ODOT DESIGN GUIDANCE

for

ROADWAY-BASED BICYCLE FACILITIES

e.g., Bike Routes, Bike Lanes, Shoulders

October, 2005

Office of Local Projects
Ohio Department of Transportation

TABLE OF CONTENTS

I. INTRODUCTION

The Ohio Department of Transportation (ODOT) has adopted the American Association of State Highway and Transportation Officials' *(AASHTO) Guide for the Development of Bicycle Facilities, 1999* (hereafter referred to as the "*AASHTO Guide*") as its manual.

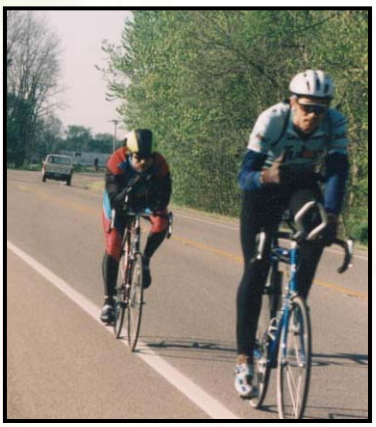
This on-line document, ODOT Design Guidance for Roadway-Based Bicycle Facilities serves as a supplement to the *AASHTO Guide*, and provides guidance on expectations for facilities constructed by ODOT. The text is organized by types of facilities, features found on roadways, improvements that will provide better accommodation, maintenance, and frequently asked questions.

Several additional organizations, listed in RESOURCES, offer on-line resources that also explain the purpose, appropriate design, and maintenance of on-street bicycle facilities. These resources are listed for informational purposes only, and have not been adopted as ODOT standards. Specific hyperlinks to these on-line resources are presented throughout this web document.

II. TYPES OF ROADWAY-BASED BICYCLE FACILITIES

Roadway–based bicycle facilities include the typical shared roadway, signed bike routes, wide curb lanes, bike lanes, shoulder bike lanes, and paved shoulders.

Shared Roadways
(Supplements pages 7 & 16 of the *AASHTO Guide*)



SR 104 near Waverly
Photo by Sharon Todd

Approximately 98% of Ohio's streets and roads are shared roadways. Shared roadways include collectors, arterials, 4-lane expressways, and freeway over- and under-passes, as well as neighborhood streets and country roads. (Freeways – which bicyclists are prohibited from using – make up the remaining 2%.) Some shared roadways used frequently by bicyclists have bicycle route signs posted along them, however, neither bicyclists, nor bicycle route signs, need to be present for the road to be a shared roadway.

Factors that make a road easily shared or difficult to share includes gradient, alignment, surface width and condition, volume and speed of traffic, plus weather and lighting conditions. A road with badly deteriorated pavement is a challenge and a safety concern for even a solitary road user. The concerns increase with the presence of other traffic, darkness or bad weather.

For more information about shared roadways, see the first two chapters of the *Bicycle Design Guide* at The National Center for Bicycling and Walking (NCBW) website.

Signed, Shared Roadways
(Supplements pages 7 and 19-21 of the *AASHTO Guide*)

Calumet St., Columbus Photo by Dale Hooper

A signed, shared roadway, also known as a bike route, is the same as a shared roadway with the addition of bicycle route signs posted alongside it. Some signed, shared roadways are numbered and others are named (e.g., the Cardinal Trail). Signs appropriate for signed shared routes (e.g., D11-1) can be viewed in Chapter 9 of the *OMUTCD*.

For more information about signed routes, go to the Pedestrian and Bicycle Information Center (PBIC) website.

Wide Curb Lanes
(Supplements the information on page 17 of the *AASHTO Guide*)

Source: www.pedbikeimages.org, photo by Dan Burden

Wide curb lanes perform well as shared roadways: Motorists are able to pass bicyclists without crossing the center line, and bicyclists are able to travel unimpeded.

The width of wide curb lanes varies considerably from place to place, as do the reasons for their existence.

Some communities find that motorists wander around within wide curb lanes, and to fix this, mark an "edge" line on the pavement to define the expected travel path of motorized traffic. Marking an edge line provides an unofficial bike lane, as drivers stay closer to the centerline.

Wide curb lanes are discussed on the PBIC website and in the "Major Urban Streets" chapter of the *Bicycle Design Guide* at NCBW's website.

