# CHAPTER 6: SHARED USE PATHS

## 6.1 Introduction

National guidelines for the design of shared use paths are provided in AASHTO's *Guide for the Development of Bicycle Facilities* (1999 or latest edition). This guide offers a great deal of information to path designers, and should be referenced in addition to the text in this chapter.

Shared use paths are physically separated from motorized vehicular traffic by an open space or barrier and are located either within the highway right-of-way or within an independent right-of-way. Shared use paths may also be used by bicyclists, pedestrians, skaters, wheelchair users, joggers, and other non-motorized users (AASHTO, 1999). Shared use paths should not preclude the installation of on road bicycle facilities. They should serve as complement to the roadway transportation system, and not as a substitute for roadway access.

## 6.2 Design for Accessibility

The Americans with Disabilities Act (ADA) "prohibits public entities from designing new facilities or altering existing facilities, including sidewalks and trails, that are not accessible to people with disabilities (FHWA, 2001)." Shared use paths should comply with the Office of Highway Development's guidelines set forth in SHA's Accessibility Policy and Guidelines for Pedestrian Facilities along State Highways.

The design for accessibility should also be applied to all connections to the shared use pathway including parking lots, neighborhood connectors, adjoining roadways, and adjoining facilities (rest stops, buildings, restrooms, etc.).

## 6.3 Path Cross Section

Shared use paths should be designed with consideration given to the volumes, various speeds and space requirements of different user groups. Generally, shared use paths should be designed with a minimum cross section of 10 feet with 2 foot shoulders (Figure 5.1). This will enable the path to operate as a two way facility with a center passing lane. In areas where high volumes of pathway users are anticipated (such as in urban areas near major origin and destination zones), 12-14 foot widths are recommended. In areas where pedestrian activity is expected to be light, such as in rural areas, an 8 foot wide path is acceptable. Eight-foot wide paths are generally not acceptable in suburban or urban areas.

In extremely constrained conditions where a pinch-point (below 8 feet in width) is unavoidable, warning signage should be provided in advance to notify bicyclists that the pathway narrows ahead (per the MUTCD).

Trail users generally co-exist on shared use paths without requiring separate lanes for pedestrian versus bicycle traffic. For pathways in an extreme urban environment where it is possible to provide a separate parallel facility for pedestrians, this may help to reduce conflicts.

## 6.3 Shared Use Paths Adjacent to Roadways (Sidepaths)

The AASHTO *Guide for the Development of Bicycle Facilities* (1999 edition) makes a number of specific statements that recommend against providing shared use paths directly adjacent to the road (a facility that is often termed a "sidepath"). Despite these statements, sidepaths are widely used throughout Maryland and the U.S. Due to a number of safety reasons detailed

below, sidepath design must be done with a high level of care and attention to the safety of all users, and the recognition that a sidepath is not the appropriate design solution for some locations.

Sidepaths that are located immediately adjacent to roadways create particular conflicts between bicycles and motor vehicles as intersections and driveways. Studies have shown a higher crash risk among bicyclists using sidepaths. A 1994 study compared crash statistics with riding location and exposure (bicycle volume counts) and found that riding on a sidewalk, even with the direction of motor vehicle traffic, put the bicyclist at nearly double the risk of a crash than if they were riding within the roadway. This same study showed that a bicyclist who rides against traffic flow, regardless whether he/she is in the roadway or on the sidewalk, has a 3.6 times greater risk of a crash (Wachtel and Lewiston, 1994).

The issue of providing sidewalk bikeways (or sidepaths) is also affected by Maryland State Law, which prohibits the use of bicycles on sidewalks except where allowed by local ordinance (Maryland Code, Title 21, Section 21-1103).

In locations with frequent driveways and intersections, sidepaths are not recommended. In urban and suburban areas, where a path parallels the roadway, some cyclists may opt to use the roadway rather than the path. For this reason, provisions to accommodate on-road bicyclists should also be made.

Exceptions to this may exist in some urban areas, where one-way streets require that two-way bicycle facilities be constructed on one side of the roadway. These are unique facilities that require engineering judgment.

