Chapter 6: Bridges, Over/Underpasses, Rest Areas and Shuttle Sites

6-1.0 Introduction

This chapter provides guidelines for planning and designing bikeways on bridges used by vehicular traffic, bicycle and pedestrian overpasses and underpasses, and bicycle accommodations at rest areas and scenic overlooks. The chapter concludes with a discussion of bus or van shuttles across barriers to bicycle and pedestrian movement.

6-2.0 General Considerations

Bridges provide essential links for bicyclists and pedestrians. Understanding the future transportation demand, including bicycle and pedestrian modes, is an important step in life cycle planning of bridges, which are typically reconstructed less frequently than connecting roadways.

Bridges and interchanges on major highways are investments of public funds that are often expected to result in new development and significant growth in travel demand. Designed and constructed to last fifty years or more, bridges on or across highways should be planned, designed and constructed with pedestrian and bicycle facilities appropriate for future development patterns. For bridges in urban areas or other areas that are likely to see increased development, this may require additional width and accommodations for bicycles and pedestrian modes of travel on or under a bridge. In areas with low population density, where development is unlikely, bicycles and pedestrians would be reasonably accommodated by current design standards for bridge shoulders. Current bicycle and pedestrian demand may not be a reasonable basis for planning and design of a bridge that will remain in service for 50 years after construction, or up to 70 years after the time the bridge is planned.

The determination to provide a grade-separated crossing for bicycles and pedestrians should be analyzed on a case-by-case basis. Analysis is based upon expected bicycle/pedestrian traffic volume, latent demand for bicycle/pedestrian facilities, safety hazards, existing and desired bicycle/pedestrian routing, motor vehicle speeds and volume, and other factors listed in Chapter 4 of this manual. Table 5-12 in Chapter 5 provides guidelines for conditions where a grade-separated bikeway crossing is warranted, but additional factors should be considered based on existing conditions and the community.

Determining the appropriate type of grade-separated crossing for bicycles and pedestrians depends on practicality at an individual site. Topography, right-of-way limits, and other constraints may dictate whether an underpass or overpass is more appropriate.
6-3.0 Highway Bridges with Bikeways

Bridge structures should be coordinated with approaching bikeways so that facilities are compatible and continuous, with a smooth transition from the bikeway pavement to bridge abutment. On all bridge decks, bicycle-safe expansion joints should be used (as close to 90 degrees to the direction of travel as possible, with small gaps and non-skid plates). Many expansion joints and plates currently in use are very slippery, especially when wet. As a safety consideration, materials should be evaluated for bicycle traction under wet conditions.

Where future demand for a bikeway is anticipated, even if current bicycle use is minimal, new highway bridges and bridge rehabilitation should be planned, designed, and constructed with sufficient width to accommodate bicycle and pedestrian traffic. Bicyclists on highway bridges can be accommodated with a separated bike path, shoulders, bike lanes, wide curb lanes, or sidewalks. However, sidewalks are not preferred for bicycle use, for reasons discussed in Section 5-1. Sidewalks, bikeways, and paved shoulders all shall have a minimum cross slope of 1 percent for drainage, but as required by the ADA, no more than 2 percent for the safety of those with mobility impairments.

On highways with high-speed, high-volume vehicle traffic, an off-road path is typically the best design to accommodate bicycle and pedestrian traffic. Where an off-road bikeway is carried across a highway bridge, the bikeway width on the bridge should be the same as the approaching shared-use path, plus an additional 0.6 m (2 ft) clear width, up to a maximum width of 4.2 m (14 ft). However, for certain types of bridge structures 3.6 m (12 ft) may be a practical maximum width based on cost. Carrying the clear width across the structure provides minimum horizontal shy distance from the railing or barrier and offers maneuvering space to allow bicyclists to avoid conflicts with other users.

