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OVERVIEW AND PURPOSE

This document provides interim guidance for design practices that accommodate bicycles until such guidance is formally incorporated in TxDOT’s Roadway Design Manual (RDM). The RDM does include some guidance in Chapter 6 – Special Facilities Section 4 – Bicycle Facilities and this interim guidance provides more details and clarifications. This guidance is in support of the August 20, 2013 Guidance Memorandum from the U.S. Department of Transportation (U.S. DOT) that expresses:

“The Federal Highway Administration (FHWA) <supports> taking a flexible approach to bicycle and pedestrian facility design. The American Association of State Highway and Transportation Officials (AASHTO) bicycle and pedestrian design guides are the primary national resources for planning, designing, and operating bicycle and pedestrian facilities.” *(10)*

Further emphasis was recently provided by FHWA’s Bicycle and Pedestrian Planning, Program, and Project Development guidance:

“Bicycle and pedestrian needs must be given “due consideration” under Federal surface transportation law (23 U.S.C. 217(g)(1)). This consideration should include, at a minimum, a presumption that bicyclists and pedestrians, including persons with disabilities, will be accommodated in the design of new and improved transportation facilities. In the planning, design, and operation of transportation facilities, bicyclists and pedestrians should be included as a matter of routine, and the decision to not accommodate them should be the exception rather than the rule.” *(5)*

Accordingly, accommodating bicyclists applies to all types of roadways except those that specifically prohibit bicycle travel. Bicycle accommodations should be designed to accommodate the greatest number and type of bicyclists with the safest facility possible within local constraints. This is especially important in urban and suburban settings where a high concentration of destinations may attract a broader range of bicyclists of varying age and ability. Due to the wide range of constraints that engineers may need to consider in their design, this document, and the references at the end of the document, outline the flexibility allowed when selecting the appropriate bicycle accommodation.

**Important Note:** For the purposes of this guidance when a speed criteria is mentioned it will mean the higher of the design or posted speed (speed limit). The vehicular ADT or traffic volumes referenced pertain to existing conditions. The respective sidepath, or bicycle volumes referenced pertain to existing conditions or anticipated beginning conditions. Note that the anticipated growth in usage should also be considered when defining the footprint for the bicycle accommodations.

SUPPORTING POLICY AND DESIGN GUIDANCE

**National and State Statutes**

Title 23 §217(g)(1) of the United States Code states, “Bicycle transportation facilities and pedestrian walkways shall be considered, where appropriate, in conjunction with all new construction and reconstruction of transportation facilities, except where bicycle and pedestrian use are not permitted.”

Title 23 §217(e) of the United States Code states, “In any case where a highway bridge deck being replaced or rehabilitated with Federal financial participation is located on a highway on which bicycles are permitted to operate at each end of such bridge, and the Secretary determines that the safe accommodation of bicycles can be provided at
reasonable cost as part of such replacement or rehabilitation, then such bridge shall be so replaced or rehabilitated as to provide such safe accommodations.

Title 23 §109(m) of the United States Code states, “Protection of Nonmotorized Transportation Traffic.

The Secretary shall not approve any project or take any regulatory action under this title that will result in the severance of an existing major route or have significant adverse impact on the safety for nonmotorized transportation traffic and light motorcycles, unless such project or regulatory action provides for a reasonable alternate route or such a route exists.”

Likewise, the Texas Administrative Code (TAC) and the Texas Transportation Code (TTC) provide directives for the design of bicycle facilities in the state of Texas. Title 6 §201.902(c) of the TTC requires TxDOT to adopt rules relating to the use of roads in the state highway system by bicycles. Title 43 of the TAC requires the following:

- §25.53 TxDOT must take bicycle accommodation into consideration during the planning and implementation of all construction and rehabilitation projects.
- §25.54 TxDOT adopts the latest version of the AASHTO Guide for the Development of Bicycle Facilities (1).
- The Department will continue to review guidelines for the design, construction, and maintenance of bicycle facilities with the intent to adopt new guidelines as appropriate.
- As the previous bullet indicates, this TxDOT Bicycle Accommodation Design Guidance is based on the review of new national guidelines for the best practices for the design of bicycle facilities and supersedes AASHTO’s Guide for the Development of Bicycle Facilities (2012 – 4th Edition) (3). If a specific design criterion or guidance is not provided herein, the AASHTO guidance shall apply. It is anticipated that all guidance herein provides further enhancements to the safety and comfort level of most cyclists compared to the current AASHTO Guide for the Development of Bicycle Facilities (4th Edition) and is consistent with the draft AASHTO Guide for the Development of Bicycle Facilities (5th Edition) that is under review.

**AASHTO vs. FHWA Guidelines**

The 2012 AASHTO Guide for the Development of Bicycle Facilities continues to be the governing document for specific design criteria. However, the FHWA’s Bikeway Selection Guide (9) (and relevant supplements, Traffic Analysis and Intersection Considerations to Inform Bikeway Selection(16) and On-Street Motor Vehicle Parking and the Bikeway Selection Process(17)) should be considered a companion to the 2012 AASHTO guide, and, in instances of contradictions, the FHWA guide shall take precedence because it contains design guidance more current than the 2012 AASHTO Guide. The 2012 AASHTO guide does not cover certain bicycle facility types that are contained in this TxDOT Bicycle Accommodation Design Guidance document. For example, design for separated bike lanes is quickly evolving and, as such, a flexible design approach is encouraged. For further information on FHWA’s position on design flexibility, refer to the August 2013 FHWA memo “Bicycle and Pedestrian Facility Design Flexibility”. (10)
U.S. Department of Transportation

On March 11, 2010, a federal policy statement on Bicycle and Pedestrian Accommodations Regulations and Recommendations was signed by U.S. DOT (4). This policy statement emphasized that, “every transportation agency, including U.S. DOT, has the responsibility to improve conditions and opportunities for walking and bicycling...transportation agencies are encouraged to go beyond minimum standards to provide safe and convenient facilities for these modes.” The incorporation of “safe and convenient walking and bicycling facilities” into transportation projects is important to address health, safety, environmental, transportation, and quality of life goals. This guidance was further emphasized and updated by FHWA’s Bicycle and Pedestrian Planning, Program, and Project Development (2019) guidance.

TxDOT Memo on Shared Lanes with Revision and Clarification

The U.S. DOT released a policy statement in 2010 and shortly after TxDOT issued an administrative memo on March 23, 2011 which outlined guidance for emphasizing bicycle and pedestrian accommodations. This memo was subsequently incorporated into the RDM. The memo allowed the use of 14-foot-wide curb lanes (shared lanes) for all widening and non-widening urban projects within the existing right-of-way (ROW). However, since the issuance of the memo, bicycle accommodation selection guidance has evolved and the previously referenced shared lane should only be considered as a suitable bikeway accommodation when the following applicable conditions are met:

- In an urban/urban core/suburban/rural town context, the roadway is 35 mph or less and has less than 3,000 vehicles per day, or;
- In a rural context, the roadway is 45 mph or less and has less than 1,000 vehicles per day.

Other Revisions and Considerations

Another key component being modified is the bike lane width. The current RDM allows a 4-foot minimum bike lane width. The following guidance specifies a 5 to 7 foot desirable bike lane width, with a 4-foot minimum bike lane allowed only under specific circumstances. See the Bicycle Facility Types section of this document for the specific guidelines for each bicycle facility type.

It continues to be critical that bicycle accommodations are fully considered and discussed as the need and purpose of a project is defined during the National Environmental Policy Act (NEPA) process, taking into consideration existing and anticipated bicycle and pedestrian facility networks and needs. In the NEPA document, the managing office should include in the project description a discussion of proposed bicycle and pedestrian facilities and linkages to transit stops and corridors. Public input, when applicable, as well as local government and metropolitan planning organization bicycle and pedestrian plans, must be taken into account. If no bicycle or pedestrian facilities are included in the project, the managing office must justify why these facilities are not necessary or cannot be accommodated.

