City of Memphis
Bicycle Design Guide (Draft)

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1. Introduction

The purpose of the *City of Memphis Bicycle Design Guide* is to provide engineers, planners, and designers with a primary source for providing suitable bicycle accommodations within the City of Memphis. This guide also provides citizens, developers, and others involved in the transportation planning process, guidance on the critical design and planning elements which will promote bicycle safety, efficiency, and mobility.

This guide provides the information necessary to develop safe and effective bicycling facilities. The *City of Memphis Bicycle Design Guide* should be used in conjunction with the current versions of the *Guide for the Development of Bicycle Facilities* published by the American Association of State Highway and Transportation Officials (AASHTO) and the *Manual on Uniform Traffic Control Devices* (MUTCD) published by the Federal Highway Administration (FHWA). Design treatments within the guide draw upon creative solutions in use in other locations in Tennessee and throughout the United States. This document does not attempt to replace material covered within the AASHTO *Guide* or *MUTCD*, but rather, to provide additional guidance and to clarify local treatments of bicycle facility design.

The design guide includes guidance for selecting appropriate bicycle design treatments based on a set of national indices which take into consideration five general categories of concern when determining bicycle accommodations. The guide then includes specific provisions for both on-street bicycle facilities and off-street bicycle facilities. Guidance and specifications are provided along with applications and additional resources for each bicycle treatment. Appendix A, Bicycle Facility Drawings, contains the drawing details for the bicycle facility treatments.

Bicyclist Utilizing an On-Road Bicycle Facility

Bicyclist and Pedestrian Utilizing an Off-Road Bicycle Facility

2. Choosing the Appropriate Facility Type

The selection of a bikeway suited for a travel corridor depends on many factors, including bicyclists' abilities, corridor conditions, current and future land use, topography, roadway characteristics, and the cost to build and maintain the bikeway. There are many ways bicyclists can safely and conveniently be accommodated on roadways and other right-of-way. This section provides guidelines to help select and design safe on-road and off-road bikeways. A framework is provided in this section for considering factors that affect bikeway selection and design, and includes a Bikeway Design Selection Table as a guide for engineers and planners in selecting an appropriate type of on-road bikeway accommodation.

To determine the appropriate roadway design treatment to accommodate bicyclists, several factors associated with the specific route or project must be assessed. In general, standards for selecting appropriate bicycle facility accommodations are formed around five basic categories of concern:

- Skill level of the bicycle user - What types of bicyclists will the route most likely serve?
- Traffic operational factors - What are the current and anticipated traffic operations and design characteristics of the route that will affect the choice of a bicycle design treatment?
- Land use and location factors - In the context of the route, how will the proposed bicycle design treatment best serve existing and future land uses and how will the bicycle design treatment connect with the existing and/or proposed bicycle network?
- Physical constraint factors - Are there right-of-way and/or other physical limitations within the corridor?
- The type of roadway involved - What type of roadway project is involved (new construction, reconstruction, or retrofit)?

A description of each category is presented in the following text.

Skill Level of the Bicycle User

Industry standards define three basic types of bicycle users. A, B, and C riders are defined as follows:

- Advanced or experienced riders are generally using their bicycles as they would a motor vehicle. They are riding for convenience and speed and want direct access to destinations with a minimum of detour or delay. They are typically comfortable riding with motor vehicle traffic; however, they

"A Level" Bicyclists

need sufficient operating space on the traveled way or shoulder to eliminate the need for either themselves or a passing motor vehicle to shift position.

"C Level" Riders

- Basic or less confident adult riders may also be using their bicycles for transportation purposes, e.g., to get to the store or to visit friends, but prefer to avoid roads with fast and busy motor vehicle traffic unless there is ample roadway width to allow easy overtaking by faster motor vehicles. Thus, basic riders are comfortable riding on neighborhood streets and shared-use paths and prefer designated facilities such as bike lanes or wide shoulder lanes on busier streets.

- Children, riding on their own or with their parents, may not have knowledge of traffic laws and may not travel as fast as their adult counterparts but still require access to key destinations in their community, such as schools, convenience stores, and recreational facilities. Residential streets with low motor vehicle speeds, linked with shared-use paths, and busier streets with well-defined pavement markings between bicycles and motor vehicles, can accommodate children without encouraging them to ride in the travel lane of major arterials.

These definitions suggest that bicyclists with different skill levels will prefer certain facility types. Advanced bicyclists, because of their advanced skills, desire for speed, convenience, and direct access, prefer direct routes even though these routes may also carry significant vehicle traffic, without any dedicated space for bicyclists. Children, however, prefer shared residential roads with little traffic or separated paths.

Traffic Operational Factors

A general consensus has emerged among transportation planners and engineers working with bicycle facilities regarding the traffic operations and design factors having the greatest effects on bicycle use. The six factors most often cited include:

Bicycle Facility in High Traffic Volume

- Traffic Volume - Higher motor vehicle traffic volumes represent greater potential risk for bicyclists and the more frequent overtaking situations are less comfortable for group B/C bicyclists unless special design treatments are provided.

- Average Motor Vehicle Operating Speed - The average operating speed is more important than the posted speed limit, and better reflects local conditions. Again, motor vehicle speed can have a negative impact on risk and comfort unless mitigated by special design treatments.

- Traffic Mix - The regular presence of trucks, buses, and/or recreational vehicles (i.e., approximately 30 per hour or more) can increase risk and have a negative impact on comfort for bicyclists. At high speeds, the wind blast from such vehicles can create a serious risk of falls. Many bicyclists will choose a different route or not ride at all where there is a regular presence of such traffic unless they are able to remove themselves several feet from these motor vehicles.

- On-Street Parking - The presence of on-street parking increases the width needed in the adjacent travel lane or bike lane to accommodate bicycles because of the risk of dooring. Dooring occurs when a vehicle parked in on-street parking space opens their door into a bicyclist. This is primarily a concern associated with streets and highways built with an urban section.

- Sight Distance - A cyclist's ability to see hazards in time to react to them and a motorist's ability to see and react to a bicyclist is referred to as sight distance. "Inadequate sight distance" for bicyclists often relates to situations where bicycles are being overtaken by motor vehicles and where the sight distance is likely less than that needed for a motor vehicle operator to either change lane positions or slow to the bicyclist's speed. This problem is primarily associated with rural highways and roads, although some urban streets have sight distance problems due to poor design and/or sight obstructions.

- Number of Intersections - Intersections pose special challenges to bicycle and motor vehicle operators, especially when bike lanes or separate bike paths are introduced. Turning movements of both bicyclist and motorist create many potential conflicts. The AASHTO *Guide* and various State design manuals include general guidelines for intersection treatments. When possible, the number and/or frequency of intersections should be considered when assessing the use of bike lanes.

Key Land Uses will Generate Bicycle Trips

Land Use and Location Factors

Land use and location factors represent the most significant category affecting suitability. Since bicycle trips are generally shorter than trips made by other modes, there must be a manageable distance between origins and destinations such as between residential areas and places of employment. There are certain key land uses which are especially likely to generate bicycle traffic if good bicycle facilities are available. These consist of, but are not limited to transit centers, schools, employment centers with nearby residential areas, recreation areas and mixed use areas.

Roadway Geometrics can Limit the Application of Bicycle Facilities

Physical Constraint Factors

Physical constraint factors consist of highway geometric or physical obstacles to bicycling which are difficult or costly to remedy. For example, a roadway may be suitable because of location factors but not suitable because of the existence of physical constraints to bicycling such as a narrow bridge, insufficient right-of-way, or intersections with restricted lane widths. The feasibility of reconstructing and improving these physical constraints must be weighed in deciding the designation of bikeways.

The Type of Roadway Involved

Another important consideration is whether the bicycle accommodation is being considered for new construction, reconstruction, or is a retrofit to an existing facility. Different opportunities are afforded to transportation planners and engineers depending on the type of project. For example, accommodating bicyclists with shared roadway signs and shared roadway markings could be done through a typical resurfacing project whereas constructing a new shared-use path on a new alignment is likely achieved as a major capital improvement. The importance is that there are varying opportunities for providing bicycle facility accommodations whether it is routine maintenance and/or during the construction of a new roadway or development.

Shared Roadway Signs Installed on Existing Roadway

Facility Selection Guidance

Table 1 provides roadway design treatment guidance for bicycle accommodations. Design treatment recommendations are based on national research and practices employed by other states and municipalities.

Table 1. Bikeway Design Selection Guide

Average Motor Vehicle Operating Speed	Average Annual Daily Traffic (AADT) Volume per Lane		
	600* - 1,000	1,000 - 5,000	over 5,000 or 5% Truck
≤ 30 MPH	Wide Curb Lane	Wide Curb Lane	Wide Curb Lane
31 - 40 MPH	Wide Curb Lane	Wide Curb Lane or Bike Lane	Bike Lane or Paved Shoulder
41 - 50 MPH	Bike Lane or Paved Shoulder	Bike Lane or Paved Shoulder	Bike Lane or Paved Shoulder
over 50 MPH	Bike Lane or Paved Shoulder	Bike Lane or Paved Shoulder	Paved Shoulder

Notes:

- *For volumes less than 600 AADT per lane a Shared Roadway is acceptable
- To determine the AADT per lane, divide the AADT traffic volumes by the total number of through lanes on the roadway
- Wide Curb Lane minimum width is at least 14 feet of the outer lane measured from the lane stripe to the edge of the gutter pan or drainage area
- Bike Lane minimum width is at least 4 feet from the edge of the gutter pan or drainage area
- Paved Shoulder minimum width is at least 6 feet from the edge of the gutter pan or drainage area or 8 feet if no curb & gutter

The recommended design treatments in the table above are most easily implemented when new construction or reconstruction is planned. When implementation involves retrofitting an existing roadway to accommodate bicycle use, the project can be more complex. The table is intended as a guide. Bikeway types should be modified by consideration of appropriate additional geometric, operational, and locational factors as determined by the City Engineer. In cases where on-street accommodations are not feasible and/or appropriate, off-street bicycle facility treatments may be considered.

3. BIKE LANES

A bike lane is a portion of the roadway that has been designated by striping, signing, and pavement markings for the exclusive use of bicyclists. Bike lanes should always be located on both sides of the road (except one-way streets), and carry bicyclists in the same direction as adjacent motor vehicle traffic.

Typical Bike Lane with On-Street Parking

Bike lanes are typically considered for high-volume, urban roadways, including collector roadways. According to the AASHTO *Guide*, bike lanes benefit both bicyclists and motorists by segregating users, thereby increasing overall capacity, and making the movements of the motorists and bicyclists more predictable.

Guideline

Bike lanes should be constructed as one way facilities and should carry the bike traffic in the same direction as adjacent vehicular traffic. In the case of a one-way street the bike lane should be constructed to the right of the travel lane unless there are a high number of right turning vehicles, in which case consideration may be given to the bike lane to be constructed to the left of traffic.

Specifications

The minimum recommended bike lane width for the City of Memphis shall be four feet wide in accordance with the AASHTO Guide. For roadways with curb and gutter, the bike lane stripe separating the bicycle and vehicular traffic should be six feet from the face of curb. This allows for the typical two foot gutter pan and four foot bike lane. For roadways without curb and gutter, the four foot width is measured from the edge of pavement to the bike lane stripe separating the bicycle and vehicular traffic. The bike lane should be striped with a six inch wide solid white line as shown in Drawing A1 of the Appendix.

Typical Bike Lane without On-Street Parking

Applications

Numerous urban areas including the peer cities of Chicago, Nashville, Baltimore, and Charlotte

Additional Resources

MUTCD, AASHTO *Guide*, *Chicago Bike Lane Manual 2002*

3.1 Bike Lanes with Parking Lanes

Where bike lanes are provided adjacent to on-street parking, special provisions should be made to ensure the safety of the bicyclist.

Guideline
For roads with on-street parking, the bike lane should be placed between the parking area and the travel lane. The bike lane shall be a minimum of six feet wide. The combined width of the bike lane and parking lane shall not be less than 13 feet.

Specifications
For streets where parking is allowed the bike lane should be a minimum of six feet wide to accomodate the opening of car doors. The parking area should be separated from the bike lane by a 4 inch solid white line. The travel lane should be separated from the bike lane by a 6 inch solid white line as shown in Drawing A2 of the Appendix.

Example of Bike Lanes with On-Street Parking

Applications
Numerous urban areas including the peer cities of Chicago, Nashville, and Denver

Additional Resources
AASHTO *Guide*, *Chicago Bike Lane Manual 2002*

3.2 Bike Lanes at Intersections

Special provisions are required to ensure the safety of bicyclists maneuvering through intersections. These provisions address issues that will allow motor vehicles to make a right turn as close to the right curb as possible and allow the bicyclists to go straight through the intersection to the left of the right turning vehicles. Special provisions should be made for bicyclists turning left so that the movement of the bicyclist is obvious to the vehicular traffic. In some instances it is appropriate for bicyclists to merge with motor vehicle traffic.

Example of Bike Lane Striping at a Crosswalk

Guideline

Bike lanes should not be striped through the intersection. Striping for bike lanes should stop at the crosswalk or stop line. The designer shall consider potential conflicts of turning bicyclists and motorists in their design.

Specifications

The striping of the bike lane will stop at the stop line or crosswalk on the approach to the intersection, as shown in Drawing A3 of the Appendix. Typically, bike lanes will be dashed from 100 feet in advance of the intersection to make cyclists aware of potential conflicts with motor vehicles and to allow motorists to travel across the bike lane to turn or merge.

Bike Lane Striping at an Intersection

Applications

Numerous urban areas including the peer cities of Nashville, Chicago, Baltimore, and Denver

Additional Resources

AASHTO *Guide*, *Chicago Bike Lane Manual 2002*

3.2.a Bike Lanes at Intersections with Right Turn Lanes

At intersections where right turn lanes are provided and sufficient pavement width exists, special pavement striping should be used. This should show motorists and bicyclists the maneuvers allowed by both.

Guideline
At an intersection that provides a single or dual right turn lanes, the intersection should be striped to allow weaving (crossing) between the bicyclist and motorist on the approach to the intersection as shown in Drawing A4 of the Appendix.

Specifications
A dashed line should be striped allowing vehicles to cross the bike lane and enter the right turn lane. The bike lane should be striped to the left of the right turn lane separating the through traffic and the turn lane.

In the case where an on-street parking lane becomes a right turn lane, the bike lane should be striped to the left of the right turn lane.

If adequate width is not available to continue the bike lane, the bike lane should stop at the beginning of the transition allowing bike traffic to merge with motorists, as shown in Drawing A5 of the Appendix.