Interchange bridges require careful planning and design to accommodate bicyclists. Each situation should be evaluated to consider vehicle speed and volume, signals, bicycle approach geometrics, bicyclist and pedestrian needs, maintenance, and type of interchange.

- The bike lane may be carried all the way across the bridge adjacent to a through lane, or
- The bicycle lane may be placed to the right of a turn lane to a point where the bicyclist can cross the ramp lane at a right angle and continue across the bridge.
• If a wide curb lane on the approach roadway is used to accommodate bicyclists, the extra width should be carried across the bridge in a through lane.

• Where bicycles are legal on both roads, a bicycle lane, wide curb lane, or paved shoulder should be included on the ramps, as well as across and under the bridge.

If there is not a designated bicycle or pedestrian facility on a highway bridge, paved shoulders should be provided to accommodate one-way bicycle travel on each side of the bridge. When shoulders are intended to facilitate bicycle traffic, a minimum of 1.5 m (5 ft) clear width should be provided. Use Table 4-2 and the other factors listed in Chapter 4 to determine if wider shoulders are warranted based upon vehicle traffic volume and speed.

Unless bicycles are prohibited by law from using the shoulder of a roadway, the shoulder surface should be as smooth as the travel lanes on the bridge. Rumble strips are not used on bridge shoulders.

6-3.1 Retrofitting Bikeways on Existing Highway Bridges

On many existing highway bridges, it is possible to use retrofits to accommodate bicyclists and pedestrians. Certain bridge features, however, restrict bicycle access, create unfavorable conditions for bicyclists, and make retrofitting difficult. These features include bridge width narrower than the approach roadway (especially where combined with relatively steep grades), open grated metal decks, low railings or parapets, and certain types of expansion joints, such as finger-type joints, that can cause steering difficulties. These restrictions may be overcome by adding width during reconstruction, creating a bike lane by filling open grating with lightweight concrete, modifying railings, or adding a steel plate or elastomer filler to part of the joint. If a stairway is the only feasible way to connect a shared-use path to a bikeway on an existing bridge, a bicycle wheel ramp should be included on the stairway to facilitate walking a bicycle up the stairs to the bridge.

Where a shared-use path is retrofitted onto a bridge, there are a large number of design variables to consider. The best bikeway design must be determined for each case, using a flexible approach to the design process. Several retrofit alternatives are suggested in this section.

**Carry the shared-use path across the bridge on one side**

This retrofit should be done where (1) the bridge facility will connect to a path at both ends, (2) sufficient width exists on that side of the bridge or can be obtained by narrowing or re-stripping lanes, and (3) provisions are made to physically separate bicycle traffic from motor vehicle traffic. If approach bikeways are two-way, the bridge’s bikeway facility should also be two-way.

An existing highway bridge over a barrier such as a roadway, railway, or waterway can be reconfigured to add bicycle facilities for connecting shared-use paths running parallel to and on opposite sides of the barrier. Where feasible, remove or reconfigure vehicle travel lanes to include a 3 m (10 ft) vehicle shoulder and a 3-3.6 m (10-12 ft) shared-use path. The shared-use path should be separated from vehicular traffic by a 1.2 m high (4 ft) barrier. This configuration is illustrated in Figure 6-2.
Provided wide curb lanes or bicycle lanes over the bridge

This retrofit is advisable where (1) the shared-use path transitions into bicycle lanes at one end of the bridge, (2) sufficient width exists or can be obtained by widening or re-stripping, and (3) there is a separate sidewalk for pedestrians. This option should only be exercised if the bike lane or wide outside lane can be accessed without increasing the potential for wrong-way riding or inappropriate crossing movements.