Preliminary and final engineering efforts (schematics and PS&E) shall verify that the proposed bicycle accommodations, if included, are designed according to the guidance in this document as well as the FHWA Separated Bike Lane Planning and Design Guide, the Texas Manual on Uniform Traffic Control Devices (TMUTCD), and the TxDOT Roadway Design Manual (RDM). Refer to the AASHTO Guide for the Development of Bicycle Facilities for additional guidance not found within these documents.
FHWA also recognizes that other guides published by the National Association of City Transportation Officials (NACTO) and the Institute of Transportation Engineers (ITE) build upon the flexibilities provided in the AASHTO guide, which can help communities plan and design safe and convenient facilities for pedestrians and bicyclists. These documents are helpful in developing non-motorized networks in primarily urban areas. For off-system roadways, these design standards may be substituted for the above design standards upon agreement with the local government and the respective TxDOT District.

PROJECTS THAT CAN BE EXCEPTED FROM BICYCLE ACCOMMODATIONS

Bicycle and pedestrian accommodations should be routinely included when planning and designing transportation facilities, addressing the needs of the target design user (as discussed in a later section); consequently all projects must be consistent with the identified needs for bicyclists accommodations as identified in the NEPA process. Exceptions to providing bicycle accommodations are permitted if the project meets one or more of the following numbered criteria. Although an area may fall under one of the exceptions below, it is important to plan for anticipated growth where bicycling activity might become more prevalent in the future during the life of the project. MPO and local planning documents should be reviewed and coordinated with to identify anticipated future growth when selecting bicycle accommodations outside the urbanized boundaries. The documentation for having an exception based on the following criteria will be maintained with the project file with specific documentation as to the nature of the exception, but this is not considered a formal Design Exception or Design Waiver. The circumstances requiring a formal Design Exception or Design Waiver are documented in the DESIGN EXCEPTIONS AND DESIGN WAIVERS section of this guidance.

- Note, projects located on the Texas Bicycle Tourism Trails Example Network are not excepted from bicycle accommodations regardless of location. The TxDOT Statewide Planning Map provides additional information on MPO boundaries, area types, and the Texas Bicycle Tourism Trails Example Network. Additionally, all On-System bridges regardless of location, involving bridge replacement, bridge deck replacement, or bridge rehabilitation will need to meet the bicycle clear space requirements specified in the General Bicycle Accommodation Selection Guidance portion of this document, and are not excepted. Off-system Bridges where this addition may represent an unreasonable increase in cost may be excepted from the bicycle clear space requirement.

1. The project is on a roadway where bicycle travel is specifically prohibited by law or Texas Transportation Commission Minute Order.

2. The project is located outside of a respective Metropolitan Planning Organization (MPO) Boundary; AND is also located outside of any respective city limits with a population of 2,500 or greater. The TxDOT Statewide Planning Map provides additional information on MPO boundaries and area types. Before using this exception, seek out and consider local stakeholder input and community need.

3. The project is in an urbanized setting (defined as a city, town, or Census-designated place with a population of 2,500 or greater) where a locally preferred alternative route has been adopted or implemented and bicycle accommodations are deemed impractical within the scope of the project. The project is in an urbanized setting with limited roadway improvements, and there is already a future project programmed (e.g., MPO Active Transportation Plan) where the bicycle updates would make more sense in the context of overall transportation improvements.
4. The cost to provide features exclusively for bicyclist accommodations is excessively disproportionate to the need or likely uses. While a determination of “excessively disproportionate” should be concluded on a case-by-case basis and well documented, exceeding 20% of the total project cost (including design, construction, ROW, etc.) may be considered as a general guideline. This exception should not be used if the project will help complete a gap in an overall bicycle network.

5. The source of funding specifically precludes improvements other than those for which the funding is intended. Note that although Category 8 funding (which includes HSIP, Statewide systemic widening, and Road to Zero) does not currently have funding allocated specifically for bicycle accommodations, it is allowable to place money that has been specifically designated for bicycle accommodations into Category 8. Note, the following link from FHWA provides funding opportunities for bicycle facilities. (https://www.fhwa.dot.gov/environment/bicycle_pedestrian/funding/funding_opportunities.cfm)

6. The type of work is limited in scope such that major roadway elements are not being constructed or reconstructed. For example: safety end treating culverts only, Metal Beam Guard Fence (MBGF) replacement only, sealcoat only, and other types of preventative maintenance projects. Note that resurfacing can provide the opportunity to restripe and/or improve the riding surface for bicycle accommodations in certain instances and, as such, would not necessarily warrant an exemption. Other projects with a narrow scope should be evaluated to determine if negative impacts to the bicycle accommodations may result.
BICYCLE PLANNING PRINCIPLES

Having a clear understanding of good planning and design principles is important as these concepts will ultimately be the foundation for the design intention and potential trade-offs that may occur. Bicycle planning principles that can be used include safety, comfort, connectivity, and cohesiveness. Descriptions of these principles are provided in Table 1.

Table 1. Bicycle Planning Principles

<table>
<thead>
<tr>
<th>Safety</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Separate bicycles from motorized traffic where the speed differential and traffic volumes are higher.</td>
</tr>
<tr>
<td></td>
<td>Reduce conflicts between bicycles and pedestrian traffic on shared use paths (sidepaths).</td>
</tr>
<tr>
<td></td>
<td>Minimize speed differential at conflict points where practical to minimize or eliminate injury.</td>
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<tr>
<td></td>
<td>Provide sufficient clearances to obstacles to avoid crashes</td>
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<tr>
<td></td>
<td>Reduce or eliminate conflicts along the route including intersecting roads and driveways.</td>
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<tr>
<td></td>
<td>Comfort</td>
</tr>
<tr>
<td></td>
<td>Recognize that different bicycle users have varying levels of comfort for various roadway conditions.</td>
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<tr>
<td></td>
<td>Minimize exposure to traffic, noise, and emissions.</td>
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<tr>
<td></td>
<td>Minimize or avoid conditions that require bicyclists to dismount during a trip.</td>
</tr>
<tr>
<td></td>
<td>Provide sufficient shy distance to obstacles.</td>
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<tr>
<td></td>
<td>Establish geometric criteria that provide a comfortable facility to operate a bicycle.</td>
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<tr>
<td></td>
<td>Minimize or avoid conflicts with pedestrian traffic.</td>
</tr>
<tr>
<td></td>
<td>Connectivity</td>
</tr>
<tr>
<td></td>
<td>Accommodate local bicycle and transit transportation routes and networks.</td>
</tr>
<tr>
<td></td>
<td>Connect bicycle accommodations and intersecting streets at a local scale for access to destinations.</td>
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<tr>
<td></td>
<td>Allow for user choice of routes by providing a dense and connected network.</td>
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<tr>
<td></td>
<td>Provide seamless transitions between different on-road and off-road facility types.</td>
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<tr>
<td></td>
<td>Eliminate barriers and provide continuous bicycle accommodations to support network connectivity.</td>
</tr>
<tr>
<td></td>
<td>Integrate design with local bicycle transportation plans.</td>
</tr>
<tr>
<td></td>
<td>Carry accommodations through intersections of on-system roads with off-system roads.</td>
</tr>
<tr>
<td></td>
<td>Cohesiveness</td>
</tr>
<tr>
<td></td>
<td>Employ a direct and logical structure that minimizes turns and promotes staying on the network.</td>
</tr>
<tr>
<td></td>
<td>Inform all roadway users clearly of the presence of bicyclists, especially at conflict points.</td>
</tr>
<tr>
<td></td>
<td>Provide clear and intuitive transitions between different yet connected bicycle facility types.</td>
</tr>
<tr>
<td></td>
<td>Extend bicycle accommodations to logical and safe termini.</td>
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</table>
CONTEXT CONSIDERATIONS

Context and engineering judgment play important roles in selecting the appropriate bicycle accommodations. FHWA identifies four components that are important in identifying what type of bicycle accommodation to use: project limits, land use context, types of bicyclists the bicycle accommodation is expected to serve, and key safety and performance criteria.