Example of an Intersection with a Bike Lane and a Right Turn Lane

Applications
Numerous urban areas including the peer cities of Chicago, Nashville, Baltimore, and Charlotte

Additional Resources
MUTCD, AASHTO *Guide, Chicago Bike Lane Manual 2002*

Example of a Merging Section between Vehicles and Bicycles at Right Turn Lane

3.2.b Bike Lanes at Interchanges

Where bike lanes intersect an interchange exit or entrance ramp, special provisions should be made to require the bicyclist to merge, weave, or cross the ramp where the vehicles travel. The speed difference between the vehicles on the ramp and the bicyclist make the crossing design a challenge.

Bike Lane Before Interstate Ramp with Traffic Signal

Guideline

If a bike lane is constructed on a roadway that intersects an entrance or exit ramp for the interstate or access controlled facility, the intersection should be designed to emphasize the visibility of the bicyclist and motorists and limit the amount of conflict between the two users. Entrance ramp specifications are included in Section 3.2 Bike Lanes at Intersections with Right Turn Lanes.

Specifications

If a traffic signal does not control the ramp traffic, and a bike lane exists, if feasible the bike lane should be striped so that a crossing is marked that is perpendicular to the flow of the vehicular traffic on the ramp, as shown in Drawing A6 of the Appendix. This gives the bicyclist good visibility of the vehicles on the ramp. In addition, proper signage should be installed so that the motorist is aware of the approaching intersection and the bicyclist stops so that they can see the traffic clearly. If a traffic signal is present the bike lane striping should stop at the intersection as shown in Drawing A7 of the Appendix.

Bike Lane Just Past Interstate Ramp with Traffic Signal

Applications

Portland, Nashville, Oregon

Additional Resources

AASHTO *Guide*

3.3 Bike Lane Transition to a Signed Shared Route

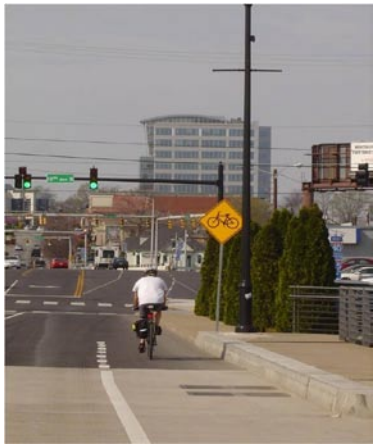
At the location where the bike lane ends it is important to clearly mark where the bicyclist should continue traveling. Signs should be installed that will inform the bicyclist and the motorist of the path the cyclist will continue to travel.

Guideline
At the point of termination of a bike lane, it should be designed assuming that the bicyclist will continue traveling to a destination. The use of signs should be considered to inform the bicyclist and motorist that the road will become a shared use roadway.

Specifications
Appropriate signing is necessary to warn and direct both bicyclists and motorists regarding the transition area. Drawing A8 in the Appendix shows the proper signage to be installed at the transition location.

Applications
Numerous urban areas including the peer city of Nashville

Additional Resources
AASHTO *Guide, Chicago Bike Lane Manual 2002, MUTCD*



Bike Lane Transitions to a Shared Roadway

Bike Lane Transitions to a Shared Roadway

Bike Lane Transitions to a Shared Roadway

3.4 Bike Lane Symbols and Signing

To inform motorists of the presence of bicycles on the roadway, signs and pavement markings should be installed along the roadway on designated bike routes.

Guideline
Bike lanes should be marked with standard pavement symbols which include a bicycle symbol and a directional arrow. Bike lane signs shall be installed along with the pavement markings.

Specifications
The specific pavement markings for bike lanes are shown in the *MUTCD* in Chapter 9C. Also, the signs that are typically used for bike lanes are shown in the *MUTCD* in Chapter 9B. Drawing A9 in the Appendix contains some of these pavement markings and signs.

Bike Lane Sign at an Intersection with a Right Turn Lane

Bike Lane Ends Sign and Share the Road Sign

Applications
Numerous urban areas including the peer cities of Chicago, Nashville, Denver, and Baltimore

Additional Resources
AASHTO *Guide, Chicago Bike Lane Manual 2002, MUTCD*

Example of Bike Lane Sign

4. Signed Shared Roadways or Bike Routes

All roads are technically classified as “shared roadways” since bicyclists are legally able to use all roadways with the exception of controlled-access freeways, such as the interstate, and roads signed to prohibit bicycles. Some shared roadways have bicycle route signs posted alongside them. The signs advise vehicular drivers that bicycles are present. Some signs provide directional information to bicyclists by providing route names and/or route numbers.

There are several reasons for designating a roadway as a bike route which include:

- The roadway provides an important link to other bicycle facilities.
- The roadway connects to land uses or activities that attract bicycle trips.
- The roadway is a common route used by bicyclist.

Guideline

Bike routes or signed shared roadways should be marked with signs to designate them as preferred routes for bicyclists. Signs should be installed on the designated shared roadways according to the AASTHO *Guide* and the *MUTCD.*

Specifications

Shared roadways and/or bike routes should be designated by signs. The signs that should be included are in the *MUTCD* in Chapter 9. Drawing A10 in the Appendix includes some of the shared roadway signs that can be installed along bike routes which are contained in the MUTCD.

Applications

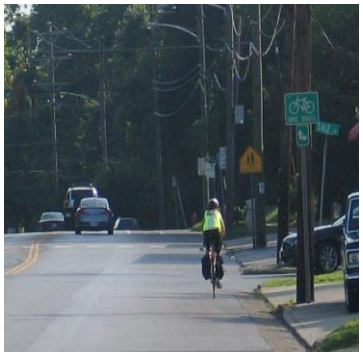
Numerous urban areas including the peer cities of Chicago, Nashville, Denver, and Baltimore

Additional Resources

AASHTO *Guide, MUTCD*

Signed Shared Roadway Signs

Example of Signed Shared Roadway Sign



Bicyclist on Signed Shared Roadway

5. Wide Outside Lanes

A wide outside lane is the right most through lane, or the outside lane, that is substantially wider than 12 feet. There are many advantages to wide outside lanes. These advantages include accommodating shared bicycle and vehicular traffic without reducing the roadway capacity for vehicles and increasing the capacity of bicyclists on the roadway.

Wide Outside Lane15 feet

Guideline

Wide outside lanes should be considered where pavement exists to accommodate both vehicular and bicycle traffic. This includes retrofitting roadways to create a wide outside lane. This can be accomplished by reducing the number of lanes and adding a center turn lane, reducing the width of inside travel lanes, reducing the center turn lane width, widening the roadway to pave a shoulder, or by removing parking.

Specifications

Wide outside lanes should be a minimum of 14 feet wide. Based on the amount of traffic, and amount of bicycle use, the lane may need to be as wide as 16 feet. Roadways with wide outside lanes may be signed as a signed shared roadway or bike route. An intersection with a wide outside lane and a right turn lane should be striped as shown in Drawing A11 in the Appendix.

10 feet Wide Lanes do not provide enough room for bicyclists and motorist to ride side by side

Applications

Wisconsin, Oregon, North Carolina, Charlotte

Additional Resources

Selecting Roadway Design Treatments to Accommodate Bicycles, Oregon DOT Bicycle and Pedestrian Plan, MUTCD

6. Paved Shoulders

A paved shoulder is an area outside the designated motor vehicle lanes separated by an edge stripe. Wide paved shoulders can be utilized by bicyclists if they are well maintained. It gives the cyclist a place to travel without entering into the vehicular path of travel. Occasional blockages may cause bicyclists to merge back into motor vehicle lanes.

Guideline
Paved shoulders for use by bicyclists should be provided where there is adequate width for a paved shoulder, where the speed limits or traffic volumes are high, or where there is a high number of bicyclists.

Specifications
The paved shoulder for use by bicyclists should be 4 feet to 10 feet wide. The width of the shoulder will depend on the traffic volumes and speed limit on the roadway. Table 2 shows the recommended width of the shoulder based on the traffic volumes and vehicular speeds.

Bicyclists on Paved Shoulder

Bicyclists on Paved Shoulder

Applications
Tennessee, Baltimore

Additional Resources
AASHTO *The Policy of Geometric Design of Highways and Streets,* City of Baltimore *Bicycle Design Toolkit*

Table 2. Recommended Width of Paved Shoulder			
Average Motor Vehicle Operating Speed	Average Annual Daily Traffic (AADT) Volume per Lane *		
	600 - 1,000	1,000 - 5,000	over 5,000 or 5% Truck
≤ 30 MPH	4 ft.	4 ft.	8 ft.
31 - 40 MPH	4 ft.	6 ft.	8 ft.
41 - 50 MPH	4 ft.	6 ft.	8 ft.
over 50 MPH	6 ft.	8 ft.	10 ft.

** To determine the AADT per lane, divide the AADT traffic volume by the toal number of through lanes on the roadway.*

7. General Standards for On-Street Bicycle Facilities

There are a variety of other design considerations related to on-street bicycle accommodations. Typically these considerations address specific safety issues and/or are intended to improve the overall provision of bicycle accommodations. Such design considerations include drain grates, rumble strips, railroad crossings, traffic signal accommodations, bike parking, bikes and transit, and traffic calming.

7.1 Drain Grates

Guideline
Drainage grates can be hazardous to bicyclists. It is important for bicycle friendly grates to be installed on all roads that are designated bike routes.

Specifications
The bicycle grates should be installed so that the bars are perpendicular to the direction of travel. The Memphis Green Grate is an example of a bicycle friendly drain grate.

Bike Wheel Caught in Bicycle Unfriendly Grate

Bicycle on Bicycle Friendly Grate

Memphis Green Grate

Applications
Numerous urban areas including the peer cities of Nashville, Baltimore, Chicago, Denver, Milwaukee

Additional Resources
AASHTO *The Policy of Geometric Design of Highways and Streets,* City of Baltimore *Bicycle Design Toolkit*

7.2 Rumble Strips

Rumble strips are grooved rows of pavement that run perpendicular to the lane of travel and alert motorists by making noise and vibrating when the vehicle tires travel over them. Rumble strips decrease the amount of travel width for bicyclists and present an unsafe surface for cyclists.

Guideline
Where rumble strips are present it is necessary to provide additional shoulder width so the bicyclist has room to travel on the shoulder without crossing into the rumble strip path.

Specifications
The use of rumble strips is typically limited to access controlled facilities. When the use of rumble strips have been determined for non-access controlled facilities there should be a minimum 4 feet provided for a bicyclist outside the rumble strip. The rumble strip should be installed to provide a 12 foot gap (gap pattern) for every 60 feet of rumble strip to allow the bicyclist to enter or exit the shoulder area.

Rumble Strips in Shoulder

Bicycle on Rumble Strips

Rumble Strip Warning Sign

Applications
Florida, Minnesota

Additional Resources
AASHTO *Guide,* FHWA *Synthesis of Shoulder Rumble Strip Practices and Policies*

7.3 Crossings at Railroads, Light Rail, & Trolleys Tracks

When crossing tracks for railroads, light rail, or electric trolleys, bicyclists need to be aware of the crossing angle and the presence of a gap that exists on either side of the rail. Crossing angles of 30 degrees or less are considered hazardous.

Guideline
The crossing should be at a 60-degree to 90-degree angle to the rails. This minimizes the hazard caused by the gaps on either side of the rail.

Specifications
The bicycle crossing should be as close to perpendicular as possible to the track. Flaring the approach of the bicycle facility to the tracks allows room for the bicyclist to maneuver to cross the tracks perpendicular to the travel direction. Fillers may be installed at the bicycle crossings that will fill the gap between the track and the roadway surface.

Applications
Oregon

Additional Resources
AASHTO *Guide*

Railroad Crossing for Bicyclists

Railroad Crossing for Shared-Use Path

Sign Warning Bicyclist of Rough Crossing

7.4 Traffic Signal Detection for Bicyclists

At signalized intersections, there are special accommodations that can be employed to improve the safety of cyclists. The detection of bicyclists at signalized intersections can improve efficiency, decrease delay to bicyclists, and discourage red light running by cyclists without causing inordinate delays to motorists.

Guideline

The visibility of cyclists at intersections is improved by using detectors. At signalized intersections where there are high volumes of bicycle traffic, detectors that detect bicycles should be installed.

Specifications

A pavement marking should be installed to indicate to the cyclist the location that will trigger the signal. Also, a sign should be installed to inform the cyclist of the detector. The pavement marking and the sign are shown on Drawing A12 of the Appendix.

Loop Detector Pavement Marking

Loop Detector Pavement Marking

Applications

California, Chicago, Denver, Wisconsin

Additional Resources

AASTHO *Guide, MUTCD,* City of Chicago *Bike 2015 Plan,* City of Denver *Bicycle Master Plan*

7.5 Bike Parking

Providing bicycle parking is an essential element in promoting bicycling. Bicycle parking facilities should be provided at both the trip origin and trip destination. The parking area should offer protection from theft and damage.

Example of Short Term Bike Parking

7.5.a Short Term Bike Parking

Short term bicycle parking is commonly used for short trips, when cyclists are planning to leave their bicycles for a few hours or less.

Guideline

Short term parking is typically handled with the use of bicycle racks which are low-cost devices that provide a location to secure a bicycle.

Specifications

The bicycle rack should be constructed so that it supports the bicycle by its frame in two places, prevents the wheel of the bicycle from tipping over, allows the frame and one or both wheels to be secured, and supports bicycles that do not have a diamond shaped frame. The bicycle rack should be secured to the ground near the entrance it serves so the racks are visible. The bicycle racks should be installed to meet Americans with Disabilities Act (ADA) accessibility guidelines and not obstruct pedestrian traffic or sight lines.

Short Term Bike Parking Area

Applications

Numerous urban areas including the peer cities of Nashville, Denver, Milwaukee, Baltimore, and Charlotte

Additional Resources

Association of Pedestrian and Bicycle Professional *Bicycle Parking Guidelines* and *Accessible Public Rights-of-Way: Planning and Design for Alterations*

7.5.b Long Term Bike Parking

The City of Memphis encourages long term bicycle parking facilities to be provided at large buildings, park-and-ride lots, and transit stations. Long term bike parking should provide bicyclists with a high level of security so that they feel comfortable leaving their bicycles for long periods of time (e.g. all day).

The Memphis Area Transit Authority (MATA) currently provides bicycle lockers at several transit stops.

Guideline
Long term bicycle parking areas should be designed to provide secure, enclosed, limited access so the cyclist is comfortable leaving their bike for a long period of time. Long term parking is intended to be used for several hours or days.

Specifications
Employee parking areas, transit stations, park-and-ride lots, and parking garages are appropriate locations for long term parking. Long term parking should be covered to protect bicycles from the weather. Additionally, long term parking should be located in a visible and prominent location or in a locked enclosure. Bike lockers are suitable for long term parking.

