DESIGN AND APPLICATION OF GUIDELINES AND STANDARDS

The Citizen Advisory and Technical Advisory Committees identified improving safety by providing consistent bicycle facilities throughout the region as a goal of the Gateway Bike Plan. This goal is reflected in their recommendation that all bicycle facilities be built to the latest MUTCD standards and AASHTO Guidelines.

**[GOAL]** Improve safety for all modes of transportation through the careful design and implementation of bicycle facilities.

**OBJECTIVE:** Improve safety by designing all bicycle facilities to the latest AASHTO bicycle guidelines and 2009 MUTCD Standards.

*Action 6.1:* Latest AASHTO bike guidelines and 2009 MUTCD are adopted by appropriate state, county, and local agencies.

*Action 6.2:* Adopt additional guidance for installing bicycle facilities that builds on AASHTO guidelines and 2009 MUTCD Standards (see Appendix B for further guidance on bike lanes, shared lane markings, and signage).

*Action 6.3:* Ensure consistent application of bicycle facility guidelines and standards through field checks to insure compliance to AASHTO guidelines and 2009 MUTCD Standards.

Consistency in facility design in terms of pavement markings and signage is important for creating a consistent interconnected bicycle network that is easy for the user to understand and navigate. Compliance with AASHTO guidelines and MUTCD standards will ensure uniformity in bicycle facility design. Each jurisdiction responsible for facility design and installation should implement a process that ensures all installed bicycle facilities are field-checked for consistency with these guidelines and standards.

*Action 6.4:* Identify creative solutions to unique issues that may be outside of standard design guidance.

While all bicycle facilities should be designed to meet current state and federal design guidance and standards, as defined by MoDOT, the AASHTO, the Americans with Disabilities Act (ADA), and the MUTCD, there will always be situations in which adopted guidelines and standards do not adequately address existing right-of-way constraints or the safety needs of the bicycle network users. In such situations, an agency must be able to use professional engineering judgment to identify creative solutions that still fall within the intent of standard design guidance. Jurisdictions should seek out precedents from neighboring jurisdictions, and, if none are immediately available, they should research what has been done in similar situations in jurisdictions in other states.

Specific local guidelines and policies, listed below, may apply to certain roadways. If the national standards or guidelines are revised in the future, they should be followed. The following publications should be referenced for greater detail on the design of bicycle facilities in the St. Louis region. Key provisions of these guidance documents are also provided.
National Guidelines and Standards


AASHTO is a not-for-profit, nonpartisan association representing state highway and transportation departments. It publishes a variety of planning and design guides, including the 1999 AASHTO Guide for the Development of Bicycle Facilities. This guide provides planning and design guidance for on- and off-street bicycle facilities. It is not intended to set absolute standards, but rather to present sound guidelines that will be valuable in attaining good design sensitive to the needs of both bicyclists and other roadway users. The provisions in the Guide are consistent with and similar to normal roadway engineering practices. Signs, signals, and pavement markings for bicycle facilities should be used in conjunction with the MUTCD.

Key provisions in the AASHTO Guide for the Development of Bicycle Facilities include:

- Bicycle planning, including types of planning processes, technical analysis tools, and integrating bicycle facilities with transit
- Bicycle operation and safety, including traffic principles for bicyclists and causes of bicycle crashes
- Design of on-road facilities
- Design of shared-use paths
- Bicycle parking facilities
- Maintenance and operations


The 2009 MUTCD is a document issued by the Federal Highway Administration (FHWA) of the U.S. Department of Transportation (USDOT) to specify the standards by which traffic signs, road surface markings, and signals are designed, installed, and used. These specifications include the shapes, colors, fonts, sizes, etc., used in road markings and signs. In the United States, all traffic control devices must generally conform to these standards. The manual is used by state and local agencies and private design and construction firms to ensure that the traffic control devices they use conform to the national standard. While some state agencies have developed their own sets of standards, including their own MUTCDs, they must substantially conform to the federal MUTCD, and must be approved by the FHWA. MoDOT uses the national MUTCD and expects to adopt the 2009 edition by the end of 2011. The National Committee on Uniform Traffic Control Devices (NCUTCD) advises the FHWA on additions, revisions, and changes to the MUTCD.

Key provisions of the MUTCD related to bicycling include:

- Bicycle-related regulatory and warning signs
- Bicycle destination guide and route signs
- Pavement markings such as bike lane symbols and striping
- Trail signs
- Significant changes in 2009 edition (from the 2003 Edition) include:
  - New shared-lane (“sharrow”) pavement markings
  - Bicycle lane regulatory signs no longer required
  - Type 3 object markers for shared-use paths
  - New bicycle destination guide and route signs
  - New mode-specific guide signs for shared-use paths

1 An update to the 1999 Guide is currently under development and is expected to be approved by the FHWA in 2011. The updated Guide will be based on design concepts and standards found in the 1999 AASHTO Guide, with additional detailed guidelines for the placement of bicycle lanes and bicycle lane symbols.

2 The manual is available at http://mutcd.fhwa.dot.gov
State Guidelines and Standards

Primary Guidance (from MoDOT)

Engineering Design Manual and Practical Design Implementation Manual, Missouri Department of Transportation (MoDOT)

The Engineering Design Manual states that MoDOT values the needs of all customers, including non-motorized travelers, realizing that they need safe, connected means of transportation. MoDOT is charged with the responsibility of using public funds wisely while providing safe choices of transportation to the traveling public. The inclusion of bicycle facilities on all improvement projects will be considered (see 23 USC section 217 below) and should be provided when one or more of the following conditions exist:

- The local jurisdiction has a comprehensive bicycle policy in the area of the proposed improvement.
- There is public support through local planning organizations or local communities for the provision of bicycle facilities.
- Bicycle traffic generators are located near the proposed project (residential neighborhoods, employment centers, shopping centers, schools, parks, libraries, etc.).
- There is evidence of bicycle traffic within the proposed project limits.
- The route provides access across a natural or man-made barrier (rivers, railroads, or access-controlled roadways). If bicycles are allowed on either end of a bridge, access across the bridge shall be provided (see 23 United States Code 217e).

Other than paved shoulders, special bicycle facilities will not be provided on interstate traveled ways. Shared-use paths within interstate right-of-way may be permitted. Shared-use paths along interstates must be barrier separated or located outside the clear zone.\(^3\)

The decision to provide or not provide bicycle facilities on any project should be documented. Bicycle traffic may be accommodated in a variety of ways, depending on the location (rural/urban), the Average Daily Traffic rate, or the speed limit. Examples of facilities include shared travel way with motorists, bike lanes, wide curb lanes, paved shoulders and shared-use paths separated from the travel way by a positive barrier. By law bicycles are allowed to operate on all roads except where specifically prohibited. Probable use of most roads by bicyclists should be considered in determining construction details such as drain grates, rumble strips, traffic detection and expansion joints. Consultation with local groups of organized bicyclists is to be encouraged in the development of projects.

