Design Policies & Safety Evaluation

Module D

Learning Outcomes:

- ✖ Discuss why we should include bicycles in the transportation network.
- ✖ Explain the challenges and opportunities to analyze bicyclist safety.

DESIGN POLICIES

Federal Law

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. 23 U.S.C. 217(g)(1)

Transportation plans and projects shall provide due consideration for safety and contiguous routes for bicyclists and pedestrians. 23 U.S.C. 217(g)(2)

USDOT Policy

United States Department of Transportation Policy Statement on Bicycle and Pedestrian Accommodation Regulations and Recommendations

Signed on March 11, 2010 and announced March 15, 2010

Purpose

The United States Department of Transportation (DOT) is providing this Policy Statement to reflect the Department's support for the development of fully integrated active transportation networks. The establishment of well-connected walking and bicycling networks is an important component for livable communities, and their design should be a part of Federal-aid project developments. Walking and bicycling foster safer, more livable, family-friendly communities; promote physical activity and health; and reduce vehicle emissions and fuel use. Legislation and regulations exist that require inclusion of bicycle and pedestrian policies and projects into transportation plans and project development. Accordingly, transportation agencies should plan, fund, and implement improvements to their walking and bicycling networks, including linkages to transit. In addition, DOT encourages transportation agencies to go beyond the minimum requirements, and proactively provide

convenient, safe, and context-sensitive facilities that foster increased use by bicyclists and pedestrians of all ages and abilities, and utilize universal design characteristics when appropriate. Transportation programs and facilities should accommodate people of all ages and abilities, including people too young to drive, people who cannot drive, and people who choose not to drive.

Policy Statement

The DOT policy is to incorporate safe and convenient walking and bicycling facilities into transportation projects. Every transportation agency, including DOT, has the responsibility to improve conditions and opportunities for walking and bicycling and to integrate walking and bicycling into their transportation systems. Because of the numerous individual and community benefits that walking and bicycling provide — including health, safety, environmental, transportation, and quality of life — transportation agencies are encouraged to go beyond minimum standards to provide safe and convenient facilities for these modes.

Authority

This policy is based on various sections in the United States Code (U.S.C.) and the Code of Federal Regulations (CFR) in Title 23—Highways, Title 49—Transportation, and Title 42—The Public Health and Welfare. These sections, provided in the Appendix, describe how bicyclists and pedestrians of all abilities should be involved throughout the planning process, should not be adversely affected by other transportation projects, and should be able to track annual obligations and expenditures on nonmotorized transportation facilities.

Recommended Actions

The DOT encourages States, local governments, professional associations, community organizations, public transportation agencies, and other government agencies, to adopt similar policy statements on bicycle and pedestrian accommodation as an indication of their commitment to accommodating bicyclists and pedestrians as an integral element of the transportation system. In support of this commitment, transportation agencies and local communities should go beyond minimum design standards and requirements to create safe, attractive, sustainable, accessible, and convenient bicycling and walking networks. Such actions should include:

Considering walking and bicycling as equals with other transportation modes: The primary goal of a transportation system is to safely and efficiently move people and goods. Walking and bicycling are efficient transportation modes for most short trips and, where convenient intermodal systems exist, these nonmotorized trips can easily be linked with transit to significantly increase trip distance. Because of the benefits they provide, transportation agencies should give the same priority to walking and bicycling as is given to other transportation modes. Walking and bicycling should not be an afterthought in roadway design.

Ensuring that there are transportation choices for people of all ages and abilities, especially children: Pedestrian and bicycle facilities should meet accessibility requirements and provide safe,

convenient, and interconnected transportation networks. For example, children should have safe and convenient options for walking or bicycling to school and parks. People who cannot or prefer not to drive should have safe and efficient transportation choices.

Going beyond minimum design standards: Transportation agencies are encouraged, when possible, to avoid designing walking and bicycling facilities to the minimum standards. For example, shared-use paths that have been designed to minimum width requirements will need retrofits as more people use them. It is more effective to plan for increased usage than to retrofit an older facility. Planning projects for the long-term should anticipate likely future demand for bicycling and walking facilities and not preclude the provision of future improvements.

Integrating bicycle and pedestrian accommodation on new, rehabilitated, and limited-access bridges: DOT encourages bicycle and pedestrian accommodation on bridge projects including facilities on limited-access bridges with connections to streets or paths.

Collecting data on walking and biking trips: The best way to improve transportation networks for any mode is to collect and analyze trip data to optimize investments. Walking and bicycling trip data for many communities are lacking. This data gap can be overcome by establishing routine collection of nonmotorized trip information. Communities that routinely collect walking and bicycling data are able to track trends and prioritize investments to ensure the success of new facilities. These data are also valuable in linking walking and bicycling with transit.

Setting mode share targets for walking and bicycling and tracking them over time: A byproduct of improved data collection is that communities can establish targets for increasing the percentage of trips made by walking and bicycling.

Removing snow from sidewalks and shared-use paths: Current maintenance provisions require pedestrian facilities built with Federal funds to be maintained in the same manner as other roadway assets. State Agencies have generally established levels of service on various routes especially as related to snow and ice events.

Improving nonmotorized facilities during maintenance projects: Many transportation agencies spend most of their transportation funding on maintenance rather than on constructing new facilities. Transportation agencies should find ways to make facility improvements for pedestrians and bicyclists during resurfacing and other maintenance projects.