Indoor Parking Area

Bike Lockers for Long Term Parking

Applications
Chicago, Nashville

Additional Resources
Association of Pedestrian and Bicycle Professional *Bicycle Parking Guidelines*

7.6 Bikes and Transit

The City of Memphis encourages a multi-modal approach to addressing transit needs. To enhance the use between public transit and bicyclists, it is important for public transit, both bus and rail, to accommodate bicyclists both on the vehicles and at the stations. Often bicycle racks or lockers are provided at stations which is the case at several MATA stops.

MATA has bike on bus accommodations on newer vehicles as depicted in the picture to the right. The MATA bike on bus racks can accommodate two bicycles at a time.

Bike Rack on MATA Bus

Guideline

Access to transit allows bicyclists the opportunity to make longer trips. Where physical conditions prevent a continuous bicycle trip, public transportation can provide a link to previously inaccessible destinations.

Specifications

For buses, the most frequent option is an exterior rack mounted on the front of the bus that can accommodate two bicycles. For rail transit, selected cars are generally equipped with interior bike racks, with the number of racks dependant on demand.

Bike Storage Area on a Train

Applications

Seattle, Portland, Miami, San Francisco

Additional Resources

Federal Transit Administration *Bicycles and Transit a Partnership that Works*

7.7 Traffic Calming

Traffic calming utilizes a variety of design techniques to create streets that are more livable and less dominated by vehicular traffic. One objective of traffic calming is to create a safer and more comfortable environment for bicycles and pedestrians. Some traffic calming techniques will result in lower vehicular volumes and speed which will create a more comfortable biking environment. When bicycle facilities are present, it is important that the traffic calming technique not hinder bicyclist travel.

Speed Hump Installed Leaving Room for Bicycles

Guideline

Provisions should be made to enable bicycle travel through an area where traffic calming devices are installed.

Specifications

If a speed hump is being installed in an area where bicycle traffic is expected, the speed hump should be installed 3 feet from the edge of pavement as shown in Drawing A13 in the Appendix. Where roundabouts are installed, bicycle facilities should end before entering the roundabout as shown in Drawing A14 of the Appendix. In general, where traffic calming devices are located, special accommodations for bicycle facilities should be made.

Bike Lanes End on the Approach to the Roundabout

Applications

Charlotte

Additional Resources

MUTCD

8. Shared-Use Paths

Shared-use paths, also referred to as greenways, are built on exclusive rights-of-way with relatively few motor vehicle crossings. A shared-use path is a facility that is physically separated from motor vehicle traffic by an open space or barrier. Paths are normally two-way facilities.

Shared-use paths offer opportunities not provided by the road system. They can provide a recreational opportunity or, in some instances, can serve as direct commute routes if cross-flow by motor vehicles and pedestrians is minimized. Shared-use paths are commonly located along rivers, canals, limited access freeways, utility rights-of-way, within college campuses, or within and between parks. The Riverwalk in Memphis is a prime example of a shared-use path which serves a variety of users and provides connections along the riverfront to various points in the downtown area.

Shared-Use Path not Striped

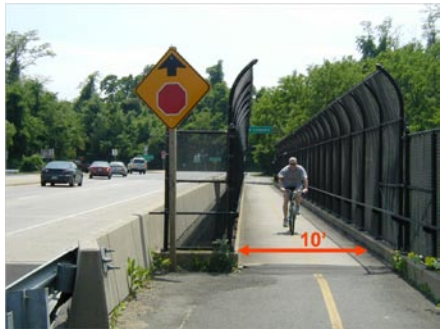
8.1 Shared-Use Path Design Standards

There are numerous design aspects that must be considered with a shared-use path. The paths should be designed to serve a variety of users including walkers, cyclists, rollerbladers, and runners and the path should be designed to serve all ages from kids to adults to seniors. This section will discuss the shared-use path widths, design speed, sight distance, horizontal and vertical clearances, grades and cross slopes, and drainage.

Shared-Use Path Striped for Bicycles and Pedestrians

8.1.a Width

A shared-use path should be wide enough to allow comfortable travel by bicyclists and pedestrians at the same time.



Width of Shared-Use Path on a Bridge

Guideline
Shared-use paths should be constructed so that there is enough pavement width to accommodate the expected volumes of bicyclists and pedestrians. Also, the path should be wide enough to accommodate maintenance vehicles.

Specifications
It is recommended that for a shared-use path the width should be 10 feet as shown in Drawing A15. If the path is expected to be a high-use area, a 12 foot width should be considered. If there are physical constraints, a minimum width of 8 feet may be considered.

Applications
Nashville, Denver, Baltimore

Additional Resources
AASTHO *Guide*

8.1.b Design Speed

The design of a shared-use path should take into account the likely speed of users and the ability of bicyclists to turn corners without falling over, skidding, or hitting their pedal on the ground as they lean over.

Design Speed should be Considered on Curves

Guideline
The design speed of the path should be conducive to a mixed-use facility so that both cyclists and pedestrians are comfortable using the facility.

Specifications
The AASHTO Guide recommends a minimum design speed of 20 mph for a shared-use path. Where downgrades exceed 4% a higher design speed may be considered.

Improper Design Speed may Cause Barriers to be Installed

Applications
Florida

Additional Resources
AASTHO *Guide*

8.1.c Sight Distance

The ability of a cyclist to stop or slow down to avoid a collision is affected by many things. The rider must have time to identify a potential problem and react accordingly. This means that they must be able to see approaching intersections or corners in plenty of time even when they are traveling at the design speed of the path.

Limited Sight Distance on Shared-Use Path

Guideline

Shared-use paths should be constructed with adequate stopping sight distance for cyclists. The stopping sight distance should be calculated based on the design speeds and grades. The total perception and brake reaction time of 2.5 seconds and a coefficient of friction of 0.5 should be used in the calculations.

Specifications

The AASTHO *Guide* provides formulas for determining the appropriate stopping sight distance.

Limited Sight Distance Due to Curve

Applications

Maryland

Additional Resources

AASTHO *Guide*

8.1.d Horizontal and Vertical Clearances

Shared-use paths require horizontal and vertical clearances to avoid obstructions such as trees, fences, tunnels, and bridges.

Guideline
Proper horizontal and vertical clearances should be provided along the shared-use path so that a cyclist and pedestrian can pass each other without leaving the path.

Specifications
There should be at least 2 feet on either side of a shared-use path for horizontal clearance. The required vertical clearance should be 10 feet. This allows maintenance vehicles to clear bridges and tunnels.

Horizontal Clearance Requires at least 2 feet on Either Side of Path

Vertical Clearance Requires at least 10 feet

Applications
Maryland

Additional Resources
AASTHO *Guide*

8.1.e Grades and Cross Slopes

Grades and cross slopes should be at a desirable level for bicyclists to travel uphill and downhill at a controlled and comfortable speed.

Guideline
Grades greater than 5% are undesirable because they are hard for bicyclists to climb and may make it difficult for riders to control their bikes coming down a hill.

Specifications
If a grade greater than 5% occurs, the following recommended lengths included in the *Final Accessibility Guidelines for Outdoor Developed Areas* should be used:

Grade	Length
5-8%	200 ft.
8-10%	30 ft.
10-12%	10 ft.

At the end of the segment with a slope greater then 5%, a resting area of 60 inches (5 feet) with a grade less than 2% should be provided. There are also other options to mitigate the impact of steeper slopes, such as, adding 4-6 feet to the width of the path, alerting cyclists to the approaching grade with signage and markings that post a speed, and using a series

Shared-Use Path with Steep Grade


Shared-Use Path with Steep Grade


Shared-Use Path with Grade Greater Than 5%

Applications
Maryland

Additional Resources
AASTHO *Guide, Final Accessibility Guidelines for Outdoor Developed Areas*

8.1.f Drainage

Shared-use paths require proper drainage to avoid water ponding and ice formation. Also, on unpaved paths proper drainage will help avoid erosion.

Guideline
To provide proper drainage the path should be constructed so that it slopes in one direction rather than crowning. This will simplify the construction of the path.

Specifications
The cross slope of the shared-use paths should be less than 2%. Sloping can be in one direction to simplify the construction of the path. If drainage grates or manhole covers are required, they should be placed outside the path of travel for the cyclist.

Cross Slope should be less than 2% in One Direction

Man Hole Covers should be Placed Outside the Path of Travel

Applications
Nashville

Additional Resources
AASTHO *Guide*

8.2 Separation between Shared-Use Paths and Roadways

According to the AASTHO *Guide,* a two-way shared-use path should not be located immediately adjacent to a highway because it increases operational and safety problems. The problems occur because a shared-use path has bicyclists traveling in both directions which means there is a cyclist traveling in the opposite direction of the adjacent traffic. Also, the proximity of cyclists to motor vehicle traffic creates potential safety problems.

Guideline
When a shared-use two-way path is located next to a roadway, adequate separation should be made or a barrier should be constructed. This design will indicate that the path functions separately from the roadway and is to be used by bicyclists and pedestrians only.

Specifications
A minimum separation distance of 5 feet should be provided where a two-way path is located adjacent to a roadway. Drawing A15 in the Appendix shows the recommended minimum separation between a shared-use path and a roadway. If a 5 foot separation is not possible, then a suitable barrier should be constructed. When used, a vertical barrier should be at least 42 inches high to prevent bicyclists from toppling over it.

Two-Way Shared-Use Path With Separation from Roadway

Two-Way Shared-Use Path Separated by a Horizontal Barrier

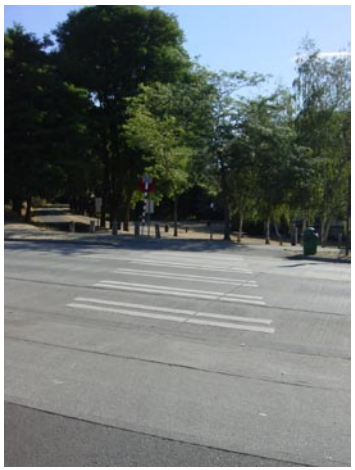
Shared-Use Path Separated by a Vertical Barrier

Applications
Wisconsin, Minnesota

Additional Resources
AASTHO *Guide*

8.3 Shared-Use Path at Intersections

Where shared-use paths must cross roadways, driveways, or other paths, it is important that the path design facilitate the safest and most convenient crossing movements possible. Intersections between shared-use paths and roadways offer special design challenges, since most users have a wide range of cycling skills and diverse characteristics.



Shared-Use Path Crossing

8.3.a Shared-Use Path Crossings

There are three basic categories of path and roadway intersections which include midblock, adjacent path, and complex. These intersection types may cross any number of roadway geometries with varying speeds and volumes of motor vehicle traffic. Also, the intersection may be uncontrolled or signed and signal controlled.

Guideline

Proper signage and markings should be made in advance of the path and roadway intersection to alert the bicyclist and the motorist that there is an intersection.

Specifications

Shared-use paths should intersect the roadway at a 90 degree angle. Signage should be provided on both the roadway and the path to alert the motorist and the bicyclist of the approaching intersection and the signs should clearly indicate whether motorists or path users have the right of way. A warning signal may be considered where the roadway geometry or traffic volumes warrant the need for more visibility of the intersection. Crosswalk markings should be installed on the roadway to increase the visibility of the intersection for the motorist. To meet ADA requirements, curb ramps and detectable warnings are required to alert path users with vision impairments of the street crossing. Drawings A16 and A17 in the Appendix shows the recommended at-grade crossing.

Shared-Use Path Crossing on a Two Lane Road

Applications

Florida, Seattle

Additional Resources

AASTHO *Guide, MUTCD,* Florida DOT *Trail Intersection Design Handbook,* Seattle's *Bicycle Master Plan, Accessible Public Rights-of-Way: Planning and Design for Alterations*

8.3.b Shared-Use Path Bridges, Tunnels, and Overpasses

A unique feature of shared-use paths is that they often have grade separated intersections with highways and other crossings. Structures of all kinds are needed to carry path users under or over obstacles such as highways, rivers, and freeways. In many cases bridges can be retrofitted to provide a bicycle crossing under/over the barrier. In some cases, the existing bicycle crossing can be upgraded to provide bicycle access.

Guideline
When a shared-use path cannot continue due to barriers, the construction of a bridge, tunnel, or overpass should be considered.

Specifications
The minimum width of the path should be maintained through the crossing. If it is possible the two foot clearance on either side of the path should also be maintained. An overhead clearance of 10 feet should be maintained as a minimum clearance through a tunnel or under a bridge. Clearances should allow for maintenance and emergency vehicles and so should the strength of a bridge. Railings, fences, or barriers should be at least 42 inches high on both sides of the path.

Tunnel for Shared-Use Path

Bridge for Shared-Use Path

Bridge for Shared-Use Path

Applications
Nashville, North Carolina, Chicago, Denver

Additional Resources
AASTHO *Guide*

8.4 Shared-Use Path Transition to On-Street Facilities

Where shared-use paths terminate at existing roads, it is important to integrate the path into the existing system of roadways. Care should be taken to properly design the terminals to transition the traffic into safe merging or diverging situations.

Shared-Use Path Transitioning to a paved Shoulder

Guideline

All shared-use roadway junctions should be designed under the assumption that bicyclists and other non-motorists may wish to exit the shared-use path to the roadway and access the shared-use path from the roadway. The use of signs, pavement markings, and channelization should be considered to induce bicyclists to ride on the proper side of the road with traffic.

Specifications

Analyze and study the actual behavior of both path users and motorists. The design should take into account shared-use path user desire lines. Appropriate signing is necessary to warn and direct both bicyclists and motorists regarding these transition areas. Care must be taken so wrong way riding is discouraged. Drawing A18 in the Appendix shows the transition for a shared-use path to a bike lane.

Shared-Use Path with a Transition to Bike Lane

Applications

Florida

Additional Resources

Florida DOT *Trail Intersection Design Handbook* and Florida DOT *Designing Trail Termini Report*

8.5 Shared-Use Path Signs and Symbols

Adequate signing and marking on shared-use paths is essential to make the paths bicycle friendly and safe.

Shared-Use Path Sign Warning Bicyclists to Watch for Pedestrians

Guideline
Shared-use paths should contain all three types of signs, regulatory, warning, and informational, and the symbols used on the signs should be consistent.

Specifications
Shared-use paths should have informational signs that inform the path users of interesting routes, direct them to destinations, and identify nearby rivers, streams, parks, and historical sites. The regulatory and warning signs should be placed at path intersections. The typical signs used on shared-use paths are listed in the *MUTCD* in Chapter 9B. Some of the shared-use path signs are shown on Drawing A19 in the Appendix. In addition, Drawing A20 in the Appendix shows directional signs that can be used on a shared-use path.

Shared-Use Path Sign

Applications
Florida, California, Maryland, Minnesota, Oregon, Wisconsin

Additional Resources
AASTHO *Guide, MUTCD,* Florida DOT *Trail Intersection Design Handbook*

Directional Signs for Shared-Use Path

8.6 Other Design Considerations for Shared-Use Paths

Other design considerations for shared-use paths include path heads, rest stops, and lighting. Installing these types of amenities creates a friendly and safe environment for the shared-use path users.

