Mini-roundabouts in Minnesota

Benefits of Roundabouts with a Smaller Footprint and Lower Cost

By William Stein, P.E.

The Minnesota Department of Transportation (MnDOT), cities, counties, and the consultant community have made great strides in utilizing a broader range of intersection types to solve transportation problems in Minnesota. By the end of the 2018 construction season, MnDOT and local agencies will have constructed 29 restricted crossing U-turn (RCUT) intersections, six diverging diamond interchanges (DDI), two continuous Green T intersections, and more than 100 roundabouts.

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Another innovative solution that has gained a foothold in Minnesota is mini-roundabouts. There are currently eight mini-roundabouts in operation with several others programmed or in the planning stages.

Table 1. Mini-roundabouts in Minnesota

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<th>Constructed</th>
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<tr>
<td>Mn Highway 4 (1st Ave) and Armstrong Blvd, St. James (2017)</td>
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<td>Mn Highway 4 (1st Ave) and 7th Street, St. James (2017)</td>
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<td>18th Ave NW (County Road 112) and 48th St NW, Rochester (2017)</td>
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<td>Washington Street/4th Avenue/Military Road, Anoka (2017)</td>
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<td>Louisiana Avenue and South Park Drive, Savage (2016)</td>
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<td>Gilmore Avenue, near US 61, Winona (2016)</td>
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<td>Spencer Street (County Road 79) and Vierling Drive, Shakopee (2014)</td>
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<td>Railroad Drive/3rd Street NW/Irving Avenue NW, Elk River (2013)</td>
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<th>Programmed</th>
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<td>Roselawn Avenue and Edgerton Street, Maplewood (2020)</td>
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Characteristics of Mini-Roundabouts

Mini-roundabouts are most often used on urban and suburban collectors and should not be confused with small traffic calming circles that are sometimes used on residential streets. They can provide similar safety and operational benefits to standard roundabouts but on a much smaller footprint—normally within the area of the existing intersection. They are also more cost effective. Costs vary depending on the site, but a general construction cost for a mini-roundabout is around US$200,000. Standard roundabouts can be $1 million or higher, particularly for multi-lane roundabouts and roundabouts with significant approach reconstruction.

Characteristics of mini-roundabouts include:

- Smaller size. The inscribed circle diameter is less than 90 feet. Acquiring additional right of way is normally not needed.
- Raised but traversable central island. A raised island provides physical channelization to reduce vehicle speeds. But the island is designed to be traversable, with no signs, landscaping, or other vertical objects. This allows trucks and other large vehicles to off-track over it, particularly for left turns.
- Splitter islands at the roundabout entrance are also normally raised, traversable, and free of vertical objects at the approach.
- Mini-roundabouts are used in urban and suburban locations where speeds are reduced. Most locations have speeds 35 mph or lower on the connecting roadways. Some have been installed in locations with 45 mph speeds.
- Volumes of large vehicles should be relatively low at mini-roundabout locations. Transit corridors with large buses or busy truck routes may not be the best site for a mini-roundabout.

- Early studies of mini-roundabouts in the U.S. indicate peak hour capacity of about 1,500 entering vehicles per hour. Capacity will vary based on the proportion of left-turn, straight through, and right-turn demands from each approach. A higher proportion of left-turn demand results in lower intersection capacity. High right-turn demand results in higher capacity.

Shakopee—An Early Minnesota Success

The first mini-roundabout constructed in Minnesota at a location with significant traffic was in Shakopee at the intersection of Vierling Drive and Spencer Street (County Road 79). The pre-construction intersection was All-Way STOP control with a four-lane cross section on Vierling Drive and two-lanes on Spencer Street. The intersection experienced poor operations, particularly in the AM and PM peak hours, with backups as long as 6 minutes along the north leg of the intersection during the PM peak.

In 2012, Scott County and the City of Shakopee worked with the Federal Highway Administration’s (FHWA) Office of Safety Research and Development (R&D) to explore the feasibility of a mini-roundabout at this location. Microsimulation traffic analysis indicated that operations at the intersection could be dramatically improved with a mini-roundabout.

The County and City moved forward with design and public outreach and the mini-roundabout was constructed in 3 weeks in June 2014, within the existing right of way (See Figure 2). Improved traffic operations were evident immediately and confirmed through video and traffic counts collected by the Office of Safety R&D as part of a national study. The post construction data collection was on November 19, 2014 shortly after some snowfall. The highest 15-minute count was 306 vehicles from 7:30 a.m. to 7:45 a.m. (equivalent to 1,224 vehicles per hour [vph]). The highest hourly vehicle count was 1,109 vph from 4:30 p.m. to 5:30 p.m. The long queues on the north leg have been eliminated. The more efficient operations also reduce fuel use and emissions.