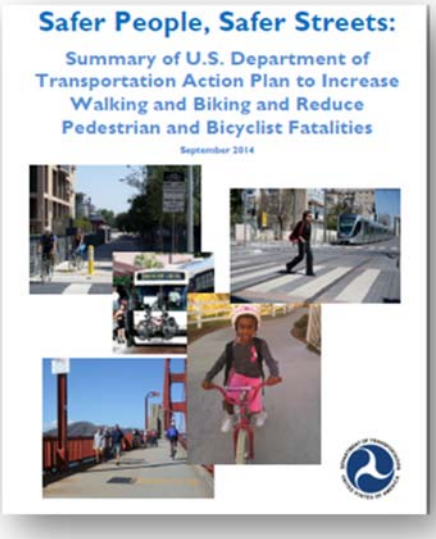
Conclusion

Increased commitment to and investment in bicycle facilities and walking networks can help meet goals for cleaner, healthier air; less congested roadways; and more livable, safe, cost-efficient communities. Walking and bicycling provide low-cost mobility options that place fewer demands on local roads and highways. DOT recognizes that safe and convenient walking and bicycling facilities may look different depending on the context — appropriate facilities in a rural community may be different from a dense, urban area. However, regardless of regional, climate, and population density

differences, it is important that pedestrian and bicycle facilities be integrated into transportation systems. While DOT leads the effort to provide safe and convenient accommodations for pedestrians and bicyclists, success will ultimately depend on transportation agencies across the country embracing and implementing this policy.

Ray LaHood, United States Secretary of Transportation

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



The Department will promote the development of multimodal networks which include interconnected pedestrian/and or bicycle transportation facilities that allow people of all ages and abilities to safely and conveniently get where they want to go.

Source: http://www.dot.gov/sites/dot.gov/files/docs/safer_people_safer_streets_summary_doc_acc_v1-11-9.pdf

FHWA Program Guidance

Bicycle and pedestrian ways shall be established in new construction and reconstruction projects in all urbanized areas unless one or more of three conditions are met:

- ✖ Bicyclists and pedestrians are prohibited by law from using the roadway. In this instance, a greater effort may be necessary to accommodate bicyclists and pedestrians elsewhere within the right of way or within the same transportation corridor.
- ✖ The cost of establishing bikeways or walkways would be excessively disproportionate to the need or probable use. Excessively disproportionate is defined as exceeding twenty percent of the cost of the larger transportation project.
- ✖ Where sparsity of population or other factors indicate an absence of need. For example, the Portland Pedestrian Guide requires "all construction of new public streets" to include sidewalk improvements on both sides, unless the street is a cul-de-sac with four or fewer dwellings or the street has severe topographic or natural resource constraints.

In rural areas, paved shoulders should be included in all new construction and reconstruction projects on roadways used by more than 1,000 vehicles per day, as in States such as Wisconsin.

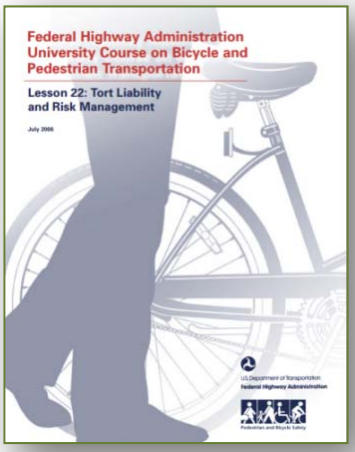
Paved shoulders have safety and operational advantages for all road users in addition to providing a place for bicyclists and pedestrians to operate.

Source: http://www.fhwa.dot.gov/environment/bicycle_pedestrian/guidance/design.cfm

Reduces Liability

It is no longer acceptable to plan, design, or build roadways that do not fully accommodate use by bicyclists and pedestrians…
With every passing year, the courts become less and less sympathetic to agencies that have not understood the message: bicyclists and pedestrians are intended users of the roadway.

Source:
www.fhwa.dot.gov/publications/research/safety/pedbike/05085/pdf/lesson22lo.pdf



EVALUATING NEEDS

Data Collection Goals

- Identify high crash locations, corridors, areas
- Identify locations, corridors, areas with high crash potential
- Prioritize high crash locations, corridors, areas
- Identify appropriate treatments

Data Collection Guidelines

- Collect only what you need
- Collect only what you can use
  - Do you need 5 years' worth of data if 3 years' worth give you a good idea of the problem?
  - Do you need crash data for the entire state to be collected if you're focused on a small area?
  - Do you need detailed reports if the raw numbers give a good picture of the problem?
  - But don't jump to conclusions too soon: incomplete data could give a false perspective of the problem
- Timely crash data
  - Try to get the most recent data possible
  - Make sure they go back far enough to be representative (min 3 years)
  - Don't go too far back: conditions change over time

Types of Safety Projects

- Spot Locations *(individual intersections and non-intersections)*
- Corridors *(½ mile to 5 or more miles in length)*
- Targeted Areas *(neighborhood, business district, or large area where pedestrian crashes are high)*
- Entire Jurisdictions *(addressed through system-wide changes)*

Crash Data Analysis

Crash data analysis can:

- Discover prevalent crash types and behaviors
- Target specific areas

- ✖ Inform selection of bicycle facility

Understanding the limitations:

- ✖ Bicycle-related crashes are generally underreported (tend to only include bicycle-motor vehicle crashes or crashes resulting in major injuries
- ✖ Fails to capture locations characterized by frequent near-misses
- ✖ Crash data is often lacking, non-traditional sources such as hospital records are difficult to collect and analyze
- ✖ Data can be difficult to interpret, is often scattered through different systems and departments, does not always yield enough crashes at a single location to produce statistically reliable results
- ✖ Process of analyzing data can involve significant effort
- ✖ Crash reporting method may leave gaps in info such as actual location or cause of crash, or other important details

