CHAPTER 4: OTHER ON-ROAD BICYCLE FACILITIES AND CONSIDERATIONS

4.1 Shared Roadways

In Maryland, shared roadways include all roadways EXCEPT the following:

- Roadways with posted speed limits greater than 50 mph and no available shoulder for bicycle use (bicycle access is prohibited by Maryland law)
- Controlled access freeways (except where specifically allowed such as sections of US 29 in Howard and Montgomery Counties).

Many local roadways in Maryland with low traffic volumes (<1,000 ADT) and/or low speeds (≤20mph) generally do not need special bicycle provisions (such as bicycle lanes) in order to be compatible for bicycle use. These roadways operate well in their current condition for shared use. However, state-maintained roadways in suburban and urban areas of Maryland typically carry higher volumes of motor vehicle traffic and are therefore less compatible to bicycling unless paved shoulders or bicycle lanes are provided.

Figure 4.1

4.2 Share the Road Warning Signage

SHARE THE ROAD warning signs can be used to alert motorists of the presence of bicyclists in locations where conflicts between motorists and bicyclists are frequent, and where there are no immediate opportunities to provide additional space for bicyclists.

The following are examples of where SHARE THE ROAD signs may be used:

- where bicycling conditions are poor (i.e. locations with high volumes of traffic, operating speeds greater than 35 mph, no shoulder space, or poor pavement condition along roadway edge);
- areas of roadway with poor sight distance;
- transitions to shared travel lanes at the end of shoulders or bicycle lanes;
- where an obstacle prevents bicyclists from continuing on an otherwise rideable shoulder.

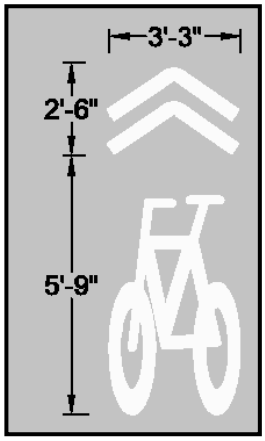


Figure 4.2 - Shared lane pavement marking

The SHARE THE ROAD sign consists of the standard W11-1 bicycle warning sign with a SHARE THE ROAD (W16-1) plaque, per the Maryland MUTCD (see Figure 4.1).

In general, SHARE THE ROAD signs should not be used in locations with good bicycling conditions, such as roadways with low traffic volumes or roads with wide paved shoulders or bicycle lanes. SHARE THE ROAD signs are not intended to designate bicycle routes. Utilizing SHARE THE ROAD signs should only be considered after consultation with SHA's Bicycle and Pedestrian Coordinator and the Assistant District Engineer for Traffic.

4.3 Shared Roadway Pavement Markings

Along urban and suburban roadways where bicycling is frequent and where it is not possible to stripe a separate bicycle lane due to width constraints, consideration may be given to providing a shared lane pavement marking.

The shared lane marking may be utilized to:

1. Help bicyclists position themselves in lanes too narrow for a motor vehicle and a bicycle to travel side by side within the same traffic lane;
2. Encourage safe passing of bicyclists by motorists;
3. Reduce the chance of a bicyclist's impacting the open door of a parked vehicle in a shared lane with on-street parallel parking;
4. Alert road users of the lateral location bicyclists may occupy; and
5. Reduce the incidence of wrong-way bicycling.

Utilizing a shared lane pavement marking should only be considered after consultation with SHA's Bicycle and Pedestrian Coordinator and the Assistant District Engineer for Traffic.

The shared lane pavement marking should be placed:

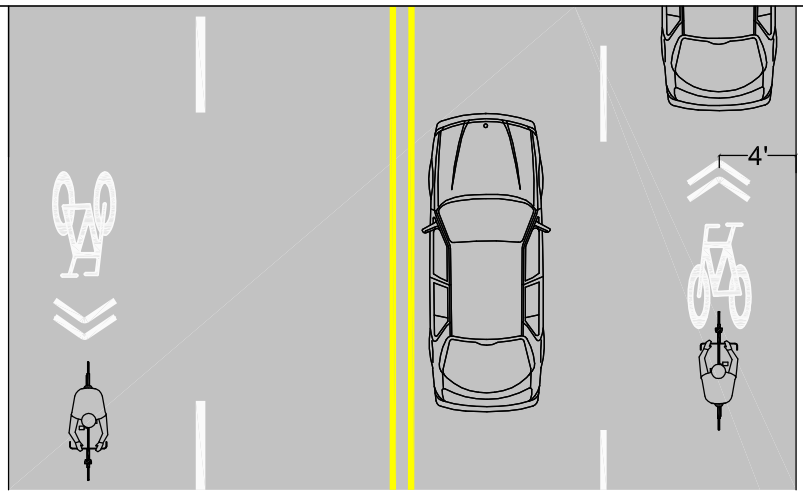
- A minimum of 11 feet from the face of the curb when used adjacent to a parking lane;
- A minimum of 4 feet from the face of curb or roadway edge when not used adjacent to a parking lane; and
- Immediately following intersections and spaced at intervals up to 250-foot thereafter;

The shared lane pavement marking shall not be placed in bicycle lanes. The shared lane pavement marking should not be placed on roadways with speed limits posted above 35 mph.