Figure 1: Peak-hour conditions at the All-Way STOP before construction.
In addition to the operational improvements, pedestrian safety was improved which was a particularly important community goal with the intersection’s proximity to Shakopee West Middle School and nearby residential areas. The sidewalk and trail network around the intersection were fully connected. The mini-roundabout geometry shortened pedestrian crossings and reduced conflict points.

Before and after video clips of the Shakopee mini-roundabout are available from the FHWA—Minnesota Division, upon request.

**St. James—Mini-roundabouts in a Constrained Urban Setting**

Two mini-roundabouts were constructed as part of an urban reconstruction project along Mn Highway 4 in St. James. The context is much different than the Shakopee location as the mini-roundabouts are in a more constrained location through a small City downtown area. The intersections were previously signal controlled, connecting a street with a wide cross section and parallel parking (See Figure 3).
During development of this project, the District worked very hard on outreach to the public and local elected officials. Several options were explored with the City and the public prior to choosing mini-roundabouts. The primary reasons for selecting the mini-roundabout option included:

- Reduced vehicle delay through the intersections compared to signals or all-way STOP control.
- Shorter pedestrian crossings.
- The proven safety performance of roundabouts.
- $600,000 lower construction cost compared to constructing new signals.
- On-street parking for adjacent businesses could be maintained. Parking was maximized by incorporating back-in, angle parking on one side.

A graphic of the proposed design, including aesthetic treatments is shown in Figure 4. MnDOT and the City of St. James received a $934,000 Federal Accelerated Innovation Deployment grant for this portion of the project.

In addition to the more urban context, another challenge at this location are agricultural trucks that use this section of Highway 4. In addition to traditional design tools like AutoTurn, the District striped out the geometry of the mini-roundabout design in a parking area and tested it with a WB-62 truck and a school bus to ensure that the design was feasible from that perspective.

The construction of the mini-roundabouts was completed in the fall of 2017 (See Figure 5). A video on how to drive the mini-roundabouts and use the back-in, angle parking can be viewed here: www.dot.state.mn.us/d7/projects/hwy4stjames/howto.html.

**Anoka—Handling Difficult Geometry**

Similar to Shakopee, the City of Anoka installed their first mini-roundabout near a middle school. As shown in Figure 6, the geometry at this location was challenging. The intersection has 5 legs, some significantly skewed, and the south leg of 4th Avenue is slightly offset. There are two entry points in the eastbound direction, one serving drivers on Washington Street and one serving drivers on Military Road. Washington Street is one-way on one side of the intersection and two-way on the other. The pedestrian crossings were long and also skewed.
The City reconfigured the intersection with a mini-roundabout, shown in Figure 7, that introduced similar and more intuitive approach geometry at each leg. Of particular note are the much shorter pedestrian crossings that are perpendicular to the approaches, which are especially beneficial near a heavy pedestrian location.

Intersections that are No Longer “Alternative”

Mini-roundabouts and several other less common intersection types have been proven in Minnesota and should no longer be viewed as “alternative” or “innovative.” Rather, they should be viewed as standard designs that should be a routine part of intersection control evaluation. In addition to roundabouts and mini-roundabouts, RCUT, DDI, and continuous Green T intersections all fall into this category.

There are several intersection types that have not yet been tried in the state that would have similar benefits. Signalized, urban expressways with safety and operational problems are excellent candidates for the Superstreet concept. The first signalized RCUT is scheduled for construction in 2019 at the intersection of Mn Highway 65 and Viking Boulevard in East Bethel. See this website for excellent animations that were created for this project: www.dot.state.mn.us/metro/projects/hwy65rci. Other intersection types that would be good solutions at certain locations include the median u-turn (Michigan Left) or thru-turn intersection, the quadrant roadway, the displaced left turn intersection, and others.

Minnesota should continue to lead the way in using a broad range of intersection types, including mini-roundabouts, to design projects that deliver high performance at reduced cost.

William (Will) Stein, P.E. is the safety and design engineer for the Federal Highway Administration’s (FHWA) Minnesota Division. Will has worked in the field of highway safety and highway design with FHWA, the Iowa and Minnesota Departments of Transportation, and the consulting firm CH2M Hill. One of his particular areas of interest is how innovative and alternative intersection types can be used to improve safety and traffic operations.