8.6.a Path Heads and Rest Stops

Shared-use paths will begin and end at a path head. Path heads may provide amenities such as parking, restrooms, and maps of the shared-use path. Also, for long shared-use paths there should be rest stops.

Path Head that Provides Maps

Guideline

The beginning and end of a shared-use path should have a path head. Along the shared-use paths rest stops should be provided at intermediate points, scenic lookouts, or near amenities such as restaurants, convenience stores, picnic areas, or parking lots.

Specifications

Path heads should contain a parking area and restrooms. There should be a map posted of the path which shows important destinations and land marks. The rest areas should be away from the path so the bicyclists will not block the path when they pull off. Informational signs should also be included at some rest stops. Rest stops should have benches, shade, a parking rack, and a trash receptacle. Also, at certain locations along the path there should be water fountains and restroom facilities. Other amenities that should be considered include emergency call boxes, emergency weather instructions, shelters, and intermodal connections.

Restrooms at a Path Head

Rest Area with Pavilion

Applications

Nashville

Additional Resources

8.6.b Lighting

Many shared-use paths in urban and suburban areas are intended to serve needs during the day and night. This usually occurs on paths that serve as commuter routes and paths that access college campuses. Lighting improves safety by increasing visibility on paths that are used after dark.

Guideline
Lighting should be installed according to the AASTHO *Guide* along paths that are expected to have night time usage, such as paths that access college campuses.

Specifications
The average maintained illumination level should be between 5 and 22 lux.

Lighting on Shared-Use Path

Shared-Use Path with Lighting

Lighting along Shared-Use Path

Applications
Denver, Florida

Additional Resources
AASTHO *Guide*

9. Work Zones and Temporary Traffic Controls

Road work commonly affects bicycle facilities, particularly in urban areas. Temporary lane restrictions, detours and other traffic control measures instituted during construction should be designed to accommodate non-motorized travelers whenever possible, especially in areas where bicycle use is common.

Guideline
Where work zones or temporary traffic controls are in place for road construction or other work, adequate warning and provisions should be provided for on-road bicyclists.

Specifications
If a work zone obstructs a road with a bike lane, the bicycle traffic may be directed to share the road with the motor vehicle traffic. If the project occurs over a long distance and an alternate route is nearby, it may be desirable to provide bicyclists an alternate route. For both situations signs should be posted alerting the bicyclists and motorists of the change.

If a shared-use path is closed or restricted for maintenance or repair, advanced warning signs should be posted on both approaches to the closure. During the construction, a minimum 36 inch wide path should be cleared of obstructions. If the path cannot be cleared, the other option is to provide a temporary path to bypass the work zone. The temporary path should be a minimum of 8 feet wide. The cross slope and longitudinal slope of the temporary path shall meet ADA requirements.

Typical construction signs are shown on Drawing A20 in the Appendix.

Applications
Denver, Maryland

Additional Resources
MUTCD, Accessible Public Rights-of-Way: Planning and Design for Alterations

Sign Used During Construction

Bicycle Facility Detour Sign used in a Work Zone

Bicycle Facility Map Showing Alternate Route

APPENDIX

BICYCLE FACILITY DRAWINGS

DRAFT

Signs:

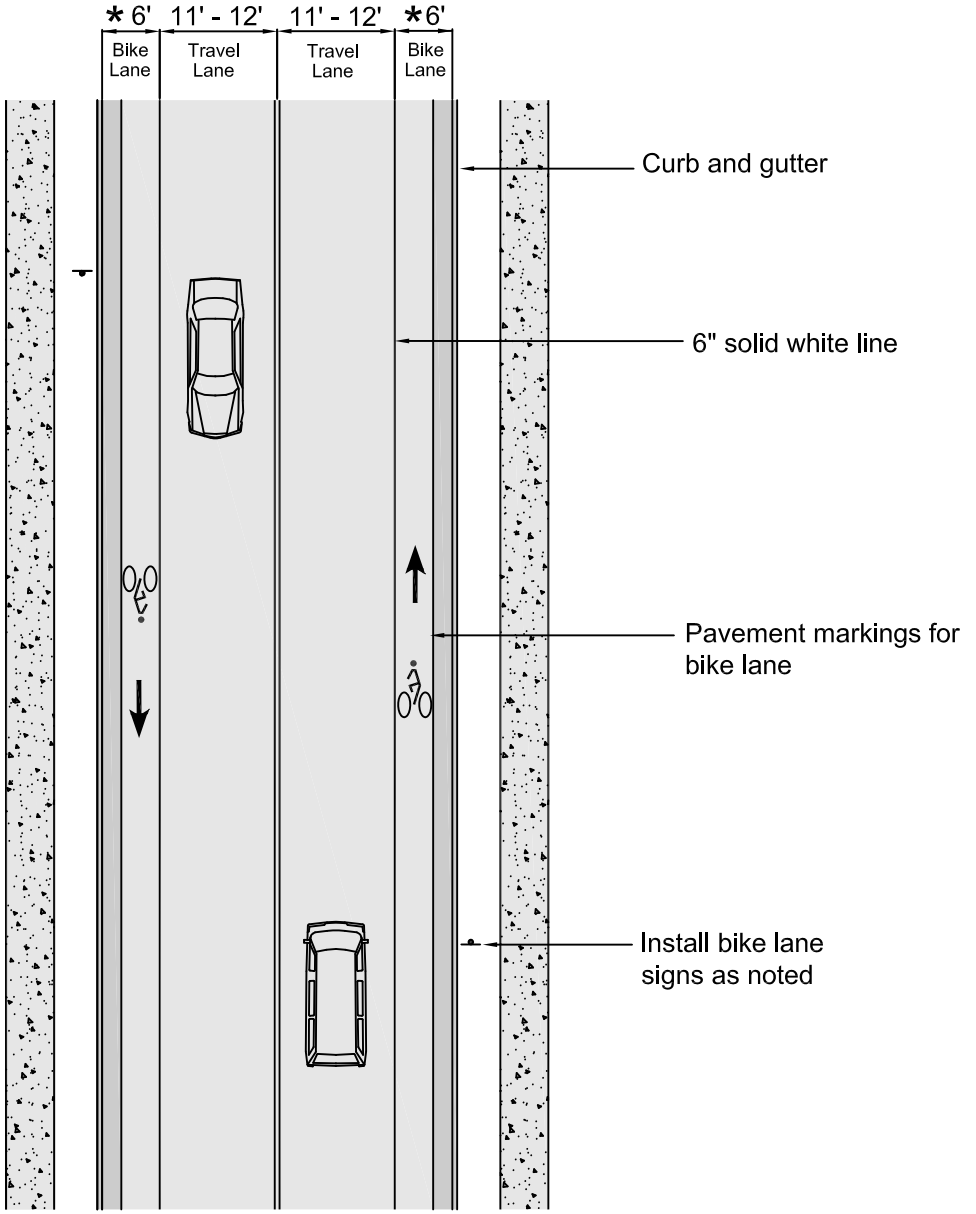
Sign #: R3-17
Size: 30"x24"
Placement: Install every 1/4 mile (maximum).

Sign #: R3-17aP
Size: 30"x12"
Placement: Install 100' before bike lane begins with sign R3-17.

Sign #: R3-17bP
Size: 30"x12"
Placement: Install 100' before bike lane ends with sign R3-17.

Specifications for all signs:

Source: MUTCD
Color: Black letters on white reflective background
Type: Highway Gothic



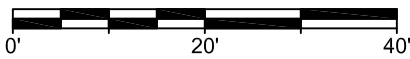
Notes:

The bike lane pavement markings should be placed every 1/4 mile (maximum), and/or after each major intersection.

The striping and pavement markings shall be done with the appropriate material as directed by the City Engineer.

* The 6 feet from face of curb allows for a 4 foot bike lane and a 2 foot gutter pan.

GRAPHIC SCALE



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CITY OF MEMPHIS
DIVISION OF ENGINEERING

Typical Bike Lane Striping Through an Intersection

DWG. NO. A1

Signs:

Sign #: R3-17
Size: 30"x24"
Placement: Install every 1/4 mile (maximum).

Sign #: R3-17bP
Size: 30"x12"
Placement: Install 100' before bike lane ends with sign R3-17.

Sign #: R3-17aP
Size: 30"x12"
Placement: Install 100' before bike lane begins with sign R3-17.

Specifications for all signs:

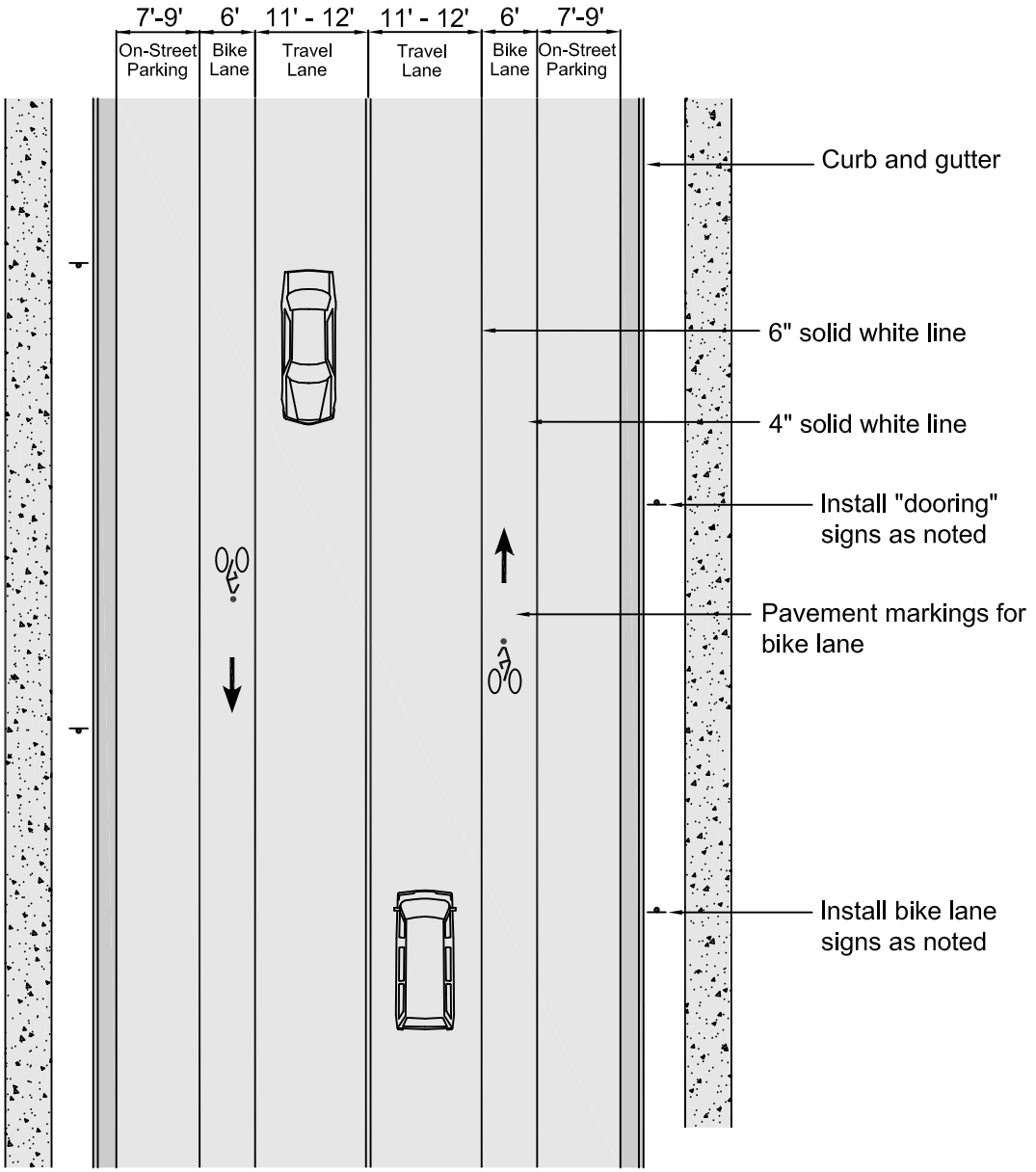
Source: MUTCD
Color: Black letters on white reflective background
Type: Highway Gothic

Notes:

On-street parking is prefered to be 8'.

The bike lane pavement markings should be placed every 1/4 mile (maximum), and/or after each major intersection.

The striping and pavement markings shall be done with the appropriate material as directed by the City Engineer.



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GRAPHIC SCALE

0' 20' 40'

CITY OF MEMPHIS
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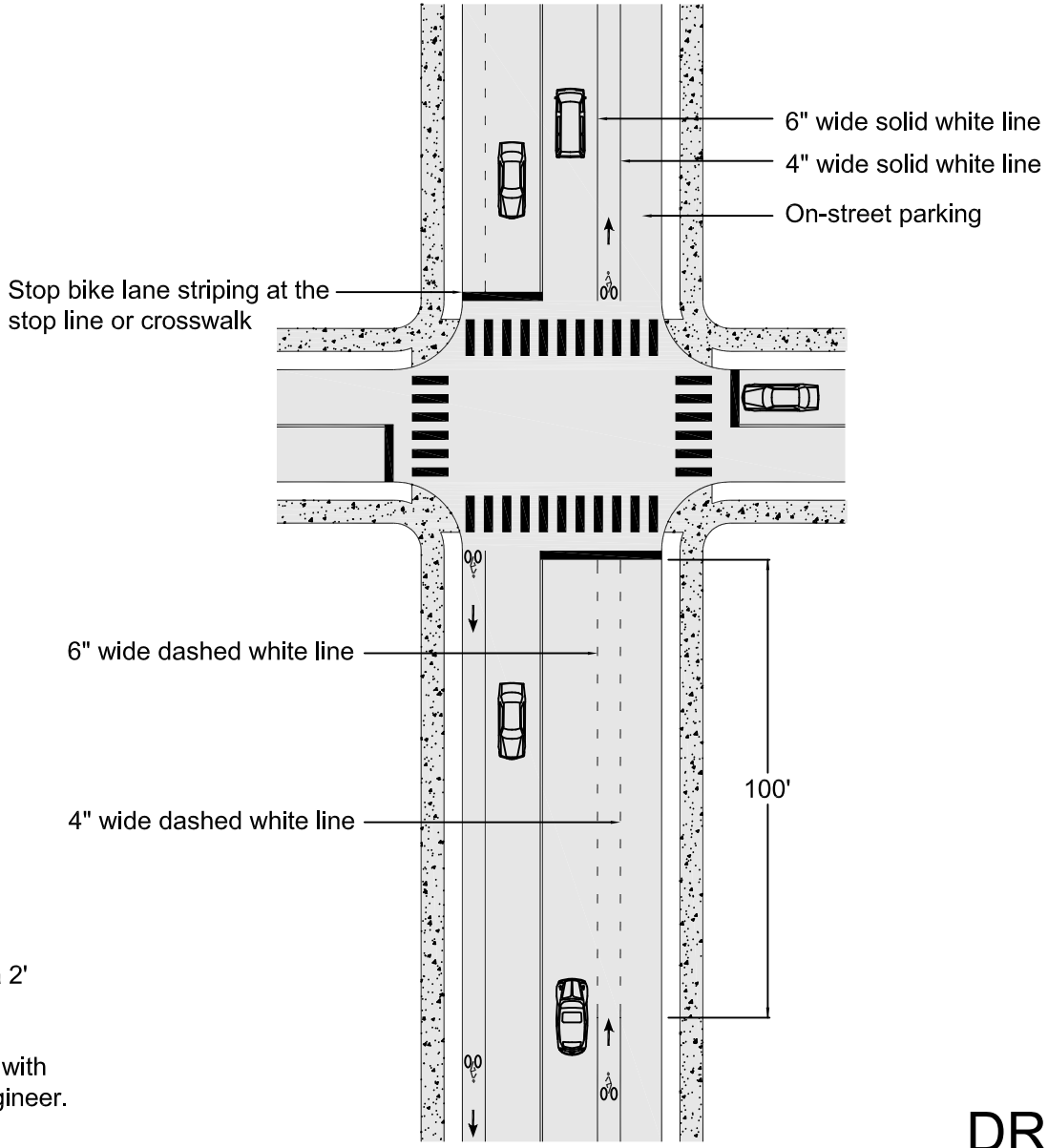
Typical Bike Lane Striping Through an Intersection

DWG. NO. A2



Notes:

The dashed white line should be constructed with a 2' dash and 6' spacing.