Special Considerations: Bridges, viaducts, overpasses and underpasses that cross major roads, railroads, rivers or other travel barriers present a special opportunity for accommodating bicycle travel. A greater than usual proportion of bicycle travel is funneled onto these facilities since local roads often do not cross these barriers.

23 USC 217 (e): On highways without full control of access where a bridge deck is being replaced or rehabilitated, and where bicycles are permitted to operate at each end, the bridge shall be reconstructed so that bicycles can be safely accommodated when it can be done at a reasonable cost.\(^4\)

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4 [http://www.law.cornell.edu/uscode/html/uscode23/usc_sec_23_00000217----000-.html](http://www.law.cornell.edu/uscode/html/uscode23/usc_sec_23_00000217----000-.html). This is the federal law as passed under SAFETEA-LU.
Federal Aid Policy Guide, Sec. 652.5 states: On highways without full control of access where a bridge deck is being replaced or rehabilitated, and where bicycles are permitted to operate at each end, the bridge shall be reconstructed so that bicycles can be safely accommodated when it can be done at a reasonable cost.\(^5\)

**Funding**

Costs for new bicycle facilities, including right-of-way, construction and maintenance may be funded by local jurisdictions, by other non-department sources or by the department itself. Federal Enhancement funds cannot be used for maintenance of bicycle facilities. State funds will only be used for facilities located on MoDOT right-of-way. Existing bicycle facilities disturbed by any MoDOT improvement will be replaced at MoDOT’s expense. Normal right-of-way and construction costs for this restoration will be included as a project cost for the proposed improvement. Special consideration will be given to projects funded by local partners.

**Guidance**

Additional guidance regarding sidewalk design can be found in the AASHTO publication *Guide for the Planning, Design and Operation of Pedestrian Facilities*, the Americans with Disabilities Act (ADA) Accessibility Guidelines (Part 2 Designing Sidewalks and Trails for Access), or the FHWA publication *Selecting Roadway Design Treatments to Accommodate Bicycles*.

Technical assistance on a case-by-case basis is also available from the State Bicycle and Pedestrian Program Coordinator.

MoDOT’s Practical Design Manual states that the agency will provide bicycle facilities on improvement projects during planning, and that design activities are necessary when any one or more of the following conditions exist:

- The local jurisdiction has a comprehensive bicycle policy in the area of the proposed improvement.
- There is public support through local planning organizations for the provision of bicycle facilities.
- The local jurisdiction agrees to fund the total cost of the facility (right-of-way and construction) plus the provision of future maintenance.
- Bicycle traffic generators are located near the proposed project (residential neighborhoods, employment centers, shopping centers, schools, parks, libraries, etc.).
- There is evidence of bicycle traffic along the proposed project or the local community supports the incorporation of facilities at this time.
- The route provides access across a natural or man-made barrier (bridges over rivers, roadways, or railroads) or under access controlled facilities.\(^6\)

The Practical Design Manual also states that the installation of bicycle facilities is at the sole discretion of the director or the district engineer acting as the director’s designee. A preference is given to locate bicycle facilities off right-of-way whenever possible, such as on a paved shoulder. The manual elaborates further: In developed areas, bicycle accommodations differ according to ADT and speed limit. Examples include bike lanes, wide curb lanes, paved shoulders, and a shared-use path.

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\(^6\) *Practical Design, Missouri Department of Transportation, Revised February 24, 2006.*
separated from the traveled way by a barrier curb; mountable curbs are prohibited as a positive separation. In rural areas, bicycle accommodation may include a shared roadway with low Average Daily Traffic volume or a paved shoulder on roads with higher Average Daily Traffic volume. Because state law allows bicycles to operate on all state highways except travel lanes of interstates or where specifically prohibited, probable use by bicyclists is considered in determining construction details such as drain grates and expansion joints, even on roadways where special bicycle accommodation is not provided.7

Local Guidelines and Standards

City of St. Louis
The City of St. Louis has implemented several road diets using the following standards:

- 5-foot bike lanes
- 9-foot parking lanes minimum
- 10-foot center turn lane
- 10- to 11-foot through lanes

Sixty-foot curb-to-curb sections will include bike lanes. In the case of 50-foot roadway sections shared lane markings will be placed in the trough lanes. At locations where five lanes are maintained, shared lane markings will be used centered in the outside lanes.

St. Louis County
The following Figure is a policy statement from the Department of Highways and Traffic regarding signing and striping to accommodate bicyclists on County arterial and through roadways. There are discussions in progress to update this policy, and to further define implementation of bicycle facilities on St. Louis County roadways. Included in Appendix K is a copy of the full May 3, 2011, St. Louis County Bicycle Facilities Plan document, and the cover is shown in Figure 6-1.

At-Grade Bicycle Path/Roadway Crossing Guidelines
St. Louis County does not include bicycle facilities in its street and highway design criteria. The County does provide guidelines for at-grade bicycle path/roadway crossings, recognizing that the number of trails will continue to increase throughout the county. The guidelines provide a list of approved traffic control devices at bicycle path/roadway crossings, which are consistent with MUTCD:

- Mid-block traffic signals, with pedestrian signal heads for path users
- Intersection traffic signals, with pedestrian signal heads for path users
- Minor street stop control at intersecting roads where there is a path/roadway crossing at the intersection
- Multi-way stop control at intersecting roads where there is a path/roadway crossing at the intersection
- Mid-block marked crosswalks at path/roadway crossings with stop control only for path users

7 Ibid.
The guidelines also provide guidance on where proposed path/roadway crossing may be located in relation to intersections with existing control devices, as well as striping and signage to be used at crossings, the cover of this document is shown in Figure 6-2.  

**St. Charles County**

Engineering judgment is used to develop appropriate bicycle facilities on a project by project basis to reflect the context of the area that the project will serve.

**East-West Gateway Council of Governments**

The EWGCOG developed the St. Louis Regional Bicycling and Walking Transportation Plan provides definitions and limited guidelines for bicycle and pedestrian facilities. In addition to providing dimensional guidelines for a limited number of bicycle facilities, such as bicycle lanes and wide outside lanes, the Plan also provides basic guidance for maintaining road surfaces, directional/informational signage, and intersections. The Plan also touches on establishing multimodal transportation connections, links to bicycle facilities to destinations, and connections past barriers.

**General**

In addition to the above, the following guidance documents should also be referenced:


**Additional Guidance for Bicycle Facilities**

**History and Current Practice**

An update to the 1999 AASHTO Guide for the Development of Bicycle Facilities is currently under development and is expected to be approved by the FHWA in 2011 or 2012. The updated Guide will be based on design concepts and standards found in the 1999 AASHTO Guide, with additional detailed guidelines for the placement of bicycle lanes and bicycle lane symbols.