Safety Evaluation Tools

Highway Safety Manual Methodology

Urban & Suburban Segments

$N_{biker} = N_{br} \times f_{biker}$

Where:

N_{biker} – vehicle-bicycle collision frequency

N_{br} – crash frequency, excluding bikes and peds

f_{biker} – bicycle crash adjustment factor

Table 12-8. Pedestrian Crash Adjustment Factor for Roadway Segments

Road Type	Pedestrian Crash Adjustment Factor (fpedr)	
	Posted Speed 30 mph or Lower	Posted Speed Greater than 30 mph
2U	0.036	0.005
3T	0.041	0.013
4U	0.022	0.009
4D	0.067	0.019
5T	0.030	0.023

Note: These factors apply to the methodology for predicting total crashes (all severity levels combined). All pedestrian collisions resulting from this adjustment factor are treated as fatal-and-injury crashes and none as property-damage-only crashes.
Source: HSIS data for Washington (2002–2006)

Source: *Highway Safety Manual*, 1st edition, Volume 2, 2010.

Urban & Suburban Intersections

$N_{bikei} = N_{bi} \times f_{bikei}$

Where:

N_{bikei} -- vehicle-bicycle collision frequency

N_{bi} -- predicted intersection crashes (no bikes/peds)

f_{bikei} – bicycle crash adjustment factor

Table 12-17. Bicycle Crash Adjustment Factors for Intersections

Intersection Type	Bicycle Crash Adjustment Factor (f_{bikei})
3ST	0.016
3SG	0.011
4ST	0.018
4SG	0.015

Note: These factors apply to the methodology for predicting total crashes (all severity levels combined). All bicycle collisions resulting from this adjustment factor are treated as fatal-and-injury crashes and none as property-damage-only crashes. Source: HSIS data for California (2002–2006)

Source: *Highway Safety Manual*, 1st edition, Volume 2, 2010.

CMF Limitations

▼ Countermeasure: Install bicycle lanes

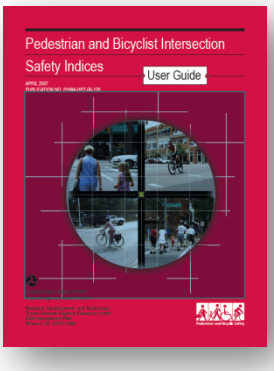
CMF	CRF(%)	Quality	Crash Type	Crash Severity	Area Type	Reference	Comments
1.05	-5	★★★☆☆	All	All	Urban	Jensen, 2008	
0.944	5.6	★★★☆☆	All	All	Urban	Chen et al., 2012	
1.509	-50.9	★★★☆☆	Vehicle/bicycle	All	Urban	Chen et al., 2012	
1.057	-5.7	★★★☆☆	All	All	Urban	Chen et al., 2012	Includes signalized, all-way stop controlled, ... [*read more*]
1.281	-28.1	★★★☆☆	Vehicle/bicycle	All	Urban	Chen et al., 2012	Includes signalized, all-way stop controlled, ... [*read more*]

▼ Countermeasure: Installation of bicycle lanes at signalized intersections

CMF	CRF(%)	Quality	Crash Type	Crash Severity	Area Type	Reference	Comments
1.37	-37	★★☆☆☆	Vehicle/bicycle	All	Urban and suburban	Turner et al., 2011	
0.8	20	★★☆☆☆	Vehicle/bicycle	All	Urban and suburban	Turner et al., 2011	
0.63	37	★★☆☆☆	Vehicle/bicycle	All	Urban and suburban	Turner et al., 2011	Crossing crashes at 90 degrees ... [*read more*]
1.33	-33	★★☆☆☆	Vehicle/bicycle	All	Urban and suburban	Turner et al., 2011	Crash Type: Cyclist through, left ... [*read more*]
1.01	-1	★★☆☆☆	Vehicle/bicycle	All	Urban and suburban	Turner et al., 2011	Crash Type: Rear end & ... [*read more*]

Source: Selected crash modification factors from http://www.cmfclearinghouse.org/

Bicyclist Intersection Safety Indices



Source: http://www.fhwa.dot.gov/publications/research/safety/pedbike/06130/06130.pdf

WHAT ARE THE PEDESTRIAN AND BICYCLE INTERSECTION SAFETY INDICES?

The Pedestrian and Bicycle Intersection Safety Indices (Ped ISI and Bike ISI) are a set of models that enable users to identify intersection crossings and intersection approach legs that should be the greatest priority for undergoing pedestrian and bicycle safety improvements. Using observable characteristics of an intersection crossing or approach leg, the tool produces a safety index score, with higher scores indicating a greater priority for an indepth safety assessment. Each leg of an intersection may have different characteristics affecting pedestrian or bicyclist safety; therefore the tools are intended to provide an evaluation of the safety of an individual crossing (Ped ISI) or approach leg (Bike ISI) rather than evaluating the intersection as a whole. A practitioner can use the tool to develop a prioritization scheme for a group of pedestrian crossings or bicyclist approaches. This method enables the practitioner to prioritize and proactively address sites that are the most likely to be a safety concern for pedestrians or bicyclists.

WHY ARE PED ISI AND BIKE ISI NEEDED?

The need to address pedestrian and bicyclist safety is ever present. National crash statistics for 2004 show that 4,641 pedestrians and 725 pedalcyclists were killed in crashes, accounting for approximately 13 percent of all traffic fatalities in the United States.(1) Most of these crashes occur at intersections. Many States and municipalities have pedestrian and bicycle safety programs to identify and address high crash locations. Although these safety programs can treat pedestrian or bicyclist hazards as they are identified, it would be preferable to use a proactive method of prioritizing which intersections should be examined first to ensure that potentially risky locations are addressed before they become crash problems.