As part of these overarching themes, the elements outlined below should be documented in the design process and used to determine the selection of an appropriate bicycle facility type, as discussed in the following sub-sections:

- **Project Identification**: Project name, project ID (CSJ), roadway name, limits, county
- **Roadway Context**: Adjacent roadway functional class, speed, average daily traffic volume, project length, intersection frequency and crossing road functional classification, driveway density
- **Area Context**: Land use context (see below)
- **Intended Bicycle Accommodation Users**: Target design user (interested but concerned or all ages and abilities)
- **Other Roadway Users**: Truck percentage and key movements, transit operation (headway) and key stops, curbside lane activity, expected pedestrian demand

**Land Use Contexts**

The land use context that surrounds a potential bicycle accommodation may influence the type of users (e.g., target design user), the number of users, and the potential interactions of other roadway users with the facility. Two context groupings have been used when providing guidance for bicycle facility selection:

- **Urban and Suburban Contexts** (referred to as “urbanized” and includes urban core and rural town which is defined in FHWA’s Separated Bike Lane Planning and Design Guide)
- **Rural Contexts**

The urban core and rural town are land use contexts that are anticipated to be added to a future version of the Roadway Design Manual that will allow additional flexibility with respect to the roadway, and bicycle facility planning and design. The urban core would be contained within the current definition of an urban area, the rural town would be contained within the current definition of a rural area. A city with a minimum population of 2500 and less than a population of 50,000 is defined as an urbanized cluster by the US Census and for the purposes of this guidance will fall with the Urban and Suburban Contexts. Note that certain towns with populations less than 2500 will have characteristics of a rural town as described below and may utilize the rural town bicycle criteria as deemed applicable.

**Urban Core Context**

The urban core context includes areas of the high-density, with mixed land uses among predominantly high-rise structures and with small building setbacks. The urban core context is found predominantly in central business districts and adjoining portions of major metropolitan areas. On-street parking is often more limited and time restricted than in
the urban context. Substantial parking is in multi-level structures attached to or integrated with other structures. The area is accessible to automobiles, commercial delivery vehicles, and public transit. Sidewalks are present nearly continuously, with pedestrian plazas and multi-level pedestrian bridges connecting commercial parking structures in some locations. Transit corridors, including bus and rail transit, are typically common and major transit terminals may be present. Some government services are available, while other commercial uses predominate, including financial and legal services. Structures may have multiple uses and setbacks are not as generous as in the surrounding urban area. Residences are often apartments or condominiums. Driver speed expectations are low and pedestrian and bicycle flows are high. See Figure 1 for a depiction of Urban Core.

![Figure 1. Typical Street in the Urban Core Context](image)

Rural Town Context

The rural town context applies to roads in rural areas located within developed communities. Rural towns generally have low development densities with diverse land uses, on-street parking, and sidewalks in some locations, and small building setbacks. Rural towns may include residential neighborhoods, schools, industrial facilities, and commercial main street business districts, each of which present differing design challenges and differing levels of pedestrian and bicycle activity. The rural town context recognizes that rural highways change character where they enter a small town, or other rural community, and that design should meet the needs of not only through travelers, but also the residents of the community. See Figure 2 for a depiction of Rural Town.
Figure 2. Typical Street in the Rural Town Context

**Speed and Volumes of Motor Vehicles**

There are many factors to consider when selecting and designing bicycle accommodations, with motor vehicle speed and volume as the initial determinants of suitable bicycle facilities. The influence of speed and volume on the safety and perceived safety or comfort of bicycle riders is an important factor and the respective criteria for appropriate speeds and traffic volumes is contained in the subsequent guidance.

**Other Factors**

Other factors that should be considered in the selection of bicycle accommodations are listed in the FHWA Bikeway Selection Guide and summarized in Table 2.

<table>
<thead>
<tr>
<th>Factor</th>
<th>Description and Design Considerations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unusually high motor vehicle peak hour volumes</td>
<td>On roadways that regularly experience unusually high peak hour volumes, more separation can be beneficial, particularly when the peak hour also coincides with peak volumes of bicyclists.</td>
</tr>
</tbody>
</table>
| Traffic vehicle mix            | Additional separation between bicyclists and motorists is particularly important on moderate volume to high-volume streets where heavy vehicles are an abnormally high percentage of traffic. Higher percentages of trucks and buses increase risks and discomfort for bicyclists due to vehicle size and weight, and the potential for motorists to not see bicyclists due to blind spots. This is particularly a concern for right turns, where large vehicles may appear to be proceeding straight or even turning left as they position to make a wide right turn movement. Visibility and awareness of bicyclists can be improved by providing:  
- additional buffer width between a separated bike lane or shared use sidepath to the travel lane, |
<table>
<thead>
<tr>
<th>Parking turnover and curbside activity</th>
<th>Providing markings and signs denoting the crossing, providing raised crossings, or at signalized locations, phase separating the conflict. Parking turnover and curbside activity refer to parked or temporarily stopped motor vehicles. High parking turnover and curbside loading (commercial and passenger) may expose bicyclists to being struck by opening vehicle doors or people walking in their travel path. Vehicles stopped within bicycle lanes or travel lanes may require bicyclists to merge into an adjacent travel lane. In locations with high parking turnover or curbside loading needs, wider bike lanes or separated bike lanes in lieu of bike lanes, can help to alleviate conflicts. This issue also encompasses locations where transit vehicles load and unload passengers within a bicycle lane or shared curb lane.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Driveways/intersection frequency</td>
<td>The frequency of driveways and intersections also impacts decisions regarding the design of separation between the street and the bicycle accommodation as well as the design of driveways. Motorists need adequate sight distance to enter and exit intersections and driveways and benefit from sufficient space to yield to bicyclists. This is particularly important for sidepaths (the AASHTO Bike Guide enumerates the potential areas of conflict) and two-way separated bike lanes located on one side of two-way streets where contra-flow bicyclist may be unexpected by motorists. High driveway frequency may make a one way bicycle facility type a preferable option. Consideration may be given to consolidating driveways as applicable. Wider buffers and clear sight lines can improve bicyclist safety. Where contra-flow bicycling occurs, additional design features that slow motorists' turning movements and give motorists more time to see oncoming bicyclists may significantly improve safety for all users. Frequent, closely spaced driveways may limit the ability to provide vertical elements necessary to provide separated bike lanes. In these locations, buffered bicycle lanes, bicycle lanes or shoulders may be the only viable bicycle facility unless it is feasible to provide a raised bike lane at sidewalk level to provide greater separation from traffic.</td>
</tr>
<tr>
<td>Direction of operation</td>
<td>For separated bikeways, a determination must be made as to whether the bikeway will be provided as a one-way facility on each side of the road, a two-way facility on one side of the road, or as two-way facilities on both sides of the road. As discussed above, the contra-flow bicyclist may be unexpected by motorists requiring additional design mitigations. This decision requires engineering judgment based on the bikeway's role in the broader bike network, connectivity, safety impacts, the locations of destinations within the corridor, physical conditions, and other factors.</td>
</tr>
<tr>
<td>Constraints</td>
<td>Vulnerable populations</td>
</tr>
<tr>
<td>-------------</td>
<td>------------------------</td>
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<tr>
<td>constraints within the ROW, and an assessment of intersection operations and frequency of driveways and intersections.</td>
<td>The presence of high concentrations of children and older adults should be considered during project planning. These groups may only feel comfortable bicycling on physically separated facilities, even where motor vehicle speeds and volumes are relatively low. Typically, these populations are less confident in their bicycling abilities and, in the case of children, may be less visible to motorists and lack both roadway experience as well as sufficient cognitive or physical maturity to recognize and anticipate potential conflicts. They can also create more conflicts with pedestrians when they are expected to share the same space.</td>
</tr>
</tbody>
</table>
TARGET DESIGN USER

Different bicycle riders may have varying tolerances associated with the importance of the individual planning principles outlined above. Figure 3 indicates the array of potential bicycle riders that should be considered when scoping and designing a roadway project.