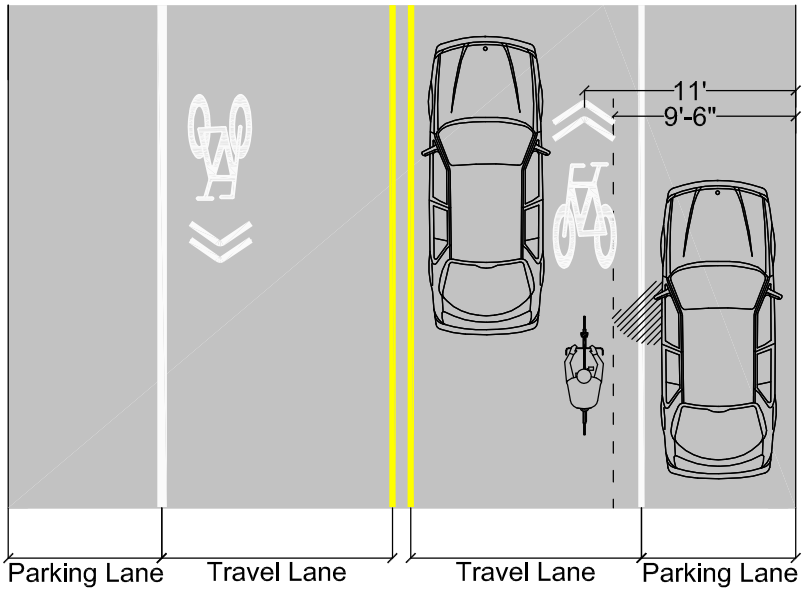
See Figures 4.3 and 4.4 for typical placement locations of the shared lane marking.

Figure 4.3 - Shared Use Lane Marking

SYMBOL PLACEMENT - NO PARKING:



SYMBOL PLACEMENT - PARKING:



SUITABLE LOCATIONS FOR SHARED LANE MARKING:

- Symbols may be used on roadways that are too narrow for bicycle lanes.
- Symbols may be used on narrow roadways to connect disconnected bicycle facilities such as bicycle lanes, designated routes, and shared use paths.
- Symbols should only be used on roadways with posted speeds less than 40 mph.

DESIGN OF SHARED LANE MARKINGS:

- Symbols shall be placed after each intersection. Symbols shall be placed no closer than every 250' thereafter.
- If used on roadways with on-street parking, symbols shall be placed so that their centers are a minimum of 11' from the adjacent curb face.
- Symbols placed in a shared lane without parking shall be placed so that their centers are a minimum of 4' from the adjacent curbface.
- Do not place symbols on lane lines.

Figure 4.4 - Example Shared Lane Marking Placement

4.4 Wide Outside Lane

Wide curb lanes are useful in situations where existing road widths do not enable re-striping for bicycle lanes or shoulders. The additional width of a wide outside lane allows more separation between bicyclists and motor vehicles than more typical 10- to 12-foot wide travel lanes.

Wide outside lanes may also be utilized for short durations to provide additional room for safe passage of bicyclist in constrained locations. An example situation of a developed bypass lane with a wide outside lane accommodation is shown on Figure 4.5.

Figure 4.5 - Wide Curb Lane

In situations where additional space is available, however, it is often beneficial to stripe a separated shoulder or bicycle lane rather than providing a wide outside lane, for two reasons:

- motorists tend to drive faster in wide lanes, therefore reducing bicyclists' level of comfort
- studies show that both motorists and bicyclists tend to act more predictably when bicycle lanes (or paved shoulders) are provided instead of a wide curb lane (Hunter et al, 1999)

Notwithstanding these shortcomings, there are situations where wider lanes are the only type of bicycle accommodation that is feasible, particularly in areas with right-of-way constraints.

4.5 Shared Bus/Bicycle Lanes

Shared Bus/Bicycle lanes are typically wider than the standard 11-foot lane. Bus/bicycle lanes have been used in Maryland (in Ocean City), the District of Columbia, and other parts of the country, however due to the conflicts inherent in this type of facility, it shall only be considered in consultation with SHA'S Bicycle and Pedestrian Coordinator.