WHAT ARE THE BENEFITS OF PED ISI AND BIKE ISI?

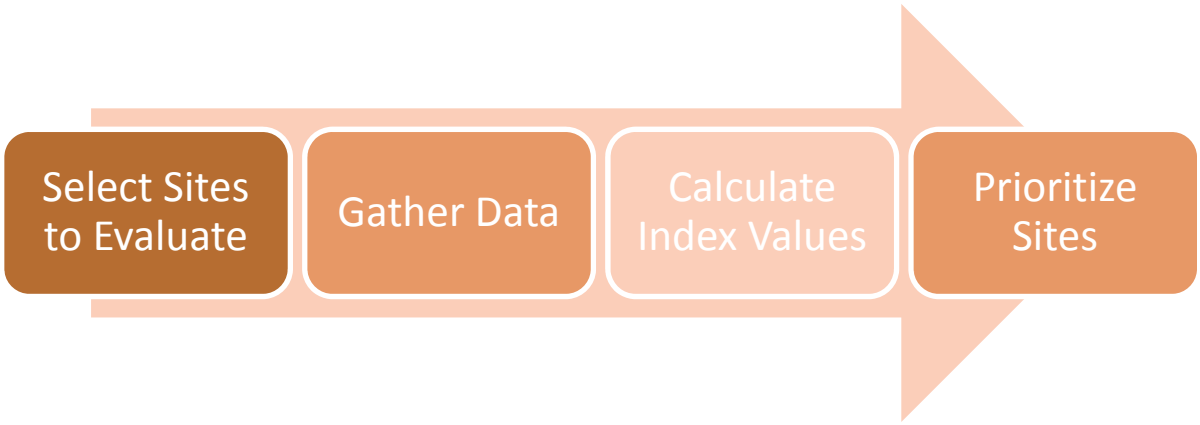
Ped ISI and Bike ISI proactively prioritize pedestrian crossings and bicyclist approaches with respect to safety. They also provide forward-looking State and local planning agencies with a safety rating tool for proposed intersections. Each tool uses observable and easy-to-gather data.

WHERE CAN PED ISI AND BIKE ISI BE USED?

Ped ISI and Bike ISI were developed at urban and suburban intersections with the following characteristics:

- Three-leg and four-leg intersections.
- Signalized, two-way stop, and four-way stop.
- Traffic volumes from 600 to 50,000 vehicles per day.
- One-way and two-way roads.
- One to four through lanes.
- Speed limits from 24.1 to 72.4 kilometers per hour (km/h) (15 to 45 miles per hour (mi/h)).

Ped ISI and Bike ISI are used most appropriately at intersections that meet the above ranges. Safety index values produced for intersections with characteristics outside these ranges should be used only with the understanding that the models were not developed using intersections of that type.



STEPS FOR USING THE PED ISI AND BIKE ISI

1. Select Sites To Evaluate—Identify pedestrian crossings (Ped ISI) or intersection approaches (Bike ISI) to evaluate. It is not necessary to evaluate all intersections in a given locality at once, especially where there is a large number of sites. Here are some useful tips for considering how to begin selecting sites:

   – Are there sites in the planning stage that could be modified in the design phase to avoid potential problems?

– Is there an area where there may be moderate to high pedestrian and/or bicyclist activity, such as in a central business district or near a popular pedestrian or bicyclist attractor?

– Are there sites that have already been identified in the community (including residents or other users) as possible problems?
– Are there sites where a crash has occurred? Typically these tend to naturally receive focused attention, but it may also prove useful to develop a safety index score to provide perspective, or to help identify what factor(s) may be affecting safety.

2. Gather Data—Gather data on geometric and operational characteristics of the selected sites, either through electronic databases or brief field visits. If the sites are in the planning stages, determine what characteristics the sites are expected to have. See the list of data required for the safety indices on page 7. A sample data collection form is available in Appendix A.

3. Calculate Index Values—Use Ped ISI and Bike ISI to produce index values for each site. Each site will receive a safety index value between 1 (safest) and 6 (least safe). The Ped ISI equation is shown on page 8; the Bike ISI equation is shown on page 11. Example calculations of index values are found starting on page 20. Users may also opt to use the Quick Reference Tables found in Appendix B to determine safety index values when a computer is not available. 4. Prioritize Sites—Sort sites according to index values. Sites with the highest index values generally have the highest priority for further indepth evaluation of pedestrian and/or bicycle safety. However, the existence of a high Ped ISI or Bike ISI value does not mean that a crosswalk or intersection approach is necessarily “hazardous.” There are many characteristics and behaviors at an intersection that will result in a pedestrian or bike crash, and no method can include all of these factors. Knowledge of the area should also be used in the prioritization of sites. The Ped ISI/Bike ISI method merely provides a way to prioritize locations to identify those which may warrant more indepth study.

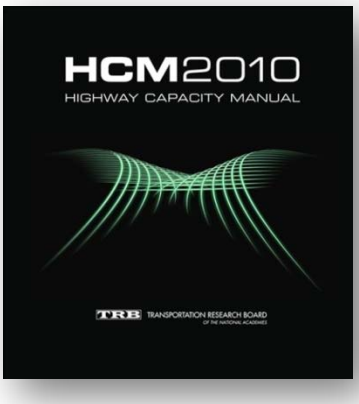
Table 2. Bike ISI models and variable descriptions.