**Best Practices for Locating and Installing Bicycle Lane Lines and Symbols.**

The following guidelines are a supplement to the MUTCD Part 9: Traffic Control for Bicycle Facilities and the AASHTO Guide for the Development of Bicycle Facilities. They are not design standards, and should not be used as such. Application of guidance provided in this document requires the use of professional engineering judgment when installing bicycle lanes.
1. Bicycle Lane Placement

Bicycle lanes should be one-way facilities and carry bicycle traffic in the same direction as adjacent motor vehicle traffic. Two-way bicycle lanes on one side of the roadway are not recommended when they result in bicycles riding against the flow of motor vehicle traffic. However, there may be special situations where it is appropriate to have a two-way bicycle lane for a short distance, such as a one-way street.

On one-way streets, bicycle lanes generally should be placed on the right side of the street. Bicycle lanes on the left side are unfamiliar and unexpected for most motorists. This should only be considered when a bicycle lane will substantially decrease the number of conflicts, there are a significant number of left-turning bicyclists or the right lane is unavailable because of a special purpose lane, such as a transit lane.

Appendix B contains cross-section illustrations that show bicycle lanes on a variety of roadway and travel lane configurations.

Considerations for Bicycle Lane Line Marking Placement

The minimum width for a bicycle lane between a parking lane and a travel lane is 5 feet. The inside bicycle lane line (parking lane line) will be located 7 to 8 feet from the face of the curb or roadway edge. Generally, a narrower parking lane is desirable to encourage motorists to keep the vehicle as close to the edge of the roadway as possible to maximize the available travel lane width, which will improve the bicyclist’s level of comfort on the roadway.

The minimum width of a bicycle lane next to a curb (no parking) is 5 feet from the face of curb, but the bike lane must also be at least 3 feet from the joint between the gutter pan and the road pavement (4 feet preferred). In general, bicycle lanes should be no wider than 6 feet to discourage motor vehicles from using them as a travel lane. Bicycle lane lines should not be extended through a marked crosswalk.

It is recommended that the transition for tapering centerlines and travel lanes (moving the lines gradually to the right or the left) to create space for bicycle lanes follow standard MUTCD practices.

Considerations for Use of Dotted versus Solid Bicycle Lane Lines

Solid lines should be used at all locations where through moving motorists are to be discouraged from entering the bicycle lane. Parking motorists may cross the solid line as necessary to park their vehicle.

Dotted lines (2-foot lines with 4-foot gaps) should be used to demarcate areas where motorists are likely or are to be encouraged to merge into or across the bicycle lane for turning movements. Dotted lines should be used 50-200 feet in advance of intersections where motorists are permitted to turn right. Where there is a parking restriction in advance
of an intersection, including bus stops, the dotted line should be continued through the parking restriction. The dotted line should generally discontinue at the crosswalk or back edge of the perpendicular street sidewalk if a crosswalk is not present on the near side of an intersection. On the far side, the dotted line should become a solid line at the back edge of the sidewalk or the tangent point of the curb radius (whichever is larger). A dotted line through an intersection may be desirable to provide additional guidance through intersections where bicyclists must cross more than 4 lanes of traffic or cross uncontrolled intersections of any width.

**Considerations for Bicycle Lane Symbol Placement**

The “bicycle with rider” symbol, with an arrow, should be used to identify bicycle lanes. Typically, the bike lane arrow and rider symbol should be located within the center of the bike lane. To reduce wearing, bicycle lane symbols are typically not located within dotted bike lanes; however, it may be desirable to place bicycle lane symbols within dotted lines at locations of frequent conflicts between merging motorists and through-moving bicyclists.

**Considerations for Bicycle Lane Symbol Placement Frequency**

Bicycle lane symbols should be placed at the far side of an uncontrolled intersection, at both sides of an arterial intersection with traffic control, and at mid-block locations where block faces are more than 250 feet. Where there are marked crosswalks, the tip of the bicycle lane symbol should be placed 25 feet beyond the far side of the marked crosswalk. The frequency of placement of a bicycle lane symbol will depend on a number of factors, including the following:

- Visibility to motorists and bicyclists (markings should be placed to take into account changes in topography or not be blocked by overhanging vegetation or signs when looked at from a distance).
- Generally, the markings should be located in accordance with the proposed guidelines (far side of intersections; then mid-block if block faces are more than 250 feet long).
- Generally the markings should not be located adjacent to each other when located mid-block. It is recommended that they be separated by a minimum of 20 feet.
- Markings may be adjusted from the above dimensions to stay out of the wheel track of turning vehicles to lengthen lifespan.
MUTCD Guidance on Bike Lane Markings and Signage

- If used, the bicycle lane symbol marking shall be placed immediately after an intersection and at other locations as needed.
- The bicycle lane symbol marking shall be white.
- If the bicycle lane symbol marking is used in conjunction with other word or symbol messages, it shall precede them.
- If the word or symbol pavement markings are used, Bicycle Lane signs shall also be used, but the signs need not be adjacent to every symbol to avoid overuse of the signs.
- A through bicycle lane shall not be positioned to the right of a right turn only lane.
- When the right through lane is dropped to become a right turn only lane, the bicycle lane markings should stop at least 100 feet before the beginning of the right turn lane.
- Through bicycle lane markings should resume to the left of the right turn only lane.
- An optional through-right turn lane next to a right-turn only lane should not be used where there is a through bicycle lane. If a capacity analysis indicates the need for an optional through right turn lane, the bicycle lane should be discontinued at the intersection approach.
- Posts or raised pavement markers should not be used to separate bicycle lanes from adjacent travel lanes.  

Cost

Costs to design and install bicycle lanes will vary from $25,000 to $30,000 per mile. Costs will be on the higher end if installation requires grinding out old paint lines; they will be on the lower end if no grinding is required.

Bicycle Climbing Lane Treatment Criteria

The decision to install a climbing bicycle lane should be based upon site conditions. Generally, it is recommended that climbing lanes should be used when roadway grades exceed 4 percent for at least 300 feet. It is recommended that the bicycle lane be striped on the uphill portion. For roadways with parking located on one side, consideration should be given to locating the parking lane on the uphill side of the roadway unless it creates pedestrian safety issues. If a roadway grade is less than 4 percent, or if the length of a relatively steep grade is less than 300 feet, maintaining equally spaced wide outside lanes could be considered in place of a climbing bicycle lane.

Considerations for Climbing Lane Transitions
In general, the bicycle lane should be located on the uphill portion of the roadway. For roadways where changes in slope create defined peaks and valleys, it is recommended that the bike lane be switched from side to side unless engineering judgment deems it necessary to maintain a bicycle lane on a consistent side of the roadway.

Appendix B contains additional cross-section illustrations of climbing lanes on a variety of roadway and travel lane configurations.

Cost
Costs to design and install climbing lanes will vary from $15,000 to $20,000 per mile. Costs will be higher if the installation requires grinding out old paint lines; they will be lower if no grinding is required.

