
2017 ITS-WISCONSIN FORUM
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Presenter

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LOCATIONS

- Washington, DC
- Baltimore, MD
- Berkeley, CA
- Boston, MA
- Denver, CO
- Madison, WI
- Minneapolis, MN
- Orlando, FL
- Portland, OR
- Seattle, WA
- Spartanburg, SC

ENGINEERS • PLANNERS • LANDSCAPE ARCHITECTS

Making walking and biking possible for every trip
About Toole Design Group

Engineers
Planners
Landscape Architects
Researchers
Leaders

“we deliver results”
1974 AASHTO Bike Guide

Protected Bike Lanes & Intersections

Davis, California 1967
Protected bike lanes removed in 2nd edition of the Bike Guide

(1.5m). Bicycle lanes should always be placed between the parking lane and the motor vehicle lanes. Bicycle lanes between the curb and the parking lane create hazards for bicyclists from opening car doors and poor visibility at intersections and driveways, and they prohibit bicyclists from making left turns; therefore this placement should never be considered.
HELP ME!
The 1980’s Wide Outside Lanes
“Bicycle lanes tend to complicate both bicycle and motor vehicle turning movements at intersections.”
The 1990’s to 2000’s
AASHTO Bike Guide History

Published in 2012
 Written in 2009/2010
 Content directed by NCHRP panel
  - conform to 2009 MUTCD which had content written in 2007

2012 Edition expanded the guide to 7 chapters and over 200 pages, compared to the 1999 version which had 3 chapters and only 75 pages
AASHTO Bike Guide History

As the 2012 Guide was developed, new types of bicycle facilities were being installed in the United States.

- Institute of Transportation Engineers (ITE) *Separated Bikeways* (2013)
- FHWA memorandum *Bicycle and Pedestrian Facility Design Flexibility* (2013)
Separated Bike Lane Explosion

Number of U.S protected bike lanes:

The number of protected bike lanes has nearly QUADRUPLED in the U.S. since 2010

210 Predicted count by the end of 2014

200
160
120
80
40
0


PeopleForBikes launches Green Lane Project

Urban Bikeway Design Guide Released

NYC starts building modern protected lanes

Chart Source: People for Bikes
AASHTO Bike Guide Schedule

• Interim Report: Fall 2016
• 1st Draft: March 2017
• 2nd Draft: Summer 2017
• 3rd Draft: Early Fall 2017
• Final Draft and Balloting: Winter/Spring 2018
  AASHTO Subcommittee Approvals needed from: design, traffic, bicycle

Final Comments and Publication: End of 2018
1. Introduction
2. Bicycle Operation & Safety
3. Planning
4. Facility Selection
5. Elements of Design
6. Shared Use Paths
7. Separated Bike Lanes
8. Bicycle Boulevards
9. Bike Lanes & Shared Lanes
10. Traffic Signals and Active Warning Devices
11. Roundabouts, Interchanges, and Other Intersections
12. Rural Area Bikeways
13. Structures
14. Wayfinding
15. Maintenance & Operations
16. Parking & End of Trip Facilities
User Characteristics

- Until age 14, children tend to have slower response and execution times (Plumert et al., 2004; Kali, 1991)
- Children also tend to sacrifice cognitive functions to preserve motor functions, e.g., maintaining balance on bicycle (Wierda & Brookhuis, 1991)
- Older adults show slower processing time and task performance (Salithouse, 2009; Verhaeghen & Cerella, 2002)
  - Particularly true in the face of multiple stimuli (Verhaeghen & Cerella, 2002)
Chapter 2 - Bicycle Operation & Safety

4 - 7%  Experienced and confident
5 - 9%  Somewhat confident
51 - 56% Interested but Concerned

lower stress tolerance  higher stress tolerance

Default Design User for Guide

4 - 7%

Experienced & Confident Cyclist
AASHTO 2012

51 - 56%

Interested but Concerned Cyclist
AASHTO 2018
Chapter 3- Bicycle Planning
Chapter 4- Facility Selection

