Pennsylvania’s Approach to Context Sensitive Solutions and Flexible Design

December 6, 2018
THE ROAD TO RISK MANAGEMENT
UNDERSTANDING THE CONCEPT

DESIGN MANUAL 2 REWRITE
UNDERSTANDING THE CONCEPT
What Does an Arterial Look Like?

One Size Fits All

Photo courtesy of STUDIO | BRYAN HANES
Understanding the Concept

- The Concept - Context Based Multimodal Approach
- Requires **understanding of the function of the roadway** within its current and expected future context and the needs of the potential roadway users.
PennDOT’s Context Based Design Goal

Safety, Access, and Mobility

Livability and Context-preserving scenic, aesthetic, historic, and environmentally sensitive areas

Enhance the Quality of Life for Pennsylvania Communities
• Discussed:
  - A collaborative project development process
  - Community Involvement
  - Flexibility in Design
  - Project Implementation & Network Maintenance and Operation
  - Safety and Risk Management

• Guide Book and Statewide Training in 2008
PRINCIPLES OF SMART TRANSPORTATION

1. Tailor solutions to the context.
2. Tailor the approach.
3. Plan all projects in collaboration with the community.
4. Plan for alternative transportation modes.
5. Use sound professional judgment.
6. Scale the solution to the size of the problem.
Selecting Context and Design Values

- Table for each classification
  - Regional Arterial
  - Community Arterial
  - Community Collector
  - Neighborhood Collector
  - Local Road/Street
DESIGN MANUAL 2 REWRITE
STEPS TO IMPLEMENTATION
Know What is Needed for an Effective Transportation Network

- Enable safe, convenient and comfortable travel for all residents
- Improve network connectivity for all modes and address gaps
- Focus on providing access to key destinations
- Align project designs with the goals articulated in state, regional, and local plans
Retool Geometric Design Manual

Engineering Judgement
Context Sensitive Solutions
Context Based Design
Smart Transportation
Complete Streets
Risk Management

Context classification considering all modes
Project type classification
Flexible design approach
Performance-based approach
Where do we start?

• Working with University of Kentucky
• Pennsylvania is a pilot state
Context Change

From 7 to 5 Contexts
Functional Classification

- Limited Access Freeway
- Regional Arterial
- Community Arterial
- Community Collector
- Neighborhood Collector
- Local Road/Street

- Limited Access Expressway
- Arterial
- Collector
- Local Road/Street
<table>
<thead>
<tr>
<th>Context</th>
<th>Rural</th>
<th>Rural Town</th>
<th>Suburban</th>
<th>Urban</th>
<th>Urban Core</th>
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<tbody>
<tr>
<td>Roadway</td>
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<tr>
<td>Principal Arterial</td>
<td>DRIVER</td>
<td>BICYCLIST</td>
<td>PEDESTRIAN</td>
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<tr>
<td>Minor Arterial</td>
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<tr>
<td>Collector</td>
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<tr>
<td>Local</td>
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</tr>
</tbody>
</table>

Legend:
- Low
- Medium
- High
DESIGN MANUAL 2 REWRITE
UNDERSTANDING DESIGN FLEXIBILITY
• Flexibility creates an environment for designers to use engineering judgement rather then picking numbers.

• Flexibility creates the need to Document the Decision Making Process
  - Documenting and communicating assumptions and decisions reduces misunderstandings and wasted work
    ▪ Provide a clear understanding of the project
    ▪ Understand who is responsible for the final decision
Typical Sections

- No dimensions
- Cross slope determined by drainage needs
- Mode accommodation as needed
## Matrix of Design Values – Collector