Buffered Bicycle Lanes
A buffered bike lane is a bike lane that is separated from a travel lane or parking lane by a space of 3 to 6 feet. The lane is always one-way and is buffered by cross-hatched pavement marking, and if used, a sign for the exclusive use of bicyclists. All other guidelines and considerations that apply to bike lanes described above, also apply to buffered bike lanes.

Appendix B contains additional cross-section illustrations of buffered bicycle lanes on a variety of roadway and travel lane configurations.
**Cost**
Costs will vary depending on the type of buffering treatments used. A buffered bike lane consisting of a 4 foot buffer area but no flex bollards may cost approximately $18,000 per mile, while a buffered bike lane that utilizes flex post bollards and two feet of diagonal striping may cost approximately $45,000 per mile.

**2. Shared Lane Markings**
The following guidelines supplement the 2009 MUTCD and the AASHTO *Guide for the Development of Bicycle Facilities*. They are not design standards and should not be used as such. Application of guidance provided in this document requires the use of engineering judgment when installing shared lane markings.

A Shared Lane Marking is a pavement symbol consisting of a bicycle with two chevron markings above it. This is placed in the roadway lane indicating that motorists should expect to see and share the lane with bicycles. It also indicates the legal and appropriate line of travel for a bicyclist. Unlike bicycle lanes, they do not designate a particular part of the roadway for the exclusive use of bicyclists.

The revised 2009 Edition of the MUTCD includes new provisions for installing Shared Lane Markings. The following is taken directly from the 2009 Edition of the MUTCD.

The Shared Lane Marking shown in Figure 6-7 may be used to:

A. Assist bicyclists with lateral positioning in a shared lane with on-street parallel parking in order to reduce the chance of a bicyclist’s impacting the open door of a parked vehicle,

B. Assist bicyclists with lateral positioning in lanes that are too narrow for a motor vehicle and a bicycle to travel side by side within the same traffic lane,

C. Alert road users of the lateral location bicyclists are likely to occupy within the traveled way,

D. Encourage safe passing of bicyclists by motorists, and

E. Reduce the incidence of wrong-way bicycling

**Shared Lane Marking Placement**
In general, Shared Lane Markings are installed on streets where there is not enough space for bicycle lanes, or there is no desire for a bicycle lane. Where there is only space for a bicycle lane on one side of the street, a bike lane should be installed on the uphill side with Shared Lane Markings on the downhill side. Flat streets should either have Shared Lane Markings installed on both sides (no bicycle lane) or have the bicycle lane installed on the side with the highest anticipated bicycle use (engineering judgment required). Shared Lane Markings may be the first choice (even if there is room for a bicycle lane) on some downhill sections.
**Considerations for Shared Lane Marking Placement within a Travel Lane**

The placement of shared lane markings will require engineering judgment as lane widths, quantity of lanes, operating speeds, and presence of parking will vary from street to street. In particular, the width of the shared travel lane, and the number of available travel lanes impact typical operating behavior of motorists and bicyclists. Travel lanes with widths less than 13 feet will require motorists to partially or fully change lanes to pass bicyclists. Travel lanes of 13 feet or greater generally allow motorists to pass bicyclists with minimal or no encroachment into adjacent travel lanes (allowing 3 feet of horizontal separation between the motorist and bicyclist).

Generally the center of shared lane markings should be located a minimum of 11 feet from the curb or edge of roadway at locations where parking is permitted adjacent to the travel lane. Generally the center of shared lane markings should be located a minimum of 4 feet from the curb or edge of roadway at locations where parking is prohibited.

It may be appropriate to move the shared lane marking towards the center of the travel lane (exceeding the MUTCD minimums) if engineering judgment determines that this placement will enhance the safety of the bicyclist operating within the travel lane. The shared lane marking may be moved towards the center of the lane regardless of whether it is adjacent to parking or not. In most cases it will be a combination of two or more of the following factors which will indicate that consideration should be given to moving the Shared Lane Marking towards the center of the travel lane:

- Travel lane is less than 12 feet in width
- Speed of traffic
- Number of travel lanes (it may be desirable to place the shared lane marking towards the center of a narrower outside travel lane when a center turn lane is present or when there are multiple travel lanes in the same direction)
- Grade of roadway and expected bicyclist speed (center lane placement often works well when going downhill on streets with steep grades and high bicycle speeds)
- Volume of traffic (may or may not be an issue – speed, grade, and number of lanes are more important)

**Situations Where Travel Lanes Are Less than or Equal to 12 Feet in Width**

Shared lane markings should be placed in the center of the travel lane where travel lanes are less than 12 feet to encourage bicyclists to occupy the full lane and not ride too close to parked vehicles or the edge of the roadway. A BIKES MAY USE FULL LANE (R4-11) sign may be used to supplement the marking. Travel lanes of this dimension are too narrow for sharing side by side with vehicles.

**Situations Where Travel Lanes Are Between 12 Feet and 13 Feet in Width**

Where travel lanes are 12-13 feet in width, the travel lane can appear shareable to roadway users if bicyclists operate on the right side of the lane resulting in unsafe passing maneuvers. It may be desirable to place the marking in the center, or close to the center of the lane to discourage these behaviors. A BIKES MAY USE FULL LANE (R4-11) sign may be used to supplement the marking.
**Situations Where Travel Lanes Are Greater than or Equal to 13 Feet in Width**

Where travel lanes are 13 feet or wider, motorists will generally be able to pass bicyclists within the same lane or will only need to slightly encroach on adjacent lanes to pass bicyclists. The Shared Lane Marking should generally be located in the right portion of the lane (per the MUTCD minimum requirements) with exceptions for locations adjacent to parking where it is desirable to encourage riding further from parked vehicles. A Share the Road sign (W11-1 AND W16-1P) may be used to supplement the marking.

*Shared lane markings should generally be used on arterial and non-arterial roadways with motor vehicle speeds 35 mph or less. Research has shown that placing the marking in the center of travel lanes wider than 13 feet will likely result in poor compliance by bicyclists who will travel in the right portion of the lane. This may undermine the effectiveness of shared lane markings in narrower lanes.*

Appendix B contains additional cross section illustrations that show shared lane markings on a variety of roadway and travel lane configurations.

**Considerations for Parking Lane Line Placement**

Where there are no parking restrictions, the Shared Lane Marking should be placed in conjunction with a 4 inch solid or dotted white parking lane line (2 foot line with 4 foot gaps). The dotted line should be used through uncontrolled intersections where there is no arterial traffic control and where there are parking restrictions, including bus stops. The intent is to reinforce no parking restrictions and to provide a continuous visual cue for the bicyclist. The parking lane line will be located 7 to 8 feet from the face of the curb or roadway edge. Generally, a narrower parking lane is desirable to encourage motorists to keep the vehicle as close to the edge of the roadway as possible to maximize the available travel lane width, which will improve the bicyclist’s level of comfort on the roadway.
Considerations for Symbol Placement Frequency
Shared Lane Markings should be placed at the far side of an uncontrolled intersection, at both sides of an arterial intersection with traffic control, and at mid-block locations where block faces are more than 250 feet.
When placing mid-block Shared Lane markings, they should be placed in such a manner that the first Shared Lane marking a bicyclist or motorist would come upon would be the Shared Lane marking in their direction of travel. The Shared Lane markings should be offset from each other 20 feet from the tip of the leading (top) chevron to tip of leading (top) chevron.
Where there are mid-block marked crosswalks, the tip of the chevron should be placed 25 feet beyond the far side of the marked crosswalk.

