Crossing Solutions at Roundabouts for Pedestrians with Vision Disabilities – Recent Examples

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ITE Jackson Hole, WY  May 2016
Presentation Outline

1. National Roundabout Experience

2. NCHRP-674 November 2011 – Bastian Schroeder, ITRE and NCHRP-3-78A 2011– Ron Hughes, NCSU

3. FHWA SA-15-069 September 2015 – Bastian Schroeder, ITRE

4. Some Recent Roundabout Examples
Goals

- Encourage More 2-lane Roundabouts
- Improve Safety for All Pedestrians
- Comply with PROWAG
- Low Cost Treatments

[Images of road intersections with roundabouts]
Hoback Junction Roundabout Hoback, WY
Memorandum

Subject: ACTION: Consideration and Implementation of Proven Safety Countermeasures

Date: July 10, 2008

From: Jeffrey A. Lindsey
Associate Administrator for Safety

To: Division Administrators
Federal Lands Highway Division Engineers

GUIDANCE STATEMENT:

Roundabouts are the preferred safety alternative for a wide range of intersections. Although they may not be appropriate in all circumstances, THEY SHOULD BE CONSIDERED AS AN ALTERNATIVE FOR ALL PROPOSED NEW INTERSECTIONS ON FEDERALLY-FUNDED HIGHWAY PROJECTS, particularly those with major road volumes less than 90 percent of the total entering volume. Roundabouts should also be considered for all existing intersections that have been identified as needing major safety or operational improvements. This would include freeway interchange ramp terminals and rural intersections.

MOVING THE AMERICAN ECONOMY
Roundabouts are Safer

NCHRP Report 572 – Roundabouts in the USA

Before/After Studies at 55 intersections

- 35% overall decrease in crashes
- 76% decrease in injury crashes
- 81% decrease in fatal/incapacitating crashes for single lane urban roundabouts
- 71% decrease in fatal/incapacitating crashes for single lane rural roundabouts
Key Roundabout Features – FHWA website

- Circular shape, yield control on entry, and geometric features create a low-speed environment
Comparison of Vehicle Conflict Points

32 conflict points
- High-speed
- High-angle
- High-energy

8 conflict points
- Low-speed
- Low-angle
- Low-energy

75% fewer conflicts

Michael Wallwork
Pedestrian Conflicts (Red)

Pedestrians Have Only 8 Potential Vehicle Conflicts:

1. Conflict with Entering Vehicles
2. Conflict with Exiting Vehicles

But, Speeds are Dramatically Lower
Roundabout Accessibility Challenges

- The crossing task for blind pedestrians

- Challenges
  - Uninterrupted flow
  - Potential for high speeds
  - Ambient Noise at crosswalk
  - Curving geometry
  - Low driver yield compliance

- Treatments Available
“The question of the accessibility of multilane modern roundabouts has been the topic of significant U.S. research in recent years.


The NPRM allows for other treatments that result in substantially equivalent or greater accessibility and usability under section R102: Equivalent Facilitation.”
“Variations of the standard pedestrian signal exist that can limit pedestrian-induced impacts on vehicular delay, including the Pedestrian Hybrid Beacon (PHB or HAWK), as documented in the 2009 MUTCD) and the NCHRP Report 674 at a multilane roundabout.

The PHB is explicitly mentioned as a treatment alternative in the NPRM.

However, other recently developed pedestrian crossing treatments and devices (RRFB) have the potential to achieve similar performance as a PHB, but at less cost and potentially lower impact to overall roundabout operations.”
Tasks of NCHRP 3-78A

- Identify treatments that can be applied to roundabouts and CTLs.
- Identify how each treatment contributes to improved access for blind pedestrians.
- Implement and evaluate.
- Make recommendations to users.
Some Treatments in Report 674 and 3-78A 2011

Offset or Z-Crossing (Proximal + Distal)

Proximal Xing & Distal Xing

Sound Strips used in advance of raised Xing
Some Treatments in Report 674 and 3-78A 2011

Distal Crossing with HAWK

Z-Crossing with HAWK

Proximal Crossing with HAWK

Ron Hughes, NCSU
NCHRP-674 Study

- One Lane Roundabouts
  - 3 Sites – no treatments tested

- Two-Lane Roundabouts
  - Two approaches before/after comparison
  - With: Ped Hybrid Beacons (HAWK)
  - And: Raised Crosswalks
One-Lane Roundabout Results

- One-Lane Roundabouts appear to not pose unreasonable crossing difficulties to blind pedestrians, assuming that:
  - Speeds are low (by design)
  - Drivers are courteous and yield the right-of-way
  - Detectible warnings are provided
  - Blind pedestrians are trained to cross the roundabouts.
Two-Lane Roundabout Results *Golden, CO*

Two-Lane Roundabout
Golden Rd. @ Johnson Rd.,
Golden, CO

http://www.itre.ncsu.edu  Bastian Schroeder, ITRE

ROUNDABOUTUSA
Pedestrian Hybrid Beacon (HAWK)  Golden, CO

Pedestrian Hybrid Beacon (HAWK Signal)

Figure 4F-3. Sequence for a Pedestrian Hybrid Signal

1. Dark Until Activated
2. Flashing Yellow Upon Activation
3. Steady Yellow
4. Steady Red During Pedestrian Walk Interval
5. Alternating Flashing Red During Pedestrian Clearance Interval
6. Dark Again Until Activated