Separated Bike Lane Research

- Reduced injury risk compared to riding in a travel lane ([Lusk et al., 2013; Lusk et al., 2011; NYCDOT, 2014; Winters et al., 2013])

- Clearly preferred over striped or mixed travel lanes by both cyclists and motorists ([Monsere et al., 2014; Monsere et al., 2012; Sanders, 2014])

- One-way generally safer than two-way ([Schepers et al., 2011; Thomas & DeRobertis, 2013])

- Two-way SBLs typically better on one-way roads, on the right side, and with additional design/op features like separated signal phases ([Schepers et al., 2011; Zangenehpoor et al., 2015])

More in Chapter 7
Chapter 5- Elements of Design

“How to” chapter for critical design elements

- Chapter 5: Elements of Design
  - 5.1 Introduction
  - 5.2 Design Speed
    - 5.2.2 Facility Context Examples
    - 5.2.3 Acceleration and Deceleration
    - 5.2.4 Roadway and Street Operating Speeds
  - 5.3 Sight Distance
    - 5.3.1 Criteria for Measuring Sight Distance
    - 5.3.2 Stopping Sight Distance
    - 5.3.3 Decision Sight Distance
    - 5.3.4 Intersection Sight Distance
  - 5.4 Geometric Design Elements
    - 5.4.2 Operating Width and Clearances
    - 5.4.3 Surface Considerations
    - 5.4.4 Horizontal Alignment
    - 5.4.5 Cross Slope
    - 5.4.6 Grade
      - 5.4.7 Vertical Alignment/Vertical Curves
Table 5-4. Minimum Stopping Sight Distance

U.S. Customary

\[ S = \frac{V^2}{30(f + G)} + 3.67V \]

where:

- \( S \) = stopping sight distance (ft)
- \( V \) = velocity (mph)
- \( f \) = coefficient of friction (use 0.16 for a typical bike)
- \( G \) = grade (ft/ft) (rise/run)

Stopping Sight Distance vs. Grade

- Velocity (mph): 12, 14, 16, 18, 20, 25, 30
- Grade (Ascend): 0.05, 0.1, 0.15, 0.2
Sight Triangles

Figure 5-15. Yield Sight Triangles
Horizontal Sight Distance

Table 5-6. Horizontal Sight Distance

<table>
<thead>
<tr>
<th>U.S. Customary</th>
</tr>
</thead>
<tbody>
<tr>
<td>$HSO = R \left[1 - \cos \left( \frac{28.665}{R} \right) \right]$</td>
</tr>
<tr>
<td>$HSO = \frac{R}{28.665} \left[1 - \cos \left( \frac{R - HSO}{R} \right) \right]$</td>
</tr>
</tbody>
</table>

where:

- $S$ = stopping sight distance (ft)
- $R$ = radius of centerline of lane (ft)
- $HSO$ = horizontal sightline offset, distance from centerline of lane to obstruction (ft)

Note: Angle is expressed in degrees; line of sight is 2.3 ft above centerline of inside lane at point of obstruction.

Figure 5-9. Diagram Illustrating Components for Determining Horizontal Sight Distance
Chapter 6 - Shared Use Path Design

Largely the same content except:

- Low Volume Pedestrians
  - May be shared
- High Volume Pedestrians
  - separate

- 6.2 General Design Considerations
  - 6.2.1 Width and Clearance Considerations
  - 6.2.2 Horizontal and Vertical Alignment
  - 6.2.3 Restricting Motor Vehicles
  - 6.2.4 Use of Traffic Calming on Intersection Appr...
  - 6.2.5 Curb Ramps and Aprons
  - 6.2.6 Path Widening at Intersections
  - 6.2.7 Drainage
  - 6.2.8 Lighting
  - 6.2.9 Typical Pavement Markings
  - 6.2.10 Typical Traffic Control Signs
- 6.3 Shared Use Path-Roadway Intersection Design
  - 6.3.1 Design Principles
  - 6.3.2 Road Crossing Types
  - 6.3.3 Mid-Block Crossing Design Considerations
  - 6.3.4 Marked Crosswalks
  - 6.3.5 Crossing Islands
  - 6.3.6 Traffic Signal Considerations
  - 6.3.7 Examples of Mid-Block Crossings
Figure 5-1. Typical Cross Section of Two-Way, Shared Use Path on Independent Right-of-Way