Bike Lanes
(Supplements information on pages 7, 8, and 22-32 of the *AASHTO Guide*)

Cedar Point Road, Cleveland Metroparks
Photo by Sharon Todd

Bike lane pavement markings are required when Bike Lane signs (R3-17) are used. Signs and symbols appropriate for bike lanes can be found in Chapter 9 of the *OMUTCD*. Painted or thermoplastic markings may be used. Painted markings work well but must be renewed frequently. Thermoplastic that is not slick when wet is acceptable. NOTE: Diamond markings, as shown in the photo at right, are not acceptable markings for new bike lanes.

FHWA offers two publications, "Bicycle Lanes vs. Wide Curb Lanes: Operational and Safety Findings and Countermeasures" and "A Comparative Analysis of Bicycle Lanes vs. Wide Curb Lanes: Final Report" which discuss the differences between bike lanes and wide curb lanes and the problems typically encountered by bicyclists using them. Nei ther document provides the reader with guidelines for choosing one type facility over the other.

For more information on bike lanes, the PBIC discusses bike lanes in the "Intersections" and "On-street Facilities" sections of its website, and the "Major Urban Streets" chapter of NCBW's *Bicycle Design Guide*.

The *Bike Lane Design Guide* explains how the City of Chicago found ways to create bike lanes on its urban streets. This guide has since been adopted by the City of Cleveland. The *Bike Lane Design Guide* should be used with caution for two reasons. One, discontinuous lanes can result, as lanes are created only where there is room to install them, which varies block by block and sometimes within a block. Two, it encourages addition of bike lanes by reducing vehicular travel lane widths to a width narrower than allowed by Section 300 of the ODOT *L&D Manual, Vol. 1*. For projects governed by the ODOT design criteria, the reduction in travel lane width may not be permitted. At best, a Design Exception Request, in accordance with Section 105 of the *L&D Manual*, may be required.

Paved Shoulders
(Supplements the information on pages 16 & 17 of the *AASHTO Guide*)

Many Ohio roadways, by their functional classification, have smooth paved shoulders wider than 5 feet (see Ohio's Functional Classification System). Paved shoulders are built as part of the roadway rather than to provide a place for bicyclists to ride, although they perform that function very well. There is no need to mark bike lanes on these shoulders, and no need to add another 5 feet of pavement for a marked bike lane beyond the existing shoulder.

Read more about paved shoulders at the PBIC website, and in the "Rural Road Shoulders" chapter on the NCBW website.

Shoulder Bike Lanes
(Supplements the information on pages 16 & 17 of the *AASHTO Guide*)

Shoulders of 4-6 foot width are not unique to Ohio, but it is unique that we call shoulders built specifically for bicyclists "bike lanes." Shoulder bike lanes have characteristics of both paved shoulders and bike lanes. The pavement buildup is the same as for a roadway shoulder to prevent break up when driven on by heavy vehicles, and a pavement stripe separates it from the motorized traffic lanes. Shoulder bike lanes are generally constructed next to two-lane roadways with 20-22-foot-wide pavement without existing paved shoulders, curbs, or curbs and gutters. Typically, traffic volumes are above 3,000/day, actual speeds are above 50 mph, and the road is also frequently used by bicyclists, or needed to create a corridor for area bicyclists. Shoulder bike lanes, like shoulders, work best where intersections and turning traffic is infrequent. Shoulder bike lanes are viable facilities for rural or suburban areas where there is adequate right-of-way for their construction.

The first ODOT-built shoulder bike lane was built in 1989, on SR 82 in Portage County, to improve bicycle access between two towns, one of which has a college. Shoulder bike lanes have been built on a variety of city streets and country roads, and on parts of State Routes 53 (Ottawa Co.), 212 (Tuscarawas Co.), 283 (Lake Co.), 542 (Carroll Co.), and 703 (Mercer Co.), plus U.S. 6 (Lorain Co.) and U.S. 40 (Licking, Muskingum and Guernsey Counties).

Either Bike Route or Bike Lane signs (see Ch. 9, *OMUTCD*) may be posted along shoulder bike lanes. The M1-8 Bike Route sign is used in most locations. The M1-9 interstate sign is used when a bicycle route crosses into an adjoining state. All bike route signs require a route designation (e.g., Cardinal Trail, O.S.U. Bike Route). Bike lane pavement markings are required when Bike Lane signs (R3-17) are used. Painted or thermoplastic markings may be used: Painted markings work well but must be renewed frequently; Thermoplastic that is not slick when wet is acceptable.