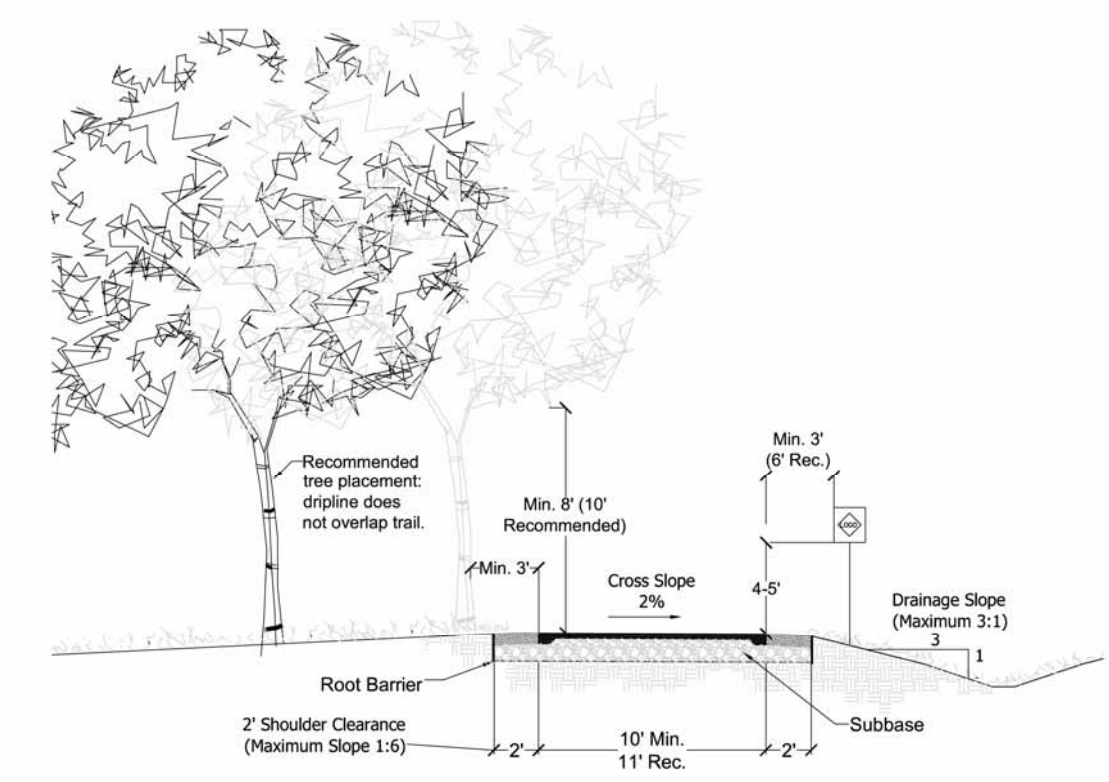



**Figure 6.1 –** Typical Shared Use Path Cross Section

The most critical design issues for sidepaths are the following:

- Reduced speeds at intersections and driveways: geometric design measures (such as tighter corner radii) should be employed to ensure that motorists' speeds are at or below 10 mph at the point of intersection with the pathway. Bicyclist speeds should also be slow at intersections and driveways (at or below 8 mph).
- Clear sight distances: per Figure 6.4, both motorists and bicyclists should have a clear and unobstructed view of each other at intersections and driveways.
- Adequate warning signs at intersections for roadway and trail users: motorists and bicyclists should be adequately warned of upcoming conflict zones.
- Clear assignment of right-of-way: it is very important to ensure that trail users and motorists are not given conflicting messages about which party has the right-of-way at intersections. For example, if pedestrian signalheads are used to indicate the right-of-way, stop signs on the trail shall not be used.

**6.4 Surface**

The surface of the trail should typically be of asphalt. In some circumstances it may be appropriate to construct the path with a soft surface where the primary uses are mountain biking, horseback riding or running. Soft surface trails are generally not recommended in areas prone to flooding or where steep grades would cause the erosion of the trail surface.

The surface should be designed to withstand the loads transferred by the heaviest maintenance vehicle intended to travel along the pathway.

**Figure 6.2** - Poorly designed trail surfaces will not support maintenance vehicles.

**6.5 Shoulders**

Two-foot wide graded shoulders should be provided along the entire length of the path unless right of way is constrained. The shoulders should typically be of some soft material to serve walkers and runners who prefer soft surfaces.

**6.6 Trees Adjacent to Pathways**

Trees can add value to the experience of using a trail. They provide shade for pathway users during summer months, and help to absorb stormwater runoff. As shown in Figure 6.1, the minimum distance between the edge of a trail and an adjacent tree is 3 feet. In general, weaving around trees in order to avoid removing them is not recommended, for two reasons:

1) The necessary excavation to form the subbase of the trail often does serious damage to tree roots, leading to the slow decline and eventual death of the tree.
2) Sharp kinks and curves in the trail around trees create blind spots which can cause crashes and conflicts between pathway users.

A better approach is to carefully lay out the trail to maximize protection of healthy specimen trees, and to remove trees when necessary to ensure the safety of trails users.

In locations where trees (such as street trees) are planted adjacent to the trail, root barriers should be provided as necessary to prevent trail deterioration (typically pavement cracking

and heaving). Roots encountered during construction should be cleanly cut and completely removed from beneath the trail surface before placing the root barrier.

