Roundabout Quick Hits

» Large Vehicles
» Pedestrian Facilities
» Noteworthy Practices
» Guidance and Tools
» Emerging Topics
» Resources
» Q&A
Large Vehicles

Image Sources: Iselbrands
Truck Tour from TRB International Conference in Green Bay (2017)

Truck Field Review Take-aways

• Left (supplementary) yield sign can block truck drivers view
• Drivers will defer to a straddle if they don’t think they have enough room
• If truck is stopped on entry usually takes about 15s to get moving if truck is loaded
• Once the truck starts turning, driver can not see a car next to them with mirrors – only can see if the truck is straight.
• Most truck driver will NOT drive side by side at a roundabout even if it is large enough to do so. They will take turns – “less risk”
Gate in the Center Island for OSOW

Image Sources: Google Earth (left), Isebrands (right)

Truck Industry Education

Photo source: Hillary Isebrands

WisDOT

FHWA
roundabout rodeos

roundabout rodeos

Roundabout Rodeos

https://www.youtube.com/watch?v=dIizzuZMKyc
Snow Plow Rodeo and Ride Along
Pedestrian Facilities

Pedestrian Performance Metrics

- Conflicts
- Accessibility
- Speed
- Yielding Rates
- Sight Distance
- Delay
- Connectivity
Multiple Threat

» 1st car stops to let pedestrian cross, blocking sight lines
» 2nd car doesn’t stop, hits pedestrian at high speed

» Advance stop or yield line
» 1st car stops further back, opening up sight lines
» 2nd car can be seen by pedestrian

Rectangular Rapid Flash Beacons

Rectangular Rapid Flash Beacons at Crosswalks

1. 1st car stops to let pedestrian cross, blocking sight lines
2. 2nd car doesn’t stop, hits pedestrian at high speed
3. Advance stop or yield line
4. 1st car stops further back, opening up sight lines
5. 2nd car can be seen by pedestrian

UPDATE
Raised Crosswalk Concept at a Roundabout

Pedestrian Accessibility

Image Source: Isebrands
Adaptations of Roundabouts

Raised Crosswalk

Pedestrian Hybrid Beacon

<table>
<thead>
<tr>
<th>Golden Road/Johnson Rd - Golden, CO</th>
<th>BEFORE</th>
<th>AFTER</th>
<th>AFTER</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 lane roundabout</td>
<td>Crosswalk signing and marking only</td>
<td>Pedestrian Hybrid Beacon</td>
<td>Raised Crosswalk</td>
</tr>
<tr>
<td>O&amp;M intervention rate</td>
<td>2.4% to 2.8%</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Average ped delay/approach</td>
<td>16 to 17 s</td>
<td>5.8s</td>
<td>8s</td>
</tr>
</tbody>
</table>

Publications of Accessibility Research at Roundabouts

» NCHRP 674 - Crossing Solutions at Roundabouts and Channelized Turn Lanes for Pedestrians with Vision Disabilities (2010)

» FHWA TOPR 34 – Evaluation of Rectangular Rapid Flash Beacon at Multilane Roundabouts (2015)

» NCHRP 834 – Crossing Solutions at Roundabouts and Channelized Turn Lanes for Pedestrians with Vision Disabilities: A Guidebook (2017)
Noteworthy Practices
Education

http://safety.fhwa.dot.gov/intersection/innovative/roundabouts/
https://vimeo.com/175859863
https://www.youtube.com/watch?v=zLMMGclhbEY
http://www.wcroads.org/faq/roundabouts/roundabout-public-education/

Sources: FHWA, Washtenaw County, Great Falls, NY

Publication Number: FHWA-SA-15-070

Figure 2. Scatter Plot. Regression models for single-lane roundabout sites with calibration to follow-up time.

Compact Roundabouts

Image Sources: Google Earth, FHWA; Left Photos – Kings Beach, CA – Placer County; Right Photo – Lakewood, CO
Innovative Construction Methods

- **CM/GC Method**
  - Owner
  - Designer of Record
  - Construction Manager/General Contractor
  - Design Subcontractors
  - Trade Subcontractors

- **Design-Build Method**
  - Owner
  - Design-Build Contractor
  - Construction
  - Design
  - Trade Subcontractors

Temporary Roundabouts

*Image Sources: San Joaquin County and Modesto Bee and Isebrands, Google Earth*
Interchanges

High Speed Roadways
Design Review Checklist (1 of 2)

» Is the diameter appropriate for context? (too big, too small?)
» What are the Fastest Path Speeds?
  » Design Speeds for R1, R2, R3, R4, R5
  » Relationship between radii
» Is there enough deflection?
» Multi-lane roundabout
  » Potential for vehicle path overlap?
  » How robust are traffic projections?
  » Should it be constructed as a SLR? (short term, long term)
» What is the design vehicle?
  » How often does design vehicle use intersection?