Figure 3. Types of Bicycle Facility Users as a Percentage of Total General Population

<table>
<thead>
<tr>
<th></th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interested but Concerned</td>
<td>51 - 56%</td>
</tr>
<tr>
<td>Somewhat Confident</td>
<td>5 - 9%</td>
</tr>
<tr>
<td>Highly Confident</td>
<td>4 - 7%</td>
</tr>
</tbody>
</table>

Research over the last decade has evaluated how to classify the general population into different types of bicyclists. This research confirms that only a relatively small percentage of people can be classified as comfortable bicyclists in mixed traffic, and that a large majority of people prefer some level of separation from higher-volume, higher-speed motorized traffic. As such, in many jurisdictions across the United States, the common target design user are those who are interested in riding but concerned about safety ("Interested but Concerned" bicyclists) as this is the largest group of potential bicycle accommodation users among the general population. According to research, these bicyclists would ride more if they felt safer and, thus, are more likely to take short trips, avoiding busier arterial roadways. "Interested but Concerned" bicyclists prefer separation from vehicles and have a lower tolerance for traffic stress than more confident riders.

To maximize the potential for bicycling as a viable transportation option, it is important to design facilities to meet the needs of the “Interested but Concerned” bicyclist user profile. Bicycle facilities which meet the needs of the “Interested but Concerned” bicyclist will generally meet the needs of all bicyclists, therefore they are considered “All Ages and Abilities” bicycle facilities because they maximize potential use. One exception to this are situations where bicyclists are operating in large groups, or where individual bicyclist who prefer to operate at higher speeds (typically greater than 20 mph) who may prefer to operate in the travel lane. In general, more separation from motorized traffic is desirable to serve a greater number and type of users more safely. TxDOT endeavors to provide bicycle facilities to serve bicyclists of “All Ages and Abilities” to maximize the number of people who may use the facility.

MAINTENANCE OF BICYCLE FACILITIES

The large majority of bicycle crashes are due to falls and collisions due to surface defects and crashes with fixed objects located within bike operating spaces. Maintenance considerations should factor into the design approach for each bikeway and long-term maintenance programs should seek to proactively mitigate these issues to reduce
crashes. Seal coat projects must be properly swept for cyclists, including on the shoulders. Use grade 5 or similar smaller size aggregate. Designers should also consider how paint markings affect cyclist safety over an interim period after a seal coat prior to placement of more permanent thermoplastic and prefabricated markings for cyclists.

GENERAL BICYCLE ACCOMMODATION SELECTION GUIDANCE

Figures 4 through 6 provide some general guidance for the bicycle planning principles, target design user, and context discussed in the previous sections. Note, these Figures should be used to provide initial recommendations. The Bicycle Facility Types Section below provides specific criteria and guidance for the possible usage and application of the different types of facilities. In particular, the respective speed criteria in the Bicycle Facility Types Section are more commensurate with the speed applications for TxDOT roadways. As long as the project meets the defined criteria in the Bicycle Facility Types section for a specific facility type, the engineer has the discretion to use the bicycle facility that is best suited to the project needs and constraints.

Requirements for Selection – Urban, Urban Core, Suburban, and Rural Town Contexts

For all urbanized (urban, urban core, suburban, and rural town) contexts, the following guidance is provided for various types of construction (the selection guidance is based primarily on FHWA’s Bikeway Selection Guide):

1. For construction projects within the existing right-of-way and the scope of work is limited to within the existing roadway typical section or involves pavement widening, the project should make accommodations for bicyclists by choosing facilities recommended in Figure 4. Where proper bicycle accommodation width(s) are not feasible for the recommended facility types, see “Considerations for Alternatives and Design Exceptions or Design Waivers” section below. Note: Texas Accessibility Standards/Americans with Disabilities Act Accessibility Guidelines (TAS/ADAAG) requirements for each facility type must be met as well.

2. For full reconstruction projects or new construction projects, either in the existing right-of-way or with additional right-of-way, the project should provide the desired bicycle accommodation as shown in Figure 4 and geometric values should adhere to this guide. For values not provided in this guide, refer to the AASHTO Guide for the Development of Bicycle Facilities and, for separated bike lanes, FHWA’s Separated Bike Lane Planning and Design Guide. Where proper bicycle accommodation width(s) are not feasible for the recommended facility types, see “Considerations for Alternatives and Design Exceptions or Design Waivers” section below. Note: TAS/ADAAG requirements for each facility type must be met as well.

3. For projects involving bridge replacement, bridge deck replacement, or bridge rehabilitation, the following guidance is provided:

   – A 5-foot minimum clear space (4-foot shoulder and 1-foot offset measured to the toe of the barrier) shall be provided on the structure and along the adjacent barrier. Off-system Bridges where this addition may represent an unreasonable increase in cost may be excepted from this requirement. Where feasible, desirable shoulder width as shown in Figure 5 should be used.

   – For roadways identified on the Texas Bicycle Tourism Trails Example Network, preferred 10-foot (minimum 8-foot) shoulder width should be provided on bridges.
Figure 4. Recommended Bicycle Facility Selection for Urban, Urban Core, Suburban, and Rural Town Context

Notes:

1. Use the higher of the design speed and the posted speed for the speed.

To be conservative when designing for all ages and abilities facilities, designers should attempt to use the higher level facility at the respective boundary limits.
Requirements for Selection – Rural Context
For rural context (not rural towns), the following guidance is provided for various types of construction:

1. For new construction, reconstruction, or widening projects in a rural setting where right-of-way is being acquired, the following guidance is provided:
   - When the scoping process and NEPA documentation indicates a need for bicyclist accommodations, the recommended bicycle accommodation is shown in Figure 5, indicating the desirable shoulder widths for various posted speeds and traffic volumes. In some cases, a shared use path or other locally preferred facility type may be identified during stakeholder outreach. See the bicycle facility types guidance below for additional guidance on shoulders and shared lanes. Where proper bicycle accommodation width(s) are not feasible for the recommended facility types, see “Considerations for Alternatives and Design Exceptions or Design Waivers” section below. Note: TAS/ADAAG requirements for each facility type must be met as well.
   - Roadways indicated in TxDOT’s Bicycle Tourism Trails Study(13) should be designed with a minimum 8-foot shoulder, a shared use path, or another locally preferred facility type.

2. Where new construction, reconstruction, or widening is accomplished without additional right-of-way, the above should be followed where feasible. If not feasible, see “Considerations for Alternatives and Design Exceptions or Design Waivers” Section below. Note: TAS/ADAAG requirements for each facility type must be met as well.

3. For projects involving bridge replacement, bridge deck replacement, or bridge rehabilitation, the following guidance is provided:
   - A 5-foot minimum bicycle clear space (4-foot shoulder and 1-foot offset measured to the toe of the barrier) shall be provided on the structure and along the adjacent barrier. Off-system Bridges where this addition may represent an unreasonable increase in cost may be excepted from this requirement. Where feasible, desirable shoulder width as shown in Figure 5 should be used. For roadways identified on the Texas Bicycle Tourism Trails Example Network, preferred 10-foot (minimum 8-foot) shoulder width should be provided on bridges.
Figure 5. Recommended Bicycle Facility Selection for Rural Context

Notes:
1. A separated shared use path is a suitable alternative to providing paved shoulders solely for the purpose of bicycle accommodations and should be considered on Bicycle Tourism Trail Example Network segments as well as rural roads with ADT above 6000 vehicles per day.
2. Use the higher of the design speed and the posted speed for the speed.
3. If the percentage of heavy vehicles is greater than 5%, consider providing a wider shoulder or a separated path.