The striping and pavement markings shall be done with the appropriate material as directed by the City Engineer.

If a stop line is not present, the bike lane striping should stop at the crosswalk.

If neither a crosswalk or a stop line are present, the bike lane striping should stop at the radius return.

GRAPHIC SCALE

0' 40' 80'

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CITY OF MEMPHIS
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Typical Bike Lane Striping Through an Intersection

DWG. NO. A3

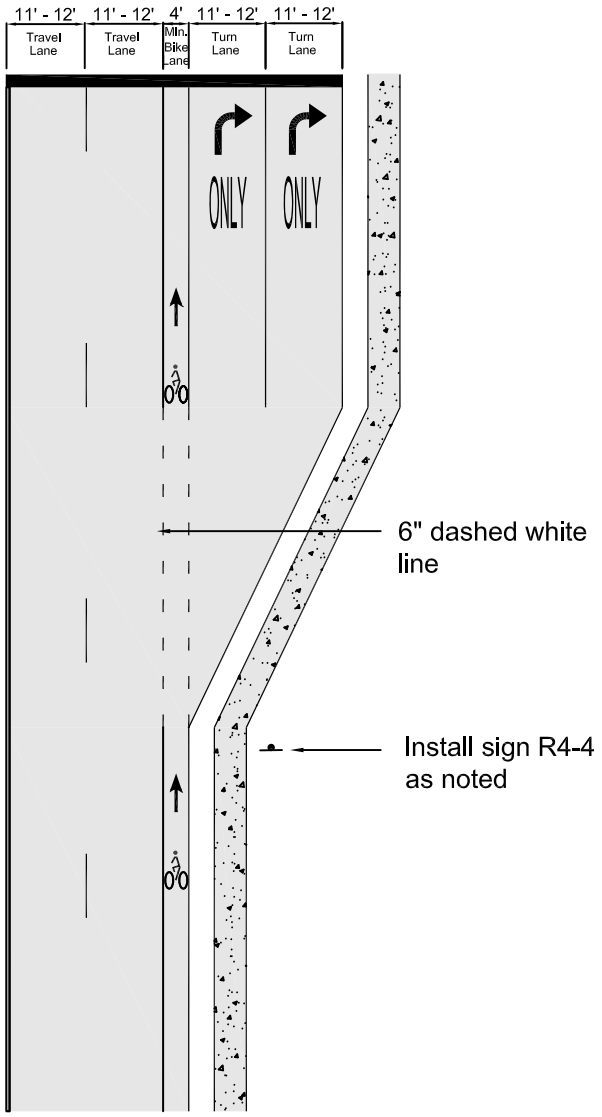
Signs:

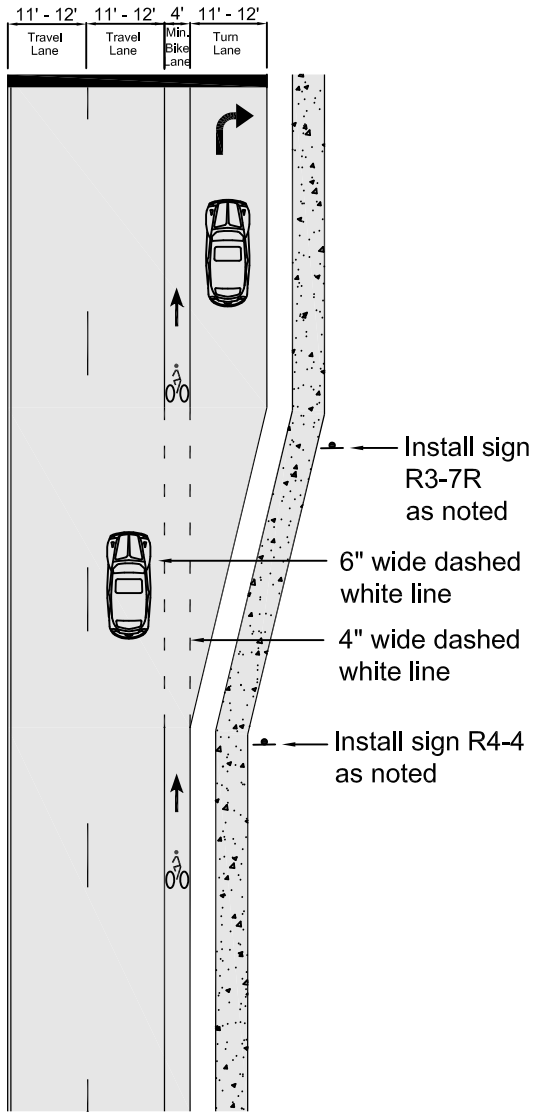
Sign #: R4-4
Size: 36"x30"
Placement: Install before right turn lane transition.

Sign #: R3-7R
Size: 30"x30"
Placement: Install before full width of right turn lane.

Specifications for all signs:

Source: MUTCD
Color: Black letters on white reflective background
Type: Highway Gothic





Notes:

The dashed white line should be constructed with a 2' dash and 6' spacing.

The dashed bike lane striping should begin at the right turn lane transition.

The striping and pavement markings shall be done with the appropriate material as directed by the City Engineer.

GRAPHIC SCALE
0' 30' 60'

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Typical Bike Lane Striping Through an Intersection

DWG. NO. A4

Signs:

Sign #: R4-4
Size: 36"x30"
Placement: Install at the end of the parking lane.

Sign #: R3-17
Size: 30"x24"
Placement: Install 100' before the right turn lane begins.

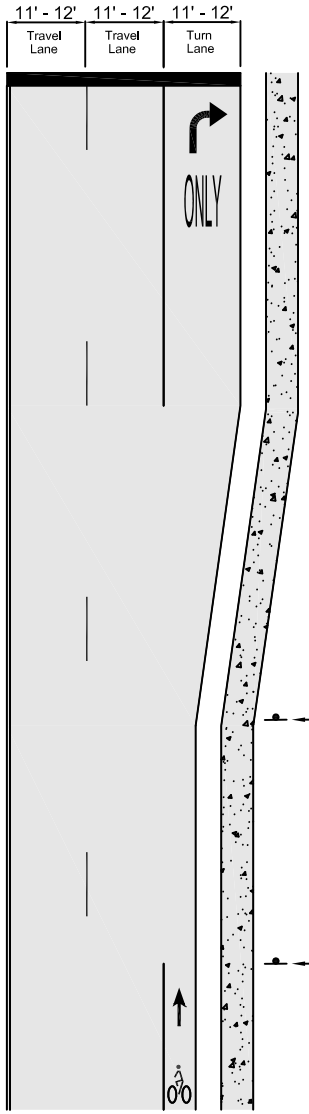
Sign #: R3-7R
Size: 30"x30"
Placement: Install before full width of right turn lane.

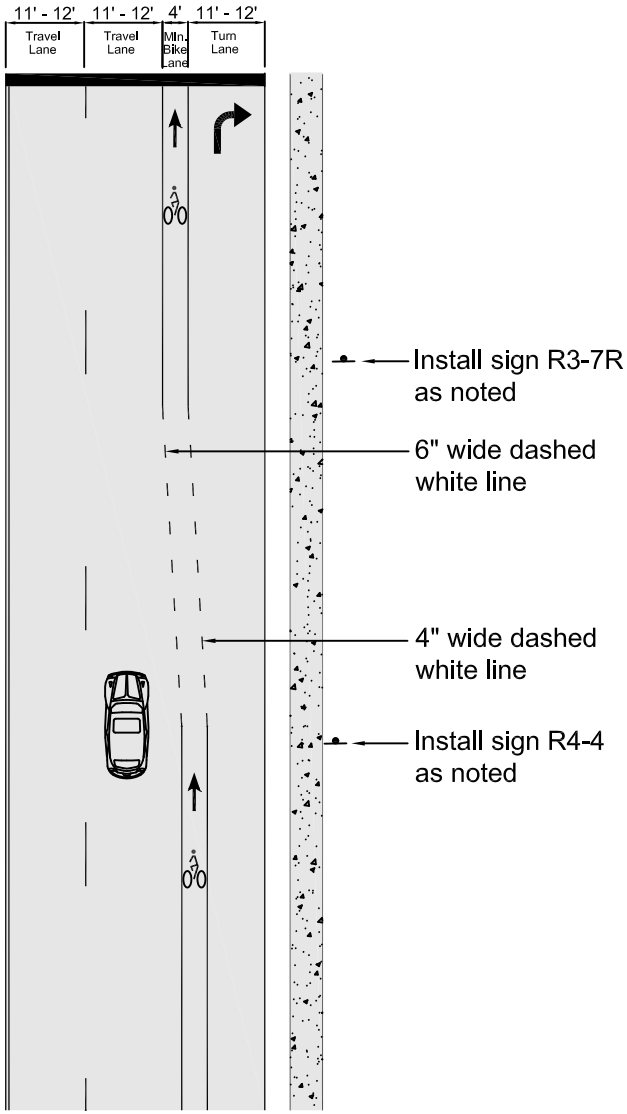
Sign #: R3-17bP
Size: 30"x12"
Placement: Install 100' before the right turn lane begins.

Sign #: W11-1
Size: 24" x 24"
Placement: Install at the beginning of the right turn lane transition.

Specifications for all signs:

Source: MUTCD
Color: Black letters on white reflective background
Type: Highway Gothic





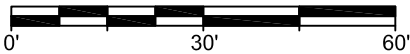
Notes:

The dashed white line should be constructed with a 2' dash and 6' spacing.

Begin the dashed lines where the parking ends.

The striping and pavement markings shall be done with the appropriate material as directed by the City Engineer.

GRAPHIC SCALE



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CITY OF MEMPHIS
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Typical Bike Lane Striping Through an Intersection

DWG. NO. A5

Signs:

Sign #: OBR1-1
Size: 18" x 18"
Placement: Install at the ramp intersection.
Source: Oregon Bike & Ped Plan
Color: Black bike on white reflective background with typical stop sign color

Sign #: W11-1
Size: 24" x 24"
Placement: Install on the ramp at the crossing location.

Sign #: W16-7p
Size: 24"X12"
Placement: Install with W11-1 on the ramp at the crossing location.

Sign #: W16-2p
Size: 12" x 12"
Placement: Install with W11-1 on the ramp according to table 2C-4 in the MUTCD.

<u>Specifications for all signs except OBR1-1:</u>

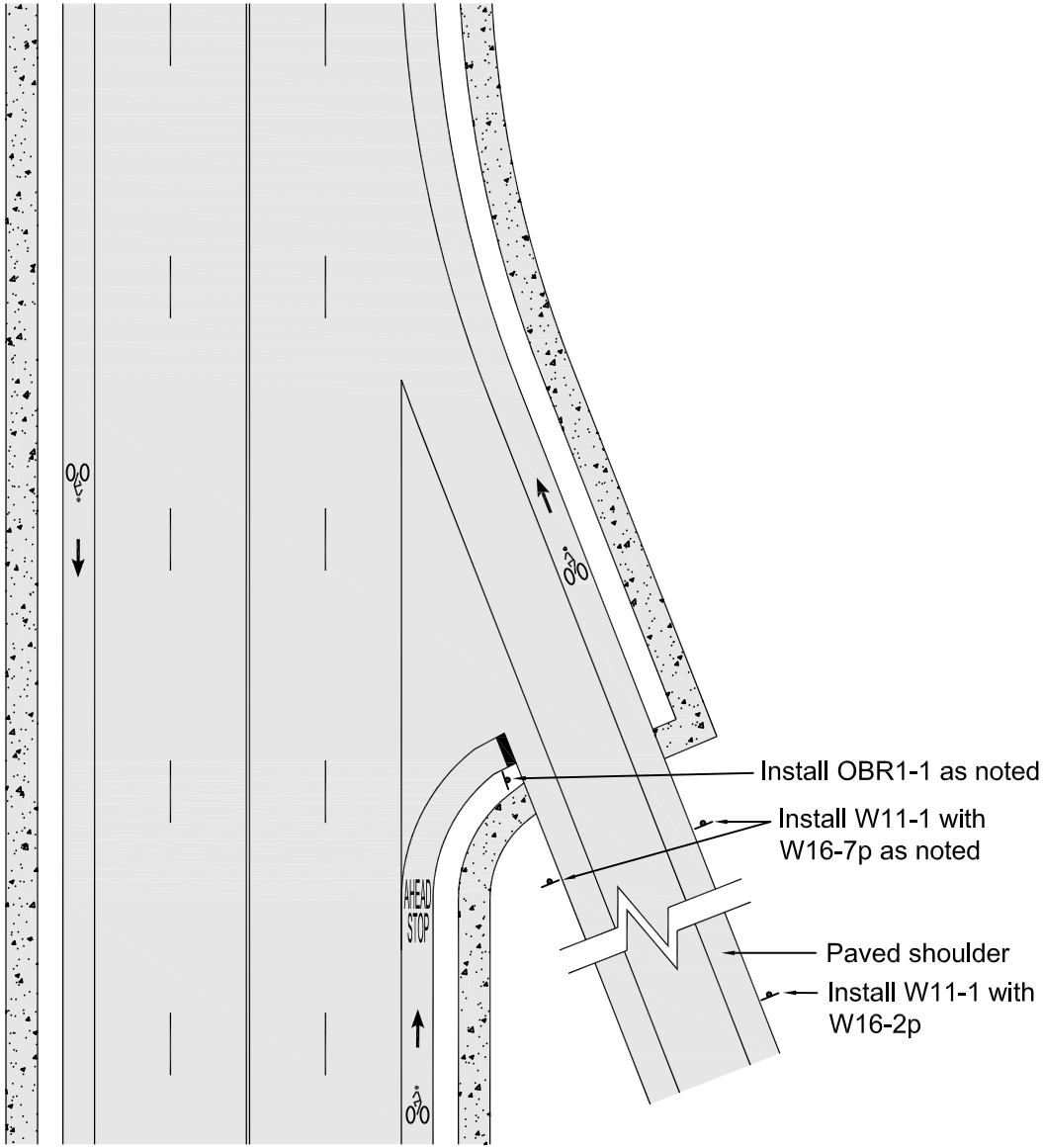
Source: MUTCD
Color: Black letters on yellow reflective background
Type: Highway Gothic

Notes:

The bike lane striping should stop at the stop line on the approach to the interchange ramp.