To summarize, where high volume is combined with hills, poor sight distance, narrow pavement or motor vehicle speeds 50 mph or greater, some improvement (paved shoulders, wide curb lanes) should be considered to better accommodate bicyclists.

III. ACCOMMODATING BICYCLISTS ON ROADWAYS

Roadway features built into or added to the paved surface of a roadway often need a bicyclists' attention in order to remain upright on the bike rather than spilled on the pavement.

Bike-Safe Drainage Grates
(Supplements information on page 18 of the *AASHTO Guide*)

Bike-safe grates were adopted by ODOT in the 1970's and all unsafe grates formerly placed on state highways have been replaced. There are still some grates with long, wide slots in use within communities and in parking lots, where ODOT has no jurisdiction. Any road upon which bicyclists ride should have bike-safe grates installed. ODOT Standard Roadway Construction Drawings CB 2.1, CB 2.2 and CB 2.3 show bicycle-safe inlet grates typically used in Ohio. The *Location and Design Manual (hereafter called L&D Manual)*, Vol. 3, includes a sample plan note D101 for catch basins.

www.pedbikeimages.org, photo by Dan Burden

For additional information, see the "Drainage Grates and Utility Covers" chapter of the *Bicycle Design Guide*.

Shoulder Rumble Strips
(Supplement to page 17 of the *AASHTO Guide*)

Rumble strips affect control of the bike, and are dangerous.

The ODOT Policy on the Use of Rumble Strips on Shoulders (Policy Number 322-001(P)) states that "Rumble strips generally should not be used on the shoulders of roadways designated as bicycle routes or having substantial volumes

of bicycle traffic, unless the shoulder is wide enough to accommodate the rumble strips and still provide at least 1.0 m (3.25 ft.) for bicyclists. Also, gaps should be provided in the rumble strip pattern ahead of intersections where bicyclists are likely to make left turns and to permit bicyclists to merge with traffic."

For more information about rumble strips and bicycling, see "Critical Issues and Frequently Asked Questions" on the PBIC website.

Bicycle Route Designation (Signed, Shared Roadway)
(Supplements pages 19-21 of the *AASHTO Guide*)

Bike routes involve a decision by some government body to choose a route, post signs, and be responsible for them. The route should connect destinations and the message on the bike route signs should identify those destinations. ODOT has no authority to designate bike routes on city streets or county roads unless there is a signed agreement with that local agency to do so.

A map or plan is necessary for correct installation of the signs and posts. The map/plan should be detailed enough that those installing the posts and signs will know which way each sign faces, which sign goes on each post, how far back from the curb the post will be installed. It must be determined in advance how frequently to post signs, as this decision will affect the total number of signs, sign posts, nuts and bolts needed.

Begin by drawing a map of a four-way intersection along the chosen route: determine which signs are needed and which way the signs are to face. Then list the other intersections along the route that match this "typical" intersection. Make a diagrams of any remaining intersection and determine the signs needed ad the direction they will face. Continue until each intersection is connected to an appropriate diagram. Then make a summary chart and get a tally. Verify diagrams by making a field check before submitting the data.

If the preference is to use existing sign posts/poles, permission should be obtained in writing from the owner (utility company, highway dept., etc.) before signs and posts are ordered. Provide local utility companies with a copy of the plan to help them determine whether a waterline, gas line, phone line or fibre optic line is buried just below your chosen post site. Failure to gain permission to post your sign gives the owner of the post or pole permission to remove your sign without informing you.

Evaluation of Bicycle Accommodation Levels of Existing Roadways
(Supplements the information on pages 10-13 of the AASHTO *Guide*)

There are several tools available, listed here in order of complexity, that help to evaluate roadways:

- The "Bikeabilty Checklist"
- The *Bicycle Facility Selection Guide*
- The *Guidebook on Methods to Estimate Non-Motorized Travel, Overview of Methods*
- *Guidebook on Methods to Estimate Non-Motorized Travel – Supporting Documentation*
- Bicycle Compatibility Index (BCI)
- Bicycle Level of Service (BLOS)
- The "Capacity Analysis of Pedestrian and Bicycle Facilities" (includes guidance on BLOS).

The Bicycle Compatibility Index (BCI) and the Bicycle Level of Service (BLOS), two of the methods listed, are being used by bicycle advocates and planners to evaluate urban-area roadways for bicycle suitability. These methods are slowly being adopted by consultants and other design agencies.