Through	Bike ISI = 1.13 + 0.019**MAINADT** + 0.815**MAINHISPD** + 0.650**TURNVEH** + 0.470(**RTLANES***BL) + 0.023(**CROSSADT***NOBL) + 0.428(**SIGNAL***NOBL) + 0.200**PARKING**
Right Turn	Bike ISI = 1.02 + 0.027**MAINADT** + 0.519**RTCROSS** + 0.151**CROSSLNS** + 0.200**PARKING**
Left Turn	Bike ISI = 1.100 + 0.025**MAINADT** + 0.836**BL** + 0.485**SIGNAL** + 0.736(**MAINHISPD***BL) + 0.380(**LTCROSS***NOBL) + 0.200**PARKING**

where:

Bike ISI	*Safety index values (through, right, left)*	
BL	Bike lane presence	0 = NONE or wide curb lane (WCL) 1 = bike lane (BL) or bike lane crossover (BLX)
CROSSADT	Cross street traffic volume	ADT in thousands
CROSSLNS	Number of through lanes on cross street	1, 2, …
LTCROSS	Number of traffic lanes for cyclists to cross to make a left turn	0, 1, 2, …
MAINADT	Main street traffic volume	ADT in thousands
MAINHISPD	Main street speed limit ≥ 56.3 km/h (35 mi/h)	0 = no 1 = yes
NOBL	No bike lane present	0 = BL or BLX 1 = NONE or WCL
PARKING	Onstreet parking on main street approach	0 = no 1 = yes
RTCROSS	Number of traffic lanes for cyclists to cross to make a right turn	0, 1, 2, …
RTLANES	Number of right turn traffic lanes on main street approach	0, 1
SIGNAL	Traffic signal at intersection	0 = no 1 = yes
TURNVEH	Presence of turning vehicle traffic across the path of through cyclists	0 = no 1 = yes

Bicycle Level-of-Service



Interrupted flow:

- ✖ LOS reported separately for each mode
  - + Purpose, length, and expectation differs
- ✖ Travel speed
- ✖ Intersection delay
- ✖ Bicyclist perception

Factors in bicyclist LOS score (interrupted flow):	
Motorized vehicle volume	Median
% heavy vehicles	Curb
% occupied parking	Access
# lanes	Pavement condition
Outside lane width	Motorized vehicle speed

Off-Street Bicycle Facilities

Factors in bicyclist LOS score (shared-use & exclusive paths):	
Meetings per minute	Presence of centerline
Active passings per minute	Path width
Delayed passings	

Source: *Highway Capacity Manual*, 2010.

Levels of Traffic Stress (LTS)

- ✖ LTS 1: Suitable for almost all cyclists, including children trained to safely cross intersections (paths, low volume streets).
- ✖ LTS 2: Suitable to most adult cyclists but demanding more attention than expected from children (bike lanes, sharrows).
- ✖ LTS 3: More traffic stress than LTS 2, but less stress than integrating with multilane traffic (bike lanes/sharrows on arterials).
- ✖ LTS 4: Strong and fearless.

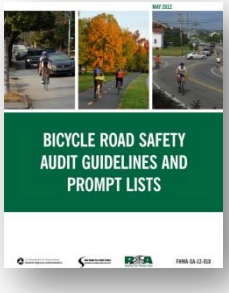
Levels of Traffic Stress			
LTS 1	LTS 2	LTS 3	LTS 4
• Physically separated from traffic or low-volume, mixed-flow traffic at 25 mph or less • Bike lanes 6 ft wide or more • Intersections easy to approach and cross • Comfortable for children	• Bike lanes 5.5 ft wide or less, next to 30 mph auto traffic • Unsignalized crossings of up to 5 lanes at 30 mph • Comfortable for most adults • Typical of bicycle facilities in Netherlands	• Bicycle lanes next to 35 mph auto traffic, or mixed-flow traffic at 30 mph or less • Comfortable for most current U.S. riders • Typical of bicycle facilities in U.S.	• No dedicated bicycle facilities • Traffic speeds 40 mph or more • Comfortable for "strong and fearless" riders (vehicular cyclists)

Source: Mekuria, Furth, and Nixon, "Low-Stress Bicycling and Network Connectivity", Mineta Transportation Institute, May 2012.

Road Safety Audit

A RSA is a formal safety performance evaluation of an existing or future road or intersection by an independent, multidisciplinary team. RSA programs have been established in most states and FHWA has guidelines regarding the RSA process. RSAs are an effective tool because they engage a diverse team to identify issues by riding the road. FHWA developed a Bicycle Road Safety Audit Guidelines and Prompt Lists document to help guide stakeholders through the process of identifying and addressing issues.

For more information: http://safety.fhwa.dot.gov/rsa/



Since bicycle crashes tend to be widely dispersed, mapping of crash locations may not yield a strong indication of problem locations. Therefore it is also important to use other methods to identify risk factors when evaluating safety for all road users. One way to get a general understanding of factors that affect bicyclists' safety is to use a bikeability checklist, such as the one available through the Pedestrian and Bicycle Information Center. Conducting a Bicycle Road Safety Audit (RSA) can also be useful for identifying roadway improvements and other strategies that may improve the safety of bicyclists.