### 6.7 Thickened Pavement Edge

Consideration should be given to providing a thickened pavement edge along trails that will serve as service roads for maintenance vehicles. Trail edges can be damaged when service vehicles are allowed to enter or exit the trail at undefined locations. The edge should be designed to handle the point load of the heaviest expected vehicle wheel that will enter/leave the trail to the adjoining property.

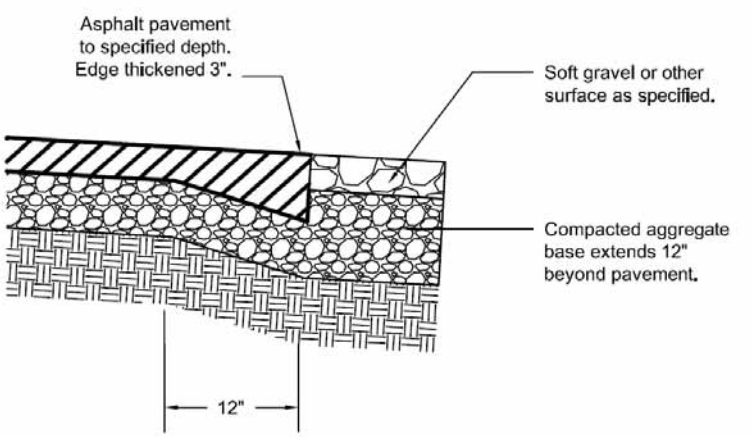



**Figure 6.3** – Example Thickened Pavement Edge

### 6.8 Design Speed

In general, shared use trails should be designed for speeds of 20 mph or lower. In urban areas, speeds should be limited to 12 mph or lower to minimize conflicts between different types of users.

### 6.9 Horizontal Alignment

The design horizontal radius of a trail is based upon the angle at which bicyclists lean when cornering to enable them to turn comfortably at speed. In general, bicyclist can not lean beyond 25 degrees without crashing. Most riders lean at an angle between 15 - 20 degrees.

The design horizontal radius also needs to provide for adequate sight distance around obstructions to facilitate safe use of the path by bicyclists traveling at the design speed. See the sight distance discussion and the AASHTO guide for further information.

The minimum horizontal radius for a curve, based on a lean angle up to 15 degrees can be found by the following formula:

$$R = \frac{0.067\ V^2}{\tan \theta}$$

Where:

R = Minimum radius of curvature (ft)
V = Design speed (mph)
θ = Lean angle from the vertical (degrees)

The minimum horizontal radius for a curve, based on a lean angle between 15 and 20 degrees must factor in the coefficient of friction between the tire and the trail as well as the

superelevation of the trail. ADA requirements limit the rate of superelevation to a maximum of 2 percent. The minimum horizontal radius for a curve can be found by the following formula:

$$R = \frac{V^2}{15\left(\frac{e}{100} + f\right)}$$

Where:
R = Minimum radius of curvature (ft)
V = Design speed (mph)
e = Rate of path superelevation (percent)
f = Coefficient of friction (see table at below)

**Friction Factor Table – On Pavement**

| Speed | Friction Factor |
|---|---|
| 12 mph | 0.31 |
| 20 mph | 0.28 |
| 25 mph | 0.25 |
| 30 mph | 0.21 |

**6.10 Vertical Alignment**

Cross slopes on shared use paths should not exceed 2%. For pathways adjacent to roadways, the pathway generally follows the roadway profile. For pathways in independent rights-of-way, care should be given to ensure that the cross slope does not create a drainage problem on one side of the pathway.

Running grades should be kept to minimum to provide for maximum accessibility. In general, grades should be restricted to a maximum of 5% to reduce the strain on ascending bicyclists and the speeds of descending bicyclists.

Every effort should be made to ensure running grades are kept within ADA guidelines on shared use paths. In limited circumstances where achieving these grades would be prohibitively expensive or would denigrate a unique natural environment, exceptions can be made to running grade requirements. Making such an exception does not eliminate the responsibility to meet ADA guidelines on all other aspects of trail design. The following steps should be taken to mitigate steeper grades in these situations:

- Provide flat landings with benches to enable trail users to stop and rest if necessary
- Provide hand rails on the sides of the trail
- Widen the trail to allow more space for slower users
- Provide an alternative accessible route and use signage to direct people with physical disabilities to the route

Steep downgrades *are not* recommended at roadway intersection approaches. Every effort should be made to keep intersection approaches at or below a 5% slope in order to reduce the possibility of a bicyclist or other wheeled user losing control and crashing into the intersection.

