FALL 2013

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WISCONSIN TRANSPORTATION INFORMATION CENTER – LTAP at the University of Wisconsin–Madison

Roundabouts replace dangerous intersections

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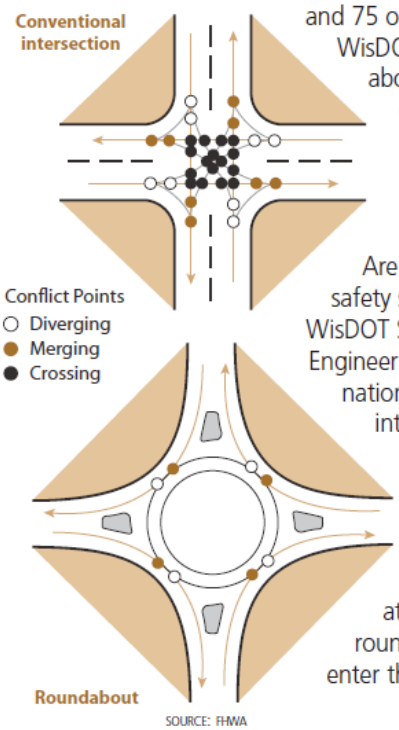
INTERSECTIONS ACCOUNT for almost 40 percent of fatal and injury crashes on US highways every year. Along with roadway and lane departure crashes, they are a major focus of highway safety improvements at federal, state and local levels.

An intersection control solution gaining acceptance in states like Wisconsin is the roundabout. They first appeared on Wisconsin roads in 1999 and, over the last eight years, the Wisconsin Department of Transportation has incorporated roundabouts in state highway projects where engineering studies indicate they make sense. By the end of 2013, there will be about 200 roundabouts on state roads and 75 on local roads in Wisconsin. WisDOT now includes roundabouts in the design standards that appear in its Facilities Development Manual (FDM).



Conventional intersections TOP have more potential conflict points than roundabouts BOTTOM, including T-Bone crashes that do not occur on the circular roadway.

Safety factors

Are roundabouts an effective safety solution on local roads? WisDOT Standards Development Engineer Patrick Fleming says national studies show that intersections on two-lane rural roads are good candidates in particular. There is a substantial reduction in the severity of crashes at those locations with a roundabout because vehicles enter the intersection and circulate at slower speeds, and there are fewer conflicts than with conventional intersections.

Roundabouts, like this one in Oconomocwoc, are an intersection design gaining popularity in Wisconsin as a safety solution at certain locations.

Fleming illustrates this by jcomparing the possible conflict points of a two-lane roadway in a typical roundabout and a signalized intersection. He calculates eight conflict points in the roundabout scenario and 32 conflict points at the signalized intersection. Half involve crossing collisions (the deadly T-Bones) that do not occur with roundabouts.

The Traffic Operations and Safety (TOPS) Laboratory at the University of Wisconsin-Madison is conducting ongoing research on roundabout safety in Wisconsin that includes a review of crash data on state road projects before and after roundabout installation. TOPS Lab Traffic Safety Engineering Research Program Manager Andrea Bill says they are analyzing information on factors that affect how the intersections perform to determine if they work as expected.

Early findings from the 2013 study of 30 roundabouts across the state show a 38 percent decrease in fatal and injury crashes after installation and no fatal crashes in that same period. TOPS researchers did find a 12 percent increase for all crashes across all study locations. These include low-severity crashes, a circumstance the researchers suggest resembles early outcomes on roadways with newly installed traffic signals or median barriers. They say important next steps are assessing the need

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from page 1

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for more public education on how to use roundabouts and identifying potential design improvements.

Bill notes that roundabouts are an additional tool for local governments exploring intersection design. "When highway and street departments consider their options, it's important to document what type of turning movements occur at an intersection, the travel speed on the road and other conditions to come up with the safest, most operationally effective solution," she advises.