Consider using the existing bridge sidewalks for bicycle traffic

This retrofit may be appropriate when the sidewalk is wide enough to accommodate bicyclists and pedestrians, particularly if the approach paths are one-way facilities. In general, however, the designated use of sidewalks (as a signed, shared facility) for bicycle travel is unsatisfactory, particularly if the sidewalk is raised and no railing exists between the sidewalk and traffic lanes. Remember, too, that employing extremely wide sidewalks does not necessarily increase safety, since wide sidewalks encourage higher bicycle speeds and increase potential conflicts with pedestrians and fixed objects.
Sidewalk bikeways should be considered only under certain limited circumstances where unfriendly bicycle and pedestrian elements exist. For example, they may be appropriate on long, narrow bridges where the rightmost travel lane is too narrow to accommodate both a cyclist and motor vehicle.

Sidewalk bikeways must be at least 2.4 m (8 ft) wide, and preferably 3 m (10 ft) or greater. Sidewalks should be modified to have adequate drainage and must be accessible to bicyclists and pedestrians, including those with mobility impairments. Signage warning cyclists of substandard bikeway conditions and a 1.4 m (4.5 ft) railing is required on the outside of the sidewalk.

Where necessary, curb cuts and flush ramps shall be installed at path approaches so that bicyclists are not subjected to the hazard of a vertical lip crossed at a flat angle. Curb cuts should have a minimum width of 2.4 m (8 ft) to accommodate tricycles for adults and two-wheeled bicycle trailers. A curb cut width of 1.8 m (6 ft), which meets ADA minimum requirements, is not wide enough for bicycle traffic on a shared-use path.

6-3.2 Railings and Protective Screening on Bridges

A list of standard railing applications for barriers on combined (vehicle traffic and bicycle/pedestrian) bridges and bicycle/pedestrian bridges is provided in Table 13.2.1 of Chapter 13 (Railings) in the Mn/DOT LRFD Bridge Design Manual (October 2003). That manual discusses three general classes of bridge railings or barriers:

- Traffic railings, designed to contain and redirect vehicles
- Bicycle/pedestrian railings, designed for pedestrian and bicyclist safety
- Combination railings, designed to contain bicycles as well as vehicles

Where a designated bikeway is constructed on a bridge, and motor vehicle speed is 45 mph or greater, a traffic barrier is required between the bikeway and the vehicle lanes, with a bicycle/pedestrian railing or combination railing on the outside edge of the bridge. The type of traffic barrier required will depend on the speed of vehicular traffic. Additional considerations in selecting barriers may include aesthetics, volume of vehicular traffic, and the expected amount of bicycle and pedestrian traffic.

On bridges with motor vehicle speeds of 40 mph or less, where a bikeway is on a raised sidewalk, or where a bicycle lane is striped on the roadway next to a raised sidewalk, a combination railing may be used on the outside edge of the bridge without a traffic barrier between the roadway and bikeway. The sidewalk curb height shall be 200 mm (8 in). If there is no sidewalk, and the designated bikeway is at the same elevation as the roadway (bikeway on the shoulder), a traffic barrier or combination railing should be used between the roadway and the bikeway, with a bicycle/pedestrian railing or combination railing at the outside edge of the bridge.

Bicycle/pedestrian railings must be a minimum height of 1.4 m (4.5 ft). For bridges over roadways, the opening between elements of a bicycle/pedestrian railing or combination railing shall not permit a 100 mm (4 in) sphere to pass through the lower 0.7 m (27 in) of the railing, and a 150 mm (6 in) sphere shall not pass through any opening above 0.7 m (27 in).
Mn/DOT has developed a bicycle railing attachment to the Type F barrier for use when bridge shoulders carry a bicycle route. (See *Bridge Details Manual Part II*, Figure 5-397.158.) This railing may be applied to other traffic barriers where the same or greater offset distance to the face of metal rail is provided and the post attachment has the same or greater strength.

If the bridge is over a roadway or railroad, protective screening or fencing to a height of 1.8 to 2.4 m (**6 to 8 ft**) is required to prevent objects from being thrown onto the roadway below. Mn/DOT policy requires a protective screening system to be incorporated into the railing on new bridges, or when railings are replaced on existing bridges. The standard height for protective screening is 2.4 m (**8 ft**). The protective screening shall not allow passage of objects greater than 150 mm (**6 in**).