For situations where a steeper grade is unavoidable the following guidelines are provided by AASHTO:

| Percent Grade | Maximum Length |
|---|---|
| 5-6% | 800 feet |
| 7% | 400 feet |
| 8% | 300 feet |
| 9% | 200 feet |
| 10% | 100 feet |
| 11+% | 50 feet |

**6.11 Sight Distance Requirements**

Bicyclists must have time to react to other pathway users (walkers, bicyclists, dogs…etc.), intersecting road and pathway users (cars, pedestrians…etc.), and physical objects (bridges, walls, poles…etc.). Bicyclists brake reaction and perception time has been found to be about 2.5 seconds. Bicyclists' eye height has been assumed to be 4.5 feet from the ground surface. The following formula calculates the required minimum stopping sight distance for bicyclists:

$$S = \frac{V^2}{30\,(f \pm G)} + 3.67V$$

Where:
S = Stopping sight distance (ft)
V = Design speed (mph)
G = Grade (ft/ft)
f = Coefficient of friction (use 0.25)

For stopping sight distance based on grade, see the most recent version of the AASHTO *Guide for the Development of Bicycle Facilities*.

Motorists should be given time to react to pathway users who may unexpectedly enter the roadway environment. For paths located parallel to roadways, the motorists should be provided enough clear sight distance to be able to react and stop when turning across a pathway.

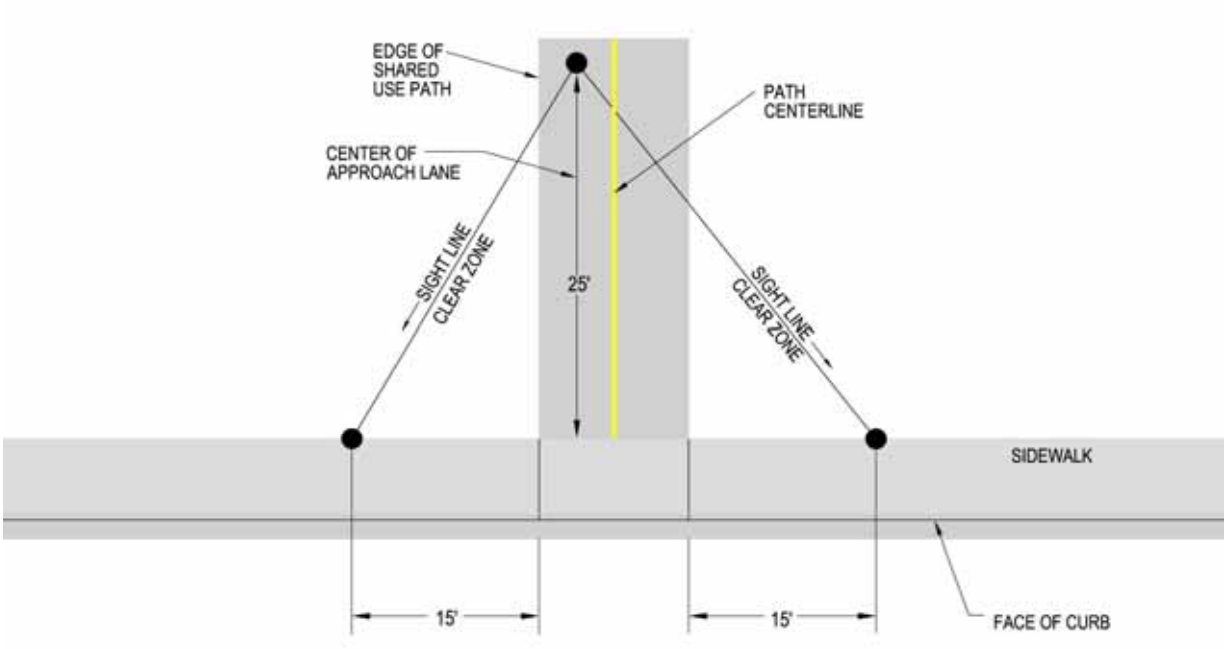



**Figure 6.4** – Minimum Sight Distance Triangle at an Intersection with a Sidewalk

A minimum sight distance allowance should also be provided at the intersection of pathways with adjoining sidewalks. The clear zone space will enable pedestrians approaching the pathway to see oncoming bicyclists who may or may not be stopping. This will increase safety for both groups approaching the intersection. This clear zone will also create a decision making space for bicyclists to look for oncoming vehicular traffic to make the determination whether to stop, yield, or proceed across the intersection. See Figure 6.4.

### 6.12 Shared Use Path Pavement Markings and Signs

Signing and marking of shared use pathways should follow the Maryland MUTCD. Section 9 of the Maryland MUTCD provides for specific signs and pavement markings to be utilized for pathways.

