Introduction

The roundabout, a sometimes unfamiliar type of intersection that is growing in popularity in the United States, is appearing more frequently across Wisconsin. This increasing use of roundabouts has led some in the public and legislators to wonder why this type of intersection is replacing some traditional intersections.

Roundabouts are sometimes met with confusion or controversy. But luckily for the roundabout, initial public opinion quickly improves with education and experience. According to an Insurance Institute for Highway Safety study, public opinion on roundabouts evolves, with the proportion of drivers who favored roundabouts increasing from just 34 percent prior to construction to up to 70 percent over one year after construction. ([Public Opinion, Traffic Performance, the Environment and Safety after the Construction of Double-Lane Roundabouts 2013](#))

The fact is that roundabouts provide many advantages to the traveling public – whether auto drivers, truck drivers, pedestrians or bicyclists. Through this white paper, we will explore the typical concerns about and benefits of roundabouts and how engineers carefully evaluate and design intersections. Roundabouts have been proven safe, efficient and environmentally friendly. And, through proper education, travelers become accustomed to driving, walking or cycling through roundabouts with confidence and benefit from the efficiency of roundabouts.

Most are familiar with the Hippocratic Oath taken by physicians swearing to practice medicine honestly and without harm. Professional engineers also are bound by a code of ethics, the American Society of Civil Engineers Code of Ethics, which states:

> Engineers shall hold paramount the safety, health and welfare of the public and shall strive to comply with the principles of sustainable development in the performance of their professional duties.

Professional engineers design roundabouts and other infrastructure improvements with the public’s best interests in mind. Supported by design principles and studies, professionals believe the roundabout is a safe, effective and environmentally friendly intersection design option. It is chosen after careful consideration, through an intersection control evaluation - and not at any and every intersection. The roundabout is a tool in the professional engineer’s tool box. Like the tools we have at home, roundabouts, signal lights, stop signs and yield signs all have their place and purpose. Engineers are trained to know the right tool for the job. However, there are also checks along the way. Professional engineers use the National Environmental Policy Act process to evaluate potential environmental effects and take into account public input when determining the appropriate intersection design that is in the public’s best interest. And there are a number of reasons why roundabouts often win out as the tool of choice.

The Wisconsin Department of Transportation and its partners are charged with lowering the number and severity of traffic crashes. The [Wisconsin Strategic Highway Safety Plan (SHSP)](#) describes critical safety issues and outlines a course of action to significantly reduce fatalities and serious injuries on our streets and highways. One of the strategic plan’s high priority areas is improving the design and operation of intersections. The SHSP identifies
Roundabouts
Safe | Efficient | Environmentally Friendly

increasing the number of roundabouts as one of many strategies available to enhance safety, along with J-turns, diverging diamond interchanges and technology improvements for signals.

As a trade association representing professional engineers across the state of Wisconsin, the American Council of Engineering Companies of Wisconsin is invested in educating the public on the uses and benefits of infrastructure improvements, including roundabouts. Our goal is to explain the benefits and educate people to better understand roundabouts as a safe, efficient and environmentally conscious intersection design option.

What is a Roundabout?
Many Wisconsinites have experienced a roundabout in one way or another. The Wisconsin Department of Transportation Facilities Development Manual defines the roundabout as a “one-way circular intersection where circulating traffic is given priority over entering traffic and where entry speeds are relatively low.” While the definition is simplistic, the decision-making and design processes are incredibly technical.

Roundabouts are a tool engineers consider as a method of intersection control. The decision to design a roundabout is a calculated decision; not all intersections are appropriate for roundabouts. The Wisconsin Department of Transportation requires an intersection control evaluation (ICE) for each intersection under investigation. Safety, operational analysis, construction costs, right-of-way impacts, operation and maintenance costs, pedestrian and bike accommodations, environmental impacts and practical feasibility are all taken into account as part of the ICE process. By comparing intersection alternatives, the engineer can compare apples to apples. During the ICE process, WisDOT presents all available intersection types to the public. The Department then makes the decision with local participation and input.

Roundabouts are considered at:
- High crash rate locations
- Intersections with large traffic delays
- Complex geometry
  (more than four approach roads)
- Frequent left-turn movements
- At interchange intersections

Roundabouts are used across the country and the world. Wisconsin is one of 23 states across the country embracing the roundabouts as a design solution. In the Midwest, Illinois, Indiana, Michigan and Minnesota have active roundabout programs.

Roundabouts are Safe
By their nature, intersections are risky. Vehicles cross paths and drivers need to quickly monitor and react to different situations. In fact, intersection crashes accounted for 47 percent of injury crashes. (Public Opinion, Traffic Performance, the Environment and Safety after the Construction of Double-Lane Roundabouts 2013) Engineers are responsible for looking at alternatives to reduce risks and injuries. The roundabout is often a solution, since it reduces risks at intersections.

