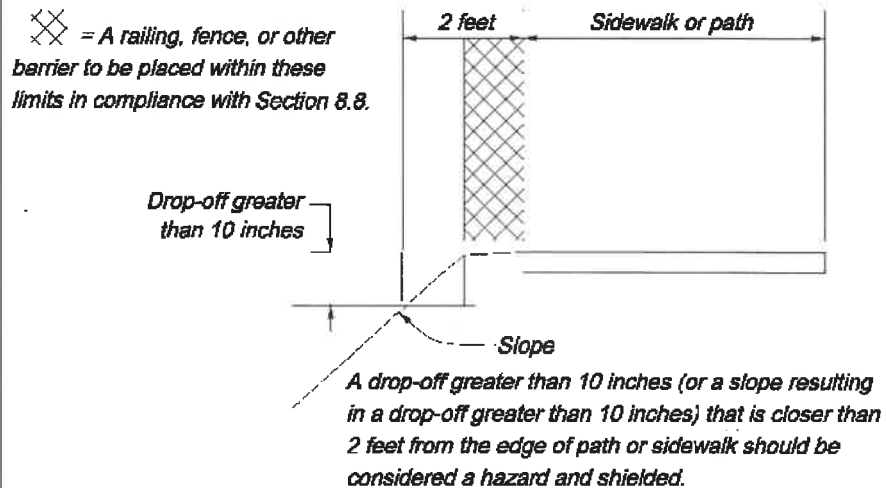
Drop-off hazards are defined as steep or abrupt downward slopes that can be perilous to pedestrians and bicyclists. Consider shielding any drop-off determined to be a hazard. Care should be taken when using Pedestrian/Bicycle Railings or fencing near intersections or driveways as they could obstruct the driver's line of sight. To reduce the need for railings as a sidewalk or shared use path approaches an intersection, consider extending cross drains and side drains to minimize drop-offs.

There are two cases that require shielding as shown in Figure 8 – 4 Drop-Off Hazards for Pedestrians and Bicyclists. Depending on the depth of the drop-off and severity of the conditions below, shielding may be necessary for cases other than described above.

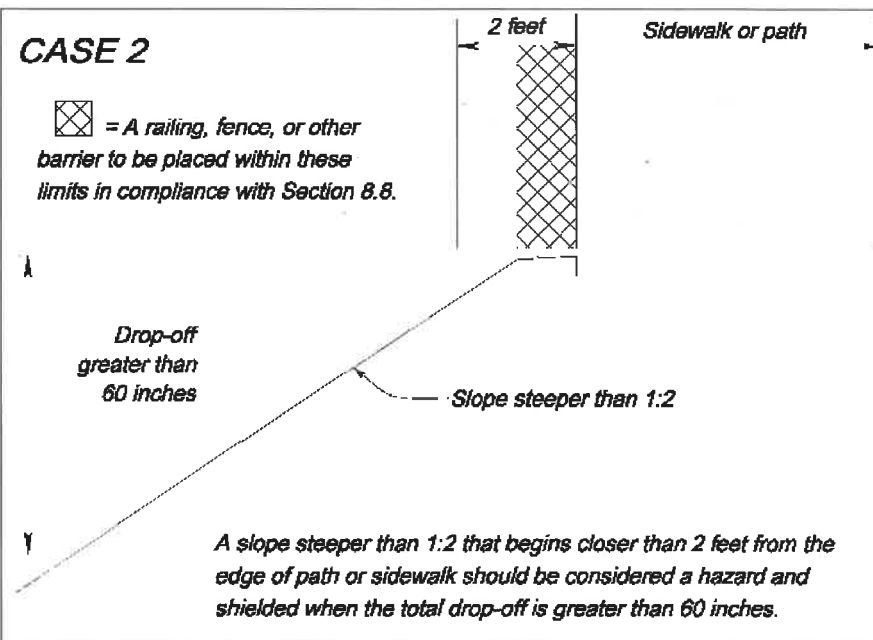
Railings or fences should be provided for vertical drop-off hazards or where shielding is required. The standard height for a pedestrian/bicycle railing is 42 inches. A 48 inch tall pedestrian/bicycle railing should be used when sidewalk grades are steeper than 5% and bicycle travel is expected. A standard railing is generally intended for urbanized areas, locations attaching to bridge rail or along concrete walkways. Fencing is generally intended for use in rural areas along paths and trails.

Figure 8 – 4 Drop-Off Hazards for Pedestrians and Bicyclists

CASE 1



CASE 2



G PEDESTRIAN CROSSINGS

The design of pedestrian crossings and parallel pathways within the right of way shall be considered an integral part of the overall design of a street or highway.

The development of protection at any remaining crossings or conflict points must be adequate to achieve a total pedestrian transportation mode that is reasonably safe.

G.1 Crosswalks

The design of pedestrian crosswalks should be based on the following requirements:

- Crosswalks should be placed at locations with sufficient sight distances
- At crossings, the roadway should be free from changes in alignment or cross section
- The entire length of crosswalk shall be visible to drivers at a sufficient distance to allow a stopping maneuver
- Stop bars or yield markings, in conjunction with the appropriate signing, shall be provided at all marked crosswalks
- Crosswalks shall be easily identified and clearly delineated, in accordance with the [*Manual on Uniform Traffic Control Devices \(MUTCD\)*](#) and [*Rule 14-15.010, F. A. C.*](#)

G.1.a Marked Crosswalks

Marked crosswalks are one tool to allow pedestrians to cross the roadway safely. They are often used in combination with other treatments (signs, flashing beacons, curb extensions, pedestrian signals, raised median or refuge islands, and enhanced overhead lighting). Marked crosswalks serve two purposes: 1) to inform motorists of the location of a pedestrian crossing so that they have time to lawfully yield to or stop for a crossing pedestrian; and 2) to assure the pedestrian that a legal crosswalk exists at a particular location. See Figure 8 – 5 Pedestrian Median Refuge with Curb Extensions for an example of a pedestrian median refuge with a curb extension.

Figure 8 – 5 Pedestrian Median Refuge with Curb Extension



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

Marked crosswalks on an uncontrolled leg of an intersection or a mid-block location shall be supplemented with other treatments (such as signing, beacons, curb extensions, raised medians, raised traffic islands, or enhanced overhead lighting) when any of the following conditions exist:

1. Where posted speeds are greater than 40 mph.
2. On a roadway with 4 or more lanes without a raised median or raised traffic island that has an ADT of 12,000 or greater.
3. On a roadway with 4 or more lanes with a raised median or raised traffic island that has or is projected to have (within 5 years) an ADT of 15,000 or greater.

See **Chapter 6 – Lighting** for information on illuminating crosswalks and pedestrian facilities.

Additional guidance on marked crosswalks can be found in the [AASHTO Guide for the Planning, Design, and Operation of Pedestrian Facilities](#) and [FHWA's Safety Effects of Marked vs. Unmarked Crosswalks at Uncontrolled Locations: Executive Summary and Recommended Guidelines](#).

Marked crosswalks can also be used to create midblock crossings.

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 require 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.

Include sidewalk curb ramps at the following locations:

- At curbed returns for intersections and turnouts. Include a landing at the top of each ramp.
- 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, $\frac{1}{4}$ inch height protrusion, and slopes flush with the surrounding surface.

Curb ramps should be in line with the crossing. At intersections where more than one road is crossed, provide curb ramps at both ends of each crossing. 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 ramp slopes should not exceed 15 feet in length.

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.

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 are provided in the *Department's* [Standard Plans, Index 522-002](#)

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 is provided in the Department's [Standard Plans, Index 522-002.](#)

G.4 Controls

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 use of accessible pedestrian signals that include audible and/or vibro-tactile, and visual signals should be considered for pedestrian traffic control and regulation.

G.5 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.6 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 in excess of 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
<http://www.dot.state.fl.us/transit/Pages/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/guidelines-and-standards/transportation/facilities/ada-standards-for-transportation-facilities>
- 2012 Florida Accessibility Code for Building Construction
<https://www.flrules.org/gateway/ruleno.asp?id=61G20-4.002>
- AASHTO – Guide for the Planning, Design, and Operation of Pedestrian Facilities
<https://bookstore.transportation.org/>
- AASHTO – Roadway Lighting Design Guide I
<https://bookstore.transportation.org/>
- NACTO Urban Streets Design Guide
<http://nacto.org/usdg>
- Designing Walkable Urban Thoroughfares (CNU and ITE)
<http://www.cnu.org/streets>
- Project Management Handbook (CSS)
<http://www.dot.state.fl.us/projectmanagementoffice/Publications/default.shtm>
- FHWA Policy Memo for Flexibility in Pedestrian and Bicycle Facility Design
http://www.fhwa.dot.gov/environment/bicycle_pedestrian/guidance/design_guidance/design_flexibility.cfm
- AASHTO Load and Resistance Factor Design (LRFD) Bridge Design Specifications, 6^h Edition, (2012) with 2013 Interim Revisions
<https://bookstore.transportation.org/Home.aspx>
- Federal Railroad Administration General Manual - Policies, Procedures, and General Technical Bulletins (July 2014)
<http://www.fra.dot.gov/Elib/Details/L16208>

CHAPTER 9

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CHAPTER 9

BICYCLE FACILITIES

A INTRODUCTION

Bicycle facilities should 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 should be considered in all phases of transportation planning, design, construction and maintenance activities. Particular 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, the 2006 Americans with Disabilities Act Standards for Transportation Facilities as required by 49 C.F.R 37.41 or 37.43 and the 2017 Florida Accessibility Code for Building Construction as required by 61G20-4.002 impose additional requirements for the design and construction of facilities such as shared use paths and structures that include provisions for pedestrians.

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 should 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 should 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.