To differentiate shared use pathway crossings from pedestrian crosswalks, the designer shall utilize the shared use pathway crosswalk striping pattern shown in Figure 6.5.

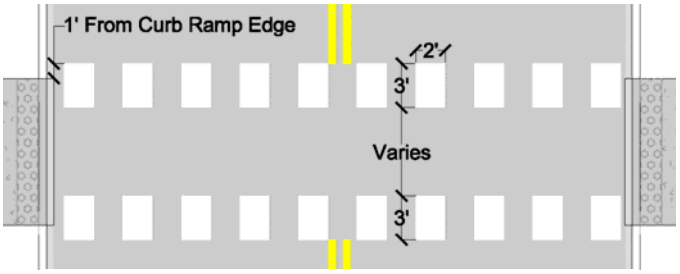



**Figure 6.5** – Shared Use Pathway Crosswalk Striping

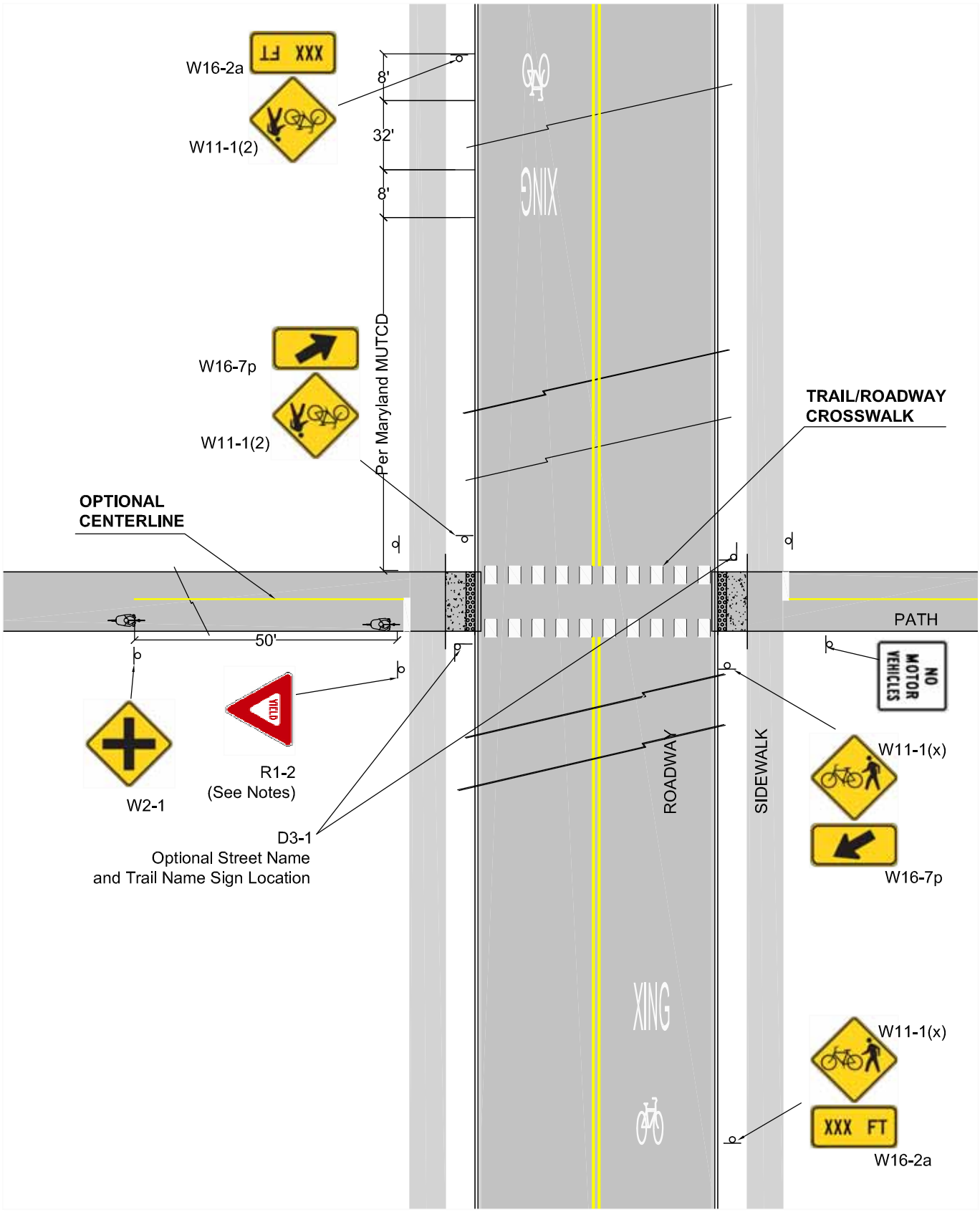
### 6.13 Shared Use Path Intersection Design