- The BCI is usually determined by surveying bicyclists of varied skill levels after they view videos or photos of roadways. The video can be taped as convenient and the survey offered later. Those running the BCI survey may choose to evaluate an entire corridor or just one problematic segment of a corridor, thus, it is less time consuming than BLOS.
- The BLOS is an inventorying effort used to define the level of service roadways provide to bicyclists along an entire corridor, using stress levels, roadway conditions, and volume of traffic as measures. BLOS uses first-hand impressions of bicyclists of various skill levels, immediately following their bicycle ride on each segment of the corridor being inventoried. Bicyclists rank each segment on a scale of A to F, where "A" is reasonably safe for users 10 years or older and "F" is generally not suitable for pedestrians or bicyclists. This system is similar to the automobile LOS where "A" is free-flowing and "F" is gridlock. Designated bicycle routes should be on roads with "A" to "C" LOS. Mapping the LOS rankings will define bike route corridors, and define segments of the corridor where LOS is less than "C" where roadway improvements are needed.

The Florida Department of Transportation has developed a "point" level of service concept which helps identify a short D/E/F segment of an otherwise acceptable corridor. Click on *Multimodal LOS "Point" Level of Service Project Final Report -- August 2001.*

Bridge Accommodation
(Supplements pages 55-56 of the *AASHTO Guide*)

When a regional bikeway plan identifies a bridge or roadway as part of the regional network, field conditions at the bridge site often force bridge designers to make a decision between meeting the guidelines and compromising to make the path's addition safe, feasible, and affordable. Shown below are photos of acceptable bicycle/pedestrian facilities on two roadway bridges:

Floating Bridge, Seattle, Washington

Bridge with Metal Grate Deck, Portland Oregon

Source: www.pedbikeimages.org, photos by Dan Burden

Note that the outside railing shown in the left photo, above, is attached to the outside of the deck. If the railing must be installed on the deck surface, the deck should be widened an equal amount to accommodate it.

ODOT requirements for Bridges, Box Culverts, and Retaining Walls can be found in the *Bridge Design Manual* and in the *L&D Manual*, Section 300, Cross Section Design. More on requirements for lane width, shoulder width, lateral clearance, bridge criteria, etc. for roadway bridges can be found in the *L&D Manual,* Section 300, Cross Section Design.

Consider the following figures from Section 300 of the *L&D Manual* when planning to replace a bridge: Figures 301-2, Rural Lane Widths, and 301-3, Rural Shoulder Criteria; 301-4, Urban Roadway Criteria Lane & Shoulder Widths; Figure 302-1, New and Reconstructed Bridges; and figures related to sidewalks and curb ramps, 306-2, 306-3, 306-4, and 306-5.

The cost of modifying existing bridges in order to accommodate bike lanes or a shared use path is highly variable and site specific. Urban fringe areas that are farmland where development seems imminent are especially difficult to deal with, as there is no traffic to justify the cost. In all cases, the cost of modifying the bridge is to be compared with the cost of a new, independent structure before making a decision to proceed. The ODOT *Policy on Accommodating Bicycle and Pedestrian Travel on ODOT Owned or Maintained Facilities* explains these factors.

Open metal grate bridge decks are a danger to bicyclists and should always be identified with a warning sign. In dry conditions, the primary danger is falling due to steering difficulties with the uneven, channelizing surface. In wet conditions, the dangers are falling and skidding, caused by either steering difficulties, or by

the slickness of the metal surface. Injuries to the bicyclist or damage to the bicycle are likely. Fallen bicyclists have been known to slide off one wet metal grate bridge, a bridge without barriers below guardrail height.
Bicyclists may be directed via signs to walk their bikes across on a sidewalk, if one exists. Some operators of open grate decks within the U.S. have filled a narrow (e.g., 1½ ft. wide) area with concrete to stabilize traction for bicyclists.

For additional information on bridges and underpasses see the Bicycle Design Guide chapters on "Roadway Bridge Modifications" and "Overcoming Bicycle Barriers."

Bridge Railings and Protective Fencing
(Supplements pages 55-56 of the *AASHTO Guide*)

ODOT's Office of Structures requires a 54" railing on all roadway bridges and all bicycle/pedestrian bridges. The BR-2-98 from the *Standard Bridge Drawings* is acceptable as a railing along a roadway if modified to meet the 54-inch minimum height, but there is no standard design for a railing of this height.

Section 304.36 of the *Bridge Design Manual* describes the Bridge Sidewalk Railing with Concrete Parapets.