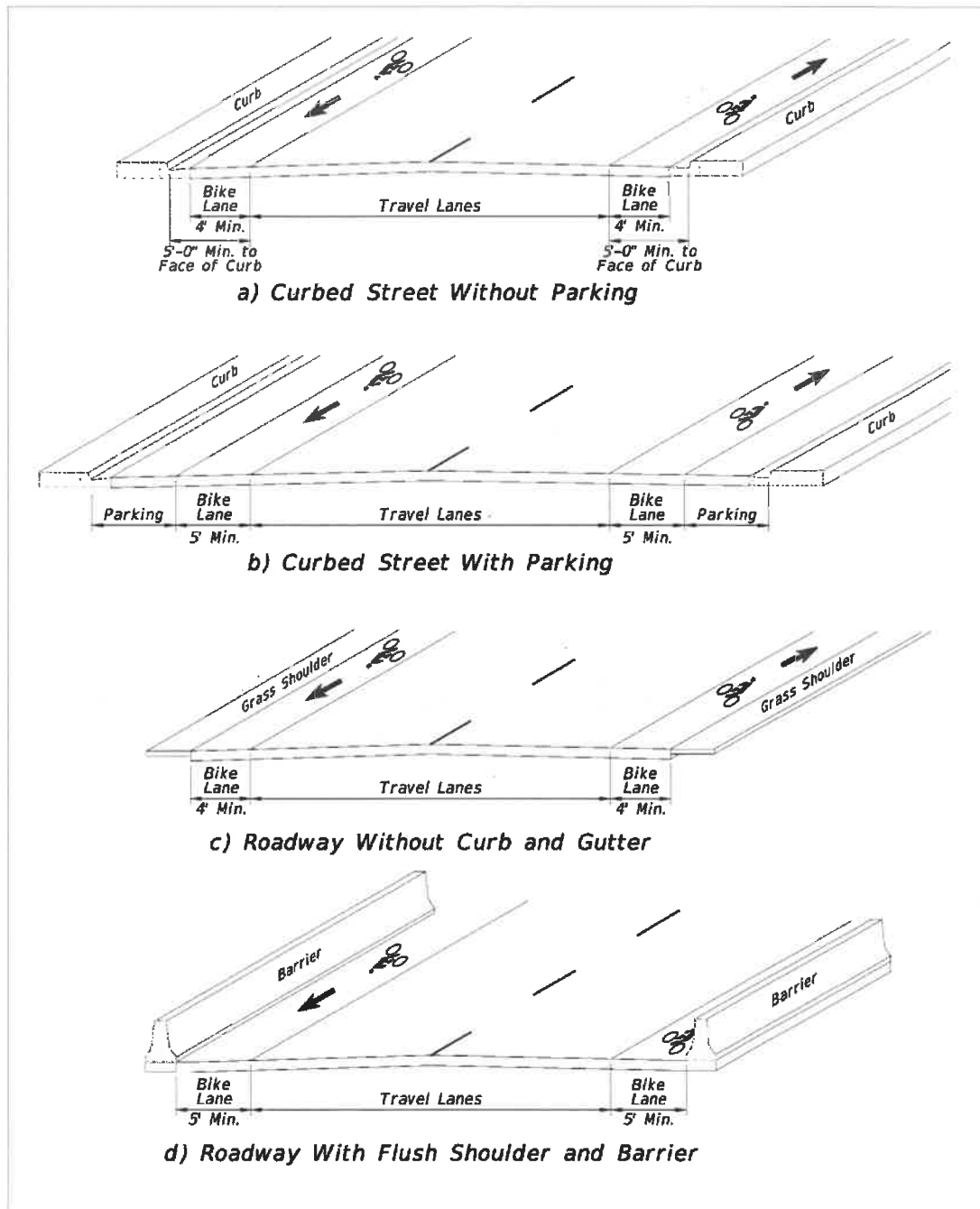
Bicycle lanes, paved shoulders, wide curb lanes, or shared lanes should be included to the fullest extent feasible. The appropriate selection of a bicycle facility depends on many factors, including motor vehicle and bicycle traffic characteristics, adjacent land use and expected growth patterns. All 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

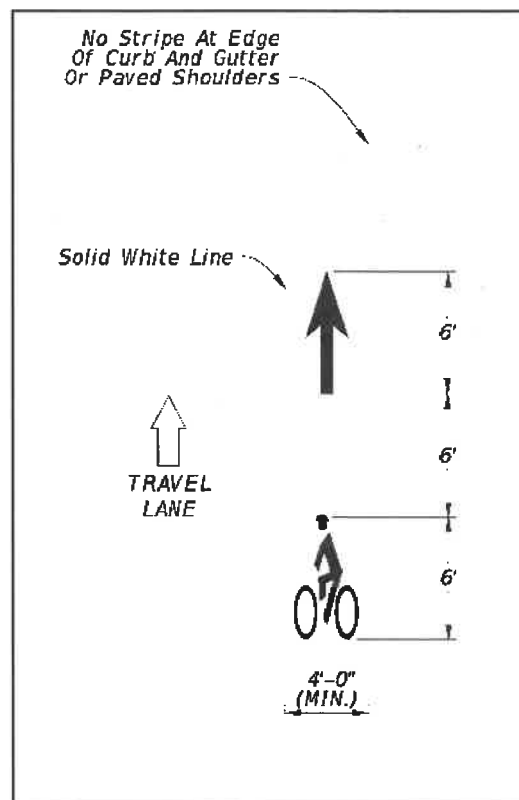


Bicycle lanes are one-way facilities and carry bicycle traffic in the same direction as the adjacent motor vehicle traffic. A bicycle lane should be delineated from the travel lanes with a solid white line and be marked with the bicycle symbol and arrow as shown in Figure 9 – 2 Detail of Bicycle Lane 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



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

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



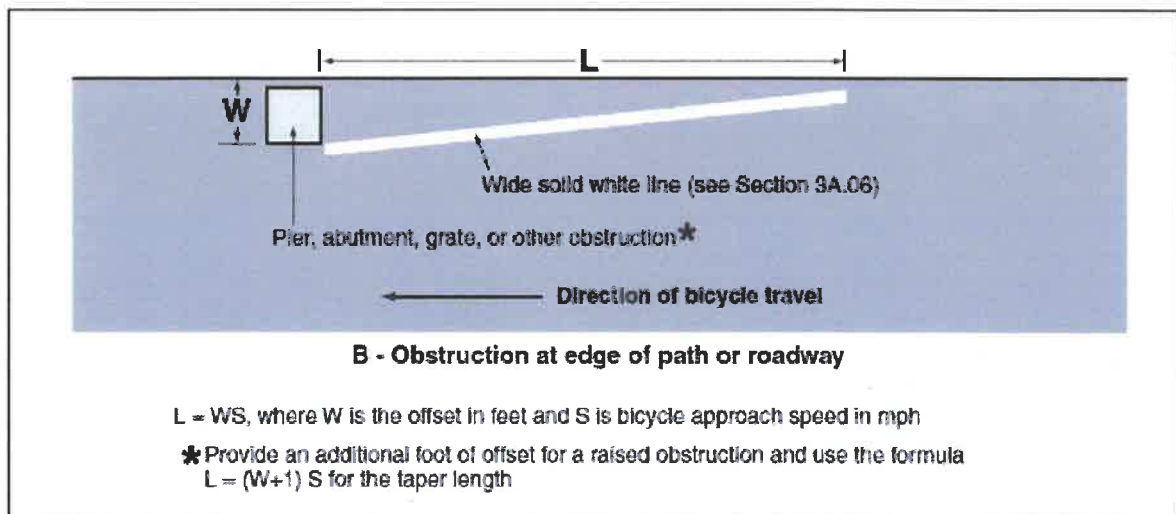
NACTO Urban Bikeway Design Guide, National Association of City Transportation Officials

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 Department's [*Drainage Manual, Section 3.7.4 Inlet Placement, January 2018 Edition*](#).

Figure 9 – 5 Example of Obstruction Pavement Markings



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.

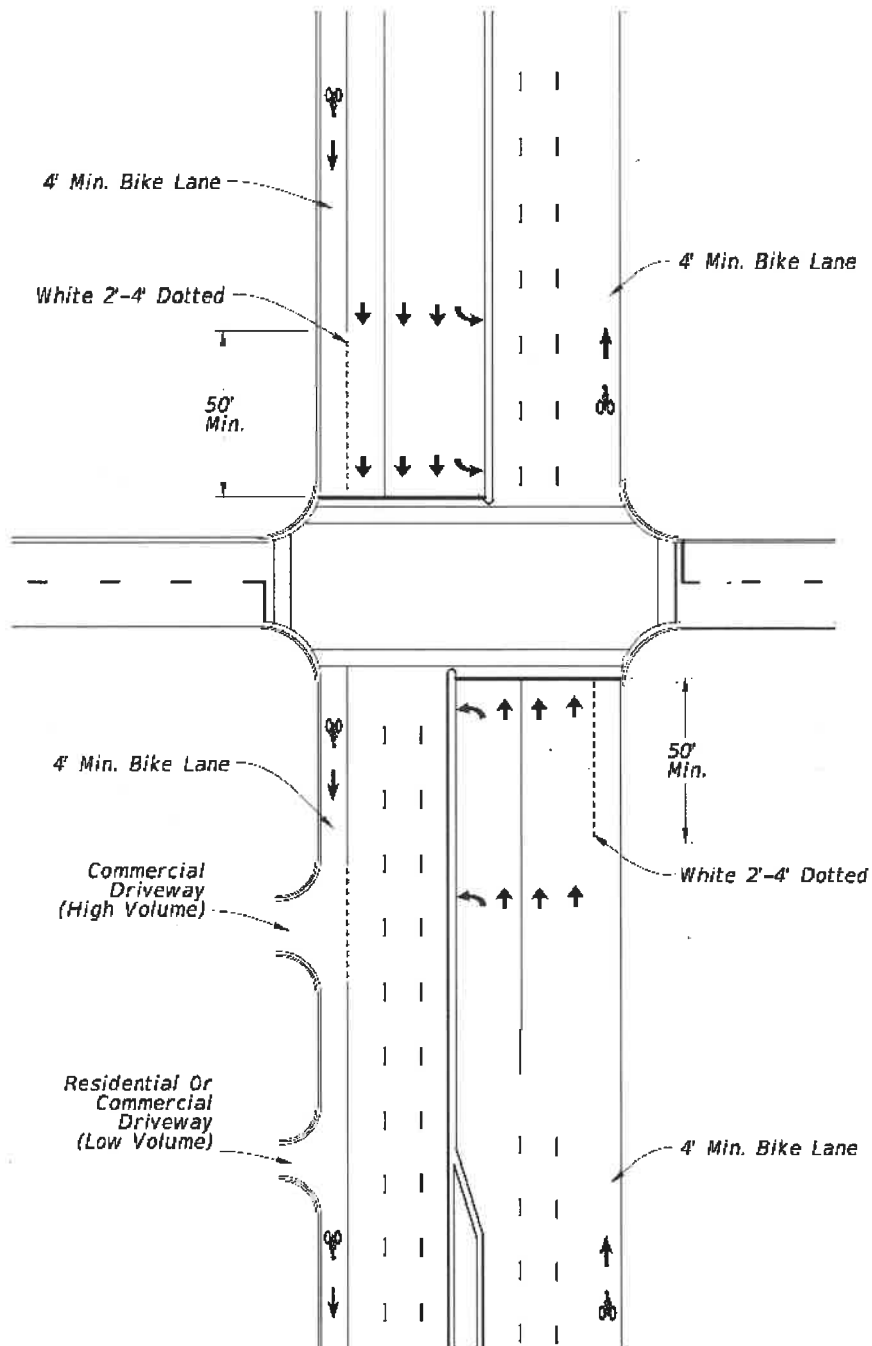
Table 9 – 1 Lane Widths
Urban Multilane or Two-Lane with Curb and Gutter

