PEDESTRIAN ACCOMMODATIONS AT ROUNDABOUTS
WHY THEY WORK FOR PEDESTRIANS IF DESIGNED CORRECTLY

- Slow speed entry = yield
- Slow speed exit
- Truck apron
- Lots of deflection = slow speeds throughout
- Slow speed entry = yield
- Crosswalk 1 car length back
- Splitter island
- Separated sidewalks direct peds to crosswalks
VEHICLE-PEDESTRIAN CONFLICT POINTS

Conventional Intersection
16 Conflict Points

Roundabout
8 Conflict Points
Converting an unsignalized intersection to a roundabout associated with 27% decrease in pedestrian crashes in Belgium.

In U.S., the impact of roundabouts on pedestrian safety, especially for visually-impaired pedestrians, is a subject of debate

- Difficult to conclude effectiveness at individual sites because of low “before” and “after” crash data
- Multiple approach or departure lanes is especially challenging for visually-impaired pedestrians

SIGHT DISTANCE

**Legend**
- d: Stopping sight distance related to approaching speed

**Formula:**
\[
d = (1.468)(t)(V) + 1.087 \frac{V^2}{a}
\]

where
- d = stopping sight distance, ft;
- t = perception–brake reaction time, assumed to be 2.5 s;
- V = initial speed, mph; and
- a = driver deceleration, assumed to be 11.2 ft/s².

<table>
<thead>
<tr>
<th>Speed (mph)</th>
<th>Computed Distance (ft)</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>46.4</td>
</tr>
<tr>
<td>15</td>
<td>77.0</td>
</tr>
<tr>
<td>20</td>
<td>112.4</td>
</tr>
<tr>
<td>25</td>
<td>152.7</td>
</tr>
<tr>
<td>30</td>
<td>197.8</td>
</tr>
<tr>
<td>35</td>
<td>247.8</td>
</tr>
<tr>
<td>40</td>
<td>302.7</td>
</tr>
<tr>
<td>45</td>
<td>362.5</td>
</tr>
<tr>
<td>50</td>
<td>427.2</td>
</tr>
<tr>
<td>55</td>
<td>496.7</td>
</tr>
</tbody>
</table>
Landscape consideration: **DO NOT** block sight line
- Raised splitter island
- Width - minimum of 6 ft at the crosswalk to provide shelter for persons pushing stroller or walking bicycle
- Typical & min. crosswalk setback of 20 ft recommended.
  - One vehicle length behind yield line
- May have crosswalk two or three car lengths 45 ft or 70 ft back especially on the exit
  - Queuing analysis at exit crosswalk may indicate more than one vehicle length is desirable to reduce likelihood of queuing into the circulatory roadway
  - Easier to distinguish exiting vehicles from circulating vehicles if crosswalks located further back
### Table 9-31 Key Design Dimensions to Accommodate Nonmotorized Users

<table>
<thead>
<tr>
<th>User</th>
<th>Characteristic</th>
<th>Dimension</th>
<th>Affected Roundabout Features</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bicyclist</td>
<td>Length</td>
<td>1.8 m [6.0 ft]</td>
<td>Splitter island width at crosswalk</td>
</tr>
<tr>
<td></td>
<td>Minimum operating width</td>
<td>1.2 m [4.0 ft]</td>
<td>Bike lane width on approach roadways; shared use path width</td>
</tr>
<tr>
<td>Pedestrian</td>
<td>Width</td>
<td>0.5 m [1.6 ft]</td>
<td>Sidewalk width, crosswalk width</td>
</tr>
<tr>
<td>Wheelchair user</td>
<td>Minimum width</td>
<td>0.75 m [2.5 ft]</td>
<td>Sidewalk width, crosswalk width</td>
</tr>
<tr>
<td></td>
<td>Operating width</td>
<td>0.9 m [3.0 ft]</td>
<td>Sidewalk width; crosswalk width</td>
</tr>
<tr>
<td>Person pushing stroller</td>
<td>Length</td>
<td>1.7 m [5.6 ft]</td>
<td>Splitter island width at crosswalk</td>
</tr>
<tr>
<td>Skaters</td>
<td>Typical operating width</td>
<td>1.8 m [6.0 ft]</td>
<td>Sidewalk width</td>
</tr>
</tbody>
</table>

Source: 2011 AASHTO Green Book
CROSSWALK TREATMENTS
JURY STILL OUT ON EXIT DESIGN
TIGHT VS. LARGE RADIUS 1/2

Example of Tight Radius Exit Curve
JURY STILL OUT ON EXIT DESIGN
TIGHT VS. LARGE RADIUS 2/2

Example of Large Radius Exit Curve
OFFSET CROSSWALKS
ADA
Blind pedestrians must master four principal tasks for crossing a street:

1. *Finding the crosswalk* & identifying the intended crossing location
2. *Aligning to cross*
3. *Deciding when to cross*
4. *Maintaining alignment while crossing* multiple lanes until the far side is reached
Single lane roundabouts appear not to pose crossing difficulties beyond those experienced at similar signalized intersections.