STOP AHEAD should be installed on the pavement at the approach to the stop line.

The striping and pavement markings shall be done with the appropriate material as directed by the City Engineer.



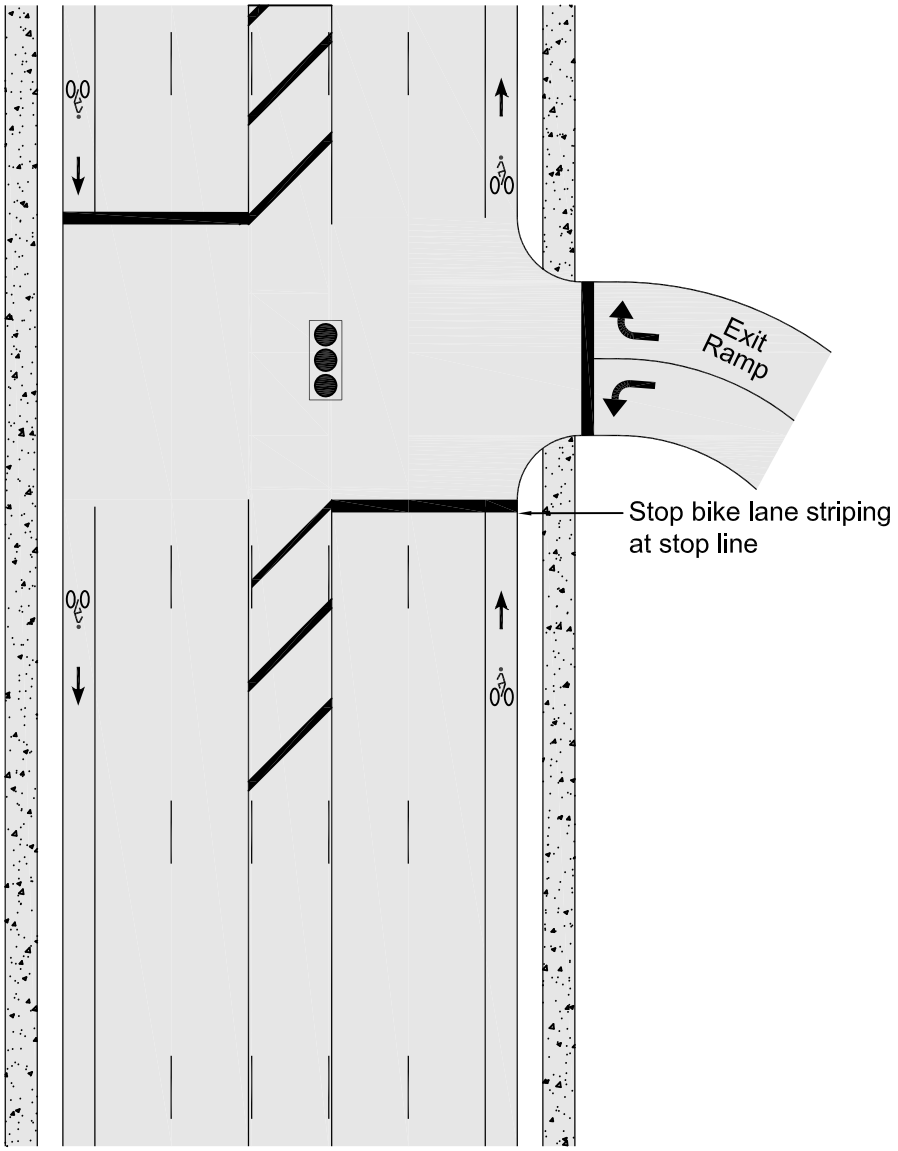
GRAPHIC SCALE
0' 30' 60'

DRAFT

CITY OF MEMPHIS
DIVISION OF ENGINEERING

Typical Bike Lane Striping Through an Intersection

DWG. NO. A6



Notes:

The bike lane striping should stop at the stop line on the approach to the intersection at the entrance and/or exit ramp.

The striping and pavement markings shall be done with the appropriate material as directed by the City Engineer.

GRAPHIC SCALE

0' 30' 60'

DRAFT

CITY OF MEMPHIS
DIVISION OF ENGINEERING

Typical Bike Lane Striping Through an Intersection

DWG. NO. A7

Signs:

Sign #: R3-17
Size: 30"x24"
Placement: Install about 50' after the bike lane begins.

Sign #: R3-17bP
Size: 30"x12"
Placement: Install 100' before bike lane ends with sign R3-17.

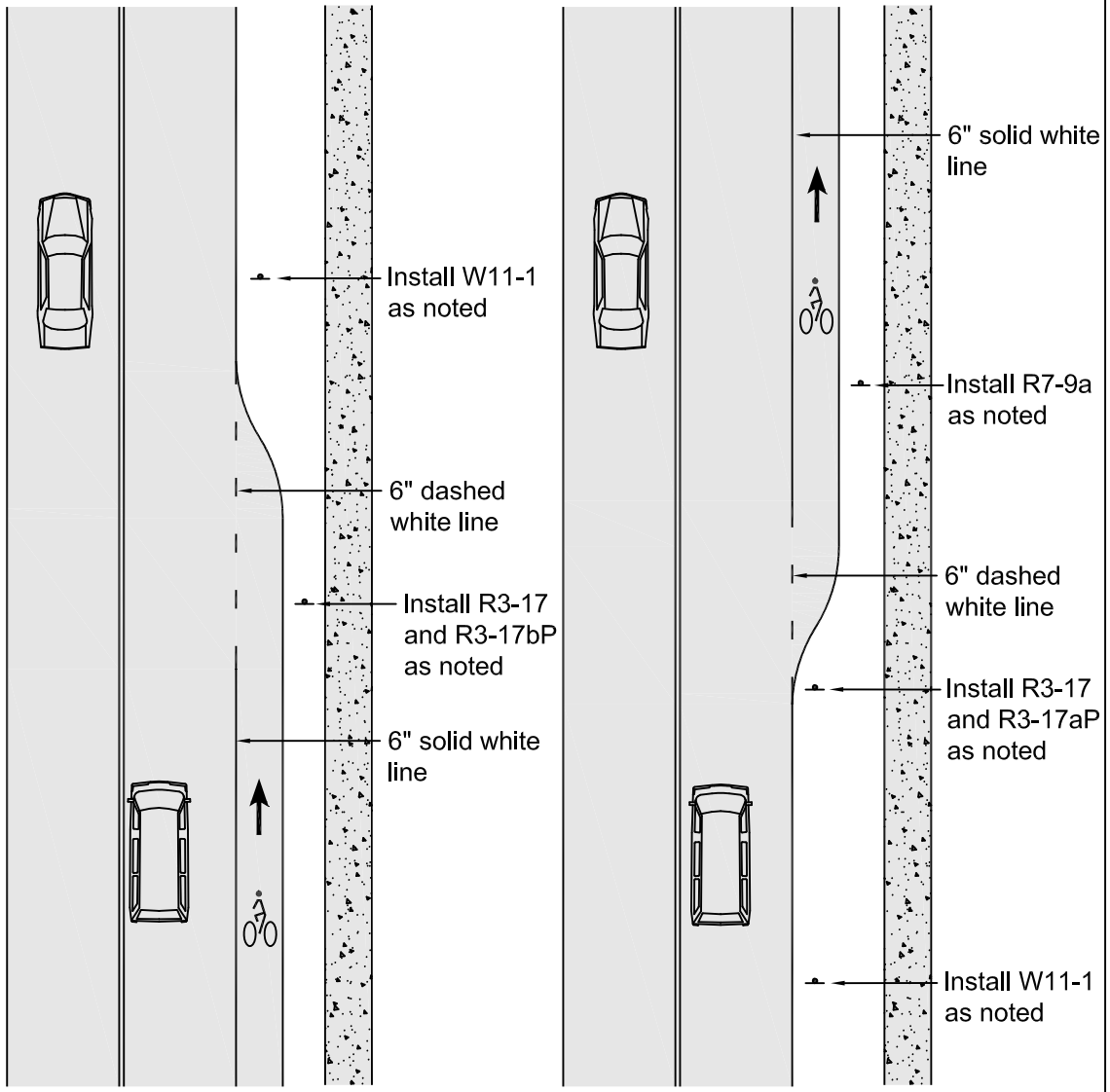
Sign #: W11-1
Size: 24" x 24"
Placement: Install at transition between bike lane and bike route.

Sign #: R3-17aP
Size: 30"x12"
Placement: Install 100' before bike lane begins with sign R3-17.

Sign #: R7-9a
Size: 12"x10"
Placement: Install about 50' after the bike lane begins.
Color: Red letters on white reflective background

Specifications for all signs:

Source: MUTCD
Color: Black letters on white reflective background (R3-16, R3-16a, R3-17)
Type: Highway Gothic



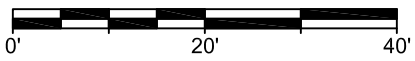
Notes:

The bike lane striping should be dashed for 50' from the beginning or end of the bike lane.

The striping and pavement markings shall be done with the appropriate material as directed by the City Engineer.

DRAFT

GRAPHIC SCALE



CITY OF MEMPHIS
DIVISION OF ENGINEERING

Typical Bike Lane Striping Through an Intersection

DWG. NO. A8

Signs:

Sign #: R9-5
Size: 12" x 18"
Color: Black letters
on white background

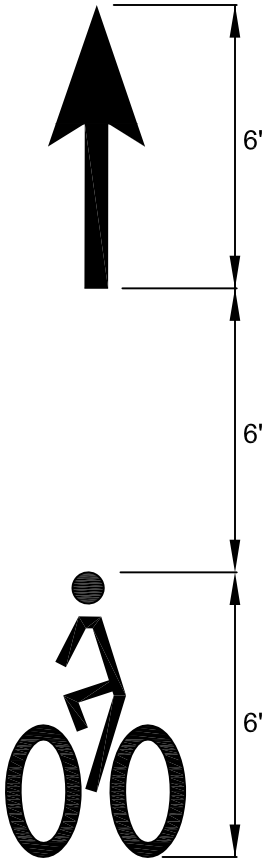
Sign #: R5-3
Size: 24" x 24"
Color: Black letters
on white background

Sign #: R7-9a
Size: 12"x18"
Color: Red letters
on white reflective
background

Sign #: R10-24
Size: 12" x 18"
Color: Black letters
on white background

Specifications for all signs:

Source: MUTCD
Type: Highway Gothic



Pavement Symbol for
Bike Lanes

Notes:

The striping and pavement markings shall be done with the appropriate material as directed by the City Engineer.

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NOT TO SCALE

CITY OF MEMPHIS
DIVISION OF ENGINEERING

Typical Bike Lane Striping Through an Intersection

DWG. NO. A9

Signs:

Sign #: W11-1
Size: 24"x24"
Color: Black letters on yellow reflective background
Type: Highway Gothic

Sign #: W16-7p
Size: 24"x12"
Color: Black letters on yellow reflective background
Type: Highway Gothic

Sign #: M1-8
Size: 18"x24"
Color: White background and letters with green oval

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CITY OF MEMPHIS
DIVISION OF ENGINEERING

Typical Bike Lane Striping Through an Intersection

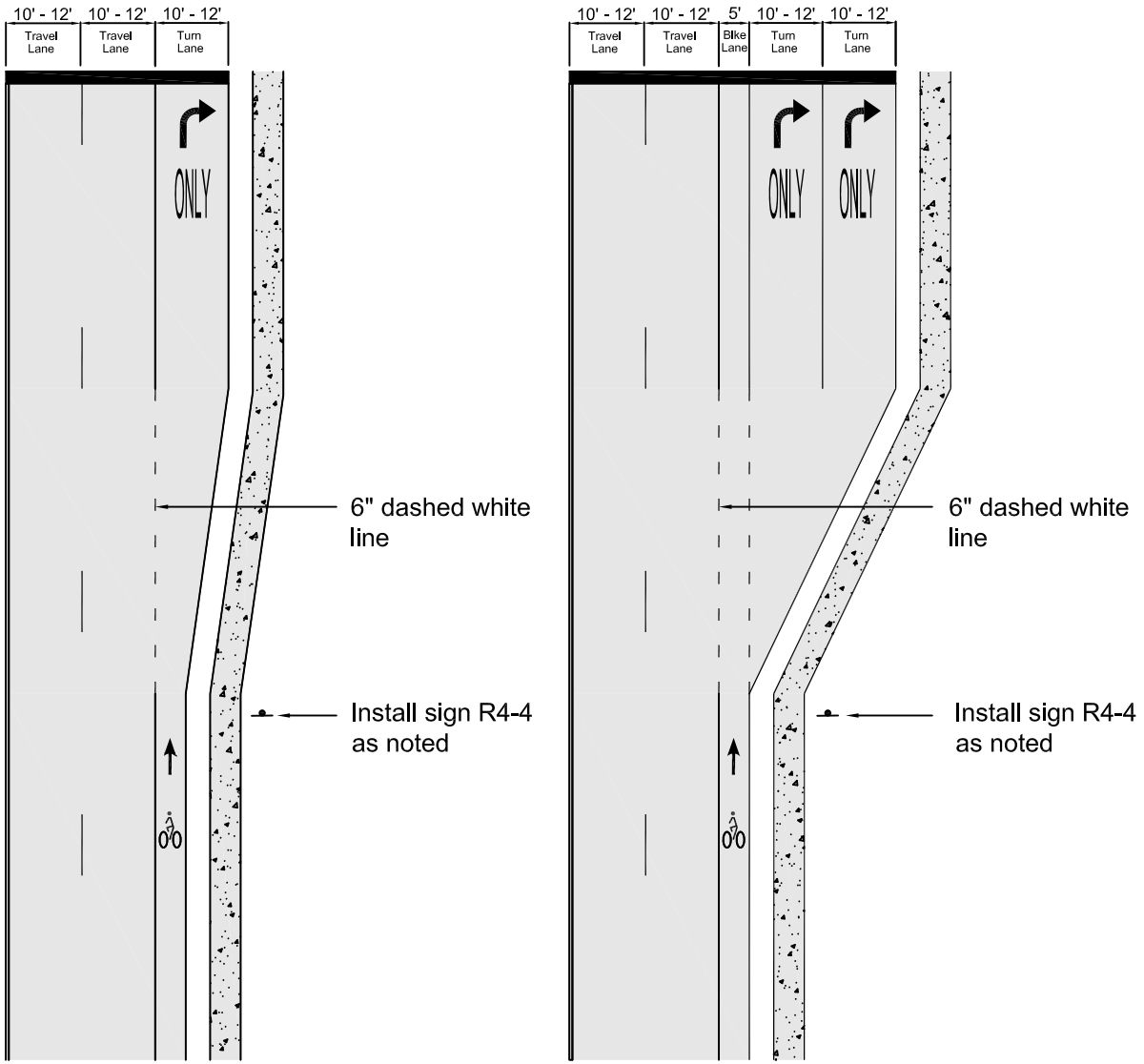
DWG. NO. A10

Signs:

Sign #: R4-4
Size: 36"x30"
Placement: Install at the beginning of the transition.