Another drawing, the RM - 5.2 Bikeway Railing from the *Standard Construction Drawings*, is acceptable for use on shared-use paths but not for roadway bridges, unless the roadway has a crash tested barrier separating it from the bicycle/pedestrian area.

Sections 305.01 and 305.02 of the *Bridge Design Manual* discuss Protective Fencing.

Lighting in Underpasses and Tunnels
(Supplement to information on page 57 of the *AASHTO Guide*)

Little natural light enters underpasses and tunnels: the adjustment from bright to dim conditions may prevent a rider from observing pavement problems. Therefore, care in maintaining the smoothness of the pavement, keeping debris, water and mud from the passage, and attention to vandalism and crime within the underpass or tunnel is necessary. Artificial lighting should be considered.

A judgement must be made to determine whether or not to add lighting within tunnels or underpasses with low light conditions. To be more specific in determining whether or not to install lighting, look at the length and curvature of the underpass or tunnel. If the underpass is relatively short (up to 5 times the

height) and one can see the exit from the entrance, lighting is usually not necessary unless the bicycle or pedestrian way itself has been provided with lighting.

If the tunnel is long (over 5 times the height) or one can not see the exit from the entrance, then lighting both day and night is recommended. In addition, the day time lighting level will need to be 10-20 times the nighttime level to keep the tunnel commensurate with the surroundings (this exceeds the levels given in the *AASHTO Guide*). Similar to night lighting levels, the lower portion (10-15 times night) is appropriate to tunnels with dark surroundings (i.e. a wooded park) and the upper portion (15-20 times night) is appropriate to tunnels with bright surroundings (i.e. an urban CBD). In addition, the average to minimum uniformity ratio should not exceed 4:1 and the maximum to minimum uniformity ratio should not exceed 10:1.

For specific information on lighting, contact the Office of Traffic.
For additional information on underpasses see the Bicycle Design Guide chapters on "Roadway Bridge Modifications" and "Overcoming Bicycle Barriers."

Traffic Light Timing and Detection at Traffic Actuated Signals
(Supplement to pages 64-67 of the *AASHTO Guide)*

Bicyclists are often caught in the middle of the intersection when a traffic signal changes from green to red. The solution is to allow a longer minimum green time – shorter than for a pedestrian but longer than for cars. The all-red clearance interval should also be increased. The bicyclist then has time to clear the intersection and delay to traffic on the cross street is minimized.

More on signal timing can be found in the *Bicycle Design Guide* chapter on "Traffic Signals."

When installing traffic loop detectors, choose the configuration with the greatest sensitivity to the expected travel path of bicyclists. Standard rectangular loops are most sensitive along the edges and are appropriate where bicyclists ride near the side of the roadway. Quadrupole loops are most sensitive in the center, thus, are appropriate in bike lanes. Angular loops are sensitive over the entire width and are appropriate in lanes shared by bicyclists and motorists. Traffic Standard Construction Drawing TC-82.10 shows the Standard, Quadrupole, and Angular loops.

Bicyclists activate Traffic Actuated Signals by pushing a button located on a pole or post near the road edge or by positioning their bicycle near a sensitive spot on a loop detector imbedded in the pavement. Bicyclists generally locate the sensitive spots on loop detectors through trial and error, but have little chance of tripping the light when the loop is not visible on the pavement surface.

Pavement markings that direct bicyclists to the bicycle-sensitive locations in the loop should be applied to the road surface if bicycle detection cannot be reliably achieved when riding along the expected travel path, particularly when the loop detector is not apparent. A recommended marking is shown on page 66 of the *AASHTO Guide*.

Steel Plates

Choose large metal plates with a textured surface, or with non-skid surfaces similar to the coefficient of friction of concrete (0.30) or bridge decks (0.35), to temporarily cover street excavation sites on roadways frequently used by bicyclists. Flat, smooth metal become slick when wet, particularly when a film of mud coats the surface and should be avoided on roads used by bicyclists.

Accommodation Policies

ODOT and several of the MPO's have established policies regarding the accommodation of bicyclists and pedestrians in construction projects. Bicycle and Pedestrian Accommodation policies exist. ODOT's *Policy on Accommodating Bicycle and Pedestrian Travel on ODOT Owned or Maintained Facilities* was created in 2005.

IV. MAINTENANCE of ON-ROAD BICYCLE FACILITIES

(Supplement to page 73 of the *AASHTO Guide***)**

Responsibility for all on-road bicycle facilities belongs to the local public agency (city, county) except for bike lanes on state highways in rural areas.