BICYCLE FACILITY TYPES
Below is a description and brief design guidance for the most common bicycle facility types. From left to right, Figure 6 shows decreasing separation between bicyclists and motor vehicles. A detailed description of each facility type can be found in the following section. For additional guidance not stated herein, see additional design resources listed in the appendix which are sourced throughout this document. It should be noted that different facility types may be used within different land use contexts or within the same land use context. Additionally, due to possible project site limitations, different facility types may be used to accommodate the origin and destination routes of bicyclists and pedestrians on each side of the roadway. For Roadways on TxDOT’s Texas Bicycle Tourism Trails Study, provide an appropriate Bike facility in coordination with the local community.
Figure 6. Bicycle Facility Types by Level of Separation

Urban/Urban Core/Suburban/Rural Town Facility Types

Shared Use Paths Adjacent to Roadways (Sidepaths)

Description

Shared Use Paths adjacent to roadways (sidepaths) are located within a roadway corridor following the roadway alignment (hence the term sidepath) and are physically separated from motorized vehicular traffic by a landscaped buffer or a barrier. Sidepaths are generally designed for two-way travel, because in addition to bicyclists, users may include inline skaters, skateboarders, and pedestrians. Sidepaths which do not provide adequate width may increase crash risk between people on the path.

Conflict points occur between motorists and path users at intersections and driveways. Of particular challenge is the contra-flow movement of higher speed users such as bicyclists. Conflict points should therefore be minimized and mitigated to the greatest extent practicable to maximize the comfort and safety of users operating on the facility. The consolidation of driveways will reduce conflicts within the corridor.

Shared use paths may also be constructed with an independent alignment from a roadway which typically limits conflict points to mid-block crossings of roadways. The shared use path on an independent alignment allows the vehicular driver to address the conflicts of the bicyclists exclusively, before proceeding to the roadway intersection and then addressing the standard conflicts with other vehicular traffic. The AASHTO Bicycle Design Guide and RDM should be reviewed for additional guidance of shared use paths in independent alignments. The following guidance is specific to sidepaths.

Basic Design Guidelines

For roadways with high driveway density, frequent street crossings, or overall high driveway volumes, a one-way bicycle facility may be a more appropriate option, with an appropriate facility provided on each side of the roadway to provide needed origin and destination points. One-way bicycle facility preferred options include a separated or buffered bike lane. As identified in the AASHTO Bicycle Design Guide, for longer distances on urban and suburban streets with a considerable number of driveways and street crossings, two-way sidepaths can create operational concerns. Additional
consideration should also be given with respect to parking configurations in the driveway vicinity that may tend to obstruct the sidepath usage or sight lines.

- A bicycle design speed of 15 mph is generally appropriate on a shared use sidepath given the fact bicyclist are operating with pedestrians and may encounter driveways and intersections due to the alignment alongside the roadway.

- When selecting a sidepath width, designers should consider the anticipated user volumes and mode split (bicycles, pedestrians, runners, etc.). The FHWA Shared Use Path Level of Service – Users Guide (SUPLOS) is a helpful tool to inform a decision regarding the width of a two-way path (the link to the SUPLOS calculator is found in the users guide). The inputs into the SUPLOS calculator include the path width, trail user volume (one direction), trail user mix (mode split), and presence of a centerline stripe; the output is the calculated SUPLOS. A SUPLOS grade of “C” or better is desirable over the life of the facility to ensure it is comfortable and safe for all users. As a starting point for a new facility (without an SUP), bike and pedestrian counts should be taken during the anticipated peak hour period on the existing roadway, and/or analogous parallel facilities which may provide a component of latent demand for the new SUP. Also, an additional information resource is available at the Texas Bicycle and Pedestrian Count Exchange which has pedestrian, and bicyclists count data available for various facilities statewide. Note that most proposed TxDOT sidepaths will likely have a greater percentage of foot traffic (if there is not a separate facility for the exclusive use of foot traffic). The SUPLOS degrades when the amount of foot traffic (runners and pedestrians) surpasses 15% of path use. Table 3 provides an example SUPLOS calculation.

  » The desirable width for a sidepath may range from 11 to 15 feet or more; depending on the SUPLOS calculation. These widths will accommodate higher user volumes while minimizing conflicts between them (based on the SUPLOS output). On a 12-foot sidepath, three “lanes” of users can operate simultaneously, allowing people to operate side-by-side while being passed by a person in the other direction. To maximize service life and to assure a reasonable SUPLOS grade, paved widths should not be less than 10 feet.

  » As path user volumes increase, designers should consider increasing the width of the sidepath up to 15 feet. As path widths begin to exceed 15 feet in width, it may be desirable to separate pedestrians from bicyclists into sidewalk and separated bike lanes to minimize speed differential between pedestrians and wheeled users.

  » Standard minimum width is 10 ft. A minimum width of 8 feet may be used in rare circumstances where all of the following conditions are met:
    - Bicycle traffic is expected to be low (< 50 bicyclists/hour) during peak hours on the path.
    - Pedestrian use of the facility is not expected to be more than occasional or less than 30% of total path traffic.
    - Horizontal and vertical alignments provide frequent, well-designed passing and resting opportunities where the width is at least 10 feet.
— The path will not be regularly subjected to maintenance vehicle loading conditions that would cause pavement edge damage.

» In constrained conditions, a minimum width of eight feet may be used for short distances to avoid physical constraints such as bridge abutments, utility structures, and environmental constraints.

Table 3. SUPLOS example calculation (higher foot traffic)

<table>
<thead>
<tr>
<th>Segment Name</th>
<th>Path Width (ft)</th>
<th>Centerline</th>
<th>Volume (users per hour in 1 direction) and Mode Split</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name</td>
<td>1 = Centerline</td>
<td></td>
<td>One-Way (per hour) Adult Bicyclists Peds Runners In-Line Skaters Child Bicyclists SUPLOS grade</td>
</tr>
<tr>
<td>More Peds</td>
<td>12.0</td>
<td>0</td>
<td>100.0 20.0% 60.0% 15.0% 2.0% 3.0% C</td>
</tr>
</tbody>
</table>

The space between the inside edge of the sidepath and the adjacent edge of the outside travel lane (uncurbed), or face-of-curb (curbed) is the street buffer. It is desirable to provide as much distance from the road as is practicable given project conditions. The minimum allowable street buffer is shown in Table 4:

TABLE 4. Two-way Sidepath (Minimum Street Buffer)

<table>
<thead>
<tr>
<th>Roadway and speed condition</th>
<th>Minimum street buffer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Curbed low-speed (45 mph or less)</td>
<td>4 feet from FOC *</td>
</tr>
<tr>
<td>Curbed high-speed (50 mph or greater)</td>
<td>6 feet from FOC *</td>
</tr>
<tr>
<td>Uncurbed all speeds</td>
<td>10 feet</td>
</tr>
</tbody>
</table>

(* For curb and gutter sections with a shoulder, bike lane or any buffer in addition to the curb offset (excluding turn lanes, accel lanes, or decel lanes), the minimum street buffer measurement begins at the edge of through travel lane. This minimum width is 10 feet. The required minimum street buffer for the sidepath then becomes the lesser of the 10 foot measurement, or the face of curb (FOC) minimum in Table 4.)

The desirable street buffer would be the respective desirable clear zone values from RDM Table 2-12. Increasing the buffer width in the vicinity of driveways provides better alignment and visibility and is beneficial to all users. A minimum shy space of 2 feet should be provided to intermittent (e.g. signs, streetlights, utility poles) and continuous (e.g. walls, railings, fences, barriers) vertical objects to minimize crash risks and increase the comfort of path users. Where space is available, wider shy spaces are desirable. In constrained conditions, this shy space may be reduced to 1 foot except to post mounted signs.

- Signs installed in the vicinity of sidepaths shall be installed in accordance with the applicable TMUTCD criteria. The TMUTCD requires all signs be located a minimum of 2 feet laterally from the nearest edge of a shared use path.

- A graded shoulder with a minimum 2 ft width, 5 ft desirable, with a maximum cross-slope of 1V:6H should be provided on both sides of all shared use paths where natural terrain is present adjacent to the path alignment.