Master Prompt List

RSA Zones				
A. Street or Path	**B. Structures**	**C. Intersections, Crossings, and Interchanges**	**D. Transitions**	**E. Transit**
1. Presence & Availability				
Are cyclists accommodated?				
2. Design & Placement				
Are design features present that adversely impact the use of the facility by cyclists?	Are bridges/tunnels designed with adequate bicycle accommodations on both sides? Does the gradient of the cycling accommodations impact the use of the facility?	Are intersection/interchange accommodations designed to reduce conflicting movements and communicate proper bicycle positioning through the crossing?	Are transition areas designed with logical termini or do they end abruptly, potentially contributing to sudden and difficult merges, midblock crossings, or behaviors such as wrong-way riding?	Are transit facilities designed and placed to minimize conflicts with other modes?
3. Operations				
Are there suitable provisions for cyclists given the characteristics of the roadway or path (speed, volume, traffic, and functional classification)? Do access management practices detract from cycling safety?		Do traffic operations (especially during peak periods) create a safety concern for cyclists?	Do shared roadway geometrics change substantially or frequently?	Are transit facilities designed and placed to minimize conflicts with other modes?
4. Quality & Conditions				
Is the riding surface smooth, stable, and free of debris and is drainage adequate? Are drainage grates designed for cyclists?	Is the grating/bridge surface designed for cyclists? Is drainage adequate to accommodate bicyclists? Are there longitudinal or transverse joints that may cause cyclists problems?	Are there any obstacles at crossings? Are the manhole covers properly designed?	Is there an abrupt change in riding surface?	Are transit stops maintained during periods of inclement weather?
5. Obstructions				
Are there any horizontal or vertical obstructions (temporary or permanent) along the facility?	Is there adequate horizontal and vertical clearance?	If bollards or other physical terminal devices are used, is the risk of occasional motorized vehicles greater than the risk of a fixed object within the travel way?		Is the waiting area free of temporary/permanent obstructions that constrict its width or block access to the bus stop?
6. Roadside				
Is the clear zone for cyclists' operating space adequate?	Are railings, guardrail, and/or parapets and other structures installed at an appropriate height and shy distance?	If bollards or other physical terminal devices are used, is the risk of occasional motorized vehicles greater than the risk of a fixed object within the travel way?		Are bicycle accommodations connected and convenient for transit users?
7. Continuity & Connectivity				
Are bicycle accommodations continuous? Do bicycle accommodations provide adequate connectivity to major destinations?	Are bicycle accommodations continuous, or do they end abruptly at bridge/tunnel crossings?	Are bicycle accommodations continuous, or do they end abruptly at crossings/intersections/interchanges?	Is there a safe way for cyclists from both directions to access connections or continue to other destinations along the street network?	Are crossings convenient and free of potential hazards for cyclists?
8. Lighting				
Is the riding surface adequately lit?	Are bridges and tunnels adequately lit?	Are the intersection/transition and paths leading to the transition adequately lit?		Are transit access ways and facilities adequately lit?

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Is the riding surface adequately lit?	Are bridges and tunnels adequately lit?	Are the intersection/transition and paths leading to the transition adequately lit?		Are transit access ways and facilities adequately lit?
9. Visibility				
Is the visibility of cyclists using the facility adequate from the perspective of all road users?	Can cyclists see approaching vehicles/pedestrians, and vice versa?	Can cyclists see approaching vehicles/pedestrians at all legs of an intersection/crossing, and vice versa?	Is the visibility of cyclists as they make the transition from one facility or roadway geometry to another adequate from the perspective of all road users?	Is the visibility of cyclists using the facility adequate from the perspective of all road users?
10. Signs & Pavement Markings				
Are signs and markings along the riding surface visible, well-maintained, easily understood, and adequate?	Are adequate warning signs posted at entrances?	Do signs and markings along the cycling facility clearly indicate the cyclist path and right-of-way at intersections?	Are signs and markings at transition areas appropriate?	Are signs and markings at designated areas for cyclists using transit appropriate?
11. Signals				
If bicycle traffic signalization and detection are present, are they properly positioned, functioning, and effective?				
Does the traffic signal design accommodate all users?				
12. Human Factors / Behavior				
What are all roadway users (vehicles, bicyclists, pedestrians, transit, etc.) doing with regards to bicycle traffic, and vice versa?				

Prompt List

A. Street or Path

A.2: Are design features present that adversely impact the use of the facility by cyclists?	
Sub-Prompt	**Description**
A.2.1: Do accommodations for cyclists conform to the state of practice, guidelines, and relevant standards, or are there more advanced designs that would better support and enhance conditions for cycling?	While an RSA is not a standards check, it is critical that some RSA team members have an understanding of design requirements for cycling facilities as well as an understanding of the relative safety benefits that various design features may provide. Guidance documents include, but are not limited to: • *AASHTO's A Policy on Geometric Design of Highways and Streets* ("Green Book"). • *Manual on Uniform Traffic Control Devices* (MUTCD). Successful practices may be found in: • *AASHTO's Guide for the Development of Bicycle Facilities.* • *FHWA's Designing Sidewalks and Trails for Access, Parts 1 and 2.(28) (29)* • *NACTO Urban Bikeways Design Guide.* Knowledge of the information contained in these resources will help RSA team members check for conditions that may present a safety issue for cyclists, especially under challenging conditions (e.g., night, adverse weather, high vehicle speeds, multiple conflicts, etc.). Chapter 1 provides a more complete list of resources.
A.2.2: Are there adequate cycling provisions on both sides / directions of the roadway? 	On-road accommodations: accommodations for cyclists are needed on both sides of a two-way roadway and certain one-way roadway pairs of streets to accommodate desire lines of cyclists. Aside from issues of continuity and connectivity (see A.7), conflicts arise when two-way accommodations for cyclists are not present (see photo, left). The roadway in the photo has a shoulder on one side of the road only, which raises several potential issues associated with this cross-section: • Cyclists are encouraged to ride against traffic. • Cyclists and pedestrians traveling opposite directions are subject to conflicts on the shoulder. • Some cyclists approach intersections and driveways from the right, creating an expectancy conflict with motor vehicle traffic. • Connectivity to destinations on the opposite side of the road is not provided, potentially resulting in unpredictable maneuvers by cyclists. A.2.9 shows two-directional travel for bicycles maintained with a counterflow bicycle lane. Off-road accommodations: facilities should allow for two-way travel that considers conflicts with other road users and desire lines of cyclists. Separated bicycle facilities may take the form of two, one-way paths or two-way paths. Priority should be carefully considered at side street crossings, especially for two-way paths. Continuity and connectivity (see A.7) with other types of facilities are also potential safety concerns.

