Multimodal Design Guidance

October 23, 2018
ITE Fall Meeting
Introductions

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By 2040, TN population expected to add over 2.1 million people. Over 70% of growth will occur in existing urban counties.
Changing Needs

Photo by George Walker IV, Tennessean
TN Senior Population Will Double by 2040

13.43% of Population 65 or Older

22.51% of Population 65 or Older
All too common...
Father of Memphis pastor killed in pedestrian crash

Pedestrian Hit, Killed In Clarksville Wreck

Pedestrian hit on Magnolia Ave dies from injuries sustained Friday

Pedestrian killed along Lebanon Pike in Hermitage
Safe Transportation for Every Pedestrian

Tennessee Non-Motorist Fatalities and Serious Injuries (5-Year Averages): 4 Year Linear Trend

- Non-Motorists Killed and Injured
- 4-Yr Linear Regression

\[ y = 24.24x + 366.6 \]
\[ R^2 = 0.9785 \]

Non-Motorists Killed and Injured: 391.8, 417.0, 432.6, 467.4, 487.8, 512.0, 536.3
Why does TDOT need Multimodal Design Guidelines?
What is covered?

• Multimodal Roadway Design Process
• TDOT Accessibility Guidance
• Pedestrian Facilities
• Bicycle Facilities
• Shared-Use Paths
• Transit Facilities
• Vehicle Facilities Supporting Multimodal Accommodations
• Additional Considerations
TDOT Multimodal Policy Implementation

- Commissioner Schroer signs TDOT Multimodal Policy
- Statewide MPO, RPO, Municipal and Transit Agency outreach
- Conducted internal Steering Committee Meetings throughout project
- Two primary documents:
  - Multimodal Project Scoping Manual
  - New Section in TDOT's Roadway Design Guidelines
- Multimodal Design Deviation Request Form
- Training

- July 31, 2015
- July '16
  - May '17
  - Dec. '17
  - March '18
- Finalized
  - April 2018
- June 2018
Multimodal Project Scoping Manual

- 160 Pages of national best practices
- Over 40 source documents
- Guidance from US Access Board, FHWA, AASHTO, NACTO, NCHRP, ITE, US EPA, internal TDOT sources, and other state and city DOTs
- Target audience is those involved in project initiation and scoping
- Available on TDOT’s Roadway Design Additional Resources website
TDOT’s Roadway Design Guideline Multimodal Guidance (New Section 9)

- 70 pages compared to the *Multimodal Project Scoping Manual’s* 160 pages
- Target audience is roadway designers
- Consolidates the national guidance in the *Multimodal Project Scoping Manual* and makes it “TDOT’s”
Balancing MM Safety, Level and Quality of Service

- Safety & Service for Each Mode
- Bicyclists
- Pedestrians
- Motor Vehicles
Design Flexibility

• The Green Book emphasizes the need for a holistic design approach and the use of engineering judgment
• Design speeds $\leq 45$ mph have considerable design flexibility
Land Use Context

SUBURBAN LOW TRAFFIC, LOW-SPEED, MODE-SHARED RESIDENTIAL STREET
Land Use Context

RURAL HIGHWAY WITH PAVED SHOULDER
Land Use Context

RURAL ROAD WITH SEPARATED SHARED-USE PATH
Land Use Context

LOW-DENSITY SUBURBAN STREET
Land Use Context

URBAN MAIN STREET
Safety

• For non-motorized users note the high rate of injury & fatal crashes:

http://maps.knoxmpc.org/MapSeries/bikepedcrash.html

Legend:
Green = Non Injury
Light Blue = Injury
Dark Blue = Fatality
Safety

• For non-motorized users note the high rate of injury & fatal crashes:

Compiled by Walk Bike Nashville
Safety

- On high-speed roadways, the HSM notes:
  - 9-foot wide travel lanes have up to a 50% increase in crashes compared to 12-foot lanes
  - 10-foot wide lanes have up to a 30% increase in crashes.
Safety

However:

• There is no statistical difference in motor vehicle safety performance for urban and suburban arterials with lane widths ranging from 10 to 12 feet and speeds $\leq 45$ mph.