Modern roundabout design

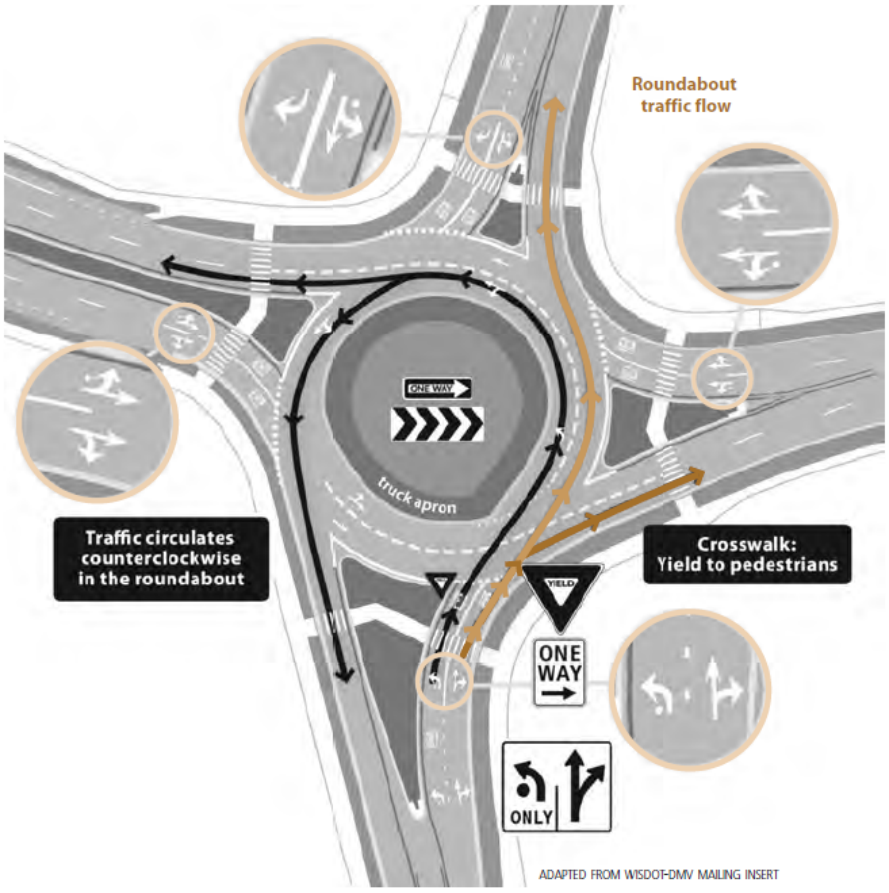
Modern roundabouts are smaller than the so-called "rotaries" of decades past—circular intersections that could measure up to 800 feet in diameter. The designs WisDOT makes a standard on state road projects today range from a diameter of about 140 feet for a single-lane roundabout to about 210 feet for a triple-lane design.

Fleming says the other change apparent in roundabouts versus the older rotaries is how they operate. Drivers entering the roundabout must yield to circulating traffic, pedestrians and bicycles. Roundabouts tend to slow travel speeds and reduce weaving or unexpected lane changes as long as drivers follow lane markings and signs. The FDM has a specific standard for roundabout pavement marking and signing that clearly indicates to drivers when to yield and what lane to follow for going straight or turning. Roundabout entry lanes that see more truck traffic often feature a painted gore area on the pavement that denotes extra space for large trucks to line up and maneuver safely into the circle.

Roundabouts constructed in Wisconsin using state or federal funds require a ***design consistency review.*** An experienced roundabout designer conducts the review in the proposal stage to verify that the preliminary design is a viable solution and the project meets FDM guidance. Local governments constructing a roundabout with local dollars do not need this review but Fleming encourages them to work with a designer who has experience designing roundabouts.

Information in the FDM can help local road agencies judge the viability of a roundabout design and conduct an operational analysis for a proposed project. It also contains details about space requirements and design elements like entrances, lane size, signing, marking and landscaping. WisDOT maintains a list of designers qualified in roundabout design that is available as a resource to local governments.

"Experience matters in the design of roundabouts," Fleming says. "It is a solution that requires knowledge of traffic control issues, conflict points, access management and other considerations that apply uniquely to these intersections."



Pavement markings and signage indicate the correct lane choice for all turns and through traffic in a roundabout.

Useful FDM criteria

For local road officials deciding whether a roundabout is the right solution, the FDM outlines eight criteria to guide their planning. Briefly, the key factors and evaluation steps include:

1-Safety Review crash data for the intersection and access points to evaluate how a roundabout or signalized intersection can reduce the type and percent of crashes.