Source: http://safety.fhwa.dot.gov/ped_bike/tools_solve/fhwasa12018/

Bikeability Checklist

Go for a ride and use this checklist to rate your neighborhood's bikeability.

How bikeable is your community?

Location of bike ride (be specific): **Rating Scale:** 1 awful, 2 many problems, 3 some problems, 4 good, 5 very good, 6 excellent

1. Did you have a place to bicycle safely?

a) On the road, sharing the road with motor vehicles?

- ☐ Yes
- ☐ Some problems (please note locations):
  - ☐ No space for bicyclists to ride
  - ☐ Bicycle lane or paved shoulder disappeared
  - ☐ Heavy and/or fast-moving traffic
  - ☐ Too many trucks or buses
  - ☐ No space for bicyclists on bridges or in tunnels
  - ☐ Poorly lighted roadways

Other problems:

_____

_____

b) On an off-road path or trail, where motor vehicles were not allowed?

- ☐ Yes
- ☐ Some problems:
  - ☐ Path ended abruptly
  - ☐ Path didn't go where I wanted to go
  - ☐ Path intersected with roads that were difficult to cross
  - ☐ Path was crowded
  - ☐ Path was unsafe because of sharp turns or dangerous downhills
  - ☐ Path was uncomfortable because of too many hills
  - ☐ Path was poorly lighted

Other problems:

_____

_____

Overall "Safe Place To Ride" Rating: (circle one)
1 2 3 4 5 6

2. How was the surface that you rode on?

- ☐ Good
- ☐ Some problems, the road or path had:
  - ☐ Potholes
  - ☐ Cracked or broken pavement
  - ☐ Debris (e.g. broken glass, sand, gravel, etc.)
  - ☐ Dangerous drain grates, utility covers, or metal plates
  - ☐ Uneven surface or gaps
  - ☐ Slippery surfaces when wet (e.g. bridge decks, construction plates, road markings)
  - ☐ Bumpy or angled railroad tracks
  - ☐ Rumble strips

Other problems:

_____

_____

Overall Surface Rating: (circle one)
1 2 3 4 5 6

3. How were the intersections you rode through?

- ☐ Good
- ☐ Some problems:
  - ☐ Had to wait too long to cross intersection
  - ☐ Couldn't see crossing traffic
  - ☐ Signal didn't give me enough time to cross the road
  - ☐ Signal didn't change for a bicycle
  - ☐ Unsure where or how to ride through intersection

Other problems:

_____

_____

Overall Intersection Rating: (circle one)
1 2 3 4 5 6

Continue the checklist on the next page...

Source: Excerpt from http://www.pedbikeinfo.com/pdf/bikeability_checklist.pdf

SELECTING COUNTERMEASURES

Design Guidelines

Memorandum
U.S. Department of Transportation
Federal Highway Administration

Subject: Bicycle and Pedestrian Facility Design Flexibility

From:
Gloria M. Shepherd
Associate Administrator for Planning,
Environment and Realty

Date: August 20, 2013

Reply to: HEPH-10

Walter C. (Butch) Waidelich, Jr.
Associate Administrator for Infrastructure

Jeffrey A. Lindley
Associate Administrator for Operations

Tony T. Furst
Associate Administrator for Safety

To:
Division Administrators
Directors of Field Services

This memorandum expresses the Federal Highway Administration's (FHWA) support for 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. The National Association of City Transportation Officials (NACTO) *Urban Bikeway Design Guide* and the Institute of Transportation Engineers (ITE)*Designing Urban Walkable Thoroughfares* guide builds upon the flexibilities provided in the AASHTO guides, which can help communities plan and design safe and convenient facilities for pedestrian and bicyclists. FHWA supports the use of these resources to further develop nonmotorized transportation networks, particularly in urban areas.

AASHTO Guides

AASHTO publishes two guides that address pedestrian and bicycle facilities:

- *Guide for the Planning, Design, and Operation of Pedestrian Facilities*, July 2004, (AASHTO Pedestrian Guide) provides guidelines for the planning, design, operation, and maintenance of pedestrian facilities, including signals and signing. The guide recommends methods for accommodating pedestrians, which vary among roadway and facility types, and addresses the effects of land use planning and site design on pedestrian mobility.

- *Guide for the Development of Bicycle Facilities 2012, Fourth Edition* (AASHTO Bike Guide) provides detailed planning and design guidelines on how to accommodate bicycle travel and operation in most riding environments. It covers the planning, design, operation, maintenance, and safety of on-road facilities, shared use paths, and parking facilities. Flexibility is provided through ranges in design values to encourage facilities that are sensitive to local context and incorporate the needs of bicyclists, pedestrians, and motorists.

NACTO Guide

NACTO first released the *Urban Bikeway Design Guide* (NACTO Guide) in 2010 to address more recently developed bicycle design treatments and techniques. It provides options that can help create "complete streets" that better accommodate bicyclists. While not directly referenced in the AASHTO Bike Guide, many of the treatments in the NACTO Guide are compatible with the AASHTO Bike Guide and demonstrate new and innovative solutions for the varied urban settings across the country.