» Where a bikeway is adjacent to a hazardous condition such as a parallel body of water or steep downward slope, a shoulder between the bikeway and the top of the slope of 5 ft is desirable. For steep slopes where the shoulder is less than 5 ft, physical barriers or rails are recommended where the bikeway is adjacent to any of these conditions:
- Slopes 1V:3H or steeper, with a drop of 6 ft or greater
- Slopes 1V:3H or steeper, adjacent to a parallel body of water or other substantial obstacle
- Slopes 1V:2H or steeper, with a drop of 4 ft or greater
- Slopes 1V:1H or steeper, with a drop of 1 ft or greater

- Crashworthy barriers, when used on locations with sidepaths, should be located between the roadway and sidepath. A minimum of 1 ft of shy distance is needed between the vehicular traffic and the sidepath traffic.
  
    » On roadways which do not have roadside obstacles requiring a barrier, a barrier or railing should be considered to improve path user safety where the facility has all these conditions present:
    
    - The road is uncurbed
    - If shoulders are present, the road has shoulders less than 4 feet in width
    - and the road is a high speed facility

    » A barrier that separates vehicular traffic from a sidepath or separated bike lane must be a minimum of 31 inches in height, meet the current barrier standards, and provide an end treatment consistent with current Roadway Design standard practice. Where barriers are used immediately adjacent to a sidepath with minimum width dimensions, there may be a risk a bicyclist could fall over the top, in these circumstances a minimum barrier height of 42 inches is recommended. Barriers across bridge structures must meet the respective Bridge Railing Manual Requirements.

    » Barriers or railings located on the outside of a sidepath used to protect bicyclists and path users from falling into a hazard must be a minimum of 42 inches in height. A higher 48 in. to 54 in. continuous barrier or railing may be considered in locations where:

    - bicyclist speeds are likely to be high (such as on a downgrade),
    - high winds are typical (such as on bridges), or
    - a bicyclist could impact a railing at a 25-degree angle or greater (such as on a curve).

    Shy spaces to railings and barriers shall not be included within the width of the SUP (see Figure 7).

**Figure 7. Example Bridges with Barriers for Sidepaths; high-speed (left), low-speed (right)**
Where sidepaths or separated bike lanes (SBL) with sidewalks (SW) are provided on a bridge where the roadway cross section must narrow, the narrowing should be prioritized in the following order:

» Minimize shy distances to constrained conditions to vertical barriers (1 foot)
» Minimize street buffer to minimum width (4 feet)
» Narrow SUP width from desired to constrained minimum, or
  ▪ narrow SBL width from desired to minimum
  ▪ narrow SW width to the minimum

To improve the safety of contra-flow bicyclists who may be unexpected by motorists, the following measures should be considered during design:

» Provision of 6 to 20-foot street buffers at crossings to create space for motorists to yield path users while turning
» Provision of clear sight lines allowing a motorist to see approaching bicyclists, pedestrians, and motorists
» Provision of traffic control signs, and clearly marked bicycle crossings following TMUTCD (Part 9) to alert motorists of bicycle travel
» Reduction and consolidation of driveways to the greatest extent practicable to reduce conflict points.
» Constructing driveways at sidewalk level to emphasize bicycle use along a side path to motorists entering/exiting driveways to slow turning motorists and improve their likelihood of yielding to crossing path users.
» At signalized intersections consider:
  ▪ Provide a leading interval or phase separation to minimize conflicts where path volume exceeds 100-150 users/hour and right turning vehicle volume exceeds 100 vehicles/hour
  ▪ Provide a leading interval or phase separation to minimize conflicts where path volume exceeds 100-150 users/hour and left turning vehicle volume exceeds 50 vehicles/hour or roadway speeds exceed 35mph
  ▪ prohibit right turns on red where vehicles frequently block the crosswalk.

Each end of a sidepath should directly connect to an on-street bike facility, another trail or path, or to a bicycle-compatible local street. Where no interconnecting bicycle accommodations exist, advanced signage should be installed informing roadway users that the path ends, and bikes may use the full lane. Additional signage in conformity with TMUTCD can be provided that directs bicyclists to interim facilities along alternate routes.
**Separated Bike Lanes**

*Description*

A separated bike lane is a bicycle lane that is physically separated from the adjacent motor vehicle traffic by vertical elements in the street buffer. They typically are designed to operate one-way but may also operate two-way. These are sometimes also referred to as protected bike lanes. Separated bike lanes combine the user experience of a shared use sidepath with a designated area for bike use only like a conventional bicycle lane, separate from pedestrians. They are distinct from the sidewalk but may be at sidewalk level (see Figure 8). Vertical elements separating the bike lane from the travel lane may include continuous raised medians, flexible posts, intermittent concrete curbing (see Austin, TX Figure 8 example), or parked vehicles.

Separated bicycle lanes are more appealing to a wider range of bicyclists on higher volume and higher speed roads than striped bike lanes. They avoid the conflict with an opening car door and prevent motor vehicles from driving, stopping, or waiting in the bikeway. They also provide greater comfort to pedestrians by separating them from bicyclists operating at higher speeds and further separating pedestrians from motor vehicles. Full guidance can be found in FHWA’s *Separated Bike Lane Planning and Design Guide*\(^{(12)}\) and the Massachusetts DOT *Separated Bike Lane Planning & Design Guide*\(^{(15)}\).

**Figure 8. Examples of Separated Bike Lanes by Separation Types**

- **Austin, TX.**
  - Street Level with Concrete Curb Separation

- **Cambridge, MA.**
  - Sidewalk Level with Parking Separation

- **Raleigh, NC**
  - Street Level with Flexible Post Separation

**Basic Design Guidelines**

- Raised medians, curbs, or other low-profile, hard separators on separated bicycle lanes should only be used in locations with speeds of 45 mph or less. Seperated bike lanes with flexible posts or crashworthy barriers are allowable for high-speed roadways. In addition, raised SBLs (at sidewalk level) are allowable for all speeds. The desirable width of a separated bike lane depends upon the volume of users and the context of the design as shown in Table 5 for one-way separated bike lanes. Two-way separated bike lane widths should follow the previous guidance for Shared Use Path width. The use of constrained dimensions should only be considered:
  - for limited distances.
  - as an interim measure where the larger values will result in the preferred design not being constructible.
» at locations with low volumes of bicyclists where those volumes are anticipated to remain low (< 50 bicyclists/hour).

### TABLE 5. One-Way Separated Bike Lane Widths (Minimum to Desirable)

<table>
<thead>
<tr>
<th>Peak Hour Directional Bicyclist Volume</th>
<th>Between Vertical Curbs or Flex Posts</th>
<th>At Sidewalk Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 150</td>
<td>6.5 – 8.5 feet</td>
<td>5.5 – 7.5 feet</td>
</tr>
<tr>
<td>150 - 750</td>
<td>8.5 – 10 feet</td>
<td>7.5 – 9 feet</td>
</tr>
<tr>
<td>&gt; 750</td>
<td>&gt; 10 feet</td>
<td>&gt; 9 feet</td>
</tr>
<tr>
<td>Constrained Condition*</td>
<td>5</td>
<td>4</td>
</tr>
</tbody>
</table>

*Peak Hour Directional Bicyclist Volume not applicable

Separated bicycle lanes that are raised to sidewalk level with a wider buffer from traffic provide a high level of separation from traffic but often require road reconstruction. The street buffer between the bike lane and travel lanes is needed to improve bicyclists’ comfort and to create space for vertical elements to reinforce the separation. For one-way separated bike lanes separated from vehicular traffic by a raised median or curb (low-speed), a minimum 2 ft buffer (measured from face of curb to face of curb) is required (see Separated Bike Lane depiction above). For non-curbed separated bike lanes, a minimum of a 2 ft buffer is required for low-speed conditions, and 3 ft for high speed conditions. Additional buffer area is recommended to improve bicyclists’ comfort and to increase the separation between bicyclists and vehicular traffic. See the Shared Use Path (sidewalk) guidance for buffers on two-way separated bicycle lanes. Two-way separated bicycle lanes also need to meet the Shared Use Path guidance with respect to intersecting driveways, and conflict points.