### 6-4.0 Bicycle and Pedestrian Overpasses

A shared-use bridge structure allows bicyclists and pedestrians to cross busy roadways, railways, or bodies of water to reach popular destinations. Preferred applications for bicycle/pedestrian overpasses include:

- Locations that would otherwise be difficult or impossible to cross (freeways, rivers, railroads, etc.)
- Connecting schools to neighborhoods over high-volume, high-speed arterial roadways where signalized crossings are more than 137.5 m (**450 ft**) apart
- When a reasonably direct on-road alignment is not available, or the direct on-road connection is perceived by the public to be unsafe
- When bicyclists and pedestrians would otherwise be required to negotiate a significant change in elevation

**Figure 6-3:**

Example of creative use of an overpass for non-motorized users

<table>
<thead>
<tr>
<th><strong>Overpass Characteristics</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Positive:</strong></td>
</tr>
<tr>
<td>- Good visibility from surrounding areas (greater sense of user safety)</td>
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<tr>
<td>- Good light during the day</td>
</tr>
<tr>
<td>- Open and airy</td>
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</tbody>
</table>
When vehicular bridges do not provide bicycle route continuity and directness.

The design of a bicycle and pedestrian overpass shall consider requirements for grade, turning radius, width, cross slope, and speed. In some cases, for the safety of all types of traffic, the bicycle design speed may need to be reduced from the approaching bikeway. The profile across a bridge should follow a smooth line with no sharp changes in grade over the piers.

To ensure the safety of users of all ability and skill level, bicycle and pedestrian overpasses should be designed in accordance with the AASHTO Guide for the Development of Bicycle Facilities (1999), the AASHTO Standard Specifications for Highway Bridges and the Mn/DOT LRFD Bridge Design Manual. ADA standards for accessible design are also applicable, but, for the most part, those have been incorporated into AASHTO standards, since accessible design benefits bicyclists and able-bodied pedestrians as well as those with mobility impairments.

The recommended minimum width of an overpass for bicyclists and pedestrians is 3.6 m (12 ft), or the paved width of the approach path plus 0.6 m (2 ft), whichever is greater. The desirable width of an overpass is the width of the approach path plus 1.2 m (4 ft). The bridge width is measured from the face of handrail to face of handrail.

Carrying the clear areas across the structure provides necessary horizontal shy distance from the railing and provides maneuvering space to avoid conflicts with pedestrians and oncoming bicyclists. Access by emergency, patrol, and maintenance vehicles should be considered when establishing vertical and horizontal clearances. The path's shoulder width should taper as necessary to match the overpass width (if applicable). Greater width may be appropriate in heavily traveled urban corridors, and near university campuses or near facilities that have pedestrian event-clearing peaks.

When physical constraints limit the width of a bicycle/pedestrian overpass, it may be necessary to provide a substandard width. In very rare instances, a reduced width of 2.4 m (8 ft) may be used, but only where all of the following conditions occur:

- Bicycle traffic is expected to be low, even on peak days or during peak hours.
- Only occasional pedestrian use of the facility is expected.
- Horizontal and vertical alignment will provide safe and frequent passing opportunities.
- Normal maintenance vehicle loading conditions or widths will not exceed the bridge design parameters.
- State Aid funds are not being used on the project.

The vertical clearance from the pavement to any overhead object on an overpass shall be a minimum of 2.4 m (8 ft) for bicyclists, but 2.7 m (10 ft) vertical clearance may be appropriate to accommodate occasional maintenance or security vehicles using the overpass. The vertical clearance of the bottom of the overpass structure over a street or highway is typically at least 5.2 m (17 ft), but requirements must be verified on a case-by-case basis.