Design Review Checklist (2 of 2)

» Is there a truck apron? (check height, width)
» Is there curb and gutter on the outside?
» Are the splitter island lengths appropriate?
  » High speed approaches
  » Driveways/Access
» Pedestrian and bicycle features
  » Landscaping buffer for way finding
  » Width of crosswalk/refuge area sufficient
  » Bike ramp
» Is the lighting design appropriate?
» Is there signing and pavement marking?
» Were any analysis for design tools used?
» Have stakeholders been engaged?
» How has the public been educated about the project?
Peer Reviews

Why are they important?
» Roundabouts are still fairly “new”
» Roundabout design not in academic curriculum typically
» Not every agency has a roundabout expert on board (and that is okay)
» An unbiased opinion almost always adds value
» You can learn a lot from a peer review – it makes you a better designer

The Roundabout “Elite 8”

8. Phased design/construction can reduce the risk with traffic projections
7. Right size the roundabout to fit the context (not too small, not too big)
6. Sight distance to the pedestrian crossings in essential
5. Pedestrian only cross one direction of travel at a time and have shorter crossing distances
4. Single lane roundabouts only have 8 veh-veh conflict points
3. Approach alignment is critical to speed control
2. Speed control and speed consistency is critical
1. Well designed roundabouts SAVE LIVES!
Turbo Roundabouts

Traffic flow
Capacity of intersection alternatives

1-lane roundabout
2-lane roundabout
Turbo Roundabout

Safety Characteristics:
- No cut-off conflicts by spiral-shaped road markings
- Opposite entrances no more than 2 circular lanes
- Small diameter guarantees low speeds
- Physical lane separations avoid lane changing in the roundabout

Roundabout Retrofits

Source: Arcadis and Fortijn
Proximity to Signals and Metering

Intersection Control Evaluation (ICE)

ICE is a data driven, performance-based framework and approach established to identify the optimal investment and solution for highway access issues and needs considering all users.

ICE Policies & Procedures

Source: Caltrans, Omni Means, City of Roseville
ICE Framework

- ICE is typically a two-stage/phase process where
  - Stage 1 is a high-level assessment that considers all possibilities but filters down to short list, and
  - Stage 2 is a more rigorous assessment of key performance criteria for the short-listed alternatives (typically with prelim engineering).

ICE Decision Matrix Example

<table>
<thead>
<tr>
<th>Performance Measure</th>
<th>Alt 2: Signalize Existing I/S</th>
<th>Alt 3: Realign &amp; Signalize</th>
<th>Alternative 4: Roundabout</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Existing AM/PM Average Delay (seconds per vehicle)*</td>
<td>25.6/29.1</td>
<td>28.6/28.7</td>
<td>7.9/9.6</td>
</tr>
<tr>
<td>2. Existing AM/PM Volumes Level of Service (LOS)</td>
<td>C/C</td>
<td>C/C</td>
<td>A/A</td>
</tr>
<tr>
<td>3. 2035 AM/PM Average Delay (seconds per vehicle)</td>
<td>44.9/46.8</td>
<td>35.7/35.5</td>
<td>14.2/24.4</td>
</tr>
<tr>
<td>4. 2035 AM/PM Volumes Level of Service (LOS)</td>
<td>D/D</td>
<td>D/D</td>
<td>C/C</td>
</tr>
<tr>
<td>5. Longest Vehicle Queue (2035 pm)</td>
<td>25 cars</td>
<td>17 cars</td>
<td>18 cars</td>
</tr>
<tr>
<td>6. Right-of-Way Requirement</td>
<td>None</td>
<td>3,500 ft*</td>
<td>40 ft*</td>
</tr>
<tr>
<td>7. Construction Traffic Control</td>
<td>$35,100</td>
<td>$210,400</td>
<td>$65,800</td>
</tr>
<tr>
<td>8. Retaining Wall</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>9. Project Cost</td>
<td>$240,000</td>
<td>$288,000</td>
<td>$1,682,000</td>
</tr>
<tr>
<td>10. Benefit (Delay Savings) / Cost Ratio</td>
<td>2.81</td>
<td>0.7</td>
<td>0.18</td>
</tr>
<tr>
<td>11. Environmental Document</td>
<td>Mitigated Negative Declaration</td>
<td>Mitigated Negative Declaration</td>
<td>Mitigated Negative Declaration</td>
</tr>
<tr>
<td>12. Collision Cost Savings (Life of Project)</td>
<td>$2,026,000</td>
<td>$1,170,000</td>
<td>$9,537,000</td>
</tr>
<tr>
<td>13. Safety Performance B/C Ratio</td>
<td>2.16</td>
<td>0.4</td>
<td>5.68</td>
</tr>
</tbody>
</table>

* The existing average delay (s/veh) based on 2012 traffic volumes is 23.4 (AM) & 10.0 (PM)

Source: Caltrans
Safety Performance Management Final Rule & ICE

- Safety PM Final Rule establishes 5 performance measures to carry out HSIP:
  - (1) Number of Fatalities
  - (2) Rate of Fatalities per 100 million VMT
  - (3) Number of Serious Injuries
  - (4) Rate of Serious Injuries per 100 million VMT
  - (5) Number of Non-motorized Fatalities and Serious Injuries
- States & MPOs establish and report on targets

ICE accelerates achievement of Safety PM targets because it applies to all investment proposals (Not limited to HSIP investments)!