Specifications for all signs:

Source: MUTCD
Color: Black letters on white reflective background
Type: Highway Gothic



Notes:

The dashed white line should be constructed with a 2' dash and 6' spacing.

Begin the dashed line where the transition starts.

The striping and pavement markings shall be done with the appropriate material as directed by the City Engineer.

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GRAPHIC SCALE
0' 30' 60'

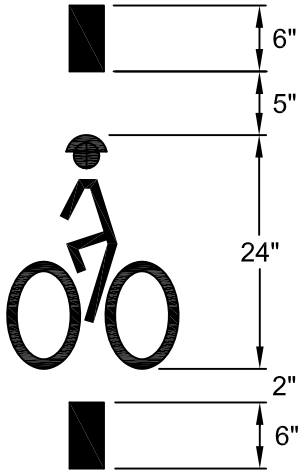
CITY OF MEMPHIS
DIVISION OF ENGINEERING

Typical Bike Lane Striping Through an Intersection

DWG. NO. A11

Signs:

Sign #: R10-22
Size: 12"x10"
Placement: Install just
before the pavement marking.
Source: MUTCD
Color: Black letters on
white reflective background.
Type: Highway Gothic



Pavement Symbol
for Bike Lane Detector

Notes:

The pavement symbol should be installed over
the loop detector.

The striping and pavement markings shall be done with
the appropriate material as directed by the City Engineer.

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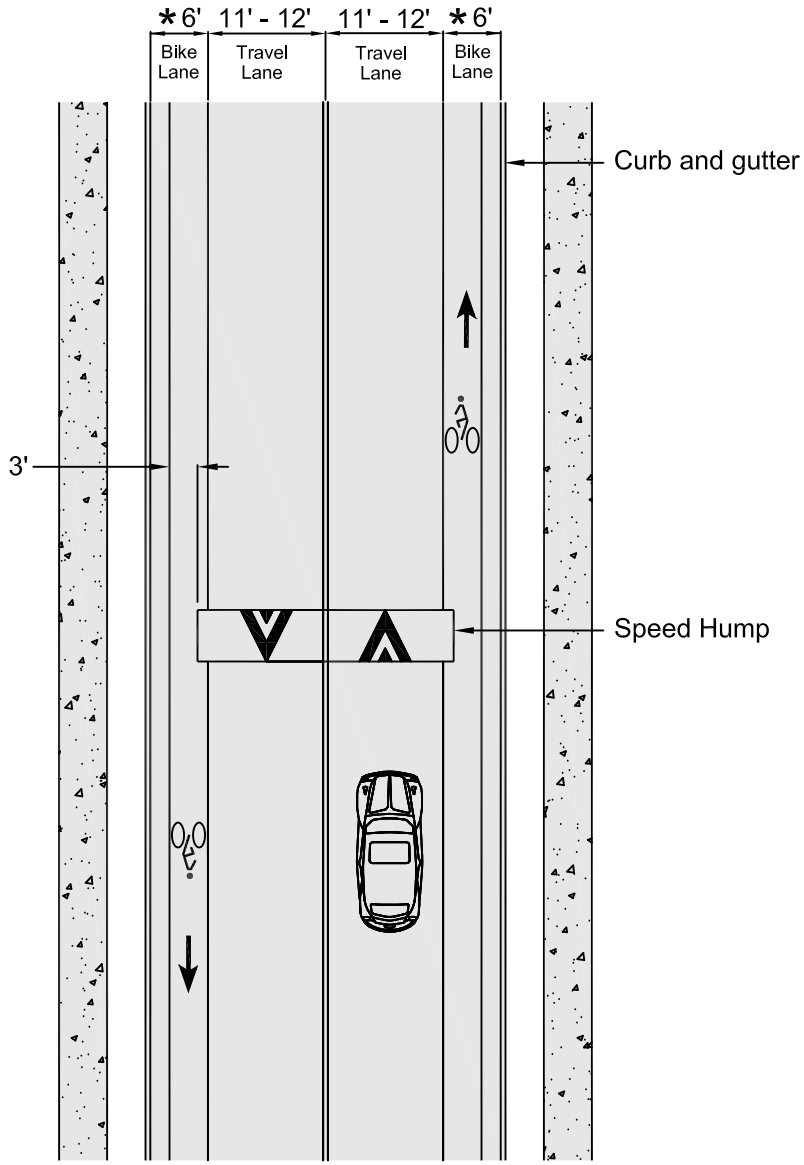
NOT TO SCALE

CITY OF MEMPHIS
DIVISION OF ENGINEERING

Typical Bike Lane Striping Through
an Intersection

DWG. NO. A12



Notes:

The striping and pavement markings shall be done with the appropriate material as directed by the City Engineer.

* The 6 feet from face of curb allows for a 4 foot bike lane and 2 foot gutter pan.

GRAPHIC SCALE

0' 20' 40'

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DIVISION OF ENGINEERING

Typical Bike Lane Striping Through an Intersection

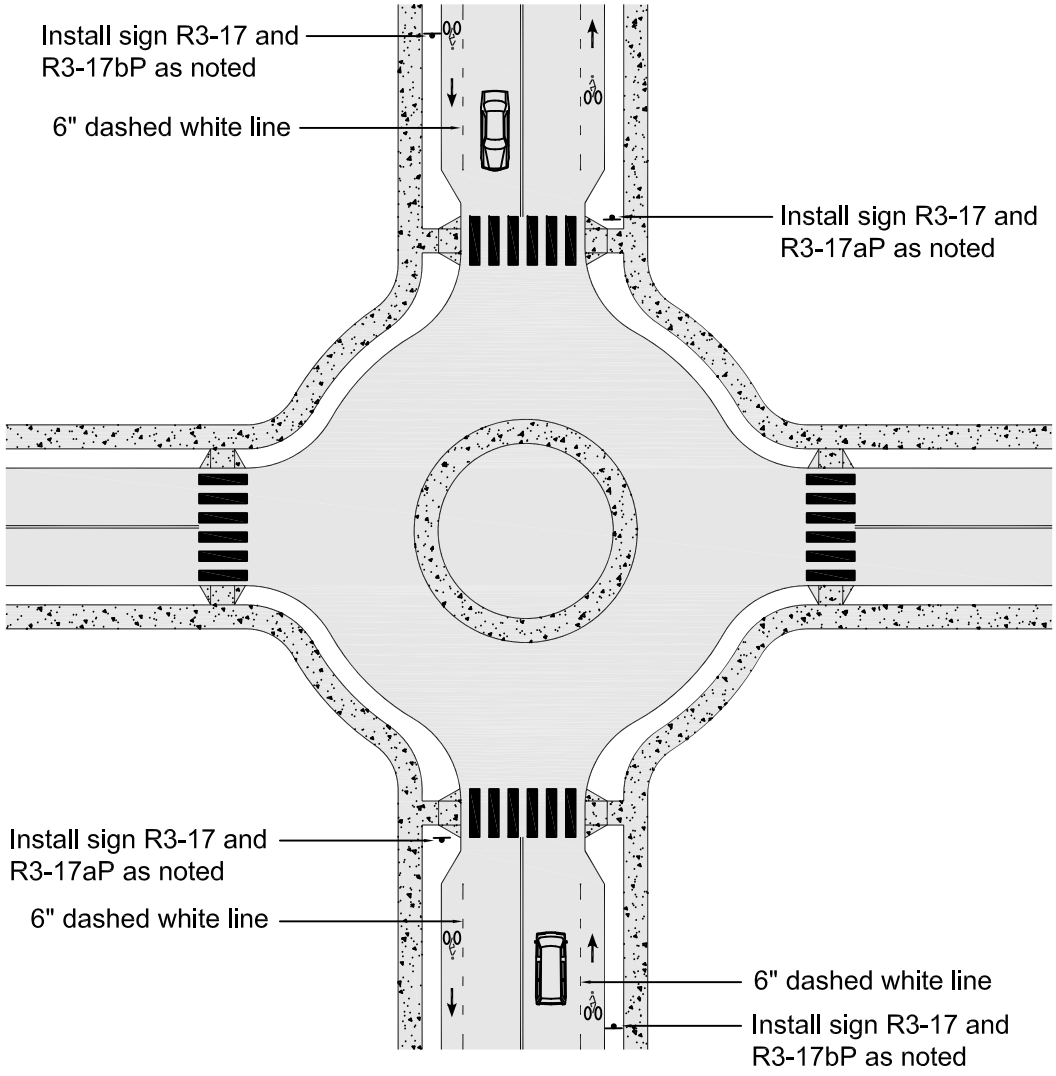
DWG. NO. A13

Signs:

Sign #: R3-17
Size: 30"x24"
Placement: Install 500' before bike lane ends and before bike lane begins.

Sign #: R3-17bP
Size: 30"x12"
Placement: Install 500' before bike lane ends with sign R3-17.

Sign #: R3-17aP
Size: 30"x12"
Placement: Install before bike lane begins with sign R3-17.



Notes:

The dashed white line should be constructed with a 2' dash and 6' spacing.

The bike lane striping should be dashed for 100' from the crosswalk and should then become a 6" solid white line.

The striping and pavement markings shall be done with the appropriate material as directed by the City Engineer.

If R.O.W. is available, a separate bike path should be constructed to allow the bicyclists to go around the outside of the roundabout without entering the motorists travel lanes.

GRAPHIC SCALE

0' 40' 80'

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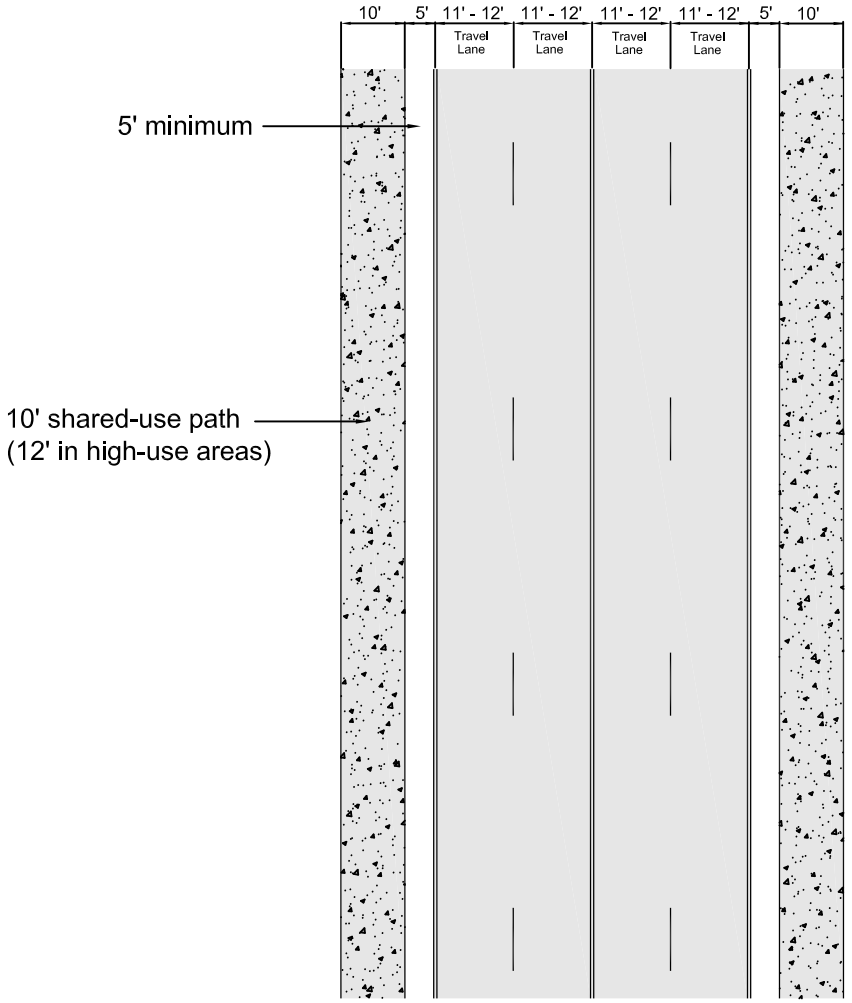
DIVISION OF ENGINEERING

Typical Bike Lane Striping Through an Intersection

DWG. NO. A14



Notes:

If the 5' minimum seperation cannot be met, then a suitable barrier should be installed.

A double yellow line can be striped on the path in the high-use areas where the path is 12' wide.

The striping and pavement markings shall be done with the appropriate material as directed by the City Engineer.

GRAPHIC SCALE

0' 30' 60'

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CITY OF MEMPHIS
DIVISION OF ENGINEERING

Typical Bike Lane Striping Through an Intersection

DWG. NO. A15

Signs:

Sign #: R1-1
Size: 18" x 18"
Placement: Install at the intersection with the road.
Color: White letters on red reflective background.

Sign #: R5-3
Size: 24" x 24"
Placement: Install at the edge of the roadway.
Color: Black letters on white reflective background.

Sign #: W11-15
Size: 24" x 24"
Placement: Install as far in advance of the crossing as possible.
Color: Black symbol on yellow reflective background.