Considerations for Shared Lane Marking Placement – Non-Arterial Streets
Shared Lane Marking installation on non-arterial streets (streets without a centerline) should generally follow the guidelines mentioned above. However, no parking lane lines should be installed. Utilizing the marking on non-arterial streets may require that the Shared Lane Markings be offset at intersections to prevent the symbols from overlapping. The tips of the leading (top) chevrons should be separated by at least 10 feet.

Cost
Costs to design and install shared lane markings will vary from $15,000 to $20,000 per mile. Costs will be higher if the installation requires grinding out old paint lines; they will be lower if no grinding is required.

3. Cycle Tracks
A cycle track is a portion of a right-of-way contiguous with the traveled way, which has been designated by pavement markings and, if used, signs, for the exclusive use of bicyclists. Cycle tracks are typically one-way (not always), may or may not be at a higher elevation than the adjacent roadway, and are separated from the motor vehicle lane by a barrier or buffer such as a curb, cross-hatched pavement marking, planting strip or parked cars.
Cycle tracks create the following operational and design challenges which should be considered:
- Motor vehicles entering the arterial roadway from a side street that is stop controlled, must cross through bicycle traffic to view arterial roadway traffic around the parked cars. This may cause motor vehicles to block the cycle track as they edge forward to see around parked vehicles.
- Drivers of motor vehicles crossing or turning from the road with cycle tracks may not be able to see bicyclists in the cycle tracks if they are blocked by parked vehicles.
- To make a left turn, bicyclists must merge into the travel lanes from behind a line of parked cars (assuming the parking is being used), creating a situation with poor sight lines between motorists and bicyclists. If parking is fully-utilized, this may not be possible except at signalized intersections where bicyclists are given an exclusive phase to make a left turn.
Motor vehicle passengers are not accustomed to looking for bicyclists when they open doors and exit on the right side of the vehicle. Consequently, several feet of shy distance (lateral space) is needed between the parked motor vehicles and the cycle track.

If the facility is a two-way bicycle track way, bicyclists may ride in the opposite direction of adjacent motor vehicle traffic, making them vulnerable to motor vehicle drivers who only look to their left when turning right from a side street.

In most cases, cycle tracks should not be placed between parked cars and the curb, unless the above issues can be addressed.

**FIGURE 6-11**
One-Way Cycle Track

**FIGURE 6-12**
Two-Way Cycle Track

**Cost**
Costs for cycle tracks may vary considerably depending on whether drainage work or new signal heads are required. The cost of a one-way cycle track on both sides of the street is approximately $670,000 per mile.
4. Paved Shoulders

Paved shoulders provide space on the outside of travel lanes for bicycle and pedestrian use. Paved shoulders should be a minimum of 4 feet without the curb; 5-foot minimum with a curb. Additional shoulder width is desirable on roadways with high motor vehicle traffic volumes, high vehicular speeds, or a high percentage of trucks, buses, and recreational vehicles. It is important to note that at intersections, additional symbols, signage, arrows, or short sections of bike lanes may be needed to provide direction to bicyclists and reduce potential conflicts between bicyclists and turning cars.

Agencies can evaluate narrowing travel lanes within AASHTO Green Book guidelines to allow pavement to be reallocated to the paved shoulder. On some roadways without curbs, paved shoulders can provide important bicycle connections. Paved shoulders also improve safety for motor vehicles and prevent pavement damage at the edge of the travel lanes.

There are two types of bikeable shoulders identified, with the difference being whether parking is allowed on the shoulder. In rural areas, no parking is allowed and shoulders should be provided as discussed above. In some areas within the City of St. Louis and other parts of the planning area shoulders may function as a parking lane. In areas where there are low occupancy rates of parking, the shoulder can function as bikeable space the majority of the time. In these instances, there is no need to provide an additional dedicated bicycle facility, and bicyclists should proceed with caution when overtaking parked vehicles. It should be noted that this situation should be regularly re-evaluated. If onstreet parking occupancy rates increase, shared lane markings may be added to provide locationspecific guidance to bicyclists and motorists.

Cost

The cost of paved shoulders will vary depending on whether the paved shoulder area already exists or additional pavement is required to provide the shoulder. Costs associated with enhancing an existing paved shoulder may include adding signage indicating a bicycle route and restriping. If the shoulder is to be added to the roadway, the cost is approximately $2.3 million per mile, assuming earthwork, base course, pavement, landscaping, traffic maintenance, utility adjustments, and striping.

Appendix B contains additional cross-section illustrations of other situations in which paved shoulders may be considered.

5. Shared Bus/Bike Lanes

When bus/bike-only lanes are developed, it is desirable for the lanes to be wide enough (15-foot minimum) for buses and bicyclists to pass each other comfortably in the lane. Shared bus/bike lanes that are part of a bikeway system should include shared lane markings.
6. Shared Roadway

Shared roadways are roadways without any designated bicycle facilities, which may or may not be signed as a bicycle route. Many non-arterial roadways with low traffic volumes and low speeds are already good places for bicyclists to ride. Roadway striping and markings are not necessary to make these streets comfortable for most bicyclists to use. Many arterial roadways are also currently shared roadways as bicyclists have the right to use all roads (unless, specifically prohibited such as on a controlled access freeway), but appropriate facilities described above should be incorporated into arterial roadways to make them more comfortable for bicyclists and motorists. Appropriate bicycle signage is required when transitioning from a roadway with a designated bicycle facility to one without any designated bicycle facility (and vice-versa).

In addition to bicycle route signs, Share the Road signs can be used on shared roadways to remind motorists to share the road with bicyclists. These signs can increase awareness of bicyclists, especially in areas where bicyclists may not be expected or where many drivers are not local. A new fluorescent yellow/green color has been approved in the MUTCD and can be used on these signs. Signs should be used judiciously, as too many signs can cause visual clutter and lead to non-compliance. Note that the Share the Road sign is a warning and should not be used for directional signing of a bicycle route. More guidance on signage is provided in Appendix C.

7. Shared-use Paths

Shared-use Paths are an important component of a bikeway system. These facilities can provide a high-quality bicycling experience because they are separated from motor vehicle traffic and often provide an opportunity for extended landscaping and preservation of green corridors. Shared-use paths are usually paved and widths range from 10 to 14 feet. Trail widths of 14 feet and even 16 feet are appropriate in high-use urban situations or where:

- There is significant use by in-line skaters, adult tricycles, or other users that need more operating width.
- The path is used by larger maintenance vehicles.
- On steep grades to provide additional passing area.
- Through curves to provide more operating space.

