Pedestrian & Bicyclist Accommodation Design for Work Zones
Learning Objectives

Upon completion of this class, participants will be able to:

• Better understand the current issues and the necessity of ped/bike accommodations in work zones, including ADA.
• Learn about existing design rules and guides on ped/bike accommodations in work zones.
• Identify the needs of ped/bike accommodations for specific types of projects.
• Gain information on techniques, tools and materials available for ped/bike accommodation design.
• Learn about procedures and guidelines to develop appropriate work zone ped/bike accommodation designs.
Can we do better?
The best solutions are likely to be found during the project design phase.

- Ped/Bike Staging Integrated into Overall Project Staging
- Appropriate Bid Items In Contract
- Temporary Easements Obtained
- No Surprises for Adjoining Property Owners
- No Surprises for the Contractor
TYPICAL PROBLEMS
No Alternate Route
Unmarked Closure

San Francisco, CA

Bethesda, MD
http://roberdyer.blogspot.com/2013/07/woodmont-avenue-sidewalk-work-creates.html
Insufficient Width


http://pedestrianliberation.files.wordpress.com/2012/03/img_2282.jpg
Delineation & Drop-off

Bethesda, MD

http://robertdyer.blogspot.com/2013/07/woodmont-avenue-sidewalk-work-creates.html
Trench
Tripping Hazards

Non-Detectable Barriers

http://robertdyer.blogspot.com/2013/07/sidewalk-closures-at-wisconsin-avenue.html
SAFETY PROBLEM OR MOBILITY PROBLEM?
Fatal Crashes in Work Zones

- About 120 non-motorized road users are killed annually in US work zones.
- 93% are pedestrians.
- Trend not improving.
- 2003: 12% of WZ crashes.
- 2012: 17% of WZ crashes.

Source: NHTSA
Analysis of Wisconsin 2004-13 Bike-Ped Crashes
n=219
Ped/Bike Crash Example 1
Improper Accommodation

- Disorganized work zone; traffic control devices not laid out well
- Pedestrian walked across two closed lanes
- Pedestrian saw her bus arriving and ran to catch it
- Pedestrian’s view partially blocked by vehicle in left-turn bay
- Pedestrian struck by fast-moving vehicle in center lane
Ped/Bike Crash Example 2

Vehicle-Worker Collision

UNIT 2 WAS WORKING CONSTRUCTION ON ATKINSON DR. AT I-43. UNIT 1 EXIT I-43 AT ATKINSON DR. AND SET UP TO MAKE A LEFT HAND TURN ONTO ATKINSON DR. UNIT 1 NEVER SAW UNIT 2 IN THE ROADWAY. UNIT 1 STRUCK UNIT 2 IN THE MIDDLE OF THE INTERSECTION.
Ped/Bike Crash Example 3

Obstructed Sight Lines

- Vehicle #1 and Bicyclist #2 could not see each other due to construction equipment and barricade blocking sight lines
- Bicyclist attempted to go around skid loader and was struck by Vehicle #1
NATIONAL GUIDANCE
MUTCD: Main Provisions

- Must provide alternate routes when pedestrian routes are closed.
- Must provide “adequate” walkways to access properties adjoining the work.
- Pedestrians must be given notification upstream of sidewalk closures.
- Accessibility and detectability for pedestrians with disabilities must be maintained during construction if the existing facility is accessible or detectable.
- If project affects existing public transit stops, access for pedestrians and transit vehicles must be maintained or relocated.
- People involved in project must be knowledgeable about MUTCD principles and implement them using good engineering judgment.
- Very little discussion of bicycle accommodations.
MUTCD Pedestrian Typical Applications

Typical Application 28

Typical Application 29

Note: See Tables 6H-2 and 6H-3 for the meaning of the symbols and/or letter codes used in this figure.
Many common situations not addressed by MUTCD Typical Applications
Public Right-of-Way Access Guide (PROWAG)