All on-road bicycle facilities have common maintenance needs:

- Debris which tends to end up in the expected travel path of bicyclists must be picked up;
- Grit, glass, etc. should be swept up at the end of the winter season and at other times of the year when an accumulation of debris impacts bicycle travel, subject to manpower and equipment;
- Potholes that develop need to be repaired and left as smooth as weather conditions allow;
- Large (3/8" wide) longitudinal cracks should be filled. They affect steering, and can trap a wheel and stop its forward rotation, throwing the rider over the handlebars;
- Address drainage at spots where puddles form. Standing water in their usual travel path will cause bicyclists to move over into the traffic lane, and puddle locations become slick icy spots in winter.

Signs on Bike Routes
Signs should be checked periodically to verify that all are still in place and readable. Replace those stolen, vandalized, or non-reflective.

Pavement Markings
Bike lane markings, stencils that mark the sensitive spot on loop detectors and other markings applied for bicyclists should be checked for visibility in both daytime and dark conditions. Non-reflective pavement markings should be replaced. Renew painted markings when paint or the glass beads that provide reflectivity have worn away. Old thermoplastic should be ground off before adding another layer due to the bump that will result with multiple layers applied. Replacement thermoplastic must be made of materials that are not slick when wet.

Special Note: Diamond markings (see photo under Bike Lanes) are no longer an acceptable marking for bike lanes. Choose from the markings shown in the *OMUTCD* Part 9 when resurfacing or reapplying markings to a bike lane.

Bike Lane Maintenance
When bicyclists move out of the bike lane or consistently pedal in the travel lane rather than the bike lane, check the bike lane for maintenance problems. Bushes, debris, gravel, or leftover winter snow may be the cause.

Corvalis and Portland, Oregon Photos by Sharon Todd

The bushes in the photo at left, above, not only cause the bicyclist to move into the travel lane, they obscure the view of the curve ahead, any traffic entering from driveways on the right, and any schoolchildren on the sidewalk. In the photo at the right, gravel has been tracked out from a gravel lot. Bicyclists will avoid riding across gravel, fearing loss of control, and the potential for flat tires.

For more information, The National Bicycling and Walking Center has a section on bicycle related maintenance in their *Bicycle Design Guide*.

V. FREQUENTLY ASKED QUESTIONS

Q: How does a community determine where to focus their efforts to better accommodate bicyclists?
A: There are several tools available, listed here in order of complexity, to help communities evaluate their roadways:

- The "Bikeabilty Checklist"
- *Bicycle Facility Selection Guide*
- *Guidebook on Methods to Estimate Non-Motorized Travel, Overview of Methods*
- *Guidebook on Methods to Estimate Non-Motorized Travel – Supporting Documentation*
- Bicycle Compatibility Index (BCI)
- Bicycle Level of Service (BLOS)
- "Capacity Analysis of Pedestrian and Bicycle Facilities" (includes guidance on BLOS).

Q: Why are highways not made to accommodate bicyclists when they are repaved/rebuilt?
A: The highways you are thinking of may have been resurfaced. Changes in design are not generally included in resurfacing projects. New and reconstructed highways may be built to accommodate bicyclists, when local public agencies and citizen groups make their desires for such accommodation well known while the corridor is being analyzed for improvements. The ODOT *Policy on Accommodating Bicycle and Pedestrian Travel on ODOT Owned or Maintained Facilities* provides additional information.

Q: A roadway used extensively by local bicyclists has a long, narrow bridge on it, and bicyclists cannot clear the bridge without holding up traffic. What can we do to alleviate this safety concern?

Clemson, S.C. Photo by Gary Todd

A: A solution for one problem spot on an roadway that otherwise can accommodate bicyclists well is worth seeking out. Bridges and underpasses are built to last, thus, any problem occurring will continue to occur for a long time unless a solution is found. A high cost solution is to construct a separate bridge or tunnel parallel to the narrow bridge or underpass: These will be used where bicyclists do not have to deviate from their route and can easily continue on their way.

Q: We have right-of-way available to add shoulder bike lanes to a roadway, but it has a narrow bridge (or underpass) that will not be replaced soon. Should we proceed, and how do we handle traffic at that location?

A: A low-cost solution is to re- designate the two sidewalks of the bridge as bikeways. Consider the number of pedestrians affected before choosing this.