In very rare circumstances, a reduced width of 8 feet may be used where the following conditions prevail:

- Bicycle traffic is expected to be low, even on peak days or during peak hours.
- Pedestrian use of the facility is not expected to be more than occasional.
- Horizontal or vertical alignments provide safe and frequent passing opportunities.
- The path will not be regularly subjected to maintenance vehicle loading conditions that would cause pavement edge damage.
**Considerations for pathways parallel to roadways**

Ideally, shared-use paths are provided on both sides of the roadway and bicyclists use the paths as one-way facilities (traveling in the same direction as adjacent motor vehicle traffic). Due to right-of-way and budget constraints, though, they are often provided only on one side of the roadway. Shared-use paths should be designed to reduce conflicts between pedestrians and bicyclists. They can function well if the following key design features are achieved:

- A minimum 5-foot buffer between the outside travel lane and edge of pathway can be built (a 42-inch vertical barrier is also acceptable).
- Conflicts with intersecting roadways and driveways (which may or may not be signalized) should be minimized.
- Paths work particularly well where they are parallel to expressways and railroad rights-of-way because they are limited access in nature. However, paths parallel to divided highways must be designed carefully, especially near crossings of high speed ramps.
- Visibility of cyclists at all crossings.
- Street trees are recommended where possible (30 to 60 feet on center).
- Crossings of free flow highway access ramps should be avoided or minimized and made sufficiently safe.
- Conflicts between pedestrians and bicyclists are minimized by having adequate width, clear space at the side of the path, and sight distance at locations where pedestrians cross or enter the facility.
- Berms and/or vegetation can be used to separate paths from adjacent areas; however, it is not desirable to place the pathway in a narrow corridor between two barriers (such as fences, bollards, or a knee-wall) for long distances. This prevents path users from leaving the path in the event of an emergency, and creates an uncomfortable experience for the user.

**Considerations for trails and greenways**

Design considerations for pathways are also applicable to trails and greenways. Additional design considerations for trails and greenways include the clear zone of trees, signs and other objects near trails. Information on clear zone requirements from the AASHTO Guide for the Development of Bicycle Facilities is included below.

- A minimum 2-foot wide graded area with a maximum 1:6 slope should be maintained adjacent to both sides of the path; however, 3 feet or more is desirable to provide clearance from trees, poles, walls, fences, guardrails or other lateral obstructions.
- Where the path is adjacent to canals, ditches or slopes steeper than 1:3, a wider separation should be considered. A minimum 5-foot separation from the edge of the path pavement to the top of the slope is desirable. Depending on the height of embankment and condition at the bottom, a physical barrier, such as dense shrubbery, railing or chain link fence, may need to be provided.¹⁰

**Side paths**

Side paths are shared-use paths located adjacent to roadways. They are often located only on one side of a road, and are intended to provide two-way bicycle and pedestrian travel. Sometimes this type of facility is the only option in a narrow roadway corridor. Side paths can function well if the following key design features can be achieved:

- Sufficient width is available to build a facility with at least a five-foot buffer between the outside travel lane and edge of pathway (a 42-inch vertical barrier is also acceptable).
- The path can be located in an area where conflicts with crossing roadways (which may or may not be signalized) can be minimized. Paths work particularly well where they are parallel to expressways and railroad rights-of-way because they have limited access by nature. However, paths parallel to expressways must be designed carefully—grade separation is preferred at freeway interchanges.
- Crossings of free flow ramps can be avoided, minimized, or made sufficiently safe.

**8. Transitions between Different Bicycle Facility Types**

While a goal for the Plan is to provide consistent bicycle facilities among jurisdictions throughout the region, it is often necessary to use different bicycle facilities to provide bicycle access within the same roadway corridor due to existing roadway conditions, surrounding land uses, available right-of-way, and other characteristics. Where this condition occurs, it is important to provide transitions between different facilities. These transitions can be made safer and more understandable for bicyclists and motorists with appropriate and consistent treatments such as spot directional signs, warning signs, pavement markings, curb cuts, etc. Transitions should be provided as a part of the bicycle facility design process.

One of the most typical transitions between bicycle facilities will be between shared travel lanes and bicycle lanes. At locations where bike lanes terminate to become shared lanes it is advisable to provide a transition to a marked shared lane for a brief distance, even if it is not desirable to mark a continuous shared lane for the remainder of the roadway. The placement of the shared lane marking should conform to guidance provided above. It is recommended that a SHARE THE ROAD sign (W11-1 and W16-1P) be used for shared lane situations where the lane is wider than 13 feet and BIKES MAY USE FULL LANE (R4-11) signs be used for narrower lane widths. The taper terminating the bike lane should also conform to the MUTCD (Figure 3B-14, 2009 MUTCD).
Bicycle Facility Intersection Treatments

The AASHTO Guide and the MUTCD provide a comprehensive discussion of intersection design for on-road bicycle facilities and off-road trail crossings of roadways. This section provides additional guidance for intersection treatments to supplement the AASHTO Guide and the MUTCD. These treatments include contrasting color pavement, bike boxes, and transitions between bike lanes and shared lanes.

9. Contrasting Green Color Pavement

The use of contrasting green color is used primarily to highlight areas with a potential for bicycle-vehicle conflicts, such as intersections or merge areas where turning vehicles must cross a through bike lane. Generally, color has been applied to sections of bike lanes that previously had been delineated by dotted white lines. Examples of the use of color are shown in Figures 6-16 and 6-17.

MUTCD Status: The use of contrasting color is presently not in the MUTCD, but was given Interim Approval status by FHWA on April 15, 2011. The use of contrasting green color has been shown through experimentation to increase awareness of bicyclist but has thus far not been shown to reduce crash rates in conflict areas. The Interim Approval status requires a jurisdiction to submit a written request to FHWA for its use until such a time as it is included into the MUTCD; an experiment is not required.

10. Bike Boxes

A bike box is generally a right angle extension to a bike lane at the head of the intersection (see Figure 618). Bike boxes require an advanced stop bar for motor vehicles and second stop bar for bicyclists. The box allows bicyclists to get to the head of the traffic queue on a red traffic signal indication, and then proceed first when the traffic signal changes to green. Such a movement is beneficial to bicyclists and
FIGURE 6-16
Green Bike Lane Through Intersection

FIGURE 6-17
Green Bike at Intersection Approach
eliminates conflicts when, for example, there are many right-turning motor vehicles next to a right side bike lane. Being in the box, and thus at the front of the traffic queue, also tends to make bicyclists more visible to motorists. The bike box may also be appropriate in situations where there is a high volume of left turn movements by bicycles. In some cases, bike boxes have been combined with the use of contrasting colored pavement to reinforce the intended use of the box.