- Separated bicycle lanes that are protected from traffic by a row of on-street parking offer a greater degree of separation. Additional vertical elements may be required to keep parked vehicles within the parking lane.
**Buffered Bike Lanes**

*Description*
A buffered bike lane is a one-way bike lane that is separated from the adjacent motor vehicle lane or parking lane by a striped buffer area that may include chevrons, diagonal lines, or wide pavement marking stripes. When sufficient roadway width is present, or if the number of travel lanes is reduced, a buffer may be striped between a bike lane and travel lane to provide additional comfort for both bicyclists and motorists. This provides space for bicyclists to pass one another or ride side by side without encroaching into a motor vehicle travel lane. The buffer adds to the perception of safety and encourages greater use of the on-street bicycle network. Providing added separation between motorists and bicyclists who may be traveling at substantially different speeds appeals to a wider array of bicycle users.

**Basic Design Guidelines**

- The desirable useable width of a buffered bike lane is 5 to 7 feet exclusive of the buffer. The minimum useable width is 4 feet exclusive of the buffer. The usable width of the bike lane is measured from the outside buffer stripe to either the gutter joint or one foot from the nominal face of a monolithic curb.

- Buffers should be a minimum of two feet wide for speeds of 45 mph or less, and three feet wide for 50 mph or greater and delineated by two solid white lines. The stripe near the travel lane should be six inches wide, while the stripe near the bicycle lane can be four inches near the bicycle. If the buffer is three feet wide, diagonal hatching should also be marked. If the buffer is wider than three feet, chevron hatching should also be marked.

- Buffers can be striped between travel lanes and bike lanes, between bike lanes and parking lanes, or both.

- Bicycle markings and signage should be used and are the same as a conventional bike lane.

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**Bike Lanes**

*Description*
Bike lanes are one-way facilities on a roadway that typically carry bicycle traffic in the same direction as adjacent motor vehicle traffic. Bike lanes are provided for the exclusive use of bicyclists and are identified through signage, striping, or other pavement markings. These lanes allow bicyclists to ride at comfortable speeds and encourage a position within the roadway where they are more likely to be seen by motorists. Bike lanes are typically on the right side of the street, between the outside travel lane and curb, parking lane, or road edge. While the bike lane distinguishes predictable areas for bicyclist and automobile movement, bicyclists may leave the bikeway to pass other bicyclists or avoid debris and other traffic conflicts.
**Basic Design Guidelines**

- Bike lanes should only be used in locations with speeds of 45 mph or less. For high speed locations, a buffered bike lane is recommended.

- The desirable width of a bike lane is 5 to 7 feet. The minimum width is 4 feet and should only be used when all other cross-sectional elements have been minimized. The usable width of the bike lane which is measured from the outside lane stripe to either the gutter joint or one foot from the nominal face of a monolithic curb. A 6 to 7 foot bike lane is desirable adjacent to parallel parking to allow the bicyclist to avoid riding in the door zone. The minimum bike lane width is 5 feet in this situation.

- A solid white edge line (6-inch wide) should be placed between the bike lane and travel lane. Lane lines between parked cars and the bike lane are optional.

- Standard bike lane symbols and arrows, per the TMUTCD, should be used to inform bicyclists and motorists of the restricted nature of the bike lane, and markings should be placed at periodic intervals to remind motorists of the presence of bicyclists.

- The effective width of a bike lane should not include rumble strips or standard drainage inlets.

- Drainage grates located in the bike lane should be designed to prevent bicycle tires from catching in the grate pattern.

**Bike Accessible Shoulders**

**Description**

Bike accessible shoulders are one-way facilities on a roadway that carry bicycle traffic in the same direction as adjacent motor vehicle traffic. A bike accessible shoulder is one that is at least as wide or wider than a bike lane to accommodate bicyclists and paved to provide a smooth, solid surface across its width. While the bike accessible shoulder distinguishes predictable areas for bicyclist and automobile movement, bicyclists may leave the shoulder to pass other cyclists or avoid debris and other traffic conflicts.

**Basic Design Guidelines**

- For any given roadway, the determination of the appropriate paved shoulder width should be based on the roadway's context and traffic conditions following the guidance in the RDM for shoulders; however, it should be noted that the shoulders in the RDM may consist of graded (soft) and paved (hard) surfaces. To ensure accommodation of bicyclists, it is desirable for paved shoulders to conform to the widths in Figure 5. Some shoulders should be up to 10 feet wide adjacent to higher speed roadways as indicated in Figure 5 to allow bicyclists to operate with more separation to the high-speed traffic. Roadways indicated in TxDOT's Bicycle Tourism Trails Study\(^{(13)}\) should be designed with a minimum 8-foot shoulder, a shared use path, or another locally preferred facility type should be available. The minimum widths for a bike accessible shoulder are defined below.

- A solid white edge line (6-inch-wide) should be placed between the shoulder and travel lane.
- Bike accessible shoulders typically do not have bike lane markings, but they may include signage indicating the presence of bicyclists.

- The width of the bike accessible shoulder does not include rumble strips. A minimum width of 4’ is allowable in low speed (45 mph or less) conditions. A minimum width of 5’ is allowable for high speed conditions. A minimum width of 5’ is required for shoulders adjacent to bridge railings, MBGF, and other vertical elements.

- Rumble strips are used to warn the driver that they are leaving the travel way and therefore may have a beneficial effect on the safety of bicycles using the shoulder. If rumble strips are to be used, or are anticipated in the future, allowances should be made in the shoulder to provide an adequate width for bike accommodations beyond the rumble strip. Profile pavement markings serve a similar function as milled rumble strips and can be considered as an option to avoid a reduction in the width of the accessible shoulder. Where bicycle traffic is expected, rumble strips should be designed as follows to minimize crash risk for bicyclists (see Figures 9 and 10). See latest RS Standards for additional guidance on rumble strips:

  - Periodic gaps (Figure 10) should be provided to allow bicyclists to safely enter or exit a shoulder as needed (e.g., to avoid debris, pass other bicyclists or disabled vehicles, make left turns, etc.) without having to ride over the rumble strips.
    - Where bicyclists are operating at 20 mph or less, a minimum 15-foot gap every 40 to 60 feet allows half a second for a bicyclist to cross the rumble strip
    - Where bicyclists are operating over 20 mph, the gap should be increased to 20 feet or more or the rumble strips should be located on the right side of the shoulder to allow bicyclists to avoid them if they encounter a need to enter the travel lane (e.g., a downhill location)
Figure 9. Rumble Strip Placement in a Shoulder

Figure 10. Rumble Strip Design and Gap Placement

**Rumble strip gap (L) dimensions:**

1. Where bicyclists are operating at 20 mph or less, a minimum 15-foot gap every 40 to 60 feet allows half a second for a bicyclist to cross the rumble strip.
2. Where bicyclists are operating over 20 mph, the gap should be increased to 20 feet or more or the rumble strips should be located on the right side of the shoulder to allow bicyclists to avoid them if they encounter a need to enter the travel lane (e.g., a downhill location).
**Shared Lanes (wide outside lane)**

**Description**

Shared lanes (wide outside lane) are lanes that allow compatibility of operation for both motorized vehicles and bicycles. Since bicycles may be operated on all roadways except where prohibited by statute or regulations, shared lanes without markings already exist in many different urban, urban core, suburban and rural town settings.

Note that although marked shared lanes are allowed in the TMUTCD for certain conditions, TxDOT as a general policy does not recommend marked shared lanes for TxDOT roadways due to the higher speed nature of TxDOT roadways as compared to local jurisdictions.

**Basic Design Guidelines**

- Shared wide outside lanes should only be used in locations with low volumes (3,000 ADT or lower) and low speeds (35 mph or less).