Another solution is to post highway signs to inform roadway users of a shared road situation ahead and its duration, particularly when there is a sight distance concern. Signs for use at bridges and underpasses can be found in Part 9 of the *OMUTCD*. Suggested sign messages include:

- Bicycle Warning (W11-1) with Share the Road (W16-1) and X Miles (W16-3) or Next X Feet (W16-4);
- Bike Lane Ends (R3-16a) followed by Share the Road (W16-1) and X Miles (W16-3) or Next X Feet (W16-4);
- Road Narrows (W5-1) or Narrow Bridge (W5-2); Do Not Pass (R4-1) or Pass With Care (R4-2);
- Lane Ends Merge Left (W9-2) followed by re-establishment of the bike lane on the far side of the obstruction.

www.pedbikeimages.org, photo by Dan Burden

It may be desirable to install a push button-activated flashing light, such as the one shown here, which allows bicyclists to warn approaching motorists of their presence on a narrow bridge or inside a dark underpass. The flashing light should be set up to become inactive after an average clearance time. Underpasses can be treated similarly.

Whatever treatment is chosen, apply it at each end of the obstruction, for each direction of travel.

Q: What are the advantages and disadvantages of bike lanes?
A: Advantages: Marking a lane specifies that bicycles are allowed and even expected on a road. The marking discourages motorists from crossing into that portion of the road. Bike lanes can be ideal along stretches of roadway where there are few intersections and where speed differences between motorists and

bicyclists are notable. The lane allows bicyclists and motorists alike to travel at their own pace.

Disadvantages: Bike lanes discourage bicyclists from using ordinary arm signals and proper lane change movements in advance of a left turn. Intolerance is often apparent when a bicyclist merges out of a traffic lane to avoid debris, water, or a disabled car stored there. Bike lanes require a high level of attention in campus or shopping areas where there are frequent crossovers, turning movements, and/or complicated intersections. Bike lanes can create a false sense of security for inexperienced bicyclists, causing them to give lessened attention to the constantly changing traffic around them.

Q: Can shoulders of freeways be used as bike lanes?
A: Shoulders of freeways cannot be used as bike lanes. The Ohio Revised Code (4511.051 (B)) prohibits bicyclists from riding within the boundary lines of a freeway. The exception is that a bicycle path designed and appropriately marked for bicycle use can be built within the freeway right of way as long as it is separate from the roadway and shoulders and separated by grade or by a feature such as the ditch line.

VI. RESOURCES

AASHTO, American Association of State Highway and Transportation Officials, P.O. Box 96716, Washington, D.C. 20090-6716. Order by mail, by phone at 1-800-231-3475, by FAX at 1-800-525-5562, or order online.

- *Guide for the Development of Bicycle Facilities*, 1999, (Prices as of August, 2005 are: $45 for the manual, $60 for the CD-ROM version, or $85 for both. Members of AASHTO receive discounts.)
- *Policy on Geometric Design of Highways and Streets, 5th Edition*

The Federal Highway Administration lists bicycle or pedestrian publications that can be ordered at no charge. Websites that provide direct access to these documents are provided below.

- *A Comparative Analysis of Bicycle Lanes vs. Wide Curb Lanes: Final Report*.
- *Bicycle Lanes vs. Wide Curb Lanes: Operational and Safety Findings and Countermeasures*.
- *The Bicycle Compatibility Index: A Level of Service Concept, Final Report*.
- The *Capacity Analysis of Pedestrian and Bicycle Facilities* provides guidance on the use of BLOS.
- *The Bicycle Compatibility Index: A Level of Service Concept, Implementation Manual*.

- The *Guidebook on Methods to Estimate Non-Motorized Travel, Overview of Methods* provides a concise overview of methods that can be used to forecast non-motorized travel demand.
- The *Guidebook on Methods to Estimate Non-Motorized Travel – Supporting Documentation* explains the real-world applications of forecasting methods.

The Florida Department of Transportation, *Multimodal LOS "Point" Level of Service Project Final Report -- August 2001*. Scroll down to "FDOT Multimodal Q/LOS Research Project Reports and Summaries"

The National Center for Bicycling and Walking offers the *Bicycle Design Guide*.