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

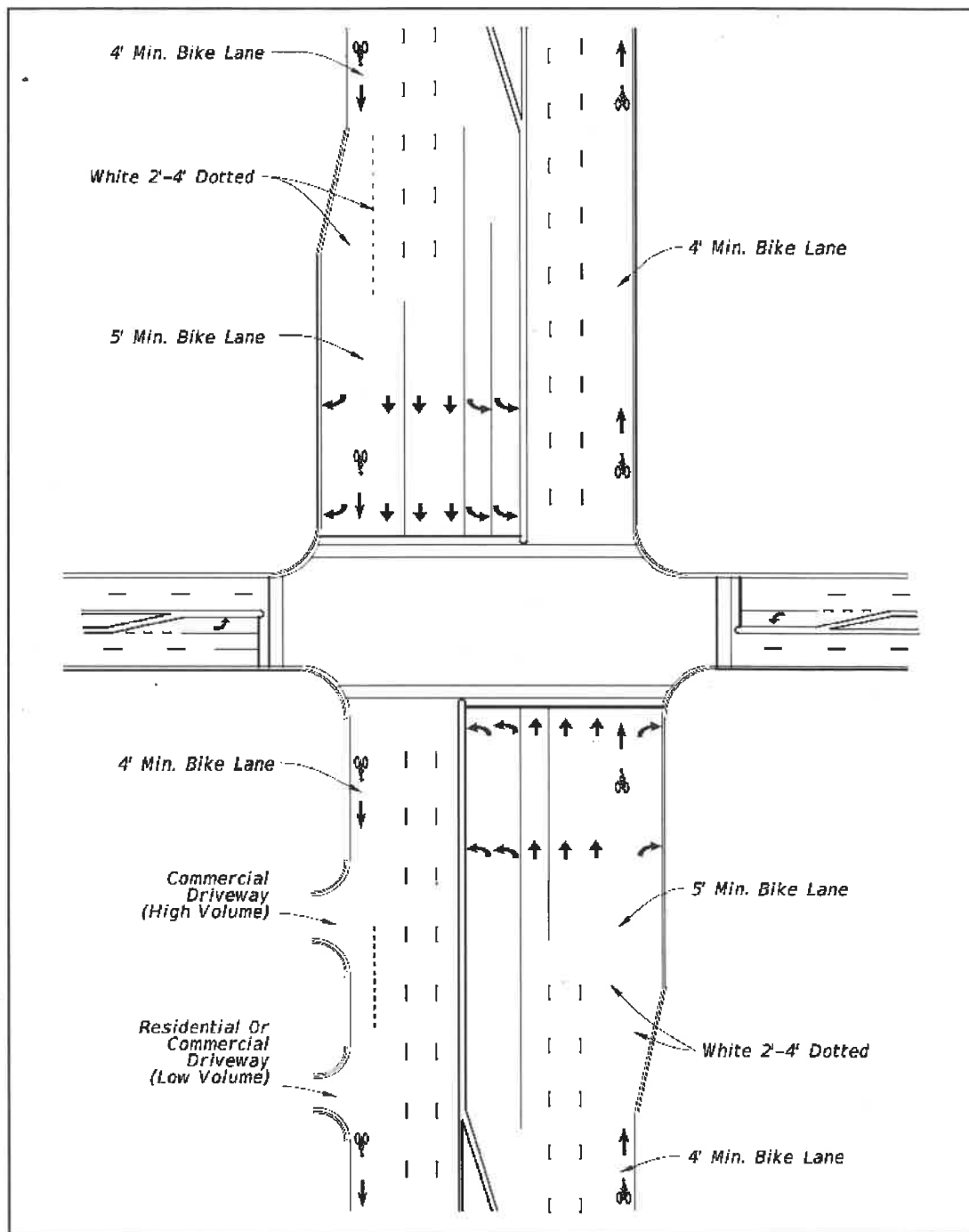
1. 11 ft. where either of the following conditions exist:
 - a) Trucks are >10% of Design Year Traffic.
 - b) Design Speed is 40 mph or greater.
2. 10 ft. for 2 Way Left Turn Lanes.
3. A minimum width of 7 ft. measured from face of curb may be left in place. Otherwise provide 8 ft. minimum, measured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

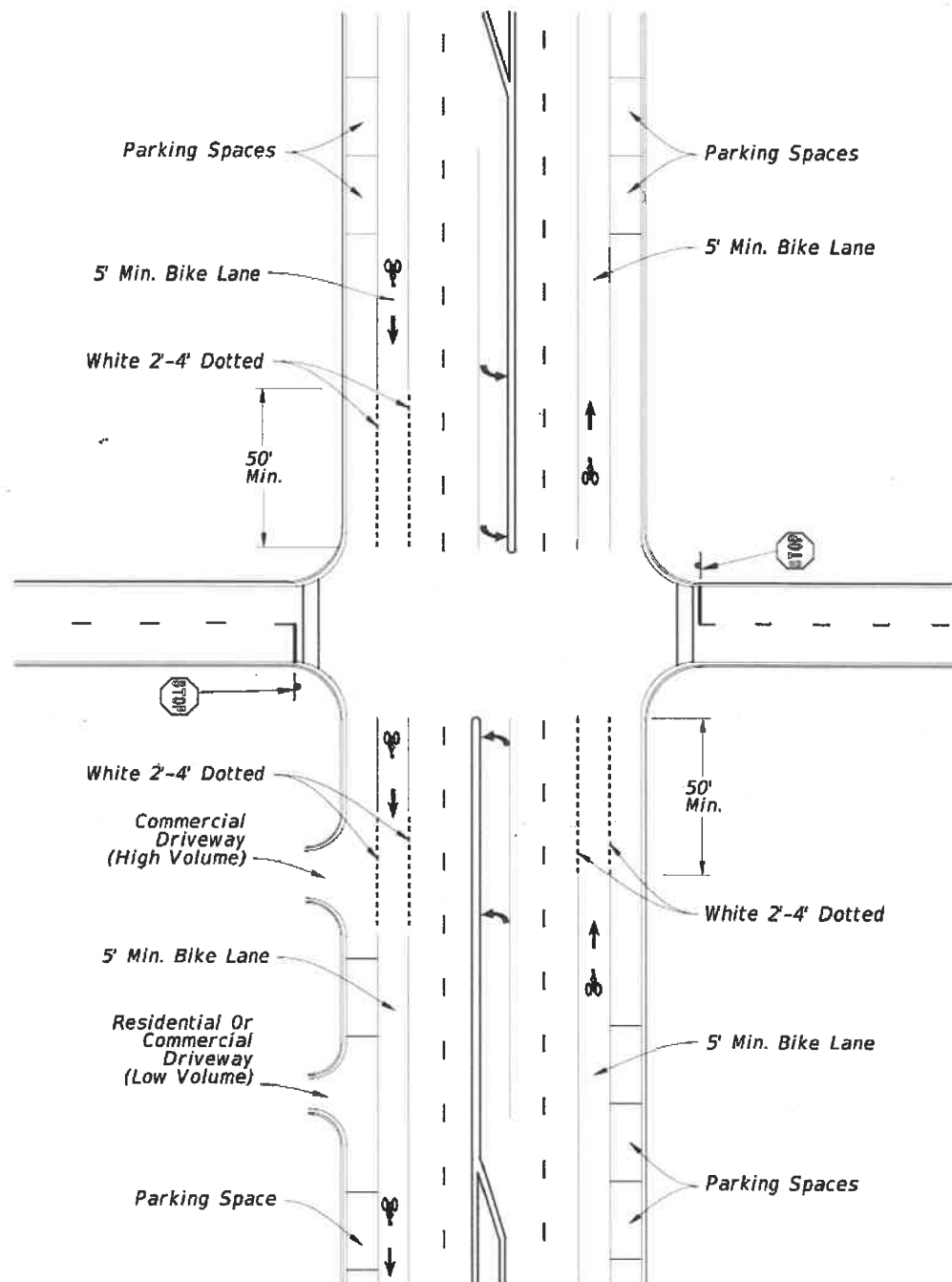
Figure 9 – 6 Bicycle Lane Markings



**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)**

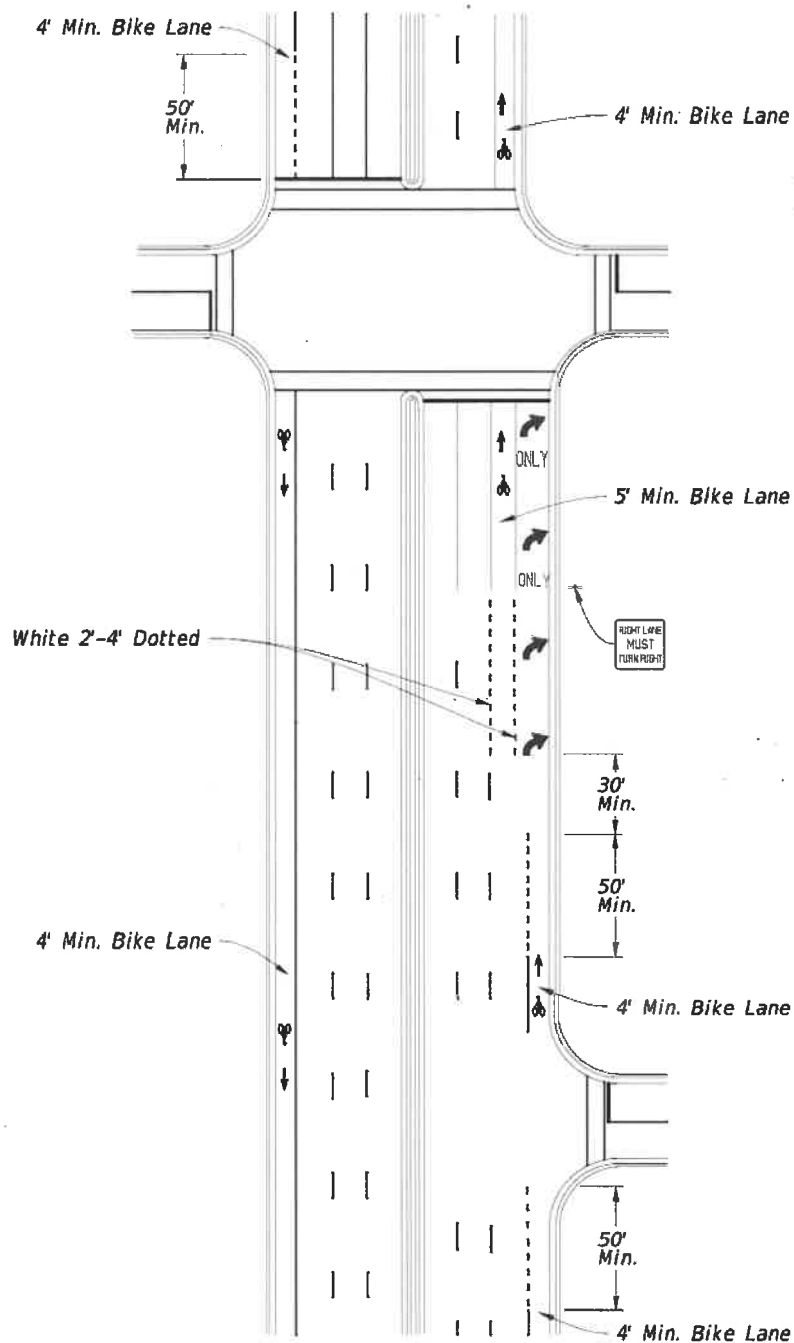


Figure 9 – 10 "Tee" Intersection with Bicycle Lane, Separate Right and Left Turn Lanes (Curb and Gutter)