<table>
<thead>
<tr>
<th>Collector</th>
<th>Rural</th>
<th>Rural Town</th>
<th>Suburban</th>
<th>Urban</th>
<th>Urban Core</th>
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<tbody>
<tr>
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<td>Preferred: 12' Minimum: 10'</td>
<td>Preferred: 11' Minimum: 9'</td>
<td>Preferred: 12' Minimum: 10'</td>
<td>Preferred: 11' Minimum: 9'</td>
<td>Preferred: 11' Minimum: 9'</td>
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<tr>
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<td>*(if No Parking or Bike Lane)</td>
<td>*(if No Parking or Bike Lane)</td>
<td>*(if No Parking or Bike Lane)</td>
<td>*(if No Parking or Bike Lane)</td>
<td>*(if No Parking or Bike Lane)</td>
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<tr>
<td>Parking Lane</td>
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<td>Parallel: Preferred: 8' Minimum: 7'</td>
<td>N/A to 8' Parallel: Preferred: 8' Minimum: 7'</td>
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<td>See DM-2, Exhibit 14 X</td>
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<td>Travel Lanes</td>
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<td>2 to 4</td>
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<td>Cross Slopes (minimum)</td>
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<td>2.0%</td>
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<tr>
<td>Cross Slopes (maximum)</td>
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<td>8.0%</td>
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<td>Vertical Grades (minimum)</td>
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<td>6.0%</td>
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<td>Vertical Clearance (minimum)</td>
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<td>14'-6'</td>
<td>14'-6'</td>
<td>14'-6'</td>
<td>14'-6'</td>
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<td>Shy Distance</td>
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<td>Preferred: 0' Minimum: 0'</td>
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<td>Clear Zone Widths (minimum)</td>
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<td>2011 AASHTO Green Book, Table 6-2</td>
<td>2011 AASHTO Green Book, Table 6-2</td>
<td>2011 AASHTO Green Book, Table 6-2</td>
<td>2011 AASHTO Green Book, Table 6-2</td>
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<tr>
<td>Stopping Sight Distance (minimum)</td>
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<td>2011 AASHTO Green Book, Table 6-2</td>
<td>2011 AASHTO Green Book, Table 6-2</td>
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<tr>
<td>Passing Sight Distance (minimum)</td>
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<td>DM-2, Exhibit X-3</td>
<td>DM-2, Exhibit X-3</td>
<td>DM-2, Exhibit X-3</td>
<td>DM-2, Exhibit X-3</td>
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<tr>
<td>Vertical Grades (maximum)</td>
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<td>2011 AASHTO Green Book, Table 6-2</td>
<td>2011 AASHTO Green Book, Table 6-2</td>
<td>2011 AASHTO Green Book, Table 6-2</td>
<td>2011 AASHTO Green Book, Table 6-2</td>
</tr>
</tbody>
</table>

**Questions:**
- If all the values are the same, do they need to be in the table?
- Move to Pedestrian Chapter?
Overlays* for:
- Bicycle
- Pedestrian
- Transit
- Freight
- Plain People Community Considerations

Each chapter contains:
- Important Context Questions
- Key Design Components

* Overlays may not exactly replicate design parameter tables
Design Manual 2 Rewrite
Chapter 14 – Bicycle Facilities
Where to Begin?

Important Context Questions

- Is this bicycle facility in an urban or rural setting?
- Is this bicycle facility identified in a local, state or regional transportation plan (indicating importance to local bicyclists)?
- What types of bicyclists will likely use the facility (e.g., commuters, young or inexperienced cyclists, bicycle touring, recreational cyclists, disabled cyclists, others)?
- Will this facility be used by others (e.g., pedestrians, equestrians, skaters, dog walkers, etc…)?

Key Design Components

- Work to Minimize Conflict Points
- Be Cognizant of Barriers
- Work Toward Continuity
Bicycle as a Design Vehicle

**Bicycle Type** | **Feature** | **Typical Dimensions**
--- | --- | ---
**Upright Adult Bicyclist** | Physical width | 2 ft 6 in
Operating width (Minimum) | 4 ft
Operating width (Preferred) | 5 ft
Physical length | 5 ft 10 in
Physical height of handlebars | 3 ft 8 in
Operating height | 8 ft 4 in
Eye height | 5 ft
Vertical clearance to obstructions (tunnel height, lighting, etc) | 10 ft
Approximate center of gravity | 2 ft 9 in - 3 ft 4 in

**Recumbent Bicyclist** | Physical length | 8 ft
Eye height | 3 ft 10 in

**Tandem Bicyclist** | Physical length | 8 ft

**Bicyclist with child trailer** | Physical length | 10 ft
Physical width | 2 ft 6 in
Facility Classification

Shared Roadway

Visually Separated Bikeway

Physically Separated Bikeway

Shared-Use Path
Facilities for Various Roadway Environments

Arterial/Highway Bikeway Continuum (without curb and gutter)

- Least Protected
  - Shared Lane
  - Marked Wide Curb Lane
  - Shoulder Bikeway
  - Wide Shoulder Bikeway
  - Protected Bicycle Lane: protected with barrier
  - Shared Use Path

Arterial/Highway Bikeway Continuum (with curb and gutter)