Legend:
- SY Steady yellow
- FY Flashing yellow
- SR Steady red
- FR Flashing red

Bastian Schroeder, ITRE
Two-Lane Roundabout Results *Golden, CO*

- **Raised Crosswalk**
  - Average delay decreased (17 sec to 8 sec)
  - 85\(^{th}\) percentile delay decreased (30 sec to 13 sec)
  - Interventions decreased (2.8% to 0%)

- **Pedestrian Hybrid Beacon (HAWK)**
  - Average delay decreased (16 sec to 6 sec)
  - 85\(^{th}\) percentile delay decreased (30 sec to 8 sec)
  - Interventions decreased (2.4% to 0%)
  - High vehicle red-light violations (12.6%)
Two-Lane Roundabout Findings *Golden, CO*

- Two-Lane roundabouts can be challenging for blind pedestrians without treatments:
  - Speed and volumes are higher (than one-lane);
  - Multiple-threat is the biggest risk;
  - Treatments proved effective in reducing speeds, increasing yielding, and creating crossing opportunities;
  - Treatments reduced delays and interventions;
  - Raised crosswalk exhibited more multiple-threat and perceived risk than the PHB (HAWK);
• Oakland County, Michigan
• Two 2x3 lane roundabouts;
• Rectangular Rapid Flashing Beacons (RRFB);
• Pedestrian Hybrid Beacons (HAWK)
RRFB Test *Oakland County, MI*
PHB/HAWK Test Oakland County, MI
## Oakland County Before/After Results

<table>
<thead>
<tr>
<th>Pedestrian Hybrid Beacon</th>
<th>Condition</th>
<th>Two-Lane</th>
<th>Three-Lane</th>
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</thead>
<tbody>
<tr>
<td>Interventions (%)</td>
<td>Pretest</td>
<td>6.4%</td>
<td>11.4%</td>
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<tr>
<td></td>
<td>Posttest</td>
<td>0.9%</td>
<td>0.4%</td>
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<tr>
<td>Average Delay (sec.)</td>
<td>Pretest</td>
<td>17.1</td>
<td>21.2</td>
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<tr>
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<td>Posttest</td>
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<table>
<thead>
<tr>
<th>Rectangular Rapid-Flash Beacon</th>
<th>Condition</th>
<th>Two-Lane (Entry/Exit)</th>
<th>Three-Lane (Entry/Exit)</th>
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<tbody>
<tr>
<td>Estimated Interventions (%)</td>
<td>Pretest</td>
<td>7.5% / 23.8%</td>
<td>12.5% / 23.2%</td>
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<tr>
<td></td>
<td>Posttest</td>
<td>0.0% / 16.4%</td>
<td>7.6% / 18.9%</td>
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<tr>
<td>Average Delay (sec.)</td>
<td>Pretest</td>
<td>20.8 / 22.2</td>
<td>35.2 / 30.5</td>
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<tr>
<td></td>
<td>Posttest</td>
<td>17.1 / 18.8</td>
<td>19.8 / 24.8</td>
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“This report presents results from a pedestrian accessibility study evaluating the effectiveness of Rectangular Rapid Flashing Beacons (RRFB) at multilane roundabouts in the U.S. Summarizes data collection and analysis performed at 12 approaches at 7 multilane roundabouts in 5 states. The study applied an Accessibility Audit to all test locations.

Overall, the results of these studies support the idea that RRFB-equipped multilane roundabouts can be accessible.”
Griffith Street Roundabouts Davidson, NC
Griffith St. 2-Two-Lane Rbts. Davidson, NC

RRFBs at the Eastbound Exit
Griffith St. 2-Two-Lane Rbts. Davidson, NC

RRFBs at the Westbound Exit
Percent Interventions by Leg

Figure 1. Chart. Percent interventions by leg for all study locations.
### Some Key Findings  
Why the High Yielding Rate?

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<td>Fuller North</td>
<td>Exit (n=60)</td>
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<td>2.9</td>
<td>4.8</td>
<td>10.1</td>
<td>94.0</td>
</tr>
</tbody>
</table>

7-10 Davidson, NC: Small town, slower speeds  
11-16 Olympia, WA: City conducts several sting ops.
Study Recommends:

- RRFB crossings
- Two-Stage Crossings
- 22 mph design speed is optimal at exits
- Sidewalks separated by park strip to improve wayfinding.
Caltalpa Roundabout (1->2 lanes) Boise, ID
Raised Crosswalks – walkbike.org
Raised Crosswalks Reduce Speeds

Malmo, Sweden

Riverdale, UT 2003
Main Street Light-Rail Roundabout Mesa, AZ

- 2-Lane Roundabout Options
  - Distal HAWK Crossing;
  - Lane Dividers; and
  - Raised Crosswalks.
Z-Crossing and Lane Dividers  

Mesa, AZ

Jacobs
Typical Offset (Z-Crossing) with Barriers
Fastest Path – with and w/o Raised Lane Markers

32 to 35mph Fast-path per NCHRP 672
Turbo/Raised Lane Dividers

Park City, UT
CONCLUSIONS

• Single-Lane Roundabouts = OK for Blind Pedestrians.
• Two-Lane Roundabouts = OK and can use treatments:
  – PHB/HAWK;
  – RRFB; and
  – Raised Crosswalks.
• More tests of Speed Reduction Using Raised Lane Dividers.

Contact: Bill Baranowski
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bbbara@msn.com
Grade Separation *Houten, NL constructed in 1942*