Trail/roadway intersections can present dangerous conflicts for trail users if not carefully designed. For at-grade intersections, there are several objectives:

- Site the crossing at a logical and visible location (see previous discussion of sight distances).
- The appropriate type of traffic control devices should be installed, based on the dynamics of each intersection. Refer to Section 9B.03 of the MUTCD for guidance on determining right-of-way (for example, where trail traffic exceeds the amount of motor vehicle traffic on the crossing street, consideration should be given to assigning right-of-way priority to trail users). In general, the least restrictive traffic control device should be used.
- Adequately warn motor vehicles and trail users if the intersection is unexpected.
- Maintain visibility between trail users and motorists.

In addition, standard street signs (indicating the name of the street and name of the trail) should be provided at trail/roadway intersections in order to assist in navigation. Other types of wayfinding signage may also be needed to direct trail users to nearby destinations (see Chapter 5).

Figure 6.6 shows an example of a Shared Use Trail at a midblock intersection.




**DESIGN OF SHARED USE PATH AT MIDBLOCK INTERSECTION:**

- Advanced Warning Sign placement and W16-2a plaque distance based upon table 2C-4 in the Maryland MUTCD for Condition B at 10 mph at the crosswalk
- Traffic control should be based upon an engineering evaluation. This is an example of one type of traffic control.

**Figure 6.6 -** Shared Use Path at Midblock Intersection

**Median Refuge at Pathway Crossings**

In locations with longer crossing distances (i.e more than two lanes) and/or higher vehicle speeds, median refuges can be used to benefit trail users. In particular, median refuges have been shown to increase safety for pathway users crossing multi-lane roadways at un-signalized crossings (Zegeer et al, 2002). The median should be constructed at minimum 30 degree angle to force the users to turn their bodies towards traffic to facilitate eye contact with vehicular traffic.

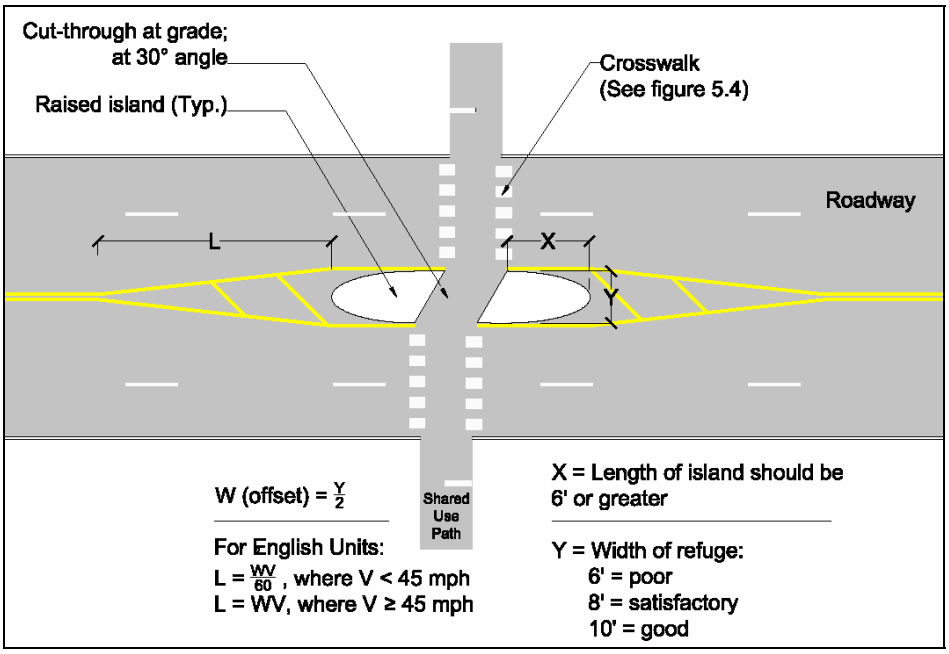



**Figure 6.7** – Median Refuge Design at Pathway Crossing

**Bollard Use at Intersections**

The use of bollards should be avoided whenever possible due to the hazards they create for bicyclists and other trail users who may crash into them, or otherwise crash when trying to avoid them. The term "bollard" in this section includes other devices (such as fences, boulders, etc.) that are used to prevent unauthorized motor vehicle access to the trail.

Whenever trails extend along and within full view of roadways, bollards should not be used. Bollards should only be used on off-road trail corridors and only in cases of known unauthorized motor vehicle entry where education and enforcement activities have failed to solve the problem.