Figure 4.6 - Example Climbing Lane

4.6 Bicycle Climbing Lanes

Bicycle climbing lanes are a hybrid bicycle facility that includes a five-foot bicycle lane on one side of the roadway (in the uphill direction) and a shared lane pavement marking on the other side of the roadway. See figure 4.6 for an example of a climbing lane facility.

Climbing lanes allow slower-moving, uphill bicyclists to have a designated bicycle lane space, therefore facilitating easier passing by motor vehicles. They also allow faster-moving bicyclists on the downhill slope to share the lane with motor vehicle traffic, which is appropriate because the speed differential between motorists and bicyclists is not as great. A shared lane marking is provided on the downhill slope, which helps make motorists be aware that the faster-moving bicyclists are more likely to merge into the travel lane. The bicycle lane and shared lane pavement markings also indicate the proper direction for bicyclists to travel on either side of the street. This type of facility may be particularly useful on roadways where the existing lanes are not wide enough to accommodate two full width bicycle lanes.

4.7 Railroad Crossings

At diagonal at-grade railroad crossings, the gap next to the rail (called the "flangeway") can trap the front wheel of a bicycle, thereby causing a bicyclist to crash. This problem is generally a concern in locations where the rails intersect with the roadway at an angle less than 45 degrees to the direction of travel.

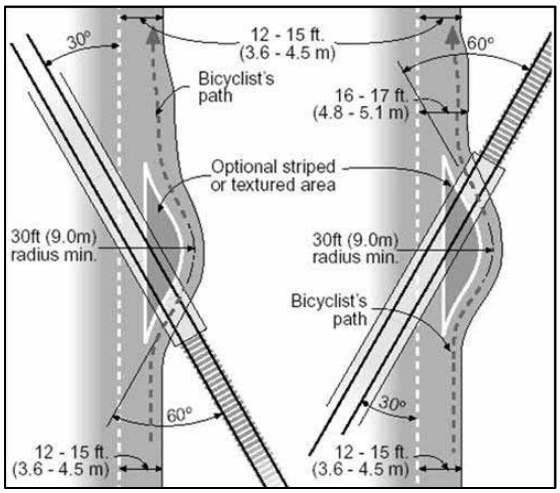


Figure 4.7 - Railroad Crossings
Source: Oregon DOT

Figure 4.8 - Skewed Railroad Crossing Madison, WI

In locations where this condition is present, the bicycle lane or shoulder should be designed so as to enable the bicyclist to approach the track at an angle closer to 90 degrees, but not less than 60 degrees, without having to swerve into motor vehicle travel lanes. The width of the dimensions of the widened area will be dependent upon the skew of the railroad tracks relative to the bicyclist crossing point. The crossing surface should extend a minimum of 3-feet beyond the right edge of the bicycle lane or shoulder. It is important that the bicyclist is given sufficient space on the approach and the departure of the crossing to safely transition back to the traveled way. An example of this widening treatment is shown in Figures 4.7 and 4.8.

Figure 4.9: Skewed Railroad Crossing Warning Sign (W10-12)

In locations where a retrofit may not be feasible or where the retrofit may not occur for a period of time, the W10-12 warning sign should be utilized to warn bicyclists of this skewed crossing. See figure 4.9 for an example of this sign.

4.8 Bicycle Detection and Signal Timing at Intersections

At signalized intersections where bicycle traffic exists or is anticipated (i.e. if it is designated in a local plan as an existing or proposed bicycle facility), consideration shall be given to bicyclists in the timing of the traffic signal, and in the method of detecting the presence of bicyclists.

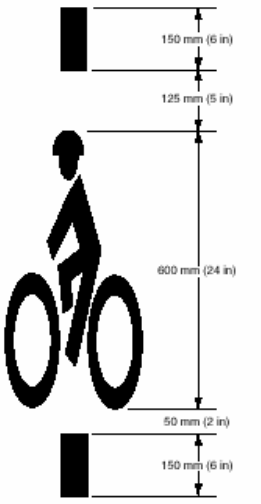


Figure 4.10: Bicycle Loop Detector Marking Symbol
Source: MD MUTCD

Loop detectors should be designed to respond to the presence of bicyclists. A number of bicycle-sensitive loop detector configurations are available and should be provided at intersections that serve bicyclists (see ITE's *Manual of Traffic Detector Design* for more information). For traffic signals where bicyclists are having difficulty being detected, a

temporary solution is to mark the spot along the loop where a bicyclist should stand in order to trip the signal. The Maryland MUTCD provides a pavement marking and a sign that can be used for this purpose (see Figure 4.9 and photo in Figure 4.10).

Figure 4.11 - Bicycle Loop Detector Marking
Photo source: Dan Burden

The Maryland MUTCD requires that visibility-limited signal faces be positioned so that bicyclists can see the signal indication. If they cannot, then separate signal faces should be provided for bicyclists.