- Marked Wide Curb Lane
- Conventional Bicycle Lane
- Buffered Bicycle Lane
- Protected Bicycle Lane: at-grade, protected with parking
- Protected Bicycle Lane: protected with barrier
- Protected Bicycle Lane: curb separated

Collector Bikeway Continuum

- Shared Lane
- Marked Wide Curb Lane
- Conventional Bicycle Lane
- Wide Bicycle Lane
- Buffered Bicycle Lane
**General Bike Route Signing**

- **D1-1b**
  - → Campus

- **D1-3c**
  - ↑ Library 3
  - → Beach 15
  - → Kingston 10

---

**Numerically Labeled Bike Route Signing**

- **M1-8**
  - 13
  - 44
  - 6

---

**BicyclePA Route**

- J1
  - 23
# Contextual Guidance

## Bicycle Facility Contextual Guidance

<table>
<thead>
<tr>
<th>Facility Type</th>
<th>Street Class</th>
<th>Average Annual Daily Traffic (1,000 veh/day or 100 veh/peak hr)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Bicycle Boulevard</strong></td>
<td>Local</td>
<td><img src="traffic_data.png" alt="Traffic Data" /></td>
</tr>
<tr>
<td><strong>Bike Route</strong></td>
<td>Local</td>
<td><img src="traffic_data.png" alt="Traffic Data" /></td>
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<tr>
<td><strong>Bike Lane</strong></td>
<td>Collector Arterial</td>
<td><img src="traffic_data.png" alt="Traffic Data" /></td>
</tr>
<tr>
<td><strong>Buffered Bike Lane</strong></td>
<td>Collector Arterial</td>
<td><img src="traffic_data.png" alt="Traffic Data" /></td>
</tr>
<tr>
<td><strong>Protected Bike Lane</strong></td>
<td>Collector Arterial</td>
<td><img src="traffic_data.png" alt="Traffic Data" /></td>
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<tr>
<td><strong>Pathway</strong></td>
<td>Collector Arterial</td>
<td><img src="traffic_data.png" alt="Traffic Data" /></td>
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### Legend

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<th>Separation</th>
<th>Minimal Separation</th>
<th>Moderate Separation</th>
<th>Good Separation</th>
<th>High Separation</th>
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<tr>
<td></td>
<td>min</td>
<td>Volume</td>
<td>max</td>
<td>Acceptable</td>
</tr>
<tr>
<td></td>
<td>min</td>
<td>Speed</td>
<td>max</td>
<td>Desired</td>
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</table>

### Rural Town, Suburban, Urban, and Urban Core Bicycle Considerations
<table>
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<tr>
<th>SPEED (miles per hour)</th>
<th>15</th>
<th>20</th>
<th>25</th>
<th>30</th>
<th>35</th>
<th>40</th>
<th>45</th>
<th>50</th>
<th>55</th>
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<td>VOLUME 1k (vehicles per day)</td>
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</table>

Shoulder Width Considerations for Rural, Rural Town, and Suburban Bicycle Accommodation
Design Guidance

- Shared Roads
- Bicycle Boulevards
- Shoulder Bikeways / Bike Lanes
- Visually Separated (Conventional) Bike Lanes
- Physically Separated Bike Lanes
- Vertical Traffic Calming
- Horizontal Traffic Calming
- Traffic Diversion
- Minor Intersection Treatments
- Major Intersection Treatments
- Single Lane Roundabouts
- Railroad Grade Crossing
- Marked / Unsignalized Crossings
- Shared-Use Paths
- Bicycle Parking
- Local Neighborhood Access ways

Marked Shared Roadway

A marked shared roadway is a general-purpose travel lane marked with shared lane markings (SLMs) used to encourage bicycle travel and proper positioning within the lane. In constrained conditions, the SLMs are placed in the middle of the lane. On a wide outside lane, the SLMs can be used to promote bicycle travel to the right of the lane. In all conditions, SLMs should be placed outside of the door zone of parked cars.

If the roadway is a collector or arterial, this should not be a substitute for dedicated bicycle facilities if space is available.