**MUTCD Status:** The use of bike boxes is presently not in the MUTCD. It is currently experimental device with multiple experiments occurring around the United States. Advanced stop lines are an approved MUTCD device. It is recommended an experiment request be submitted to FHWA prior to use of a bike box.

**11. Bike Detection**

Actuated traffic signals should detect bicycles. If a traffic signal does not detect a bicycle, a bicyclist will be unable to call a green light. If a motor vehicle does not arrive to actuate the signal, the cyclist who chooses to proceed through the intersection can do so only by treating the red light as a STOP sign. The most common type of detector is the inductive loop. Loops are wires installed in a specific configuration beneath the pavement surface that can detect the presence of a conductive metal object.

**Inductive loop configurations**

Significant research has been conducted to determine the best loop configurations to detect bicycles. Loop layouts have been developed and tested both in bicycle lanes and shared lanes. The quadruple loop detector illustrated in Figure 6-18 can detect a metal-frame or metal-rim bicycle at any location above the loop. It may
be necessary to install bicycle specific loop detectors on roadways with bicycle lanes if the motor vehicle loop does not extend into the bicycle lane sufficiently. An example is shown in Figure 6-19.

A quadruple loop detector with a diagonal configuration as illustrated in Figure 6-19 can be used when bicyclists share the lane with motor vehicles.

The most important aspects of detection are the sensitivity setting of the detector amplifier and the location on the loop where the cycle crosses the loop. The use of sensitivity settings depends on local factors like the depth of the inductive loop, size of the adjacent lanes and the percentage of truck traffic in the adjacent lanes.

At locations with bike lanes, it is possible to minimize delay to bicyclists and provide green extension time by installing one loop about 100 feet from the stop bar, with a second loop located at the stop bar. The location of the upstream detector should be far enough from the intersection to allow for the bicycle stopping distance. Another key consideration in the location of the upstream detector is to avoid being triggered by right turn vehicles. The detector located upstream of the stop bar can have a standard loop configuration. When a bicycle is detected at the upstream loop, appropriate extension time is provided to hold the green to allow the bicycle to reach the loop at the stop bar. When the detection is made at the stop bar, extension time is provided to allow the bicycle to move far enough into the intersection to safely clear before the end of the yellow interval. If the detection occurs when the light is red, the minimum timing feature programmed in the signal controller provides the required minimum green time to cross the intersection.

At locations without bike lanes, the bicycle detector pavement marking should be installed over the spot that a bicycle must stand in order to activate the signal. This pavement marking can be supplemented by a R10-22 sign to reinforce the message to the bicyclist.
12. Additional Considerations for Roadway Crossings and Bicycle Facilities

Roadway crossings are critical to the safety and convenience of a bicycle network. Many arterial streets are challenging to cross, particularly during peak travel periods. In order to make it possible for bicyclists to travel throughout the St. Louis region, there must be safe places to cross major streets. The section below describes the types of treatments that are recommended to help bicyclists cross these major roadways. Selection of the appropriate roadway crossing treatment depends on a number of factors:

- Roadway width/number of lanes
- Motor vehicle traffic volumes
- Motor vehicle speed
- Sight-distance
- On-street parking
- Presence of traffic signals at the intersection or at nearby intersections.

An appropriate combination of physical improvements should be recommended for each crossing location in a bicycle network. These crossing improvements include traffic signals, geometric improvements, signs, and markings. Specific types of recommended improvements are described below.

13. Signalized Intersections

Signalized intersections allow bicyclists to cross arterial streets without needing to select a gap in moving traffic. Traffic signals make it easier to cross the street, though it is important to make improvements to reduce conflicts between bicyclists and turning vehicles. All new signals must meet MUTCD warrants.

14. Mid-block Crosswalk Signals

Mid-block crosswalk signals allow pedestrians and bicyclists to stop traffic to cross arterial streets. Most mid-block crosswalk signals in the bicycle network will be for trail crossings. Pushbuttons should be “hot” (respond immediately), be placed in convenient locations for bicyclists, and abide by other ADA standards. Other passive methods for signal activation may also be considered. All new signals must meet MUTCD warrants.

15. Curb Extensions

Curb extensions shorten bicyclist and pedestrian crossing distance (exposure time) and increase the visibility of non-motorized users at roadway crossings. By narrowing the curb-to-curb width of a roadway, curb extensions may also help reduce motor vehicle speeds and improve bicyclist and pedestrian safety. Curb extensions are appropriate only for locations that have full time, on-street parking.

16. Curb Radius Reduction

Wide curb radii allow motorists to make high-speed turning movements. Reducing the curb radii at the corners of an intersection helps to slow turning vehicles, improves sight distance between bicyclists and motorists, and shortens the crossing distance for bicyclists and pedestrians. The choice of a curb radius is dependent on the design vehicle and speed; and whether the street is a local residential street, a neighborhood collector, or a major arterial. The appropriate radius for each corner of an intersection should be designed independently based on the specific needs of the appropriate design vehicle.
17. **Median Islands**
Median islands (or crossing islands) allow bicyclists and pedestrians to cross one direction of motor vehicle traffic at a time. Arterial roadway intersections that have low demand for left-turn movements can be potential candidates for adding median islands. Median islands can be constructed on these roadways by using the available center turn lane area, or by removing parking from one side of the street and shifting the travel lanes. Median islands are likely to be a medium- or long-term improvement on roadways where significant channelization changes are needed to provide enough space for the median island.

18. **Overpasses and Underpasses**
Overpasses and underpasses separate bicycle and pedestrian traffic from vehicular traffic, allowing bicyclists and pedestrians to cross freeways, busy streets and railroad tracks without potential conflicts. They can also be used to cross ravines, canals, and streams. However, for crossing streets or railroad tracks, they should be used with great caution as they are expensive to construct. In addition, underpasses are prone to security concerns due to limited visibility, and the inconvenience of out-of-direction travel is high (up to 1,000 feet or more), because of the need to provide accessible ramps, and many bicyclists and pedestrians will not walk this extra distance and will instead cross at-grade. To be effective, there should be a self-enforcing feature that requires the bicyclists or pedestrian to use the bridge, such as topography, or fencing. Consequently, overpasses and underpasses should be reserved for locations where there is a high demand for bicycle and pedestrian crossings and there are no other more attractive options. Adequate width (for users to pass each other comfortably), lighting, and surveillance should also be provided to increase security of these crossings.

19. **High-visibility Pedestrian/Bicycle Crossing Warning Signs**
High-visibility bicycle and pedestrian warning signs are recommended at trail crossings. These signs can increase driver awareness of bicyclists and pedestrians, especially at mid-block locations where bicyclists and pedestrians may not be expected. These signs will be most effective when combined with other treatments, such as marked crosswalks, curb extensions, median islands, etc. Signs should be used judiciously—too many signs can cause visual clutter and lead to non-compliance.