The access ramps for bicycle/pedestrian overpasses must meet ADA design standards, for which the preferred maximum grade is 5 percent (20:1). However, grades up to 8.33 percent (12:1) are permitted if a platform 1.5 m (5 ft) long is provided between each 0.75 m (2.5 ft) change in elevation. A 1.8 m (6 ft) clear flat platform is to be provided at the bottom of each ramp.
Overpasses require railings for both bicyclists and pedestrians. The railing height for bicyclists shall be 1.4 m (4.5 ft) from the overpass deck, with a pedestrian handrail at a height of 1.1 m (3.5 ft). Where a bicycle/pedestrian overpass crosses a roadway or railway, 2.4 m (8 ft) high protective screening shall be used to prevent objects from being thrown off the bridge. Refer to Section 6-3.2 for guidance on bicycle/pedestrian railings and protective screening.

Structures designed for pedestrian live loads are satisfactory for bicycles. The Mn/DOT LRFD Bridge Design Manual (Section 3.4.4, Pedestrian Live Load) specifies that bridges carrying only bicycle/pedestrian traffic should be designed with a live load intensity of 0.085 ksf. However, if maintenance and emergency vehicles may need access to the overpass, the structure must be designed for the vehicle load.

### 6-5.0 Bikeways Under Existing Bridge Structures

Highways, particularly freeways, can be significant barriers to bicycle and pedestrian movement. Many bridges can be retrofitted to provide a bicycle/pedestrian crossing under the barrier by creating a crossing where there are no bicycle or pedestrian accommodations, or by upgrading the existing bicycle/pedestrian crossing. Provide adequate lighting under structures, in tunnels, and at approaches.

Figure 6-5 provides examples of locations, separations, and widths for modifying existing roadway facilities to accommodate a bikeway. The bikeway and/or sidewalk width should be continuous under the highway structure. It is preferred that bikeways have a width of 3 m (10 ft), but a 2.4 m (8 ft) width may be allowable for short segments. Where access for emergency vehicles is necessary, vertical clearances shall be a minimum of 3 m (10 ft). Where access for emergency vehicles is not needed, vertical clearances over the bikeway shall be a minimum of 2.4 m (8 ft).

A full engineering and design analysis is required for every proposed bikeway under an existing bridge structure.
6-6.0 Bicycle and Pedestrian Underpasses and Tunnels

A bikeway underpass should be considered if there is no safe and direct on-street crossing, if the facility to be crossed is elevated, if an existing motor vehicle under-crossing is too narrow for a bicycle facility, and when the underpass would not require bicyclists to negotiate significant elevation changes. Underpass costs may be lower than those for overpasses.

**Underpass Characteristics**

**Positive:**
- Protected from weather
- Less ramping and change in elevation than overpasses due to clearance requirements

**Negative:**
- Can be dark and intimidating
- Users may not be able to see through to the other side
- Users may feel claustrophobic
- May be difficult to maintain
An underpass may have less grade change for a bicyclist to negotiate than an overpass because a typical overpass requires a 5.2 m (17 ft) vertical clearance over the highway. A disadvantage is that unless it is well located and openly designed, it may be intimidating and avoided by bicyclists and pedestrians. Providing adequate drainage may also be a problem; providing a surface that does not become excessively slippery when wet is important. Proper drainage design is a key element to prevent wet silt deposits that are a common hazard for bicyclists using underpasses. The inclusion of gutters at the edge of the underpass and the base of a retaining wall are good design elements to ensure a clear riding surface.

Underpasses are usually constructed of pre-cast concrete in a shape having the proper vertical and horizontal clearances. See Figure 6-6.

The horizontal and vertical alignments in an underpass should be straight for the full length and for an adequate distance on each approach. The minimum width of an underpass for bicyclists and pedestrians should be 3.6 m (12 ft), or the paved width of the approach path plus 0.6 m (2 ft), whichever is greater. The recommended width of an underpass is 4.2 m (14 ft), which allows several users to pass one another safely. Greater width may be justified in areas with many potential users or at a location where there is an event-clearing peak demand. The recommended vertical clearance is 3 m (10 ft) for a pedestrian/bicycle underpass. If access for emergency vehicles is not required, vertical clearance for bicyclists shall be at least 2.4 m (8 ft).