Notes:

1. Maximum slope (typ.)
2. More if necessary to meet anticipated volumes and mix of users, per the Shared Use Path Level of Service Calculator (9)
Intersection Treatments

Path Yields

Figure 5-17. Example of Mid-Block Path-Roadway Intersection—Path Is Yield Controlled for Bicyclists
MassDOT 2.0

Improved:
• ADA Guidance
• Transit Stop Design
• Sight Distance Assessment
• Constrained Tradeoff Assessment
• Transition Guidance
Separated Bike Lane Zones
Intersection Treatments

EXHIBIT 4N: ELEMENTS OF PROTECTED INTERSECTIONS

1. Corner Refuge Island
2. Forward Bicycle Queueing Area
3. Motorist Yield Zone
4. Pedestrian Crossing Island
5. Pedestrian Crossing of Separated Bike Lane
6. Pedestrian Curb Ramp
Chapter 8- Bicycle Boulevards
MUTCD Community Wayfinding
Traffic Calming 101
Mini-Traffic Circle
Raised Intersection
Chapter 9- Shared Lanes and Bike Lanes

Figure 4-5. Typical Shared-Lane Marking Cross Section on Street with Parking

Figure 4-6. Typical Shared-Lane Marking Cross Section on Street with No On-Street Parking
Typical Bicycle Lane Cross Sections

Optional Normal Solid White Line

On Street Parking

Parking Prohibited

Notes:

4 An optional normal 4 ft (1219 mm) solid white line may be helpful even when no parking stalls are marked (because parking is light), to make the presence of a bicycle lane more evident. Parking stall markings may also be used.

5 Bike lanes up to 7 ft (2133 mm) in width may be considered adequate to narrow parking lanes with high turnover.

On extremely constrained, low-speed roadways (45 mph [72 km/h] or less), with curbs but no gutter, where the preferred bike lane width cannot be achieved despite narrowing all other travel lanes to their minimum width, a 4-ft (1.2-m) wide bike lane can be used.
Buffered Bike Lanes
Chapter 10- Traffic Signals

Figure 10.14. Examples of Signal Indication Strategies for Bicyclists

Image showing examples of traffic signals for bicyclists, including a countdown timer, a green bicycle signal, and signs indicating to use the pedestrian signal.
Rectangular Rapid Flashing Beacons
More Traffic Signals

Figure 10.19. Examples of Bicycle Signal Placement with Pedestrian Signals

- The bicycle signal head shall be placed in a location clearly visible to approaching bicycles.
- A supplemental "Bicycle Signal" sign plaque should be added below the bicycle signal head to increase comprehension.
- For improved visibility, rear-wheel bicycle signals may be used to supplement far-side signals.

Graphic of bike signals.
Loop Detection

Figure 10.21. Examples of Inductive Loop Detection

Figure 4-31. Diagonal Quadrupole Loop Detector

Figure 4-32. Conventional Quadrupole Loop Detector
Confirmation of Detection

Figure 10.22. Example of Detector Confirmation Indication
Roundabouts, Interchanges & Alt. Intersections

- Provide Separated Facility
- Uncontrolled motorist crossings < 25mph or
  - Unless lots of gaps
  - Add active warning
  - Add control
- Separate peds/bikes
Chapter 12- Rural Roadways
Recommended Paved Shoulder Widths

for Urban and Suburban Roadways
see Chapter ##
Chapter 13 - Structures
Chapter 14- Wayfinding

Expanded guidance for sign design and placement

Added flexibility for sign design
Chapter 15 - Maintenance & Operations
Chapter 16 - Bike Parking