Sign #: W11-15p
Size: 24" x 12"
Placement: Install with sign W11-15.
Color: Black symbol on yellow reflective background.

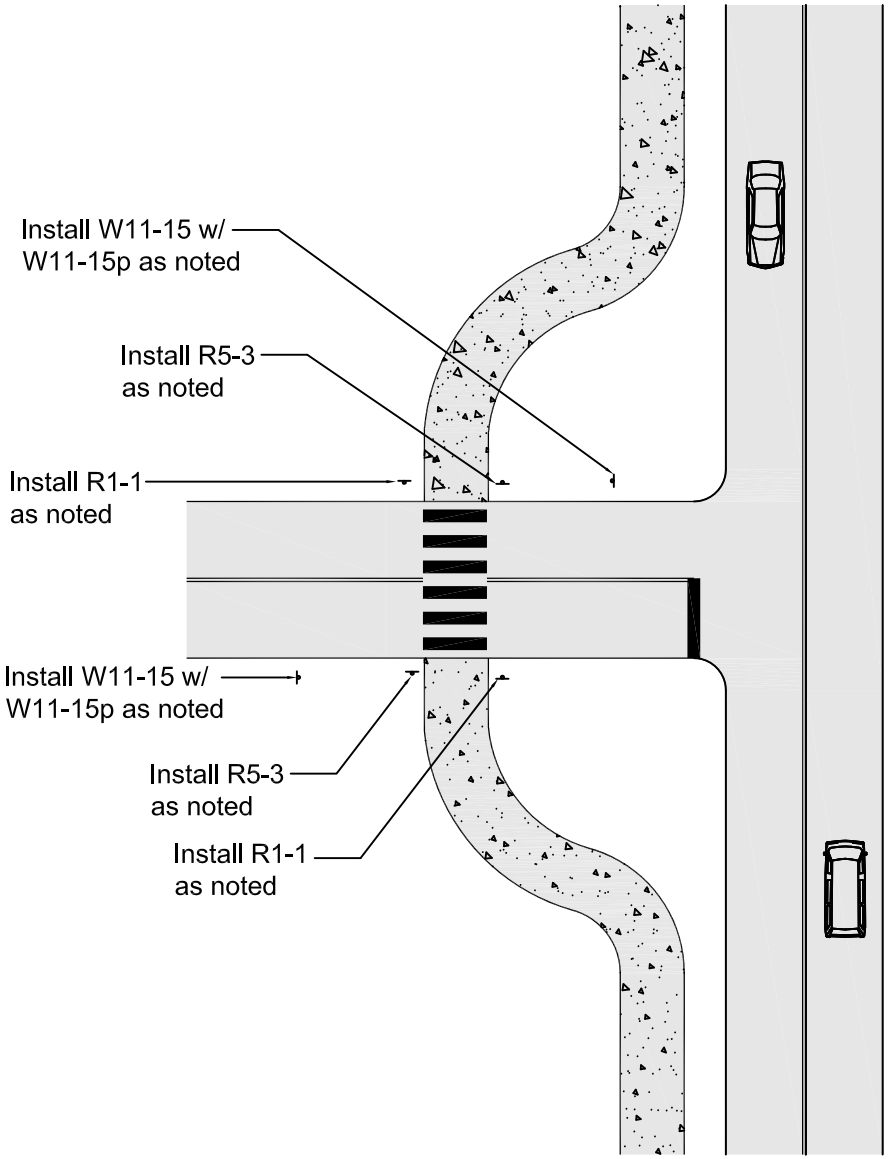
Specifications for all signs:

Source: MUTCD
Type: Highway Gothic

Notes:
The crossing should be located at least 100 feet from the intersection.

The striping and pavement markings shall be done with the appropriate material as directed by the City Engineer.

Stripe a crosswalk on the roadway where the path crosses.



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GRAPHIC SCALE
0' 30' 60'

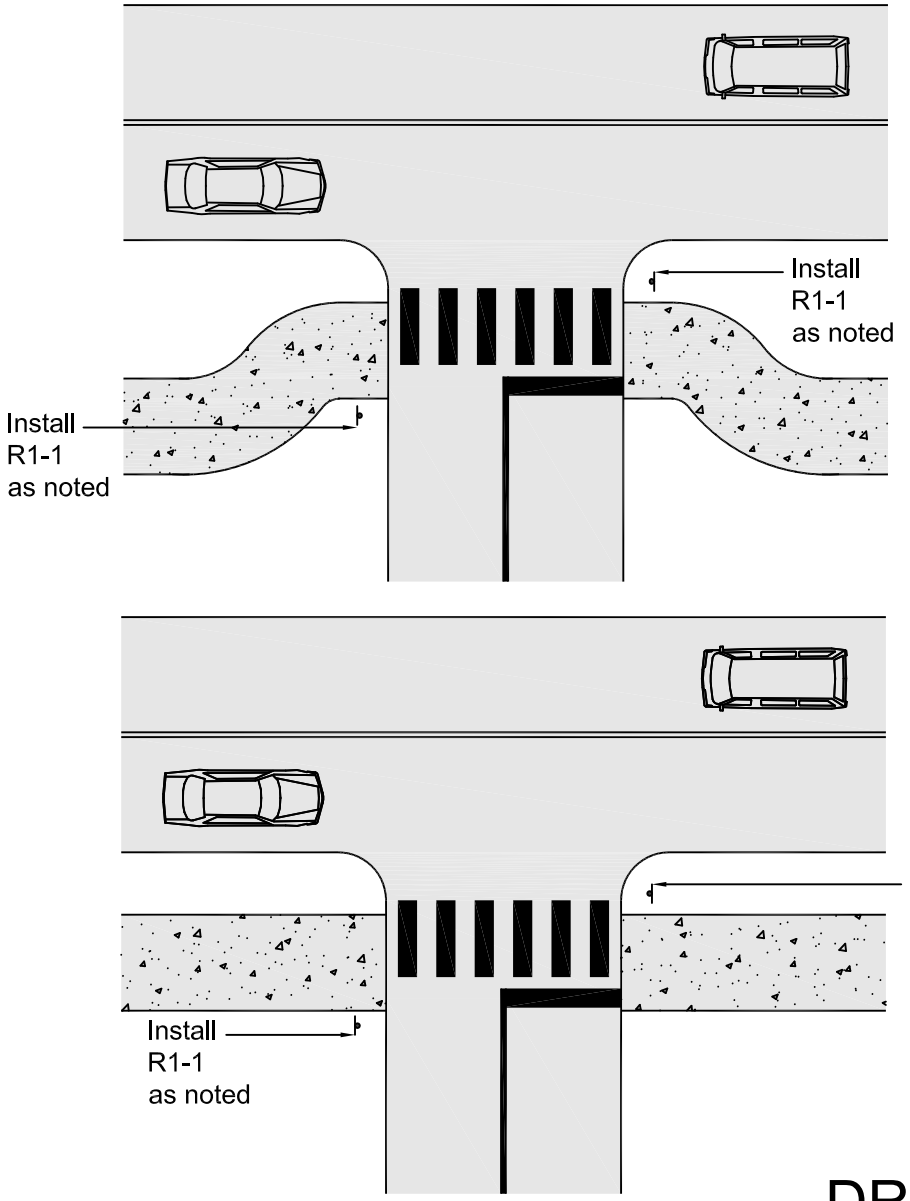
CITY OF MEMPHIS
DIVISION OF ENGINEERING

Typical Bike Lane Striping Through an Intersection

DWG. NO. A16

Signs:

Sign #: R1-1
Size: 18" x 18"
Placement: Install at the intersection with the road.
Color: White letters on red reflective background.
Type: Highway Gothic



Notes:

If the sight distance is not adequate at the intersection, then the crossing should be placed at least 100 feet from the intersection as shown in Diagram A20.

The striping and pavement markings shall be done with the appropriate material as directed by the City Engineer.

Stripe a crosswalk and stop bar on the roadway where the path crosses.

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GRAPHIC SCALE

0' 20' 40'

CITY OF MEMPHIS
DIVISION OF ENGINEERING

Typical Bike Lane Striping Through an Intersection

DWG. NO. A17

Signs:

Sign #: R3-17
Size: 30"x24"
Placement: Install every 250' (maximum).

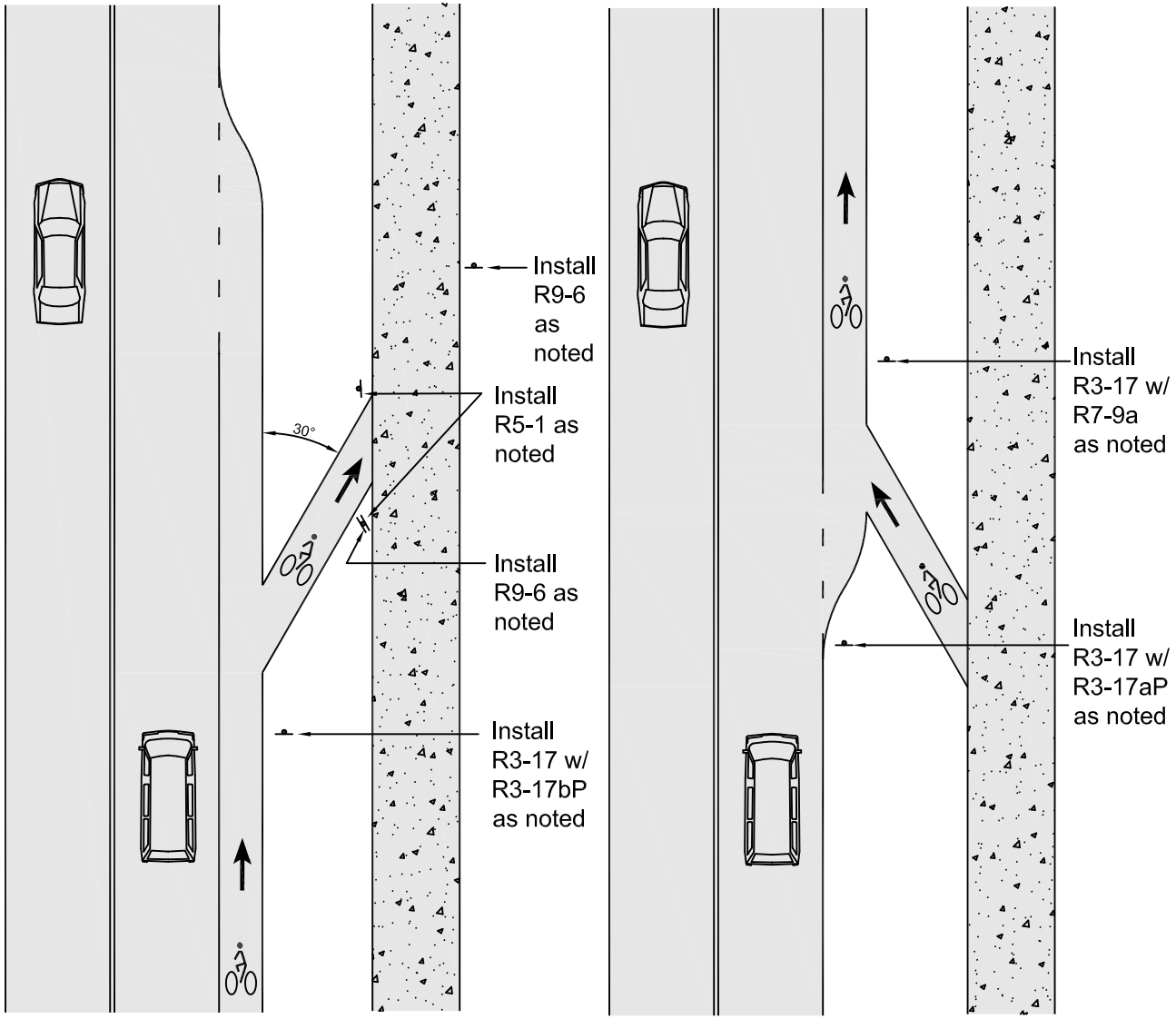
Sign #: R7-9a
Size: 12"x18"
Placement: Install at beginning of bike lane.

Sign #: R3-17bP
Size: 30"x12"
Placement: Install 100' before
bike lane ends with
sign R3-17.

Sign #: R3-17aP
Size: 30"x12"
Placement: Install 100' before bike lane begins with sign R3-17.

Sign #: R9-6
Size: 12"x18"
Placement: Install right after the bike lane merge on the shared-use path.

Sign #: R5-1
Size: 30"x30"
Placement: Install where bike lane merges on the path.
Color: Red circle on white reflective background with white letters.



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Specifications for all signs:
Source: MUTCD
Color: Black letters on white reflective background
Type: Highway Gothic

Notes:

The ramp connecting the bike lane and shared-use path should be at least 5' wide.

GRAPHIC SCALE

0' 20' 40'

CITY OF MEMPHIS
DIVISION OF ENGINEERING

Typical Bike Lane Striping Through an Intersection

DWG. NO. A18

Signs:

Sign #: W5-4a
Size: 18"x18"

Sign #: W7-5
Size: 18"x18"

Sign #: W8-3
Size: 18"x18"

Sign #: W8-10
Size: 18"x18"

Sign #: W8-10p
Size: 12"x9"

Specifications for all signs:

Source: MUTCD
Color: Black letters on yellow
reflective background
Type: Highway Gothic

Notes:

There are more signs listed in the MUTCD
for shared-use paths.

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CITY OF MEMPHIS
DIVISION OF ENGINEERING

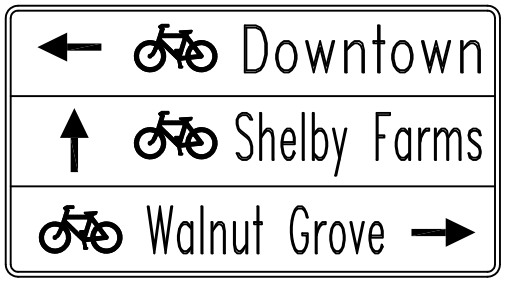
Typical Bike Lane Striping Through
an Intersection

DWG. NO. A19

Directional Signs

Sign #: D1-1
Size:24"x6"

Sign #: D1-1b
Size: 24"x6"



Sign #: D1-3b
Size: 24"x18"

Sign #: D4-3
Size: 12"x18"

Specifications for all directional signs:

Source: MUTCD
Color: White letters with
green background
Type: Highway Gothic

Construction Signs

Sign #:
Size: 30"x48"

Sign #: M4-9b
Size: 24"x30"

Sign #: M4-9a
Size: 24"x30"

Specifications for all construction signs:

Source: MUTCD
Color: Black letters/symbols on
orange background
Type: Highway Gothic

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NOT TO SCALE

CITY OF MEMPHIS
DIVISION OF ENGINEERING

Typical Bike Lane Striping Through an Intersection

DWG. NO. A20