Ohio Department of Transportation (ODOT) on-line manuals can be accessed at ODOT's Design Reference Resource Center. Always refer to the most recent version of a publication for up-to-date guidance. Refer to the DRRC website, should individual links to the following publications fail to take you to the publication:

- *Bridge Design Manual*, Ohio Department of Transportation, Division of Highway Operations, Office of Structural Engineering
- *Construction and Materials Specifications*, Ohio Department of Transportation, Office of Construction Administration. Also known as "The Spec Book." Defines differences in construction materials, explains how work is to be done, and provides codes needed in construction drawings, etc.
- *Location and Design Manual*, Ohio Department of Transportation, Office of Roadway Engineering. Also known as the "*L&D Manual*."
  - Vol. 1, Roadway Design, includes Rumble Strips, Bicycle Considerations; Vol. 2, Drainage, includes information on bicycle-safe drainage grates;
  - Vol. 3, Highway Plans, contains the sample plan note D101 for catch basins.
- *Ohio Manual of Uniform Traffic Control Devices* (*OMUTCD*), Ohio Department of Transportation, Office of Traffic Engineering. Part 9 - Traffic Control for Bicycle Facilities.
- A sample plan note D101 for catch basins.
- *Hydraulic Standard Construction Drawings* CB-2.1, CB-2.2, and CB-2.3 Catch Basins. The notes specify suppliers of bicycle-safe grates.
- *Standard Bridge Drawings*, Ohio Department of Transportation, Office of Structural Engineering Services. BR2-98, Bridge Sidewalk Railings with Concrete Parapets .
- *Standard Construction Drawings*, Ohio Department of Transportation, Office of Roadway Engineering Services.
  - BP-9.1, Shoulder Rumble Strips. See *L&D Manual* Vol. 1, section 605.1.6 for details.
  - RM - 5.2M, Bikeway Railing, appropriate for non-roadway locations.
- *Traffic Engineering Manual*, Ohio Department of Transportation, Office of

Traffic Engineering, addresses Maintenance of Traffic, Hardware used for sign installation, etc.

- Traffic Standard Construction Drawing TC-82.10 shows the Standard, Quadrupole, and Angular loops.

The Ohio Department of Transportation also offers the following resources, policies and processes:

- Functional Classification of Roadways, Office of Urban and Corridor Planning ;
- Local government agencies with the capability of administering their own programs and letting bids may qualify as Local PublicAgencies (LPAs). The *Manual of Procedures, Locally Administered Transportation Projects* explains the procedures to follow to get a job to bid. ODOT District personnel have the authority to determine whether a project will be Locally- or ODOT-Administered.
- Projects located within the area of a Metropolitan Planning Organization (MPO) will need to coordinate with the appropriate MPO. Ohio has 17 MPO areas, each having an organization that works in conjunction with, or independently of, ODOT to bring projects to completion.
- *Policy on Accommodating Bicycle and Pedestrian Travel on ODOT Owned or Maintained Facilities* explains the factors that will be considered when planning roadway construction projects.
- ODOT offers these Prequalified Consultant lists for design and environmental work:
  - Environmental
  - Design
- The *Program Resource Guide* provides an overview of available transportation infrastructure funding sources, how to access them, and contact names for assistance.
- The *Project Development Process* (PDP) was prepared to help ensure a seamless process from planning through construction phases by involving all the technical disciplines involved in the process early on.
- Any project proposed for state or Federal funding must be added to the *Statewide Transportation Improvement Process* (STIP) through either ODOT or the MPO, determined by the location of the proposed project.
- Transportation Enhancement Program funds are used for bicycle and pedestrian proposals. See the Transportation Enhancement policy and standard operating procedure regarding use of these funds. Applications are available online each January 1st.

The *Ohio Revised Code*, TITLE XLV, MOTOR VEHICLES - AERONAUTICS – WATERCRAFT, Chapter 4511 contains the rules of the road. Bicyclist rules of the road are taken from the O.R.C.

The Pedestrian and Bicycle Information Center (PBIC) offers

- Photos of all types of bicycle facilities;
- The *Bicycle Facility Selection Guide*;
- The *Bikeabilty Checklist*;
- The *Bike Lane Design Guide*;
- (Bike Lanes) and Intersections;
- On-street Facilities;
- Paved Shoulders and Rumble Strips;
- Signed Routes;
- Traffic Calming;
- Wide Lanes.

The U.S. Code, Section 217.23 requires that when a highway bridge deck, on which bicyclists are permitted or may operate at each end of, is being replaced or rehabilitated with Federal funds, then safe accommodation of bicycles is required unless the US DOT Secretary determines that it can not be done at a reasonable cost.