The needs of bicyclists should also be considered during signal timing. The greatest risk to bicyclists traveling through intersections is during the clearance interval and during actuated phases during periods of low traffic flow. Signals should be designed to provide an adequate clearance interval for bicyclists who enter the intersection at the end of the green phase. The AASHTO Guide for the Development of Bicycle Facilities provides the following formula to determine the clearance interval needed to accommodate bicyclists:

$$y + r_{clear} \geq t_r + \frac{v}{2b} + \frac{w + l}{v}$$

Where:

y	= yellow interval(s)
r_{clear}	= red clearance interval(s)
t_r	= reaction time (1.0 s)
v	= bicyclists speed (mph)
b	= bicyclists braking deceleration (4 to 8 ft/s^2)
w	= width of crossing (ft)
l	= bicycle length (6 ft)

Signals should also be designed to provide a total crossing time long enough to accommodate bicyclists starting up on a new green phase. When an intersection approach receives a green signal, the bicyclist needs enough time to react, accelerate, and cross the intersection. The amount of time needed is calculated with the following equation also from the AASHTO Guide:

$$g + y + r_{clear} \geq t_{cross} = t_r + \frac{v}{2a} + \frac{w + l}{v}$$

Where:

g	= minimum green (s)
y	= yellow interval (s) actually used
r_{clear}	= red clearance interval (s) actually used
t_{cross}	= time to cross intersection (s)
t_r	= reaction time (2.5 s)
v	= bicyclists speed (mph)
b	= bicyclists braking acceleration (1.5 to 3 ft/s^2)
w	= width of crossing (ft)
l	= bicycle length (6 ft)

4.9 Pavement Quality - Asphalt and Concrete Joint Lines

Careful consideration should be given to the placement of asphalt joint lines and concrete expansion joints. This is typically a problem on roadways where a concrete joint is located at or near the most appropriate place for bicyclists to ride (typically on the right side of the outside travel lane near on-street parking). The bicycle tire can become trapped within the joint, causing the bicyclist to crash. The placement of concrete joints should be considered during design to locate it away from the portion of the roadway where bicyclists are most likely to travel. Existing joints should be filled with an appropriate filler to reduce the chance of a bicycle crash.

Figure 4.12 - Poor concrete seam placement

Concrete joints should not be placed in locations with parking between 6' and 9' from the curb or roadway edge. See figure 4.12 for an example location where the concrete expansion joint is placed within the bicycle riding area.

Unpaved Driveways

Unpaved driveways should be paved 15 to 20 ft from the roadway edge to reduce gravel and dirt debris deposited onto shoulders and bike lanes.

Figure 4.13 - Guardrail placed too close to edge of roadway

4.10 Guardrails and Barriers

The location of guardrails and barriers along roadside edges should follow the requirements established within the Roadside Design Guide. In locations where bicyclists ride along the shoulder or edge of the travel lane, and where the offset recommendations of the roadside design guide can not be met, the designer should strive to provide a minimum offset of 2 feet from the roadside edge to the face of the guardrail or barrier to provide a comfortable shy distance to the bicyclist. See figure 4.13 for an example of a guardrail placed too close to the shoulder edge.

4.11 Storm Drain Grates

Storm grates pose a hazard for bicyclists when the openings are parallel to the bicyclists' direction of travel. Bicycle tires can get caught between the bars of these grates, and cause bicyclists to crash. Non-bicycle friendly drain grates should be replaced with one of the following types (Figure 4.14). The following Maryland Standard drain inlets are of a bicycle friendly design: MD-374.02-374.27 (standard WR/WRM/NR/NRM inlets).

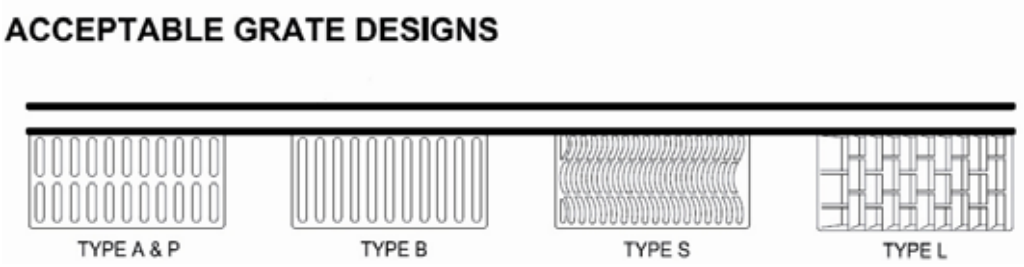


Figure 4:14: Acceptable Grate Designs. *Source: City of Baltimore Bicycle Facility Design Toolkit*