• “Outdoor” edition of ADA Design Guide
• Draft issued 2011
• Not yet finalized
• Includes:
  • Crosswalks
  • Curb ramps
  • Street furnishings
  • Signs
  • Pedestrian signals
  • Parking
  • Other public right-of-way elements
Public Right-of-Way Access Guide (PROWAG)

- Says it applies to both permanent and temporary situations
- Little clarity on standards for temporary situations
- Discusses the need for flexibility in cases of “facility alteration.”
- Compliance required to the extent practicable within the scope of the project where existing physical constraints make alterations impractical.
COMMON PROBLEMS
POSSIBLE SOLUTIONS
Temporary Accommodation Principles

• **Accessibility:** Site access for pedestrians and bicyclists (including those with disabilities) with minimal inconvenience and indirection. Also, access for emergency services.

• **Continuity:** A route free of physical interruptions both spatially and temporally.

• **Economic Feasibility:** Accomplishing the construction at reasonable cost to the citizens of your jurisdiction, bearing in mind the hidden costs of inaccessibility and (ped/bike) crashes.

• **Separation:** Physical methods to reduce conflicts between ped/bike traffic, high-speed motorized traffic, and hazardous portions of the work zone.

These often conflict!
Pedestrians Not Separated from Work Area

Problem

Possible Solution

- European guidelines strongly emphasize the need for fencing to delineate and separate the work area from the pedestrian pathway.
Trenches 1

Problem

Possible Solution

- Tape is not detectable for visually impaired.
- Tape should only be used as a delineator in emergencies.
- Portable fence panels readily available from rental yards.
Trenches 2

Problem

Possible Solution
Pedestrians Led Into Closed Area

Problem

Possible Solution
Non-Detectable Sidewalk Closure

Problem

Possible Solution
Pedestrians Led Into Closed Area

Problem

Possible Solution
Open Manholes 2

Problem

Possible Solution
Street Plates

Problem

Possible Solution
Loss of Access to Properties: 1

Problem

Possible Solution
Loss of Access to Properties: 2

Problem

Possible Solution
Loss of Access to Properties: 3

Problem

Possible Solution
Transit Passengers Boarding in Closed Areas

**Problem**

**Possible Solution**
Ped Visibility & Glare During Night Work

Problem

Possible Solution
HOW CAN WE IMPROVE?
Some solutions come in boxes.
Some solutions can be fabricated on site.
Materials Storage

- Is it purely a field engineering issue?
- Could a materials storage area be identified on the PS&E?
Benches

- Pedestrian detours require additional physical effort.
- If the detour is long or the grade is steep, peds may need a resting place.
Covered Walkways

Issues
• Strength Specifications
• Lighting
• Maintenance, Graffiti, Vandalism
Fencing & Channelization

- Type and durability of fencing should be proportionate to hazard severity and duration
Discussion

Where is this type of fencing appropriate? Not appropriate?
MORE ABOUT PROWAG AND DIMENSIONS
# PROWAG Dimensions & Slopes: Pedestrian Access Routes

<table>
<thead>
<tr>
<th>Pedestrian Access Routes</th>
<th>Criteria</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Width</td>
<td>Min 4.0' (1.2m)</td>
<td>Median/island: Min 5.0' (1.5m)</td>
</tr>
<tr>
<td>Grade</td>
<td>Matching street grade</td>
<td>Where feasible, max 5%</td>
</tr>
<tr>
<td>Cross slope</td>
<td>Max 2%</td>
<td></td>
</tr>
<tr>
<td>Surface</td>
<td>Firm, stable, slip resistant</td>
<td></td>
</tr>
<tr>
<td>Vertical discontinuities</td>
<td>Max 0.5'' (13mm)</td>
<td>Beveled with a slope less 50% (0.25' (6.4mm) - 0.5' (13mm))</td>
</tr>
<tr>
<td>Horizontal Openings</td>
<td>Max 0.5'' (13mm)</td>
<td></td>
</tr>
<tr>
<td>Flangeway Gaps</td>
<td>Max 2.5'' (64mm)</td>
<td>Non-freight rail track</td>
</tr>
<tr>
<td>Passing Spaces</td>
<td>Min (5.0' by 5.0' (1.5m))</td>
<td>Necessary where the clear width is less than 5.0' (1.5m)</td>
</tr>
</tbody>
</table>
Ramps