Underpass design and layout should carefully consider its location and user safety. Visibility through a tunnel and adequate lighting enhance users’ perception of personal safety. When the underpass is long (e.g., when traversing a four-lane road), wider or flared openings are recommended to improve natural lighting and visibility. Channeling with fences or walls into a tunnel should be evaluated for safety. If it is likely that bicyclists and pedestrians will avoid the underpass and try to cross the road or railway in unsafe conditions, barrier fencing or visual screening with dense vegetation may be needed to help direct users to the underpass. Approaches and grades should provide the maximum possible field and range of vision toward the underpass, for both bicyclist and pedestrian.

For short underpasses or tunnels, modest lighting may be all that is required. Generally, the longer the structure, the greater the need for illumination. In certain cases, lighting may be
required on a daily, 24-hour basis. For tunnels longer than 15 m (50 ft), constant illumination is recommended. All lighting should be recessed and vandal resistant. Providing skylights in the middle of the structure (an opportunity occurring with an overhead urban section roadway with a raised median) can reduce lighting needs during daylight hours. See Section 5-8 for more information on lighting.

6-7.0 Rest Areas and Overlooks

Paths, rest areas or overlooks should be created at points along the path where bicyclists are most likely to stop, such as waterways or other features of interest. Consideration should be given to a bicycle pull-off on or abutting a bridge. In instances where the bridge is on a crest, a pull-off area serves as a scenic overlook. Rest areas featuring old railroad stations or other historic structures add interest to the route and serve as points of reference. Interpretive signs installed at natural or historical points of interest serve to educate path users.

Locations already offering services, such as restaurants and museums, tend to attract bicyclists and are natural locations for rest areas. Sheltered, sunny spots can offer better climactic conditions and increase the length of the bicycling season.

Rest areas and overlooks can offer a more pleasant experience if exposure to wind and noise levels is mitigated. Planting trees and shrubs is the most aesthetically pleasing way to create windbreaks. Spruces, firs, and cedars, with their full bases, form a more wind resistant grove than trees with higher branching patterns. Reduce the ambient noise level on a bikeway located near freeways, boulevards, or industries by installing acoustic screens, such as earth berms or low walls. Avoid creating an environment where bicyclists or pedestrians might feel isolated and vulnerable.

Ideally, on a recreational bikeway, there should be a rest area every 5 km (3 mi). Access routes from the path to rest areas should be clearly marked and lead directly to bicycle parking, in order to prevent bikes being locked to trees, shrubs, and other vulnerable objects.

Rest stops may be equipped with tables or benches, secure parking facilities, waste receptacles, and trail literature. Access to restrooms and drinking water for bicyclists is desirable. At major
rest areas (or trailheads), minor repair services, telephones, and covered shelters may be made available.

To facilitate entering and leaving a busy path, an access path extending 30 m (100 ft) on either side of the rest area’s entrance may be created. This is especially recommended if the entrance is located on a steep grade or is not visible at a distance of more than 40 m (130 ft). A physical demarcation such as a low-lying hedge or ditch may discourage crowds from gathering on the path and prevent children from wandering onto it while playing.

6-8.0 Bus and Van Shuttles

Where existing bridges cannot be modified to safely accommodate bicyclists, bus or van shuttles are a way to facilitate crossing areas that are impassable except by vehicle. A shuttle service can operate on a fixed-route schedule or be initiated through a demand-response for special events.

Buses are retrofitted with racks for two bicycles, and are already offered on public transit in many cities. Vans can be equipped with special trailers to haul bicycles.

![Bike rack-equipped bus, Minneapolis](image_url)