Safe Systems Approach

Sweden’s Vision Zero approach
- Vision Zero was adopted by Sweden in 1997 and has the long term goal of eliminating death and serious injury from the road transport system. Under this approach, it is unacceptable to trade off human life and health for other benefits of the transport system (e.g. mobility).

The Netherlands’ Sustainable Safety approach
- The Sustainable Safety approach was launched in the Netherlands in the early 1990's. It aims to prevent road crashes or at least minimise their severity while allowing for human capacities and limitations. The approach recognises that human beings are susceptible to injury and prone to errors. Sustainable Safety aims to prevent these errors as far as possible or to reduce their consequences by allowing for human limitations in designing the traffic system.

Australia's Safe System approach
- Australia’s Safe System approach reflects international best practice as defined in the Organisation of Economic Cooperation and Development’s (OECD) landmark report Towards Zero: Ambitious Road Safety Targets and the Safe System Approach. This report was prepared with substantial involvement of Australian road safety officials and practitioners. The Safe System approach represents a significant shift in thinking about road safety.
- The Safe System will deliver reductions in deaths and severity of injuries by coordinating the management of all the components of the transport system that impact on safety.

Source: www.rta.nsw.gov.au | 13 22 13
Safe System

- Safer Travel
- Human tolerance to physical force
- Safer roads and vehicles (more forgiving of human errors)
- Safer travel (lower speeds, more forgiving of human errors)

Source - Australian Transport Council

Tools & Resources

Ohio Roundabout Design Guidance

400 Intersection Design

401.2.3 Roundabouts

Roundabouts shall be analyzed using HCS or SDLRA. Turn lane lengths for the approach lane of the roundabout shall be determined by accommodating the 95th percentile queue lengths as identified by HCS or SDLRA. Refer to Figures 401-14a-d for software guidance.

While it is important to plan for future traffic volumes and capacity needs, the immediate effects on users should also be considered including costs. A roundabout constructed with a wide cross section (multiple) can negatively impact users (pedestrians, trucks, unfamiliar drivers) movements. Therefore, a phased installation of multi-lane roundabouts is required if the single lane construction of the roundabout can meet acceptable levels of service based on now or future traffic. The phased implementation should be based on the available and future funding resources and location (rural or urban, drivers familiar or unfamiliar). The current user’s needs will be accommodated while still providing an opportunity for the roundabout to be expected for future traffic volume growth.

When using a phased approach, its important to design the full build layout bottom to ensure right-of-way is secured for future planned improvements. It is also beneficial to plan the construction of the roundabout to potentially allow for easier expansion in the future.

403 Roundabouts

403.1 General

Roundabouts are circular intersections with specific design and traffic control features. These features include reduced conflict, all-entering traffic, channelized approaches, and appropriate geometric curvature. The term "modern roundabout" is used in the United States to differentiate modern roundabouts from the nonconforming traffic circles or rotaries that have been in use for many years. Modern roundabouts are defined by five basic operational and design principles:

1. Yield-at-Bit: Yield-at-Bit requires that vehicles on the circulating roadway of the roundabout have the right-of-way and all entering vehicles on the approaches lane-to-lane for a gap in the circulating flow. To maintain free flow and high capacity, yield signs are used as the entry control.

2. Definition of Entering Traffic: Entering traffic (i.e., the traffic from the approaches) is not permitted. Instead, entering traffic is deflected to the right by the central island of the roundabout and by channelization at the entrance into an appropriate curved path along the circulating roadway. Thus, no traffic is permitted to follow a straight path through the roundabout.

Modern Roundabouts range in size from micro-roundabouts with installed circle diameters as small as 40 ft. to double lane roundabouts with installed circle diameters around 100 ft. Roundabout design involves trade-offs among safety, operation, and accommodation of larger vehicles.

For additional information not detailed in this section, see FHWA’s Roundabouts: An Informational Guide (W(10) Report 072).

http://wsdot.wa.gov/hub/bo/rylaa/Bo8alvbdd AIM8 4u-8al-8BB3-4(BsDA4EyC30/8dspolicy2yze.pdf

Add a footer
Recordings of TRB Roundabout Conferences

Major Research Reports since 2010

- NCHRP 03-130 Update to the Roundabouts Guide (Anticipated Start date mid 2018)
- NCHRP 17-70: Development of Roundabout Crash Prediction Models and Methods (Anticipated 2018)
- FHWA - Mini Roundabout Safety and Operational Study (Anticipated 2018)
- NCHRP 834: Guidelines for the Application of Crossing Solutions at Roundabouts and Channelized Turn Lanes to Assist Pedestrians with Vision Disabilities (2017)
  - Web Only – Document 222
Major Research Reports since 2010

- NCHRP 772 - Evaluating the Performance of Corridors with Roundabouts (2014)
- Kansas DOT Accommodating Oversize/Overweight Vehicles at Roundabouts (2013)
- NCHRP 674 - Crossing Solutions at Roundabouts and Channelized Turn Lanes for Pedestrians with Vision Disabilities (2011)

Roundabout Inventory

[Map Image]
Ohio DOT/LTAP Roundabout Education 2018

Thank You ~ Questions & Discussion

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