Permanent

- 8.3% (1:12) max slope
- 10% (1:10) slope if rising 6” or less
- 12.5% (1:8) slope if rising 3” or less

Temporary (our unofficial advice)

- Allow 10% slope for rise up to 9” if necessary to maintain property access.
- Use skid-resistant surfacing if slope exceeds 8.3%.
Small Vertical Transitions (Thresholds)
Mainly applicable to wood construction

- $\frac{1}{4}$ max
- 9.5mm
- $\frac{3}{8}$
- 9.5mm
- $\frac{1}{4}$
- 6.4
- $\frac{1}{2}$
- 13
- $\frac{3}{4}$
- 18mm
- 3½” to 7¼”
- 89 to 184 mm
Temporary Curb Ramps
Temporary Curb Ramp Fabricated from Standard Lumber

- 45° Reverse Bevel
- ¾” Oriented Strand Board (Rough Side Up)
- 4” Strap Hinge
- 5½ x ¾” x 3/8” Lap Siding (also called Bevel Siding)
- Drainage Notch
Minnesota DOT Curb Ramp Designs
What about asphalt?
Detectability – Truncated Domes

• Alerts visually impaired pedestrians to presence of cross-traffic or edge of a platform.
• Color should contrast with adjacent pavement.
• Surfacing options
  • Rubber/vinyl tiles
  • Ceramic tiles
  • Concrete paving blocks
  • Cast iron plates
  • Stainless steel plates
• If temporary, durability of materials should match expected service life.
Inlets

- PROWAG says the slots should not exceed ½ inch wide.
- What can you do if the existing covers have wider slots?
- What happens in the autumn?
Sign Supports

Large numbers: millimeters  Small numbers: inches

- PROWAG guidance on sign supports is very prescriptive
- Potential conflicts with MUTCD
- Uncertainty about crashworthiness
Other Slopes and Dimensions Covered in PROWAG

- Curb ramps (parallel and perpendicular)
- Blended transitions
- Transit stops
- Landings

PROWAG Recommended Permanent Bus Stop Dimensions

BUS 2112
Coordination with Bus Operators

- Establish early coordination for relocation of bus stops
- Consider effects on permanent transit facilities
Small Group Exercise

Your project involves re-decking an existing bridge which is 56 feet wide. It carries a four-lane undivided state highway through the central business district of a small town, which is a tourist destination with heavy pedestrian and motor vehicle volumes that persist throughout the construction season. Normally there are 12 foot travel lanes (two in each direction) and a 4 foot sidewalk on each side. The sidewalks are 6” higher than the traffic lanes.

Because of the town’s picturesque terrain, there is only one alternate route which is extremely congested. Therefore, it has been decided that the bridge will be redecked in halves, split down the middle (staged construction). It is necessary to maintain at least one traffic lane in each direction, and a pedestrian walkway on at least one side of the bridge. The usable work space needs to extend at least to the centerline. Because of previous near-misses in the town, your boss also wants a barrier to separate pedestrians from the traffic lanes.

How would you allocate the available width?
TEMPORARY SURFACING
Is this an acceptable temporary surface?
Possible Surfacing Options

- Asphalt
- Controlled Low Strength Material (CLSM)
- Stabilized Soil
- Well-Compacted Gravel
- Proprietary Matting Systems
- Plywood
- Oriented Strand Board (OSB)
- Timber

- Service life of surfacing should be proportionate to duration of the temporary condition
Controlled Low Strength Material (CLSM)

- Very lean concrete
- Target strength 150 psi (if stronger, removal requires hammering)
- Self-leveling
- 1 to 8 hour cure time
Stabilized Soil

- Soil + Portland cement or flyash
- Soil + polymer
- Tilled and recompacted
Compacted Gravel

- Rounded vs angular particles
- Open-graded vs dense-graded (breaker run)
- Limestone vs other types
- Degree of compaction
Proprietary Matting Systems