• **AND** for non-motorized users....
### Lane Widths

<table>
<thead>
<tr>
<th>Context / Roadway</th>
<th>Rural</th>
<th>Rural (Town)</th>
<th>Suburban</th>
<th>Urban</th>
<th>Urban (Core)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Principal Arterial</td>
<td>11 to 12</td>
<td>11 to 12</td>
<td>11 to 12</td>
<td>10 to 12</td>
<td>10 to 12</td>
</tr>
<tr>
<td>Minor Arterial</td>
<td>11 to 12</td>
<td>10 to 12</td>
<td>10 to 12</td>
<td>10 to 12</td>
<td>10 to 12</td>
</tr>
<tr>
<td>Collector</td>
<td>11 to 12</td>
<td>10 to 12</td>
<td>10 to 12</td>
<td>10 to 12</td>
<td>10 to 12</td>
</tr>
<tr>
<td>Local</td>
<td>9 to 12</td>
<td>9 to 12</td>
<td>9 to 12</td>
<td>10 to 12</td>
<td>9 to 12</td>
</tr>
</tbody>
</table>

- Minimum 11-foot lanes are required for design speeds of 45 mph or greater. The values assume rural areas have design speeds of 45 mph or greater, except on local streets.
- Curbside lanes with fixed-route transit service should be 11 feet wide (min.).
Median refuge islands are a proven safety countermeasure and have demonstrated a 46% reduction in pedestrian crashes.
Resurfacing Projects

- Curb ramps shall be installed/retrofitted where they are missing or are not compliant with ADA/PROWAG guidance, to the maximum extent feasible.
- Additionally, TDOT promotes that when the existing shoulders are adequate, resurfacing projects provide a good opportunity to incorporate pavement markings for bicycle lanes.
Sidewalks - Throughway Zone
## Throughway Zone - Widths

<table>
<thead>
<tr>
<th>Roadway Classification / Context</th>
<th>Sidewalk / Walkway</th>
<th>Width</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rural Roadways (&lt; 2,000 ADT)</td>
<td>Sidewalks on both sides</td>
<td>SW (5 ft)</td>
</tr>
<tr>
<td></td>
<td>Shared-Use Path</td>
<td>SUP (10 ft)</td>
</tr>
<tr>
<td>Rural Roadways (&gt; 2,000 ADT)</td>
<td>Sidewalks on both sides</td>
<td>SW (5 ft)</td>
</tr>
<tr>
<td></td>
<td>Shared-Use Path</td>
<td>SUP (10 ft)</td>
</tr>
<tr>
<td>Suburban Roadways</td>
<td>Sidewalks on both sides</td>
<td>SW (5 ft)</td>
</tr>
<tr>
<td></td>
<td>Sidewalk + Shared-Use Path</td>
<td>SUP (10 ft)</td>
</tr>
<tr>
<td>Major Arterials (Residential)</td>
<td>Sidewalks on both sides</td>
<td>SW (6 ft)</td>
</tr>
<tr>
<td>Minor Arterial and Urban Collector (Residential)</td>
<td>Sidewalks on both sides</td>
<td>SW (5 ft)</td>
</tr>
<tr>
<td>All Commercial Area Urban Streets</td>
<td>Sidewalks on both sides</td>
<td>SW (6 ft)</td>
</tr>
<tr>
<td>All Industrial Area Streets</td>
<td>Sidewalks on both sides</td>
<td>SW (5 ft)</td>
</tr>
</tbody>
</table>

SW = Sidewalk, SUP = Shared-Use Path
Furnishing Zone
### Pedestrian Facility Separation Requirements (ft.)