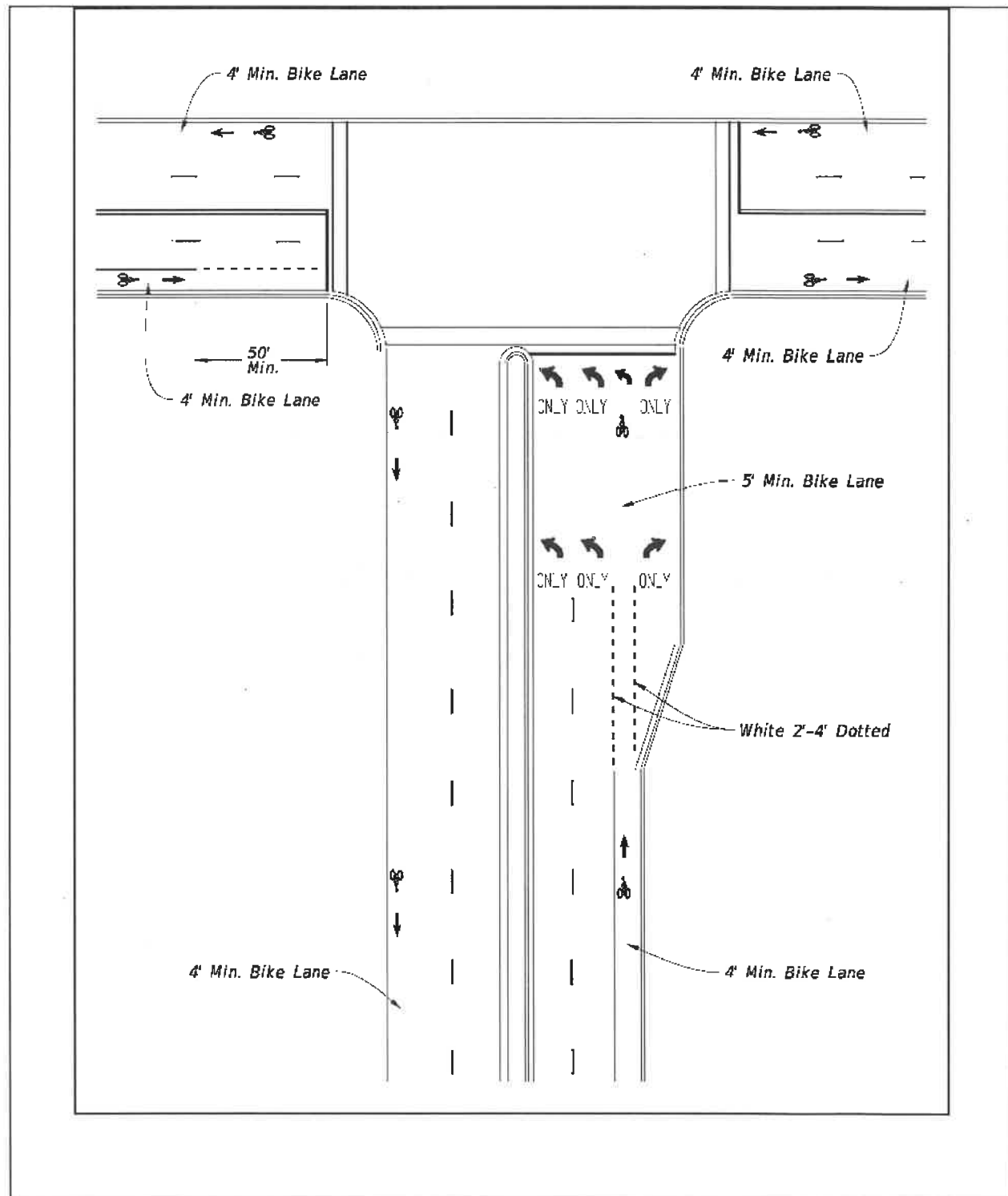


Figure 9 – 11 "Tee" Intersection with Bicycle Lanes, Left Turn Lane and Right Turn Drop Lane (Curb and Gutter)