- Plastic mats
- Manufacturer-specific surface textures
- Manufacturer-specific connection details
Proprietary Cover Systems
Plywood

- Face smoothness grading System (A-D)
- Adhesive categories
  - INTERIOR: cannot withstand water.
  - EXPOSURE 2: can withstand brief exposure to rain
  - EXPOSURE 1: can withstand intermittent rain exposure (CDX)
  - EXTERIOR: can withstand repeated wetting and drying
- Sheet sizes: 4x8, 4x9, 4x10
- Treated Plywood: C-D plywood with preservatives; longer service life but 50% higher cost than CDX
- Marine Plywood: A-B face, no preservatives, 3 times the price of CDX
T1-11 Plywood

- Rough face → Higher friction
- Shallow groves every 4” or 8”
Oriented Strand Board (OSB)

- Laminated from wood shreds
- Several layers “oriented” at right angles to each other
- Has smooth and rough sides
- No knots or weak spots
- Water resistance depends on adhesive – most are EXPOSURE 1
- Edge painting reduces swelling
Timber
STAGING
Older Downtowns: Temporary Pedestrianization of Alleys
Phasing & Coordination

<General Info>
1. Pedestrian to be accommodated on one side at all times
2. Stage 1 based on using a combination of existing sidewalk and temporary asphalitic sidewalk
3. Stage 2 based on completion of the permanent sidewalk
4. Safety fence shall be placed between the sidewalk and work zone to prevent pedestrians entering the work zone
5. Temporary pedestrian accommodations are approximate and may be adjusted in the field
## When is a ped/bike staging plan appropriate?

<table>
<thead>
<tr>
<th>Existing Ped/bike Facilities</th>
<th>Type of Work</th>
<th>Diagram</th>
<th>Pedestrian Staging Plan Required?</th>
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</thead>
<tbody>
<tr>
<td>None</td>
<td>Within Travelled Way</td>
<td><img src="image1.png" alt="Diagram" /></td>
<td>No</td>
</tr>
<tr>
<td>One Side</td>
<td>In travelled way on opposite side from ped/bike facility</td>
<td><img src="image2.png" alt="Diagram" /></td>
<td>No</td>
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<tr>
<td></td>
<td>In travelled way on same side as ped/bike facility</td>
<td><img src="image3.png" alt="Diagram" /></td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>In travelled way on both sides</td>
<td><img src="image4.png" alt="Diagram" /></td>
<td>Yes</td>
</tr>
<tr>
<td>Both Sides</td>
<td>Within Travelled Way Only</td>
<td><img src="image5.png" alt="Diagram" /></td>
<td>No</td>
</tr>
<tr>
<td></td>
<td>Motor vehicle lanes and ped/bike facility on one side</td>
<td><img src="image6.png" alt="Diagram" /></td>
<td>Usually</td>
</tr>
<tr>
<td></td>
<td>Motor vehicle lanes and ped/bike facilities on both sides.</td>
<td><img src="image7.png" alt="Diagram" /></td>
<td>Yes</td>
</tr>
</tbody>
</table>
Seven Options for Integrating Ped-Bike Construction into Overall Project Staging

Inside-Out
- Build roadway first, then sidewalks
- Difficult to maintain access to properties

Outside-In
- Build sidewalks first, then roadway

Inside-Out with Lane Closures (roadway widening projects)
- Peds remain on old sidewalk while roadway is built
- Peds temporarily moved to a closed lane while sidewalks built
- Lane opened to traffic when sidewalks completed
Seven Options for Integrating Ped-Bike Construction into Overall Project Staging

2

Outside-In with Traffic or Parking Lane Closures

• Peds temporarily relocated to closed traffic lane while sidewalks are built
• After new sidewalks are in place, roadway is built

Temporary Pedestrian Pathways

• Pedestrians relocated to a new temporary walkway
• New roadway and permanent sidewalks constructed
• Temporary walkway removed

Complete Pedestrian Detour

Accelerated Construction with Full Closures
Discussion

• What ped/bike design issues are you currently experiencing?
• What solutions are you considering?