Bollards should provide at least 5 feet of space for one-way trail traffic to pass. This enables wheelchair users, tandem bicycle riders, and bicycles towing trailers to pass. Separate passages at least 5 feet in width should be provided for each direction of travel (see Figure 6.8). Bollards should not be installed in locations where unauthorized motor vehicle traffic can still gain access to the shared use path. Bollards can not be used to prevent unauthorized entry by motorcycles and other types of motorized cycles because they will also prevent legitimate use by bicyclists and other non-motorized users.

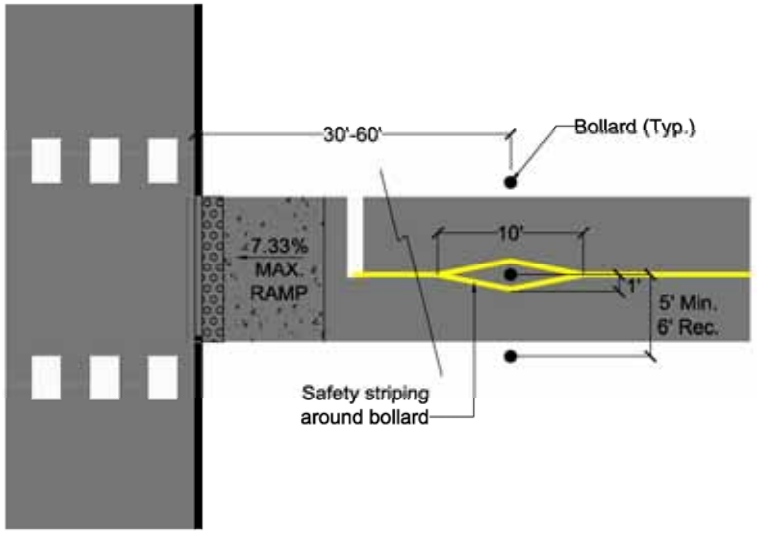



**Figure 6.8** – Bollards at an intersection

If bollards are used, they should be a bright color and reflective to ensure both day and nighttime visibility. Safety striping should accompany the bollard, per Figure 5.10. Bollards should never be placed in the center of a travel lane. Removable bollards can be used to allow access by maintenance and emergency vehicles. Handles on removable bollards should not be placed in such a way to further restrict clearance between bollards.

**Path Widening at Intersections**

For locations where queuing at an intersection results in crowding at the roadside edge, consideration should be given to widening the trail throat. The curb ramp should span the entire trail width. This can be utilized to increase crossing capacity and it will help reduce conflicts at the path entrance (see Figure 6.9).