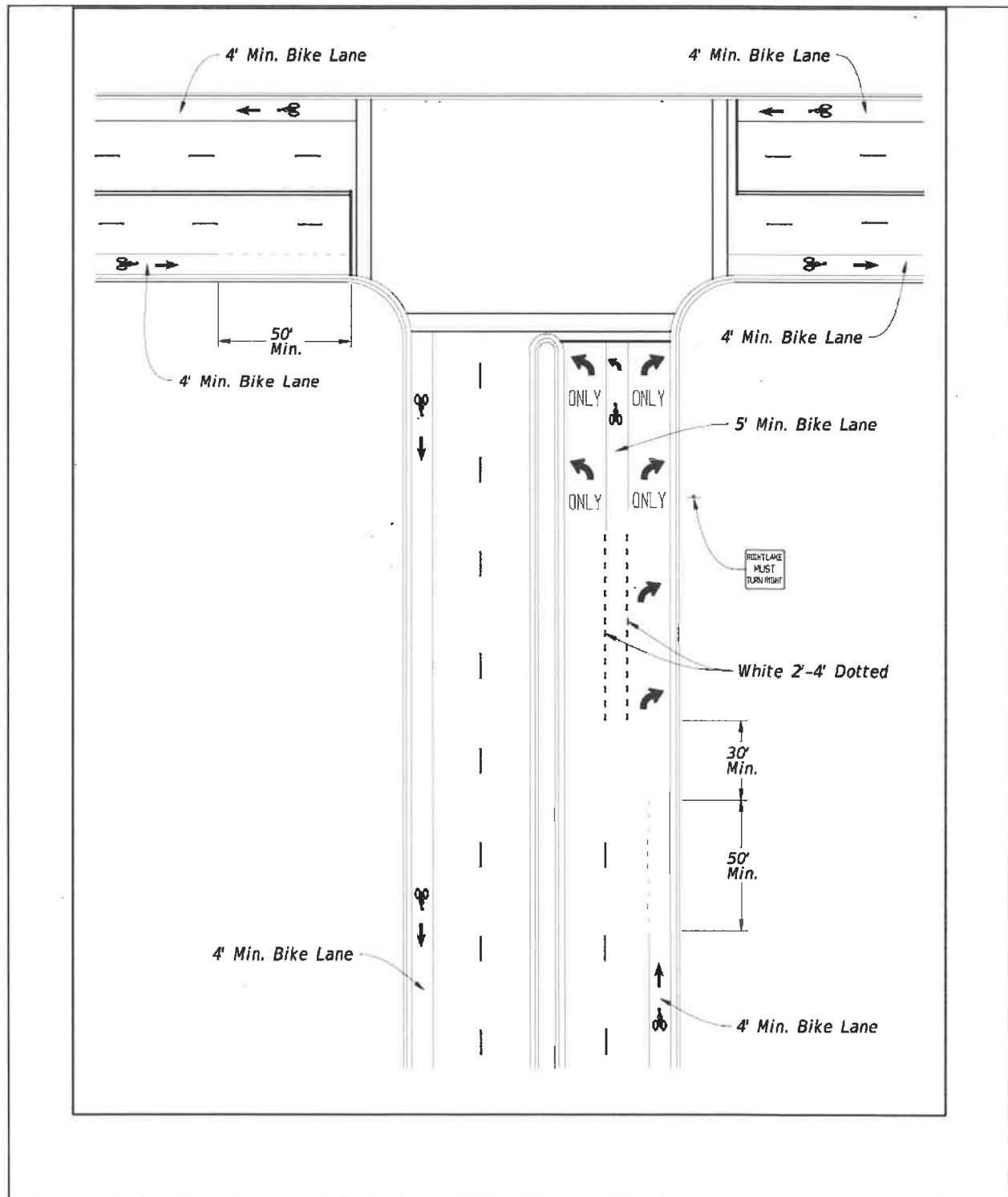


Figure 9 – 12 **Bicycle Lanes with No Right Turn Lane
(Flush Shoulder)**

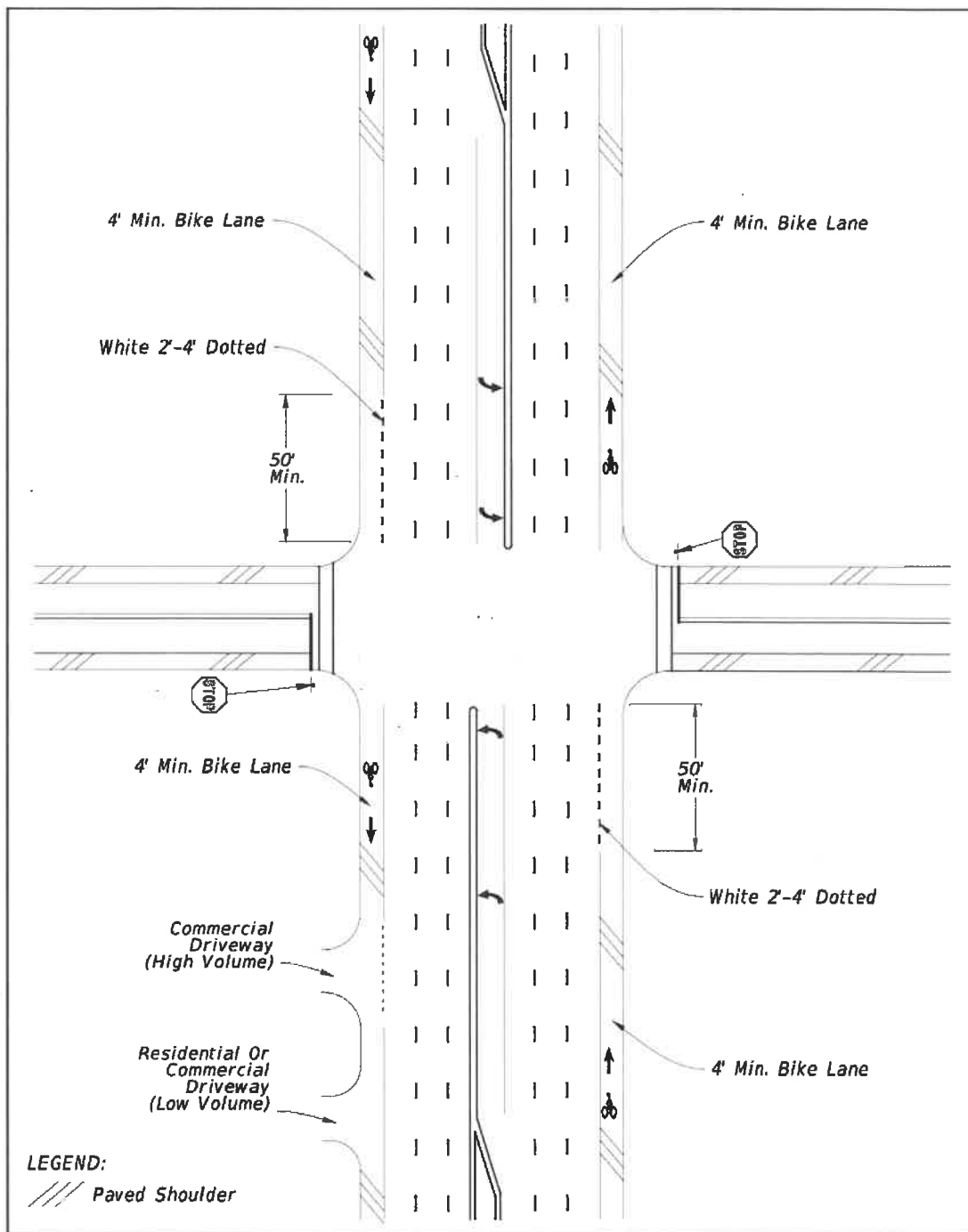


Figure 9 – 13 **Bicycle Lane with Separate Right Turn Lane
(Flush Shoulder)**

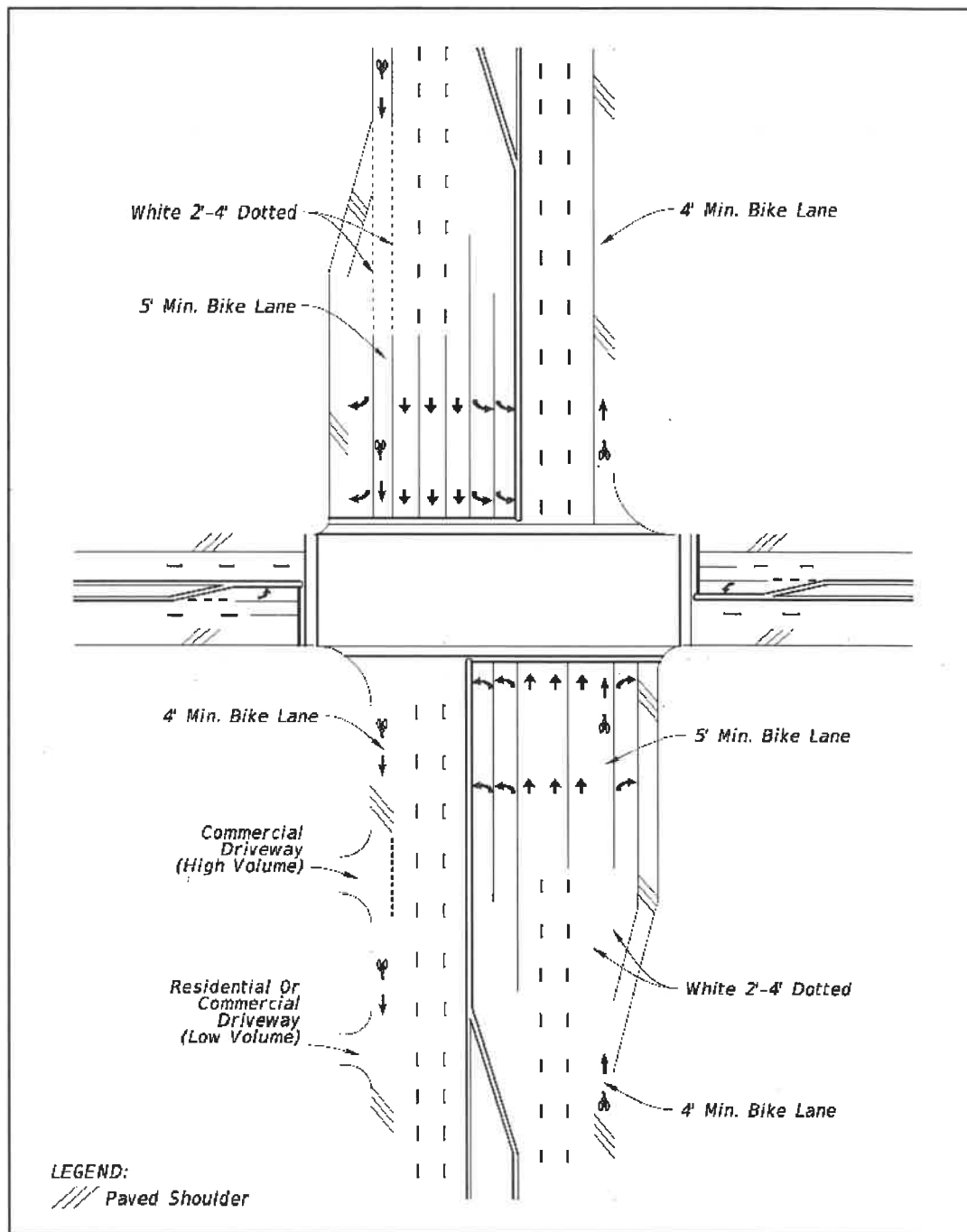


Figure 9 – 14

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

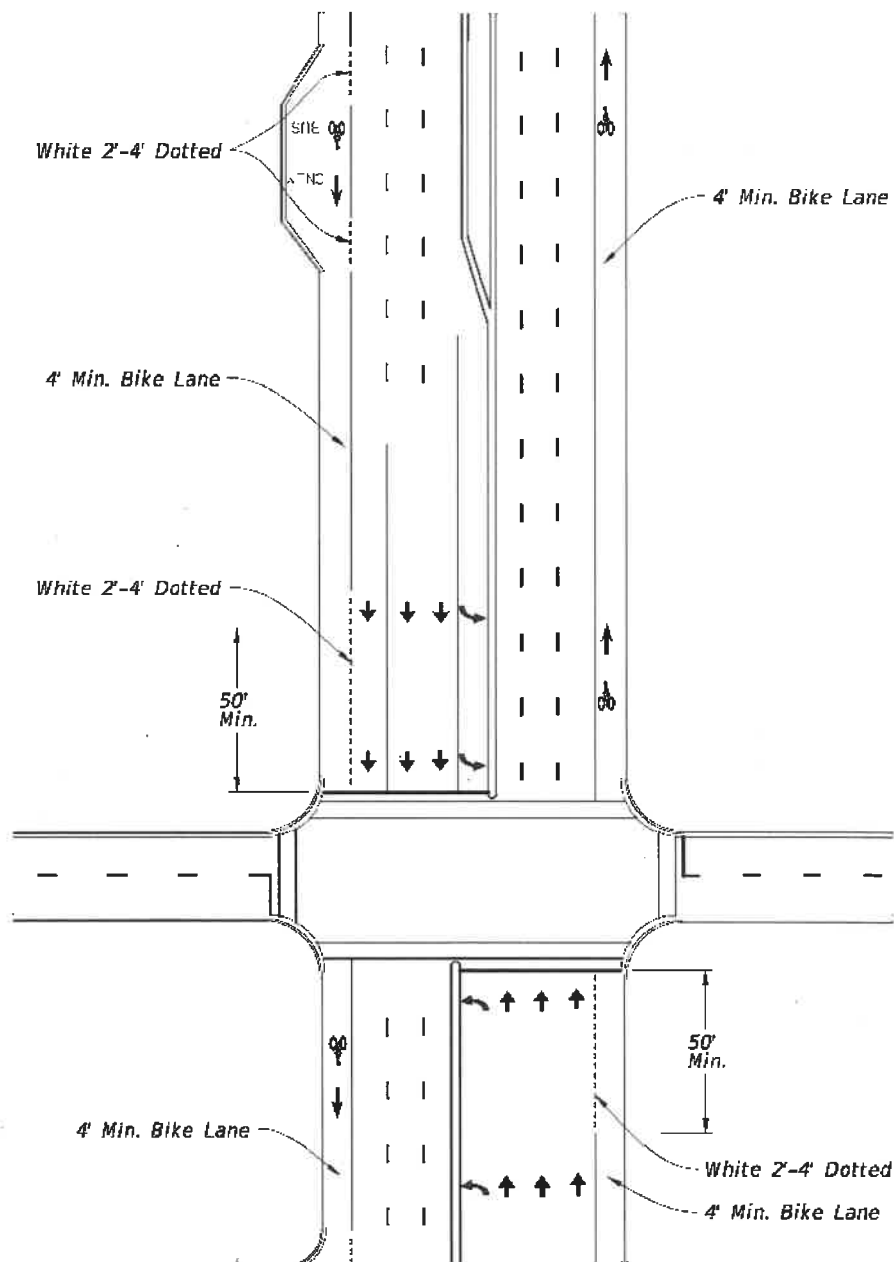
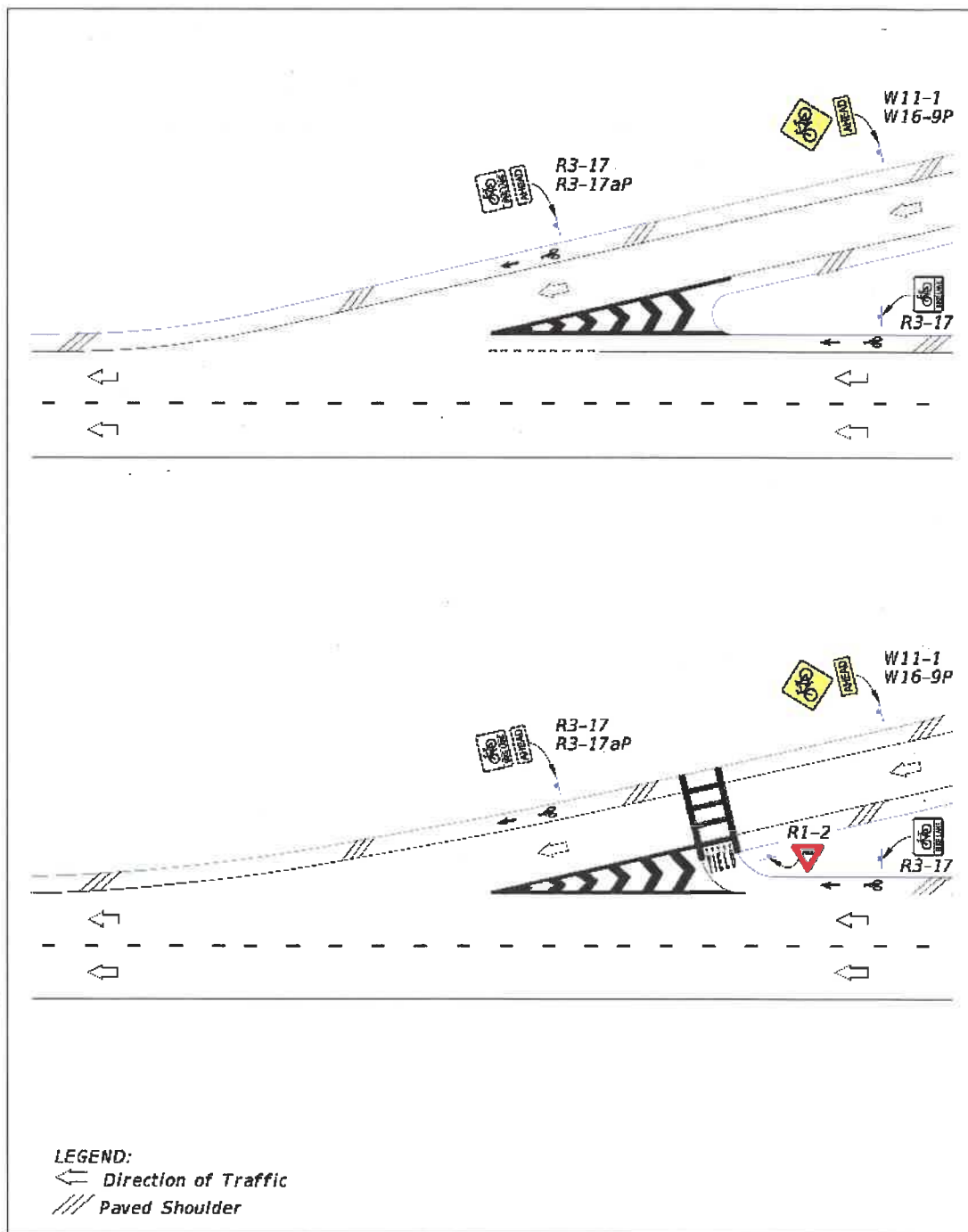


Figure 9 – 15 **Bicycle Lanes on Interchange Ramps**
(Flush Shoulder)