Bike Lanes should be considered on roadways with outside travel lanes wider than 15 feet, or where other lane narrowing or removal strategies may provide adequate road space. SLMs shall not be used on shoulders, in designated bike lanes, or to designate bicycle detection at signalized intersections. (MUTCD 9C.07)

Guidance

- May be used on streets with a speed limit of 35 mph or under. Lower than 30 mph speed limit preferred.
- In constrained conditions, preferred placement is in the center of the travel lane to minimize wear and promote single file travel.
- Minimum placement of SLM marking centerline is 11 feet from edge of curb where on-street parking is present, 4 feet from edge of curb with no parking. If parking lane is wider than 7.5 feet, the SLM should be moved further out accordingly.
• Manage Traffic Speeds
• Pay Attention to Crossings and Intersections
• Separate Pedestrians from the Roadway
• Ensure Walkway Continuity
• Remember Younger People, the Aging, and Persons with Disabilities
• Take Precautions for Backing Vehicles
Pedestrian as a Design Vehicle

Age Characteristics

<table>
<thead>
<tr>
<th>Age</th>
<th>Characteristics</th>
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<tbody>
<tr>
<td>0 - 4</td>
<td>Learning to walk</td>
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<tr>
<td></td>
<td>Requires constant adult supervision</td>
</tr>
<tr>
<td></td>
<td>Developing peripheral vision and depth perception</td>
</tr>
<tr>
<td>5 - 8</td>
<td>Increasing independence, but still requires supervision</td>
</tr>
<tr>
<td></td>
<td>Poor depth perception</td>
</tr>
<tr>
<td>9 - 13</td>
<td>Susceptible to “darting out” in roadways</td>
</tr>
<tr>
<td></td>
<td>Insufficient judgment</td>
</tr>
<tr>
<td></td>
<td>Sense of invulnerability</td>
</tr>
<tr>
<td>14 - 18</td>
<td>Improved awareness of traffic environment</td>
</tr>
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<td></td>
<td>Insufficient judgment</td>
</tr>
<tr>
<td>19 - 40</td>
<td>Active, aware of traffic environment</td>
</tr>
<tr>
<td>41 - 65</td>
<td>Slowing of reflexes</td>
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<tr>
<td>65+</td>
<td>Difficulty crossing street</td>
</tr>
<tr>
<td></td>
<td>Vision loss</td>
</tr>
<tr>
<td></td>
<td>Difficulty hearing vehicles approaching from behind</td>
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</tbody>
</table>

Selecting the Appropriate Facility

- Pedestrian Lane/Path
- Shared Roadway
- Shared Use Path
- Sidewalk
Pedestrian Attributes

- Pedestrian Travel Speed
- Flow Rate
- Spatial Characteristics

<table>
<thead>
<tr>
<th>Public Event</th>
<th>6 ft (1.8 m)</th>
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<tbody>
<tr>
<td>Shopping</td>
<td>9 ft – 12 ft (2.7 m – 3.6 m)</td>
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<tr>
<td>Normal Walk</td>
<td>15 ft – 18 ft (4.5 m – 5.4 m)</td>
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<tr>
<td>Pleasure Walk</td>
<td>35 ft or more (10 m or more)</td>
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</tbody>
</table>
Pedestrian Facility Design

- Parking Lane/Enhancement Zone
- Furnishing Zone
- Pedestrian Through Zone
- Frontage Zone

Work in Progress
Check back soon!
ADA

Ramp cross slope
Ramp running slope
Level landing

Detectable warning surface
Counter slope
Gutter
Curb

Work in Progress
Check back soon!
Design Manual 2 Rewrite
Chapter 17 – “Plain People” Community Considerations
Key Context Questions

- Are the Plain People Community considerations along an urban or rural corridor?
- What types of Plain People Community transportation modes will likely use the facility (e.g., pedestrians, scooter, roller skate/roller blade, horseback, horse & buggy, farm equipment)?
- Is the corridor along a primary walking path to the Plain People Community school?
- Are there destination points for the Plain People Community along the corridor (e.g. markets, work places, etc...)?
Intersection Sight Distance

Clear Sight Triangle Looking Left

Clear Sight Triangle Looking Right

Location of Driver’s Eye (Use 15 feet from edge of nearest through lane)
Horse-Drawn Vehicle Turnout

Constant Cross Slope

Through Lane

9 to 12 feet

200 to 500 feet

HORSE-DRAWN VEHICLE TURNOUT
XX MILE

D16-102

HORSE-DRAWN VEHICLE TURNOUT

D16-103
Horse-Drawn Vehicle Warning Detection System
<table>
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<tr>
<th>Chapter</th>
<th>Title</th>
<th>Design Guidance</th>
<th>Project Type Specifics</th>
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<td>Design Controls</td>
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<td>New Construction and Reconstruction Projects</td>
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<td>Maintenance and Protection of Traffic</td>
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bshunk@pa.gov