- 14 feet is the maximum and 13 feet is the minimum “usable width” for a shared wide outside lane. The usable width is measured from the lane stripe to either the gutter joint or one foot from the nominal face of a monolithic curb.

- If the usable width is greater than 14 feet, a bike lane should be provided instead. Use of minimum travel lane widths may be necessary to incorporate the bike lane.

- Typical supplemental signage may include: BICYCLES MAY USE FULL LANE (R4-11). See TMUTCD for proper signing applications.

- Custom signage may include language instructing vehicles to change lanes to pass or use a 3-foot passing distance.
Rural Facility Types

Shared Use Path
A Shared Use path adjacent to roadway (sidewalk) with separation from the roadway is an option on rural facilities. An additional option is a Shared Use Path on an independent alignment. While it is recognized that these types of facilities are not usually feasible on most rural projects, consideration should be given to using them on the Texas Bicycle Tourism Trails Example Network and rural roadways with ADT over 6000. If they are used, see the urban sidepath guidance, and the AASHTO Bike Guide for further design guidance.

Bike Accessible Shoulders
Description
Bike accessible shoulders in rural areas function the same as bike accessible shoulders in urban areas with the exception that the roadway will generally not have a curb at the edge. If they are used, see the Urban Bike Accessible Shoulder section, and the AASHTO Bike Guide for further design guidance.

Shared Lanes (wide outside lane)
Description
Shared lanes (wide outside lane) are lanes that allow compatibility of operation for both motorized vehicles and bicycles. Since bicycles may be operated on all roadways except where prohibited by statute or regulations, shared lanes without markings already exist in many rural settings.

Note that although marked shared lanes are allowed in the TMUTCD for certain conditions, TxDOT as a general policy does not recommend marked shared lanes for TxDOT roadways due to the higher speed nature of TxDOT roadways as compared to local jurisdictions. Also, shared lane markings alone do not provide any additional safety for bicyclists and do not substantiate a dedicated bicycle facility. If they are used, see the urban shared lane guidance and the AASHTO Bike Guide for further design guidance. In rural applications, shared wide outside lanes should only be used in locations with low volumes (1,000 ADT or lower) and speeds of 45 mph or less.
CONSIDERATIONS FOR ALTERNATIVES AND DESIGN EXCEPTIONS OR DESIGN WAIVERS

**Alternatives Considerations**

There will be locations, mostly due to ROW not being acquired, where proper bicycle accommodation width(s) are not feasible, even after all other design criteria were analyzed as minimum values (e.g. lane widths). In these cases, it will be necessary to consider downgrading the bicycle accommodation to the next best facility type and/or to provide a parallel facility.

Impacts on ridership, comfort/stress, safety, and overall network connectivity should be considered when evaluating alternative bicycle accommodation designs or parallel routes to ensure the project will still meet the purpose identified at the outset. The tradeoffs shown below need to be considered and documented in the design process. Many of the streets that need bicycle facilities will need to have them installed in a retrofit fashion, rather than new construction. The considerations listed also apply to adding bicycle facilities along an existing corridor:

- Reduced or suppressed ridership where the bicycle accommodation does not meet the needs of the target design user
- Additional length of trip when bicyclists must use a parallel route. This length should not exceed 30% more than the original route.
- Failure to provide a bicycle accommodation or critical connections that leave an important gap in the bicycle network
- Reduced safety where bicyclists must operate with relatively high motor vehicle speed and/or high-volume traffic in shared lanes
- Reduced safety where bicyclists must operate in narrow bicycle accommodation (e.g. narrow bike lanes adjacent to high turnover parking or narrow shared use paths with high volumes of pedestrians or bicyclists)
- Reduced safety where bicyclists improperly use facilities (e.g., ride the wrong way on shared lanes, sidewalk riding, etc.)
- Increased sidewalk bicycling where bicyclists are avoiding low-comfort/high-stress conditions

In instances where shared use paths or separated bike lanes are recommended by volume, speed, and/or other factors, but proper facility widths cannot be obtained, it may still be preferable to provide separated facilities with minimum or reduced paths and/or buffer widths rather than putting bicyclists in the roadway with high-speed/volume traffic.
**Design Exceptions and Design Waivers**

As previously discussed, the process for deciding if projects can be excepted from providing bicycle facilities does not require a design exception or design waiver. However, if a project includes bicycle facilities and the preferred bicycle facility type cannot meet the respective criteria or thresholds, then a design waiver or design exception would apply.

**Urbanized Context (Urban Core/Urban/Suburban/Rural Town)**

**Design Exceptions**

- Bike Lane: If the minimum width specified in the Basic Design Guidelines is not met.
- Shared Lane (Wide Outside Lane): If the traffic volume, speed, or width criteria (14-ft maximum, 13-ft minimum) specified in the Basic Design Guidelines are not met.

**Design Waivers**

- Shared Use Path (Independent alignment or Side Path): If the minimum width criteria (minimum 10-ft, 8-ft rare circumstance), buffer width, and other geometric criteria specified in the Basic Design Guidelines, and the associated AASHTO Bike Design criteria are not met.
- Separated Bike Lane/Buffered Bike lane: If the minimum criteria specified in the Basic Design Guidelines are not met.
- Bike Accessible Shoulder: For new construction, reconstruction, or widening projects where right-of-way is being acquired, a Design Waiver is required if a minimum width defined in Basic Design Guidelines is not provided.

**Rural Context**

**Design Exceptions**

- Shared Lane (Wide Outside Lane): If the traffic volume, speed, or width criteria (14-ft maximum, 13-ft minimum) specified in the Basic Design Guidelines are not met.

**Design Waivers**

- Shared Use Path (Independent alignment or side path): If the minimum width criteria (minimum 10-ft, 8-ft rare circumstance), buffer width, and other geometric criteria specified in the Basic Design Guidelines, and the associated AASHTO Bike Design criteria are not met.
- Bike Accessible Shoulder: For new construction, reconstruction, or widening projects where right-of-way is being acquired, a Design Waiver is required if a minimum width defined in Basic Design Guidelines is not provided.
REFERENCES

Policy Documents


(2) Texas Manual on Uniform Traffic Control Devices Revision 2 (2014)

(3) TxDOT Roadway Design Manual (2020)
    http://onlinemanuals.txdot.gov/txdotmanuals/rdw/index.htm

    https://www.fhwa.dot.gov/environment/bicycle_pedestrian/guidance/policy_accom.cfm

Guidance Documents

(5) FHWA’s Bicycle and Pedestrian Planning, Program, and Project Development (2019)

(6) NACTO’S Urban Bike Design Guide (2014)
    https://nacto.org/publication/urban-bikeway-design-guide/

(7) NACTO’S Designing for All Ages and Abilities (2017)

(8) ITE’s Designing Walkable Urban Thoroughfares; A Context Sensitive Approach (2010)
    https://www.ite.org/pub/?id=E1CFF43C-2354-D714-51D9-D82B39D4DBAD

(9) FHWA’s Bikeway Selection Guide (2019)
    https://safety.fhwa.dot.gov/ped_bike/tools_solve/docs/fhwasa18077.pdf

(10) FHWA’s Bicycle and Pedestrian Facility Design Flexibility (2013 Memorandum)
    https://www.fhwa.dot.gov/environment/bicycle_pedestrian/guidance/design_flexibility.cfm

(11) FHWA’s Small Town and Rural Multimodal Network (2016)
    https://www.fhwa.dot.gov/environment/bicycle_pedestrian/publications/small_towns/

(12) FHWA’s Separated Bike Lane Planning and Design Guide (2015)
(13) TxDOT’s Bicycle Tourism Trials Study (2018)


https://www.mass.gov/lists/separated-bike-lane-planning-design-guide

(16) Traffic Analysis and Intersection Considerations to Inform Bikeway Selection (2021)


Additional rules, regulations, resources, links, and information for bicyclist accommodations can be found at Public Transportation Division’s SharePoint “Bicycle & Pedestrian Coordinator” website:
https://txdot.sharepoint.com/sites/division-ptn/BikePed-Coordinator