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**

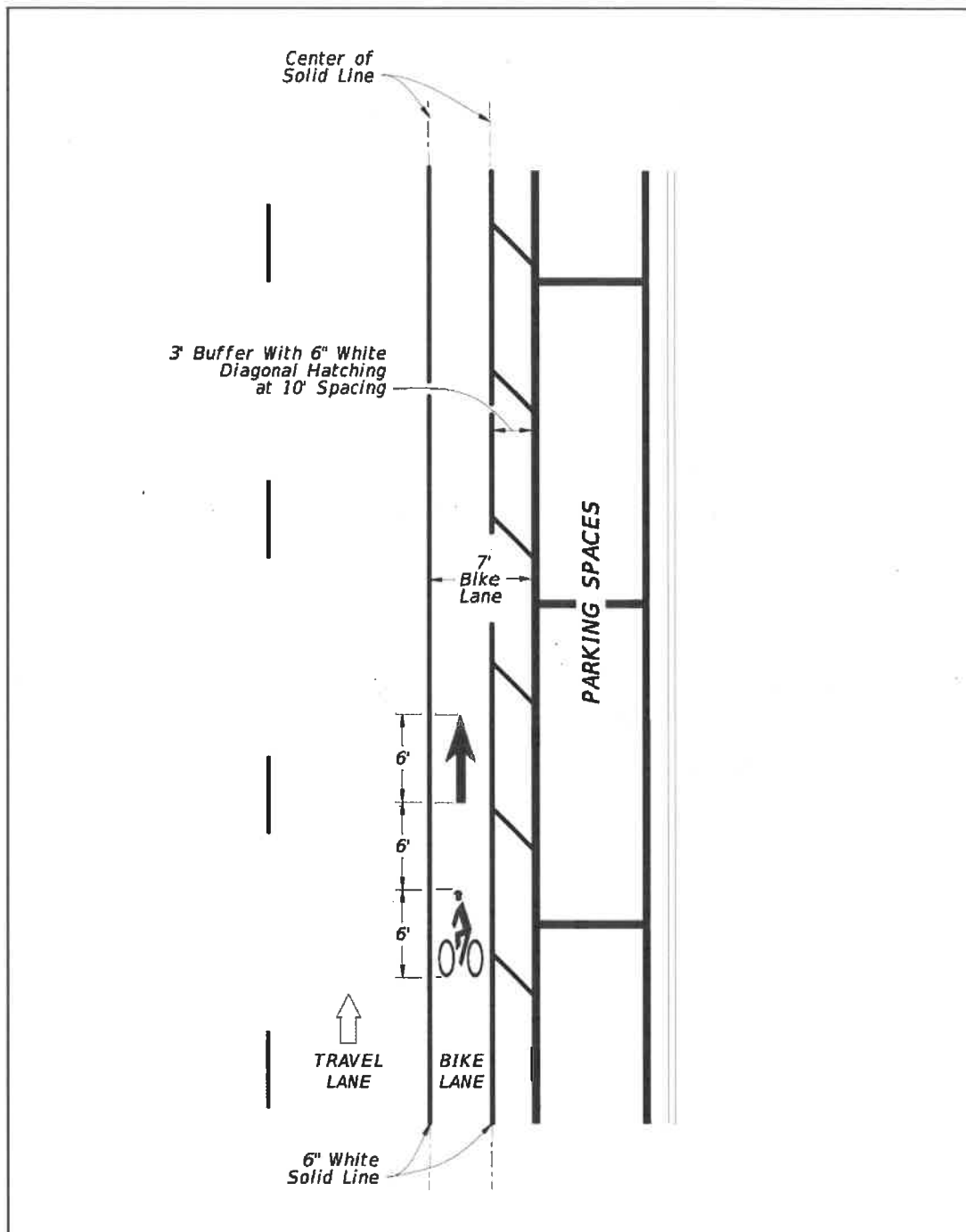


NACTO Urban Bikeway Design Guide, National Association of City Transportation Officials

The diagram illustrates the layout of a standard buffered bike lane. Key features include:

- Center of Buffered Bicycle Lane Markings:** Indicated by a dashed line at the top.
- 2'-4' Dotted Line:** A dotted line marking the edge of the buffered zone.
- EOP (End of Project):** A curved line indicating the end of the project section.
- Radius Curb Return or Stop Line:** A curved line marking the return or stop point at the curb.
- 150'**: A dimension indicating the length of the buffered zone.
- Lane Width:** A dimension indicating the width of the bike lane.
- 6'**: A dimension indicating the width of the buffered zone.
- Curb and Gutter:** A vertical line separating the bike lane from the sidewalk.
- SIDEWALK:** The area adjacent to the curb and gutter.
- TRAVEL LANE:** The area adjacent to the bike lane.
- BIKE LANE:** The area designated for bicycle travel.
- 6" White Solid Line:** A solid line marking the edge of the bike lane.
- STANDARD BUFFERED BIKE LANE STRIPING:** A circular inset showing the specific striping pattern: two 6" wide white solid lines with an 8" gap between them.

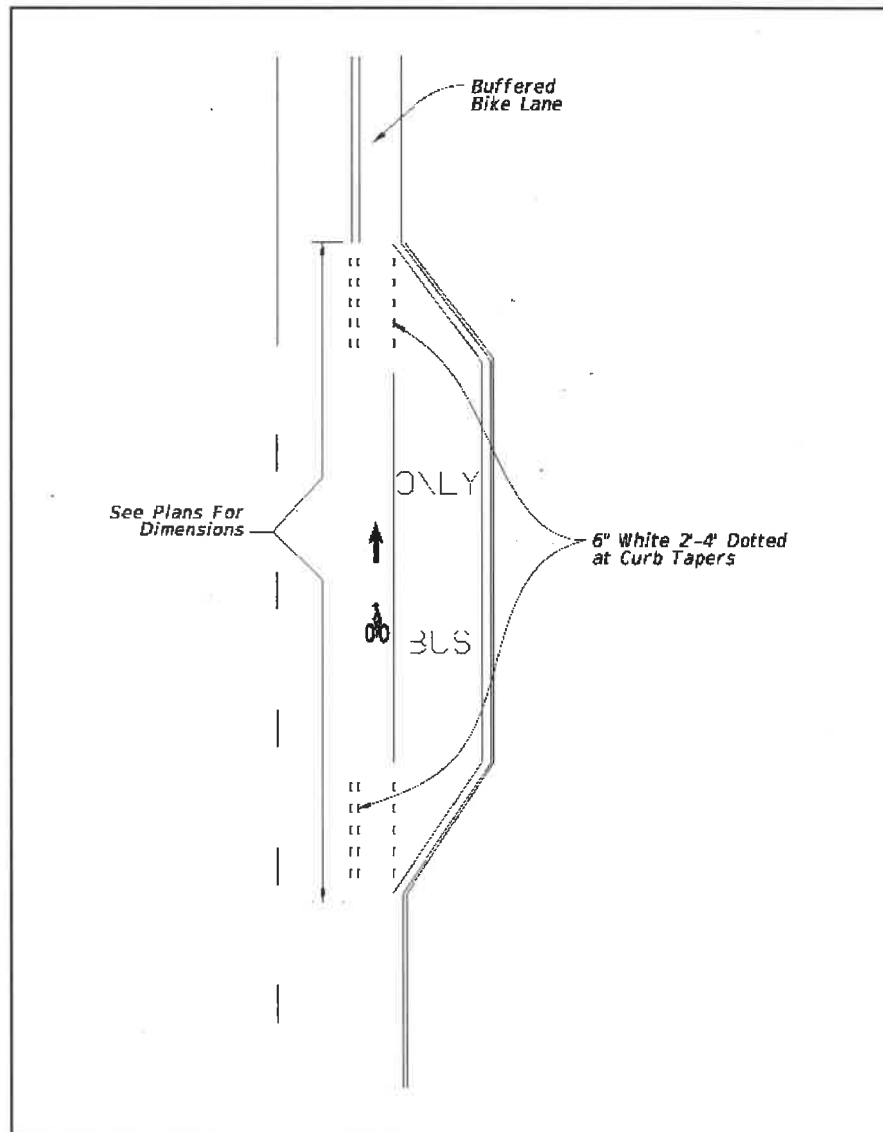
Figure 9 – 18 Buffered Bicycle Lane Markings with On-Street Parking



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 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 may be 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 by definition 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 [FDOT's Approved Product List for Specification 523, Patterned Pavement.](#)

