RESEARCH ADMINISTRATION
Bureau of Field Services
Michigan Department of Transportation

Research Spotlight

Assessing the performance of Michigan roundabouts

Roundabouts are becoming the intersection treatment of choice in Michigan and across the country as transportation agencies aim to enhance safety and reduce congestion. An in-depth analysis of the characteristics of Michigan roundabouts that make them safe, cost-effective and user-friendly intersections will help MDOT make appropriate decisions about their future use.

Project Information

REPORT NAME: Evaluating the Performance and Safety Effectiveness of Roundabouts

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COST SHARING: 20% MDOT, 80% FHWA through the SPR, Part II, Program

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Problem

Roundabouts—the circular intersections that provide traffic control without the use of stop signs or traffic signals—have gained in popularity as a way to control speeds, reduce congestion and enhance safety. National research has examined the safety and operational benefits of roundabouts, but limited research is available that employs a local context in evaluating their performance.

On-site observers found that the many trucks using this interchange at I-75 and M-81 in Saginaw County are able to maneuver through the roundabouts with relative ease. (Source: Google.)

Approach

Limiting their analysis to Michigan roundabouts, researchers aimed to assess the safety impacts of roundabout conversions, determine how roundabouts affect traffic operations and examine the economic impacts of converting conventional intersections to roundabouts. A best practices review will inform recommendations for modifications to the 2007 *MDOT Roundabout Design Guide.*

Research

Researchers selected 58 single-, double- and triple-lane roundabouts newly built or converted between 2001 and 2009 in both rural and urban areas for this analysis. Conditions before conversion to a roundabout included one-, two- or all-way stop-controlled and signalized

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"This research provides information about the characteristics of roundabouts in Michigan, highlighting the positive impacts on safety and quick return on investment. The final report will help MDOT make decisions on roundabouts in the future."

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intersections. For comparison, researchers selected reference sites with characteristics that were similar to the roundabout sites but that still operated as conventional intersections.

Using data from the Michigan State Police crash database, traffic counts and other sources, researchers conducted a simple before-and-after study and a more rigorous empirical Bayes (EB) analysis to assess the safety of the roundabout conversions. Site visits to selected roundabouts identified factors that may increase collision risk, and investigators considered crash and construction costs in their assessment of roundabout cost-effectiveness.

Results

Both before-and-after studies identified reductions in injury crashes for all classes of roundabout conversions. The EB analysis estimated injury crash reductions that range from a low of 20 percent for signalized intersections converted to three-lane roundabouts to a high of 70 percent for signalized intersections converted to one- and two-lane roundabouts.

While researchers identified an overall increase in crashes for most types of roundabout conversions, the reduction in injury crashes provides a net crash cost benefit for most conversion types.

The EB analysis also produced the first safety performance functions (SPFs) and crash modification factors (CMFs) to reflect the performance of Michigan roundabouts. An SPF is used to estimate the number of crashes that would be expected in each year of the "before" period at locations with traffic volumes and other characteristics similar to a treatment site. A CMF of less than 1.0 indicates an expected reduction in crashes after implementing a countermeasure. The table below highlights some of the CMFs developed in this project for injury crashes.

Conversion Type	CMF
Signalized intersection to a one- or two-lane roundabout	0.300
One- or two-way stop-controlled intersection to a roundabout (all types)	0.558
All-way stop-controlled intersection to a roundabout (all types)	0.636
Signalized intersection to a three-lane roundabout	0.801

Speed studies and conflict analyses augmented on-site observations of the operation of 15 roundabouts included in the study. Among the safety issues researchers identified during their observations, speeding within the circulating lanes of a roundabout was assigned the highest risk rating. Further research to examine proper speed management at roundabouts is recommended.

The economic analysis estimated the benefit from reductions in road user delays at just over $500,000 per year for a single-lane roundabout to more than $2 million for triple-lane roundabouts, indicating that the larger the roundabout conversion, the larger the benefit in reducing congestion. Despite this, researchers cautioned against overbuilding roundabouts and recommended building expandable roundabouts that accommodate opening-day traffic volumes but allow for additional lanes as increases in traffic volumes warrant.

Researchers calculated a return on investment of less than two years for all three types of roundabouts, attributing this relatively quick return to the large reduction in crashes at many of the intersections and the benefits associated with reductions in user delay.

Value

This research quantifies for MDOT the safety benefits and cost-effectiveness of Michigan roundabouts. Armed with this information and researchers' recommendations for modifications to its roundabout design guidance, MDOT can prioritize funding for roundabouts, apply the most appropriate design elements and quantify the benefits of roundabouts for Michigan communities considering them as an effective alternative to conventional intersections.

Research Administration

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