<table>
<thead>
<tr>
<th>Posted Speed</th>
<th>Buffer (Min.)*</th>
<th>Buffer Preferred</th>
</tr>
</thead>
<tbody>
<tr>
<td>≤ 35 mph</td>
<td>0</td>
<td>5</td>
</tr>
<tr>
<td>40 mph</td>
<td>4.5</td>
<td>8</td>
</tr>
<tr>
<td>45 - 55 mph</td>
<td>12</td>
<td>16.5</td>
</tr>
<tr>
<td>≥ 60 mph</td>
<td>16.5</td>
<td>24</td>
</tr>
</tbody>
</table>

*A 5-foot buffer (min.) shall be provided between the back of curb and a shared-use path*
Furnishing Zone Benefit

<table>
<thead>
<tr>
<th>Purpose</th>
<th>Dimension</th>
</tr>
</thead>
<tbody>
<tr>
<td>To serve as a pedestrian buffer</td>
<td>3 ft.</td>
</tr>
<tr>
<td>To locate mailboxes</td>
<td>3 ft.</td>
</tr>
<tr>
<td>To benefit driveway slopes</td>
<td>4 ft.</td>
</tr>
<tr>
<td>To plant trees</td>
<td>5 ft.</td>
</tr>
<tr>
<td>To place street furniture</td>
<td>Varies</td>
</tr>
<tr>
<td>To place utilities</td>
<td>Varies</td>
</tr>
</tbody>
</table>
Sidewalk Buffer with Rural Cross Section

- The minimum pedestrian facility buffer is either 5 feet from the edge of the paved shoulder or the dimensions listed in previous table.
- Where a ditch is present, the sidewalk should be placed on the far side of the ditch.
## Midblock Crosswalks

**Recommendations for Installing Midblock Crosswalks***

<table>
<thead>
<tr>
<th>Vehicle ADT</th>
<th>Speed Limit**</th>
<th>Roadway Type (Number of Travel Lanes and Median Type)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Two lanes</td>
</tr>
<tr>
<td>≤ 9,000</td>
<td>30 mi/h</td>
<td>C</td>
</tr>
<tr>
<td></td>
<td>35 mi/h</td>
<td>C</td>
</tr>
<tr>
<td></td>
<td>40 mi/h</td>
<td>P</td>
</tr>
<tr>
<td>&gt;9,000 to 12,000</td>
<td>30 mi/h</td>
<td>C</td>
</tr>
<tr>
<td></td>
<td>35 mi/h</td>
<td>C</td>
</tr>
<tr>
<td></td>
<td>40 mi/h</td>
<td>P</td>
</tr>
<tr>
<td>&gt;12,000 to 15,000</td>
<td>30 mi/h</td>
<td>C</td>
</tr>
<tr>
<td></td>
<td>35 mi/h</td>
<td>C</td>
</tr>
<tr>
<td></td>
<td>40 mi/h</td>
<td>N</td>
</tr>
<tr>
<td>&gt; 15,000</td>
<td>30 mi/h</td>
<td>C</td>
</tr>
<tr>
<td></td>
<td>35 mi/h</td>
<td>P</td>
</tr>
<tr>
<td></td>
<td>40 mi/h</td>
<td>N</td>
</tr>
</tbody>
</table>

C: Candidate Location  
P: Possible Location  
N: Not Recommended without other features
Bicycle Facilities

Types of bicycle facilities:
- On-street shared-use lanes
- Bicycles on shoulders
- Striped on-street bicycle lanes
- Buffered on-street bicycle lanes
- Separated bicycle lanes
- Shared-use paths / sidepaths
Striped On-Street Bicycle Lanes

Optional Normal Solid White Line

Normal Solid White Line

Width Varies

5–7 ft\(^6\)

7 ft (2.1 m) minimum
(8 ft (2.4 m) desirable)

Bike Lane

Travel Lanes

5–7 ft\(^6\)

1.5–2.1 m

Bike Lane

Width Varies

On Street Parking

Normal Solid White Line

5 ft\(^2\)

1.5 m

Bike Lane

Travel Lanes

4 ft min.

1.2 m

Bike Lane

Parking Prohibited

Notes:

A An optional normal (4–6-in./100–150-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.

B Bike lanes up to 7 ft (2.1 m) in width may be considered adjacent to narrow parking lanes with high turnover.