The vast majority of treatments illustrated in the NACTO Guide are either allowed or not precluded by the Manual on Uniform Traffic Control Devices (MUTCD). In addition, non-compliant traffic control devices may be piloted through the MUTCD experimentation process. That process is described in Section 1A.10 of the MUTCD and a table on the FHWA's bicycle and pedestrian design guidance Web page is regularly updated (FHWA Bicycle and Pedestrian Design Guidance), and explains what bicycle facilities, signs, and markings are allowed in accordance with the MUTCD. Other elements of the NACTO Guide's new and revised provisions will be considered in the rulemaking cycle for the next edition of the MUTCD.

ITE Guide

In 2010, FHWA supported production of the ITE Guide *Designing Walkable Urban Thoroughfares: A Context Sensitive Approach*. This guide is useful in gaining an understanding of the flexibility that is inherent in the AASHTO "Green Book," *A Policy on Geometric Design of Highways and Streets*. The chapters emphasize thoroughfares in "walkable communities" - compact, pedestrian-scaled villages, neighborhoods, town centers, urban centers, urban cores and other areas where walking, bicycling and transit are encouraged. It describes the relationship, compatibility and trade-offs that may be appropriate when balancing the needs of all users, adjoining land uses, environment and community interests when making decisions in the project development process.

Summary

FHWA encourages agencies to appropriately use these guides and other resources to help fulfill the aims of the *2010 US DOT Policy Statement on Bicycle and Pedestrian Accommodation Regulations and Recommendations* - "...DOT encourages transportation agencies to go beyond the minimum requirements, and proactively provide convenient, safe, and context-sensitive facilities that foster increased use by bicyclists and pedestrians of all ages and abilities, and utilize universal design characteristics when appropriate."

Accompanying this memo are the latest versions of the: 1) AASHTO Bike Guide, 2) NACTO Bike Guide; and 3) the ITE *Designing Walkable Urban Thoroughfares* Guide.

The attachments provide two examples that demonstrate the use of treatments illustrated in the NACTO Guide (i.e., buffered bike lanes and green colored pavement for bicycle lanes) by State or local DOTs, and a list of FHWA staff that can help with questions about pedestrian and bicycle design issues.

Attachments

Source: http://www.fhwa.dot.gov/environment/bicycle_pedestrian/guidance/design_flexibility.cfm

New Design Guidelines

- FHWA, *Separated Bike Lanes Planning and Design Guide*, 2016
  http://www.fhwa.dot.gov/environment/bicycle_pedestrian/publications/separated_bikelane_pdg/
- FHWA, Achieving Multimodal Networks: Applying Flexibility and Reducing Conflicts, 2016
  https://www.fhwa.dot.gov/environment/bicycle_pedestrian/publications/multimodal_networks/
- FHWA, Small Towns and Rural Multimodal Networks, 2017
  https://www.fhwa.dot.gov/environment/bicycle_pedestrian/publications/small_towns/

BikeSafe

Bicycle Safety Guide

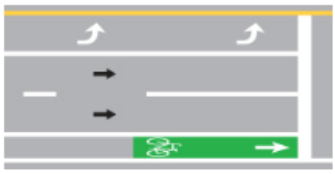
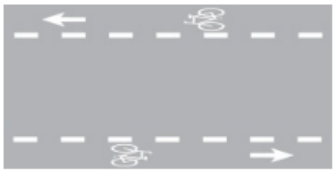
- Background—Understand what is needed to create a viable bicycle network
- Statistics—Learn about the factors related to the bicycle crash problem
- Analysis—How crash typing can lead to the most appropriate countermeasures
- Implementation—Needed components for treatments

Countermeasure Selection System

- Selection Tool—Find countermeasures based on desired objectives
- Selection Matrices—Find countermeasures based on crash types and performance objectives
- Countermeasure List—A comprehensive list of all countermeasures

Note that BikeSafe is currently undergoing an update, and new information will be included.
Source: http://www.pedbikesafe.org/bikesafe/

Traffic Control Devices

Subject to Experimentation	Available through Interim Approval	Interpretations
 Two-Stage Turn Box	 Green-Colored Pavement	 Use of R4-11 Sign on Roads with Speed Limits Above 35mph
 Dashed Bicycle Lanes	 Alternate Design for the U.S. Bicycle Route (M1-9) Sign	 Modified Bicycle Destination Sign
 Destination Guide Signs for Shared-Use Paths	 Bicycle Signal Faces	 Installation of Advance Turn and Directional Assemblies for Bike Route Signs
 Green-Colored Pavement for Use with the Shared-Lane Marking	 Bicycle Box	 Pavement Markings for Designated Bicycle Routes

Source: http://www.fhwa.dot.gov/environment/bicycle_pedestrian/guidance/mutcd/index.cfm

Additional Resources	
Allowable through the 2009 MUTCD	• Continuation of Bicycle Lanes up to Intersections • Extensions of Bicycle Lanes through Intersections • Counter-flow Bicycle Lanes • Buffer-Separated Bicycle Lanes • Bicycle Lanes on the Left-Hand Side of One-Way Streets • Two-stage turn box Jughandle movement at a T-intersection • Shared-Lane Markings • Shared-lane markings in exclusive turn lanes • Rotated bicycle symbols in bicycle lanes or separated bikeways at intersections and driveways oriented towards turning or entering motorists
Disallowed	• Combined bicycle lane/turn lane where the lane attempts to establish a bike lane • Green channelizing devices, delineators, posts, or retroreflective elements thereof • Alterations of the shared lane marking symbol, including its chevrons
Other treatments that are not traffic control devices, so no MUTCD restriction on their use	• Separated bikeways • Convex mirrors at conflict points to improve visibility • Bicycle networks • Median or refuge island for bikeway crossings
Additional Information	