20. **Sight-distance Improvements**
Sight-distance obstructions can increase the risk of bicyclists being struck by vehicles at roadway crossings. Locations may have on-street parking, landscaping, light poles, bus stop shelters, and other features obstructing the line of sight between drivers and bicyclists. While these features can make a street more attractive and serve other valuable functions, they should be placed in locations that do not obscure drivers’ views of bicyclists.

Restricting parking within a certain distance of an intersection—typically 30 feet—helps to maintain sight distance. Such a restriction should be put in place in all jurisdictions within the Plan area, if it is not already. Enforcement of this law should be targeted on arterial roadways with bicycle lanes and at intersections where signed bicycle routes cross arterial roadways. At certain locations, it may be appropriate to restrict parking further to achieve the desired improvement in sight distance.

Model Bicycle Parking Guidelines

The Association of Pedestrian and Bicycle Professionals (APBP) Bicycle Parking Guidelines, 2nd Edition covers virtually everything related to bicycle parking, including recommended racks, site layout, security, aesthetics, weather protection, lighting maintenance etc. It even provides model legislation for determining required parking for new developments.

The APBP guidelines are applicable in both urban and suburban contexts. The only significant difference will be scale. The number of bicycle parking racks needed at a particular location may be less in suburban and semi-rural areas. This difference in demand will immediately be captured if parking requirements are based on density and distance (addressed in APBP Guidelines). Lower densities and longer distances from population centers will generally result in lower demand for bicycle parking.

22. Bicycle and Transit Integration

Recommended guidelines for bicycle parking at transit stations.

Metro, like many transit agencies across the country, provides bicycle parking at transit stations. Bicycle parking is attractive for several reasons, including the following:

- Promotes transit ridership
- Is relatively cheap to install
- Can be installed on an as-needed basis when demand increases (assuming there is space)
- Can accommodate several bicycles (passengers) in a relatively small footprint
- Saves the cost of constructing expensive parking garages.

Simply providing a few racks and lockers at transit stops, however, is not enough to realize the full potential for accessing transit by bicycle. It requires a thoughtful and purposeful approach that addresses user concerns about security and will attract the maximum number of bicyclists.

The Association of Pedestrian and Bicycle Professionals (APBP) has a comprehensive publication on bicycle parking titled APBP Bicycle Parking Guidelines, 2nd Edition that should be adopted by Metro for use at all transit stations. The manual covers virtually everything related to bicycle parking including recommended rack types, site location and layout, security, aesthetics, weather protection, lighting, maintenance etc.

The City of St. Louis and other cities should coordinate with Metro to incorporate into station area planning the parking recommendations for transit stations from the APBP Bicycle Parking Guidelines. They call for the following:

- Long-term Bicycle Parking Requirement: Spaces for 5 percent of projected morning peak period daily ridership. Long-term parking racks provides a high level of security and are typically in cages and bicycle rooms as well as lockers located in-doors and out-doors.
Short-term Bicycle Parking Requirement: Spaces for 1.5 percent of morning peak period daily ridership. Short-term parking usually consists of simple bicycle racks that are convenient and utilitarian but do not provide a high level of security.

When installing bicycle parking at stations, it is desirable to include some excess capacity to accommodate future bicyclists. Some people may decide against riding simply because they feel that there is insufficient available bicycle parking.

Bicycle parking needs should also be considered at heavily used bus stations using the same formula. Separate studies may be required to determine parking needs on a station specific basis.

Not all stations will require this amount (see above) in the short run. If fewer spaces are provided, they should be regularly monitored with more spaces provided as demand increases. In all cases, ground space should be set aside to meet these parking requirements in the future.

The APBP Bicycle Parking Guidelines provides very good guidance for installing and managing bicycle lockers. They also point out some of their shortfalls—they can be used for nefarious activities (storage), they may be rented but seldom used, there is often a waiting list for those wanting to rent a locker, renters are generally restricted to one location (unless they rent lockers at multiple stations), and they can be a challenge to administer.

Another approach that is gaining widespread acceptance is to install high capacity bike parking facilities. While there are different designs, they are essentially free-standing, unattended, see-through buildings that require a key card or similar device to enter. Once inside, personal locks secure bikes to traditional racks (see Figure 6-20). This approach has several advantages:

- Transit passes (monthly or yearly) can be used to access the buildings thus avoiding the need to issue individual keys.
- The transparency of the buildings allows for easy surveillance.
- Anyone with a transit pass can use any facility—they are not limited to renting a single locker at just one facility.
- There are generally fewer moving parts, which makes them easier to maintain.

Metro could either manage the high capacity bike parking facilities or contract with a vendor. An additional fee could be added to the cost of the monthly/yearly/daily passes to cover some of the operating costs. However, the amount of this fee should be balanced against the potential to deter cyclists from riding to transit stations. For example, the City of Portland has been experiencing relatively low bike parking utilization rates and the fee amount was determined to be a contributing factor.
Recommended Criteria for Implementing Bicycle Facility Improvements at and to Transit Stations

Metro should consider installing appropriate bicycle parking at new stations and in conjunction with major retrofitting of existing stations. Space for future bicycle parking should be included in station designs from the onset of a project, regardless of how many bicycle parking spots are installed.

Metro should also prioritize existing stations to determine which stations should be targeted for enhanced bicycle parking. This should be done in conjunction with local jurisdictions so that Bikeway System improvements providing bicycle access to the stations can be completed at the same time. To accomplish this, Metro and the local jurisdiction will need to agree on mutually acceptable criteria for setting priorities. A good way to start is by counting the number of bicycles currently parking at each station (count bicycles at racks and elsewhere at the stations). However, this information should be used with care since it may be misleading in situations where there are no facilities leading to the stations from adjacent neighborhoods (i.e. lack of bicycles does not always mean lack of demand). Another good approach is to develop a prioritization map for the city or region that uses a variety of factors to determine where there will likely be demand for bicycle facilities (see City of St. Louis prioritization map in Chapter 9).

This still leaves the need to prioritize stations that should be targeted for access and parking improvements. Metro and local jurisdictions are encouraged to adopt the following criteria:

- **Density**: Higher density neighborhoods generally have higher numbers of people that live within bicycling distance of a transit station.
- **Ridership**: Stations with the highest morning peak period daily ridership have more people who will potentially bicycle.
- **Distance from centers**: Stations closest to a downtown or neighborhood commercial area are likely to attract more bicycling while stations further out will tend to serve a different, more automobile-oriented clientele.
- **Proximity to Bicycle Facilities**: Stations close to multi-use trails and future on-road bicycle facilities will likely experience higher levels of passengers accessing the station by bicycle.
- **Other Transit Connections**: The level of connectivity to other transit services (other trains, buses) at the station indicates the station’s ability to serve a wide-ranging area.
- **Origin vs. Destination**: Some stations are at the origin of a journey while others are at the destination or end of a journey. Stations that serve both functions are often good candidates for capturing bicycle trips.