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

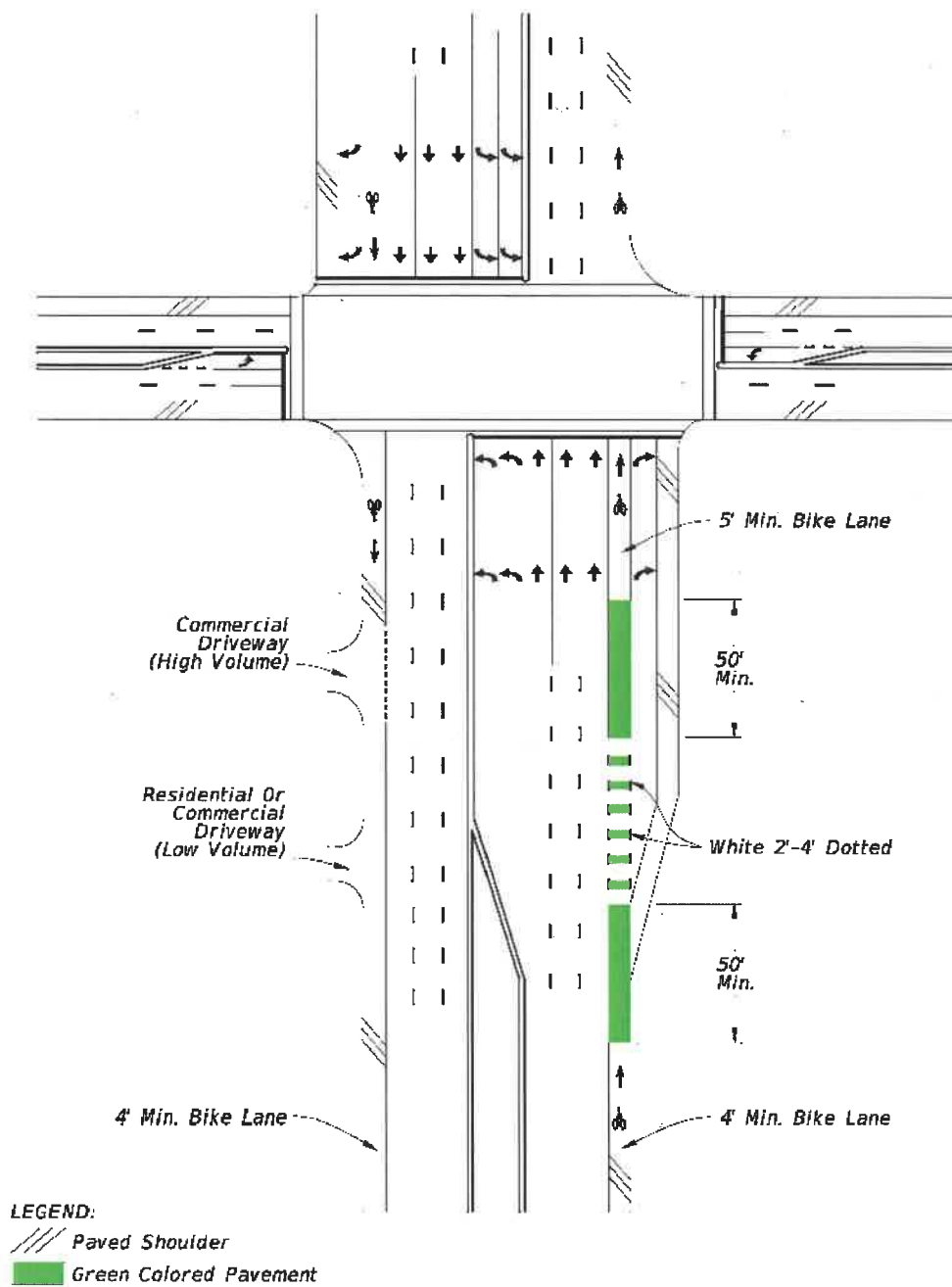


Figure 9 – 21 Green Bicycle Lane with Right Turn Drop Lane

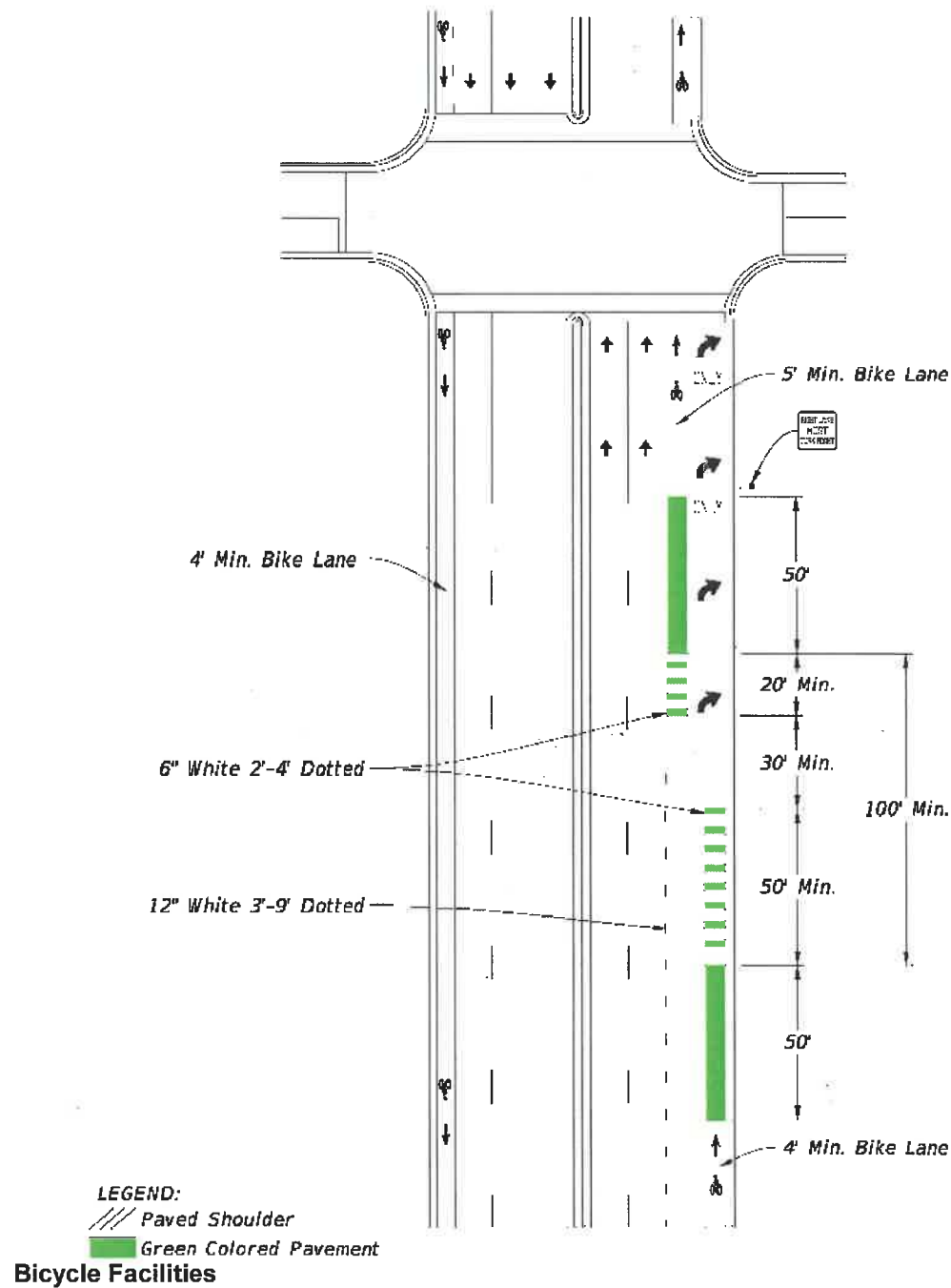


Figure 9 – 22 Green Bicycle Lane with Channelized Right Turn Lane

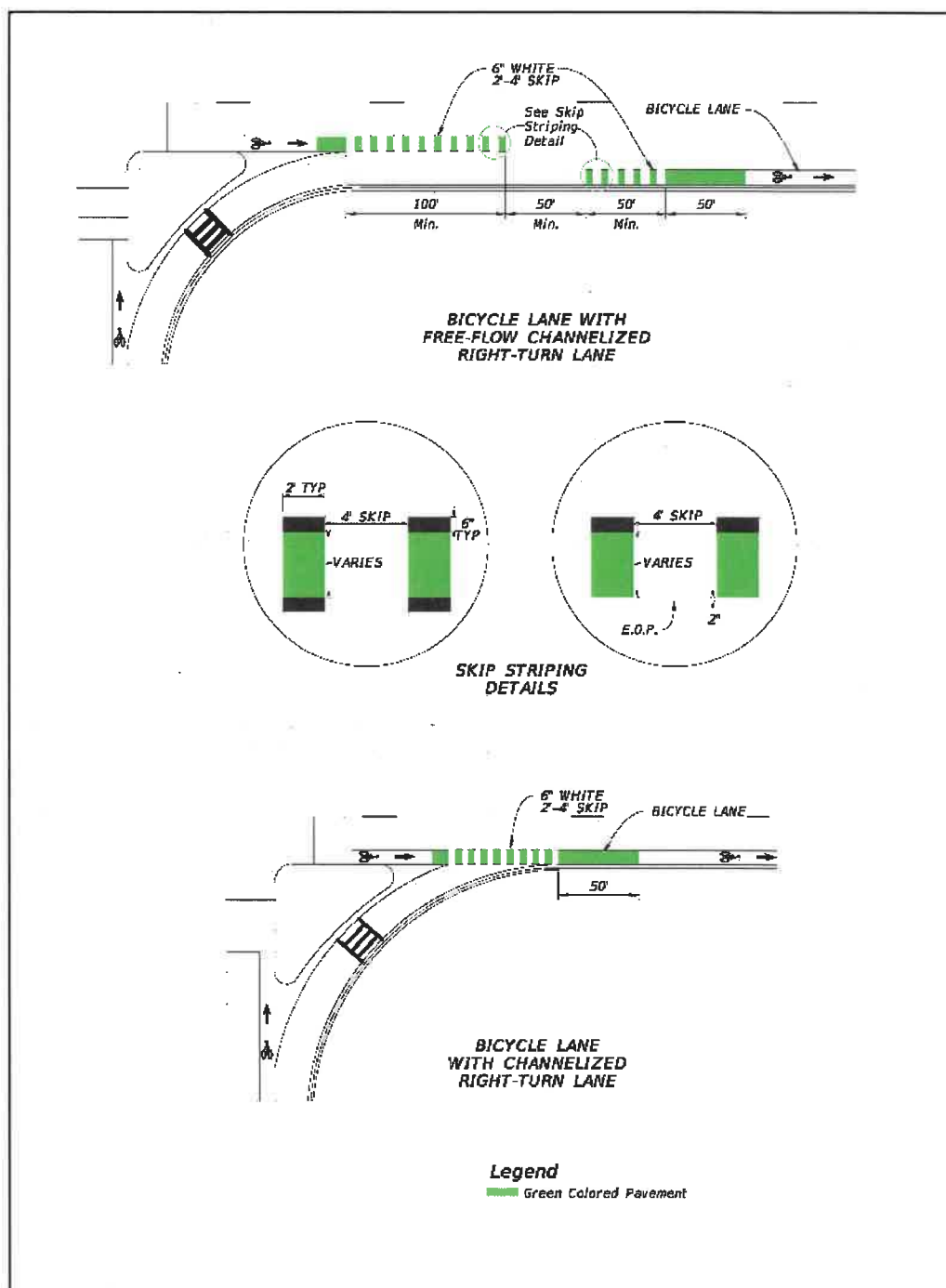
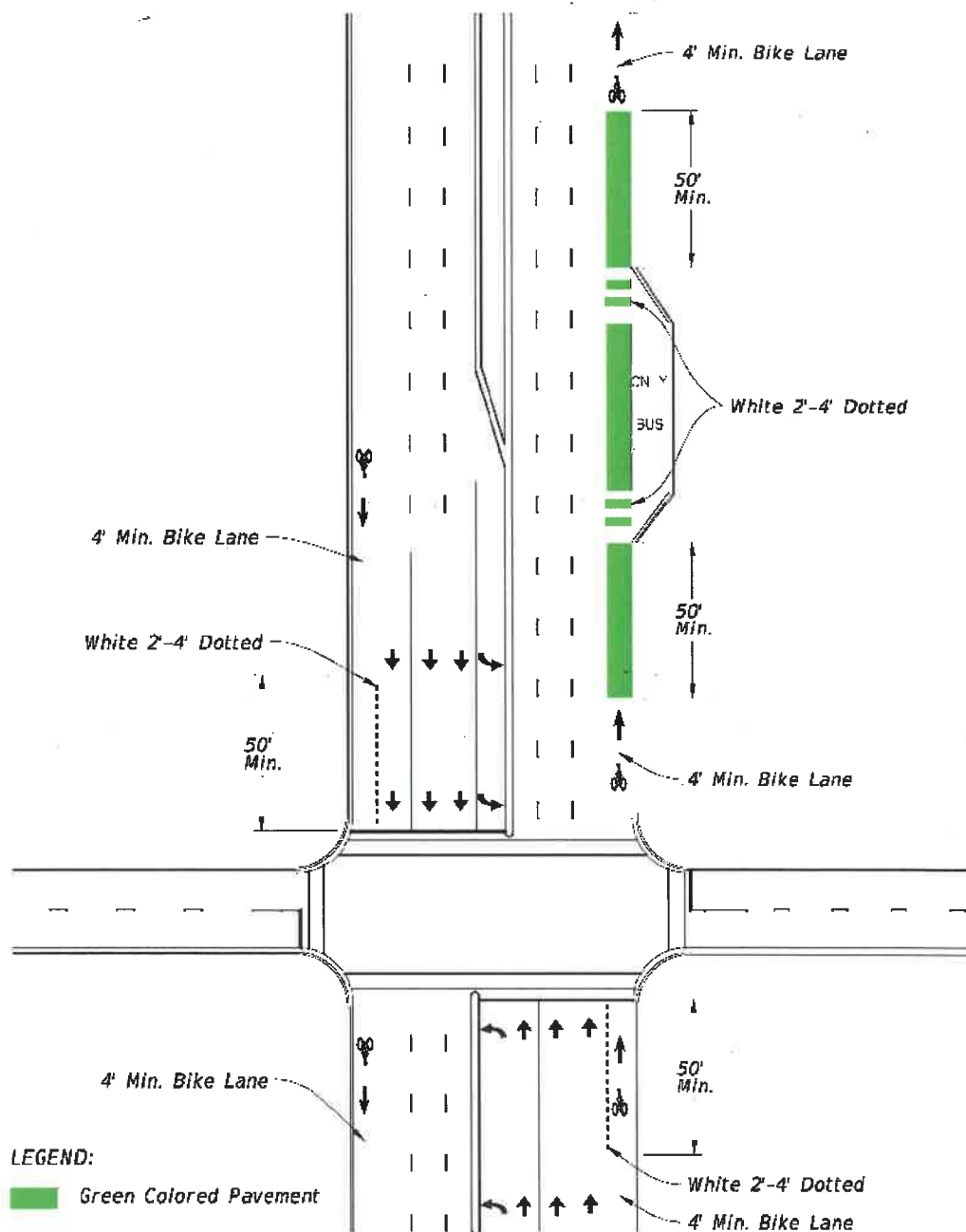


Figure 9 – 23 Green Bicycle Lane with Bus Bay



B.5 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.6 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.