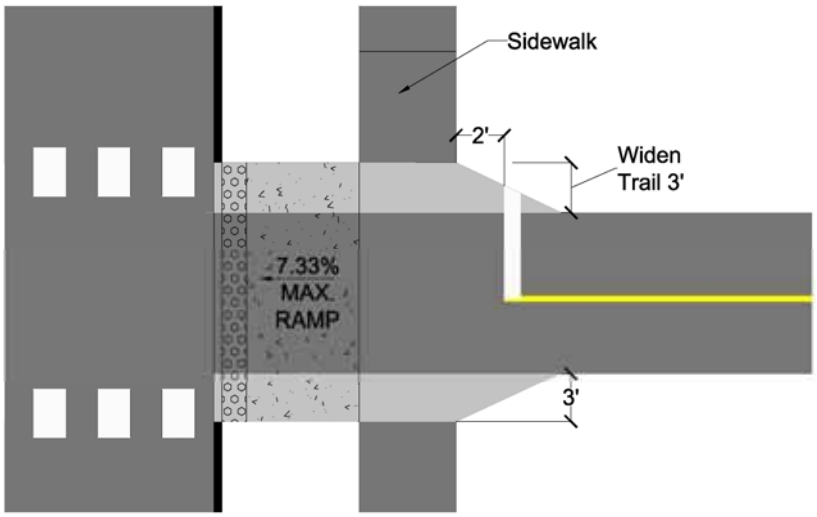



**Figure 6.9** – Path widening at an intersection

**Intersection Warning Rumble Strips**

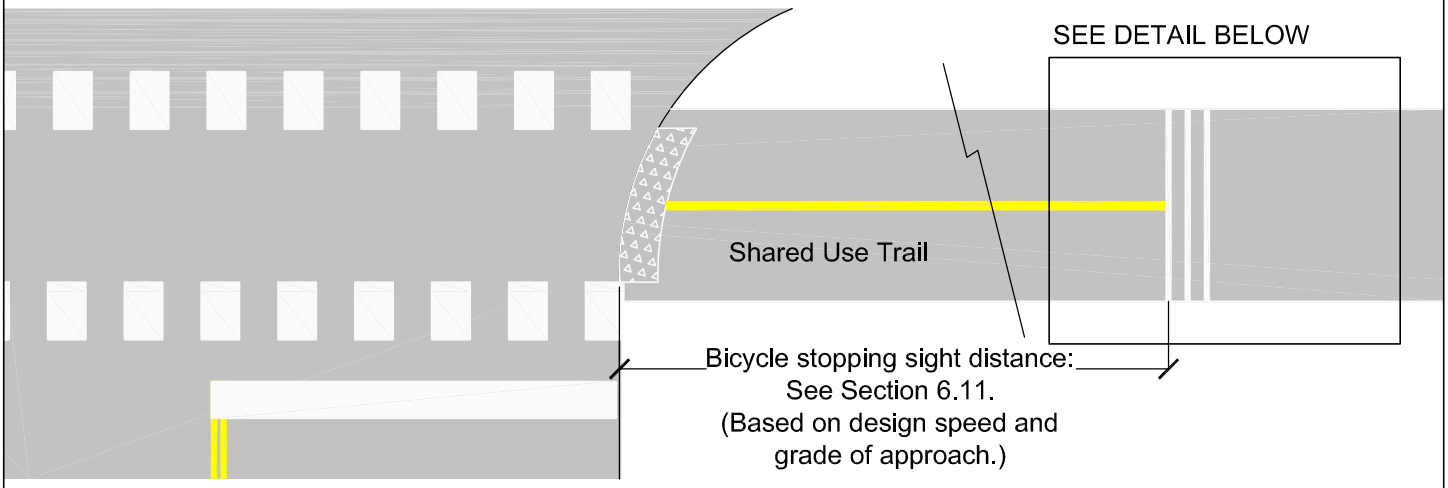
Figure 6.10 shows rumble strips that may be used on shared use trails to alert users that they are approaching an unexpected roadway intersection. Narrow thermoplastic tape or other similar material that causes a *gentle* vibration should be used (height of material should be no greater than 0.2 inches from the surface of the pavement).

The use of rumble strips should be limited to locations where there is a known safety issue, such as at intersections at the bottom of hills, at uncontrolled, midblock intersections, or in the case of a trail running parallel to a roadway, where the intersection has numerous turning movements. Engineering judgment should be used to determine when the use of rumble strips is appropriate.

**Trail Curb Ramps at Roadway Intersections**

Curb ramps should be constructed of a contrasting color to alert trail users to an approaching roadway intersection. The curb ramps should extend the full width of the trail and they shall meet ADA requirements as outlined in SHA's *Accessibility Policy & Guidelines for Pedestrian Facilities along State Highways*.

## PLACEMENT AT INTERSECTION




## DETAIL

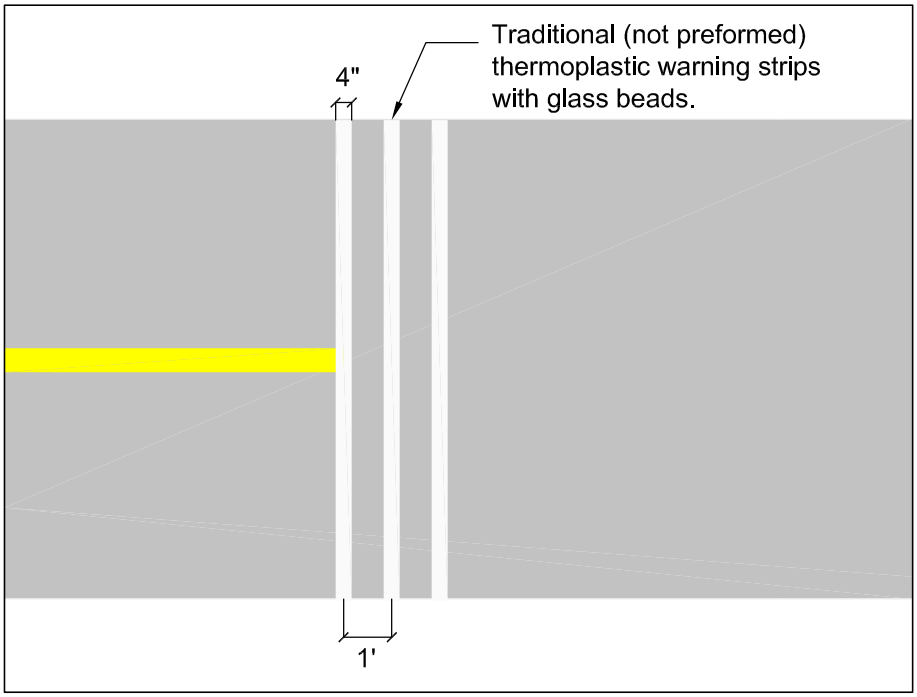



**Figure 6.10 -** Intersection Warning Rumble Strips