C On extremely constrained, low-speed roadways (45 mph [70 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 widths, a 4-ft (1.2-m) wide bike lane can be used.
### Minimum Bicycle Facility Guidance for Rural (Shoulder and Ditch) Cross Sections

<table>
<thead>
<tr>
<th>ADT</th>
<th>&lt; 2,000</th>
<th>2,000 - 10,000</th>
<th>&gt; 10,000</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Posted Speed Limit</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>≤ 35 mph</td>
<td>SL or WOL</td>
<td>SL or WOL</td>
<td>WOL</td>
</tr>
<tr>
<td>40 - 45 mph</td>
<td>PS (4 ft)</td>
<td>PS (4-6 ft)</td>
<td>PS (6-8 ft)</td>
</tr>
<tr>
<td>&gt; 45 mph</td>
<td>PS (4-6 ft)</td>
<td>PS (6-8 ft)</td>
<td>PS (10 ft)</td>
</tr>
</tbody>
</table>

SL = Shared Lane, PS = Paved Shoulder, WOL = Wide Outside Lane/Sharrow
# Bicycle Facility Guidance (Urban X-Sect.)

## Minimum Bicycle Facility Guidance for Urban (Curb and Gutter) Cross Sections

<table>
<thead>
<tr>
<th>ADT</th>
<th>&lt; 2,000</th>
<th>2,000 - 10,000</th>
<th>&gt; 10,000</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Posted Speed Limit</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>≤ 35 mph</td>
<td>SL or WOL</td>
<td>SL or WOL</td>
<td>WOL or BL (5 ft)</td>
</tr>
<tr>
<td>40 - 45 mph</td>
<td>BL (5 ft)</td>
<td>BL (5 ft) or BBL (4 ft*)</td>
<td>BL (5 ft) or BBL (4 ft*) or SBL (4 ft*)</td>
</tr>
<tr>
<td>50 - 55 mph</td>
<td>BBL (4 ft*) or SBL (5 ft*)</td>
<td>BBL (4 ft*) or SBL (5 ft*)</td>
<td>BBL (4 ft*) or SBL (5 ft*)</td>
</tr>
<tr>
<td>&gt; 55 mph</td>
<td>SUP</td>
<td>SUP</td>
<td>SUP</td>
</tr>
</tbody>
</table>

SL = Shared Lane  
PS = Paved Shoulder  
BL = Conventional Bike Lane  
BBL = Buffered Bike Lane  
SBL = Separated Bike Lane  
WOL = Wide Outside Lane  
SUP = Shared-Use Path

* Add buffer a minimum of 3 feet in width; buffered bike lanes are preferred when on-street parking is present regardless of the speed.
Bicycle Lanes at Intersections

Right-Turn-Only Lane

Parking Area Becomes Right-Turn-Only Lane

Right Lane Becomes Right-Turn-Only Lane
Striped On-Street Bicycle Lanes

• Why all these requirements?
• Because no one wants this:
Shared-Use Paths

Design Criteria:

• Shared-use paths must meet all applicable ADA/PROWAG requirements to the maximum extent feasible or to the extent it is not structurally impracticable
• 5% max grade (unless adjacent roadway is steeper)
• 18 mph min. Design Speed
• Min. horizontal curve radius is 60 feet
• **Min. width is 10 feet**
• Min. width can be reduced to 8 feet when severe constraints are present
Multimodal Design Deviation Request Form

- TDOT understands the need for flexibility in design
- Simple 3-page form to document why need to deviate from TDOT standards
- Request more likely to be approved if meet design standards from AASHTO, NACTO, NCHRP, ITE, other DOT
Training

• June 2018- Training held in all TDOT regions (Jackson, Nashville, Chattanooga, Knoxville & Kingsport)
• 255 Attendees from 47 different agencies/firms- Mix of TDOT staff, consultants, local government employees
Next Steps

• Continue to update Guidelines as needed- intended to be a living document
• Continue to offer training
• Lead by example:
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