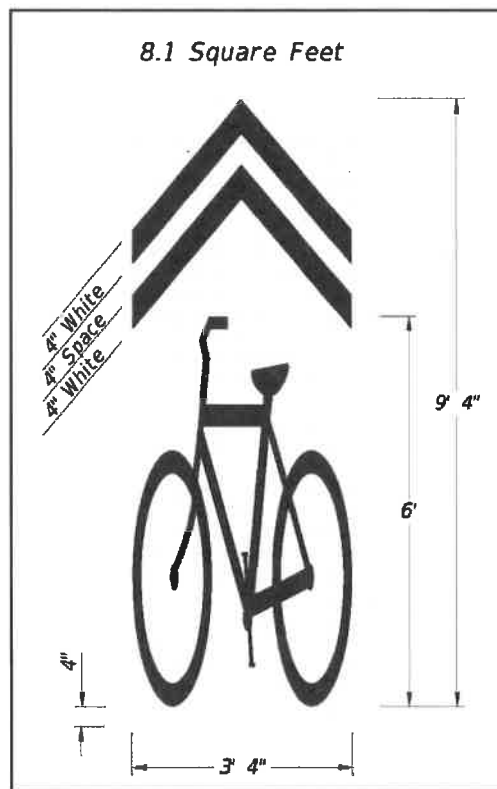
B.7 Shared Lane Markings

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)

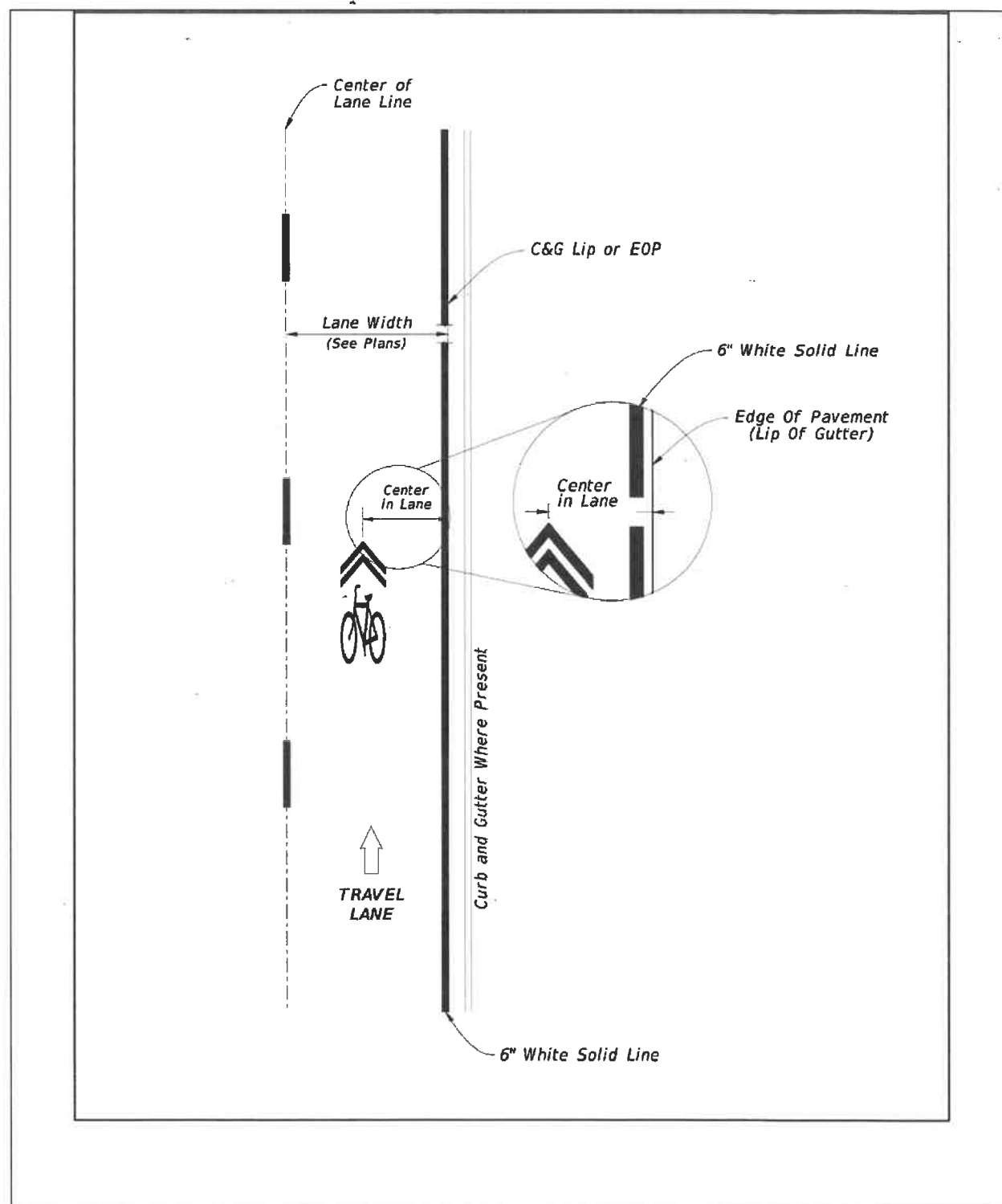
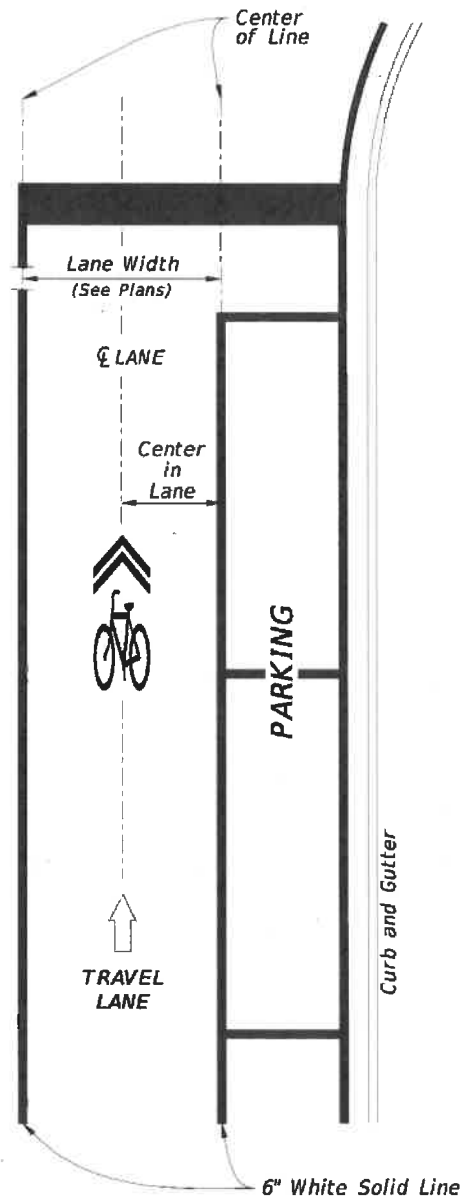


Figure 9 – 26 Shared Lane Marking Placement (With On-Street Parking)



B.8 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. The **2006 Americans with Disabilities Act – Standards for Transportation Facilities** and the **2012 Florida Accessibility Code** impose additional requirements for the design and construction of shared use paths since they serve as pedestrian facilities.

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 area with a maximum 1:6 slope should 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, 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 a recovery area is less than 5 feet, 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 the face of curb or edge of traveled way (where there is no curb) should be 5 feet. On roadways with flush shoulders, this separation is measured from the outside edge of the shoulder 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.

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 are included in the path design, they should 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 Structures

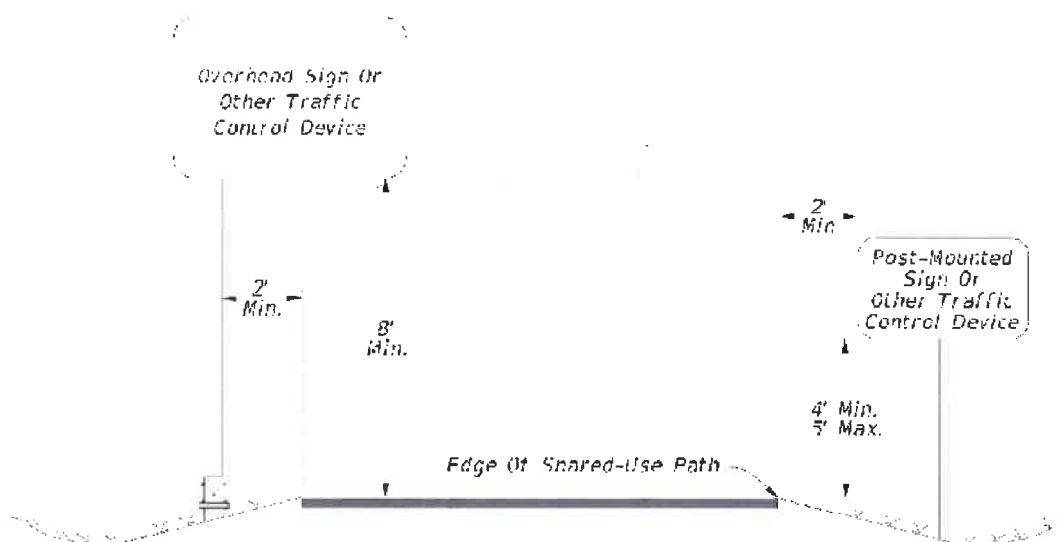
The minimum clear width on structures should be the same as the approach shared use path, plus the minimum 2 foot wide clear areas. Access by emergency, patrol and maintenance vehicles should be considered in establishing the design clearances of structures on shared use paths. Where practical, a path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

Ramps on new structures that are part of a shared use path and serve as the accessible route shall have a running slope not steeper than 1:12 and cross slope not steeper than 1:48. Landings are required at the top and the bottom of each ramp run.

C.7 Pavement Markings and Signage

The MUTCD regulates the design and use of all traffic control devices on shared use paths. Figure 9 – 27 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 – 27 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

- 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>
- AASHTO – Guide for the Development of Bicycle Facilities, 2012, 4th Edition
<https://bookstore.transportation.org/>
- NACTO Urban Streets Design Guide
<http://nacto.org/usdg>
- FHWA Policy Memo for Flexibility in Pedestrian and Bicycle Facility Design
http://www.fhwa.dot.gov/environment/bicycle_pedestrian/guidance/design_guidance/design_flexibility.cfm
- Storm Drain Handbook, Florida Department of Transportation, October 2014
<http://www.dot.state.fl.us/rddesign/Drainage/files/StormDrainHB.pdf>
- Manual on Uniform Traffic Control Devices, May 2012
http://mutcd.fhwa.dot.gov/pdfs/2009r1r2/pdf_index.htm

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CHAPTER 10

MAINTENANCE AND RESURFACING

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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 Department. 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.