2-Operational analysis Look at capacity, including normal peak traffic times and whether the intersection can handle traffic diverted due to incidents on a nearby state highway.

3-Right-of-way impacts Evaluate land-use issues and costs of land acquisition.

4-Costs Compare costs for each alternative that includes operations and maintenance.

5-Practical feasibility Document impact of each alternative on businesses, parking, real estate and utilities.

6-Pedestrians and bicycles Identify need for pedestrian and bicycle facilities.

Two examples of entry lanes in a two-lane roundabout. At left, pavement markings guide drivers' lane choice and, at right, a gore area between lanes gives large trucks room to maneuver safely into the circle.

7-Oversize/overweight freight network Evaluate use by large and heavy vehicles to determine how to move them safely.

8-Environmental impacts Consider how intersection types affect protected natural areas or a site with hazardous materials.

Costs of roundabouts and signalized intersections are comparable, says Fleming, but site-specific conditions like earthwork, utilities, drainage and real estate requirements can have a significant budget impact.

Answering all or most of the questions raised by the FDM criteria gives agencies and designers the basis for deciding which intersection control solution to recommend for a road improvement project. "Documenting their recommendation with information gathered from this exercise, especially the safety data, also helps explain to decision makers and the public why one design stands out as a good choice for a given location," Fleming says.

Pedestrians and bicyclists

Besides reducing the number of severe vehicle crashes that occur at the intersection of two or more roadways, the slower speeds in a roundabout can improve safety for foot and bicycle traffic through an intersection. Fleming notes that pedestrian exposure to moving traffic is much less in a roundabout since the distance from one side to another for someone using the crosswalk is about 34 feet. That compares to 60 feet of exposure at a conventional intersection with its four travel lanes and, in some cases, left or right turn lanes.

Bicyclists can exit the roadway and use the pedestrian path and crosswalks or ride in the roundabout by commanding a travel lane, which means abiding by the same rules as motorized vehicles. Some urban roundabout designs include the option of a separate multi-use path that goes around the perimeter of the traffic circle and entry lanes.

Educate all road users

Roundabouts have a reputation as confusing, Fleming says. But a design that addresses all operational issues and uses adequate signage and pavement markings helps drivers find their way. He cites studies showing a measurable change in attitude about roundabouts from 22 to 44 percent favorable before construction to 57 to 87 percent favorable one year after installation. "Young drivers, in particular, catch on quickly," he observes.

Lane choice is critical for getting around and through a roundabout with two or more lanes. Traffic signs and markings must communicate the correct action for all road users. Signs and pavement arrows show the right lane is for right turns, and the left lane for left turns and U-turns. Through traffic similarly follows pavement markings and signage as it navigates the roundabout.

Fleming and Bill agree that education is the key to making roundabouts work in Wisconsin. They advise local road officials to encourage road users to visit the WisDOT roundabout webpage (*wisconsinroundabouts.gov*). It has informational videos, how-to animations and other materials to help acquaint people with navigating around and through the circular intersections without incident.

Other state efforts involve testing new drivers on safe travel through roundabouts and including roundabouts in driver training.

Quantify advantages

Preventing fatal and injury crashes at intersections are important considerations in all road construction projects. A roundabout can be an effective solution worth closer scrutiny in the planning stages of a project. With guidance from the FDM and other resources, local officials can quantify the advantages and consider installing one in their jurisdictions. ■

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Resources

www.wisconsinroundabouts.gov
WisDOT roundabout resource page with links to photos, diagrams, videos, animated how-to clips and more.

http://roadwaystandards.dot.wi.gov/standards/fdm/
WisDOT link to ***Facilities Development Manual.*** Chapter 11, Sections 25 and 26, contain guidance on roundabouts standards, required for state and federally funded road projects and recommended for all others.

http://safety.fhwa.dot.gov/intersection/roundabouts/
Roundabouts information at the Federal Highway Administration website with technical information and additional outreach tools.

www.topslab.wisc.edu/programs/safety/projects/roundabouts
Link to TOPS Lab 2013 study report on roundabout safety.