Accessibility linked to:

- Low vehicle speeds at the crosswalk
- Willingness of a majority of drivers to yield to pedestrians
- Properly installed detectable warning surfaces
- Orientation & Mobility instruction customized to roundabout crossings to explain to pedestrians the intersection geometry and the expected traffic patterns at the crossing.
THE CHALLENGE OF MULTILANE ROUNDABOUTS FOR THE BLIND
Two-lane roundabouts are challenging and not accessible without
- Provision of additional crossing treatments
- Drastic change toward an increase in likelihood of drivers voluntarily yielding to pedestrians.

Crossing difficulties attributed to generally higher speeds and traffic volumes compared to single-lane facilities

Higher driver speeds appear to be inversely related to the likelihood of drivers yielding to pedestrians

Multilane carry the added risk of multiple-threat situations
Notable improvements over pretest condition resulted from:

- Pedestrian hybrid beacon (PHB, aka HAWK signal)
- Raised crosswalk

Team surprised intervention rate for both treatments was zero

- It was anticipated the raised crosswalk would not yield as great a risk reduction as the PHB
- Additional research at other locations & other individuals is necessary to determine whether there is in fact no difference in risk between these two treatments
Roundabouts with multi-lane pedestrian street crossings, a pedestrian activated signal must be provided for each multilane segment of each crossing, including the splitter island (i.e., median island used to separate opposing directions of traffic entering and exiting a roundabout, MUTCD section 1A.13).

Transportation officials who commented on the 2002 draft guidelines expressed concern that signalization of roundabouts would interfere with the flow of traffic at roundabouts.

Pedestrian Hybrid Beacons can be used at roundabouts.

Investigating other pedestrian equivalent facilitation
Volpe Center estimated the cost to provide pedestrian activated signals at new roundabouts with multi-lane crossings to range from $90,000 to $230,000 per roundabout.

Total annual costs for requiring pedestrian activated signals at new roundabouts with multi-lane street crossings range from $2.4 million to $6.2 million.

Access Board seeks additional information on multi-lane roundabouts:
- Number newly constructed on annual basis from state and local DOTs
- Costs to provide pedestrian activated signals at new multilane roundabouts
PEDESTRIAN HYBRID BEACON AKA HAWK

HAWK signals
High-intensity Activated cross-Walk
Option:

- If installed at a roundabout and an engineering study determines that pedestrians without visual disabilities can be allowed to cross the road without actuating the PHB, the pedestrian signal may be dark (not illuminated) when the PHB faces for motorists are dark.
SIGNING
Proper signing is important (YIELD, Pedestrian Warning, & guide signs)

Crosswalk markings are very important.
PEDESTRIAN SIGNS SHOULD STAND OUT
LANDSCAPING
Avoid obstructing sight distance since the splitter islands are usually located within the critical sight triangles.

Landscaping should not obscure the form of the roundabout or signing to an approaching vehicle.

Within critical visibility areas limit height to 2 ft.
Hardscape treatments, patterned concrete or paver surface, may be used on splitter islands in lieu of landscaping.
Landscaping on approaches can enhance safety by making the intersection a focal point and reducing the perception of a high-speed through-traffic movement.

Plant material in the splitter islands (where appropriate) and on the right and left side of the approaches can help to create a funneling effect and induce drivers to slow down when approaching the roundabout.

Landscaping between the sidewalk and the roadway will help to channelize pedestrians to the crosswalk areas and discourage crossings to the central island.
Wherever possible, sidewalks should be set back from the edge of the circulatory roadway with a landscape strip.

Landscape strips provide many benefits including:
- Increased comfort for pedestrians
- Room for street furniture and snow storage
- Buffer to allow for the overhang of large vehicles as they navigate the roundabout.

Two important benefits are:
- Setback discourages pedestrians from crossing to the central island or cutting across the circulatory roadway of the roundabout.
- Setback helps guide pedestrians with vision impairments to the designated crosswalks.
SIDEWALK BUFFER

- Landscape strip: 5 ft (1.5 m) or greater desired width, 2 ft (0.6 m) minimum width
- Wide sidewalk: 10 ft (3 m)
- ADA compliant ramps

- Enlarged landscape area and additional setback for pedestrians
- Alternative sidewalk alignment: 10 ft (3 m) width
- ADA compliant ramps

Overland Park, Kansas
SIDEWALK BUFFER

- Fencing – good application
- Bollards – bad application
INFORMATIONAL REPORT ON LIGHTING DESIGN FOR MIDBLOCK CROSSWALKS

- FHWA-HRT-08-053
  - April 2008
Fig 11. Traditional midblock crosswalk lighting layout

Fig 12. New design for midblock crosswalk lighting layout

Recommended lighting level: 20 lux at 5’ above pavement
LIGHTING RECOMMENDATIONS
IES DESIGN GUIDE

- Lighting placed around the perimeter of the roundabout
- Locate lighting on the approach side of the crosswalks.
Pedestrians illuminated
Signs illuminated

Study Source: Hasson and Lutkevich
## PRO AND CONS

### PERIMETER ILLUMINATION

<table>
<thead>
<tr>
<th>Illumination Type</th>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
</table>
| Perimeter illumination | - Illumination can be strongest around critical bicycle and pedestrian areas.  
- Continuity of poles and luminaires is maintained for the illumination of the lanes, as well as good visual guidance on the circulatory roadway.  
- Approach signs typically appear in positive contrast and thus are clearly visible.  
- Maintenance of luminaires is easier due to curbside location. | - Illumination is weakest in central island, which may limit visibility of roundabout from a distance.  
- More poles are required to achieve the same illumination level.  
- Poles may need to be located in critical conflict areas to achieve illumination levels and uniformity. |
## Pros and Cons

### Central Illumination

<table>
<thead>
<tr>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Perception of the roundabout is assisted at a distance by illuminating the central island.</td>
<td>Cannot achieve adequate vertical lighting levels without additional approach lighting.</td>
</tr>
<tr>
<td>Fewer poles are required to achieve the same illumination.</td>
<td>Illumination is weakest in critical pedestrian and bicycle areas.</td>
</tr>
<tr>
<td>Pole in central island is clear of critical conflict areas for all but the smallest of roundabouts.</td>
<td>Signs on the approach are in negative contrast (back lit).</td>
</tr>
<tr>
<td>Exit guide signs on the periphery appear in positive contrast (front lit) and thus are clearly visible.</td>
<td>A path is needed to the base of the central pole for maintenance.</td>
</tr>
<tr>
<td></td>
<td>There is a greater risk of glare.</td>
</tr>
<tr>
<td></td>
<td>The central pole affects central island landscaping plan.</td>
</tr>
<tr>
<td></td>
<td>High mast lighting may be inappropriate in urban areas, especially residential areas.</td>
</tr>
</tbody>
</table>
CENTRAL ILLUMINATION

- Pedestrians visible only as silhouettes
- Signs not visible

Study Source: Hasson and Lutkevich
**PEDESTRIAN ACCOMMODATIONS AT ROUNDABOUTS - COST**

<table>
<thead>
<tr>
<th>Infrastructure</th>
<th>Description</th>
<th>Median</th>
<th>Average</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Cost Unit</th>
<th>No. of Observations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Roundabout / Traffic Circle</td>
<td>Roundabout / Traffic Circle</td>
<td>$27,190</td>
<td>$85,370</td>
<td>$5,000</td>
<td>$523,080</td>
<td>Each</td>
<td>11 (14)</td>
</tr>
</tbody>
</table>

*Source: Costs for Pedestrian and Bicyclist Infrastructure Improvements: A Resource for Researchers, Engineers, Planners, and the General Public, Oct 2013*
CASE STUDIES
CASE STUDY: ROUNDABOUTS (GREAT NECK PLAZA, NY)

Problem/Background

- Small, dense, suburban community on Long Island
- High pedestrian activity & older population
  - Busy central business district
  - High-use train station
- Excessive vehicle speeds
Solution

- City received traffic calming grant from state DOT
  - Goal: calm traffic, enhance visibility of pedestrians, & improve crosswalk safety
- 4-way STOP replaced by roundabout
  - Contrasting pavement color, curb extensions, fencing, and islands used to direct traffic
- Other locations: illuminated pedestrian crossings and speed awareness devices installed
- Cost: $365,000 for the roundabout, $275,000 for the other improvements
CASE STUDY: ROUNDABOUTS (GREAT NECK PLAZA, NY)

Results

- Pedestrian collisions reduced near the roundabout after installation
- Users indicate a safer pedestrian environment
- Vehicle flow improved
- Effect of pedestrian crossing signs & speed warning devices not as good
- Officials and residents consider project a success

Speed awareness device installed at same time as roundabout
QUESTIONS?
RESOURCES