Roundabouts are a proven safety solution that prevent and reduce the severity of intersection crashes. By design, roundabouts slow traffic at intersections. Slower traffic results in reduced severity of crashes and allows more decision-
making time. Traffic travels in the same direction which eliminates left turn, right angle and head-on collisions and removes the crossing paths aspect of traditional intersections. There are only eight conflict points in a single-lane roundabout as compared to 32 conflict points at a typical four way intersection. (Roundabouts: An Informational Guide (Federal Highway Administration) 2000) This is a 75 percent reduction in conflict points and a complete elimination of crossing conflicts. The elimination of crossing conflicts, which happen at higher speed and greater impact force, reduces injuries and fatalities.

While crashes in roundabouts are reduced in frequency and severity, they still occur. An Insurance Institute for Highway Safety study of crashes at 38 roundabouts in Maryland identified run-off-road, rear-end, sideswipe and entering-circulating accounted for nearly all crashes. (Wisconsin Department of Transportation Roundabout FAQs) Many of these crashes were due to operating at unsafe speeds. The study also states collisions occurred most frequently at roundabout entrances.

Wisconsin Roundabouts are Improving Safety
- Complete elimination of fatal injury crashes
- 52% reduction in fatal and injury crashes
- 9% reduction in all crashes

UW Traffic Operations and Safety Laboratory 2011 Study of 24 Wisconsin Roundabouts

Pedestrian Safety
Pedestrians need only cross one direction at a time and splitter islands provide places of refuge before the pedestrian crosses the other direction of traffic. The crosswalk is strategically set back 20-feet from the yield line so the approaching vehicle can focus first on the pedestrian before entering the roundabout. Just as conflict points are reduced for vehicles, the same is true for pedestrians. In addition, the relatively low vehicle operating speed allows for safer crossing and reduced severity if a vehicle-pedestrian strike was to occur. A pedestrian can often cross through a roundabout more quickly than waiting at a signalized intersection.

Not only are roundabouts safe for automobiles, but pedestrians and bicyclists are also safely accommodated. According to the Federal Highway Administration, pedestrians and bicyclists have far less risk navigating roundabouts than typical intersections.
Road and Transport Research Institute

There has been considerable research done on the impacts to the visually impaired such as the Transportation Research Board’s NCHRP 3-78 study and NCHRP 674 report. However, at this time, there is no indication that one solution or combinations of solutions are ideal for the visually impaired.

Bicycle Safety
Navigating a roundabout is slightly more complex for the bicyclist. The Insurance Institute for Highway Safety reports roundabouts provide a 10 percent reduction in bicycle crashes at signalized intersections that were converted to roundabouts. (Wisconsin Facilities Development Manual) Experienced bikers should have little trouble maneuvering through the intersection and mixing with vehicles; however, less experienced bicyclists may encounter more difficulties. The slower speeds within a roundabout allow vehicles and bicycles to travel at compatible speeds. As with pedestrians, the slower speeds reduce accident severity.

To ensure the safety of bicyclists, the Federal Highway Administration recommends a side path to allow less experienced bicyclists to exit the roadway and proceed through the intersection safely.

Steps for Driving A Roundabout
• Choose the proper lane
• Yield to all lanes of traffic, pedestrians and bicyclists on your left
• Drive slowly into and through the roundabout

Designed for Large Trucks
Some people believe roundabouts are difficult for trucks and may think that semi-truck traffic was not considered. In fact, roundabouts are designed with semi-truck traffic in mind. Each roundabout has a truck apron dedicated to truck-turning movements. The truck apron is located in the central island and consists of a 10- to 12-foot wide strip of red concrete pavement. To drivers, this appears decorative, but to trucks it provides the added room necessary to navigate through the roundabout. Engineers work to accommodate Oversize-Overweight (OSOW) vehicles at roundabouts being incorporated on OSOW routes across the state. Designers typically check with local officials and the public to determine if there are any special OSOW vehicles that regularly use the route. To accommodate OSOW vehicles, a widened truck apron along the sides may be added, and additional pavement (behind a mountable curb) may also be provided along the right side of the entries to accommodate wheel off-tracking. In addition, sign posts may have to be mounted in removable sleeves to provide additional lateral space for OSOW vehicles.

Older Drivers
It may seem counter-intuitive, but roundabouts may be helpful in reducing crashes involving older drivers. Insurance Institute for Highway Safety notes older drivers are more likely to be involved in multi-vehicle intersection crashes. (IIHS Fatality Facts – Crash Types) Older drivers’ intersection crashes are often due to failure to yield the right-of-way. (Public Opinion, Traffic Performance, the Environment and Safety after the Construction of Double-Lane Roundabouts 2013) Entering roundabouts at lower speeds without the risks of left-turns and cross traffic reduces the number of crashes due to lack of yielding. Despite the benefits, the IIHS Public Opinion study indicates roundabouts are
less popular among older drivers and alternate routes may be chosen to avoid roundabouts altogether.

Whether for motorist, pedestrians, bicyclists or truck drivers, the safety statistics for roundabouts are impressive. There is potential for even better safety scores through increased education, user familiarity and evolving design procedures.

**Roundabouts are Efficient**

Due to the continuous traffic flow, roundabouts are extremely efficient, saving motorists valuable time in addition to improving safety. Several studies conducted by the Insurance Institute for Highway Safety and others have reported significant improvements in traffic flow following conversion of traditional intersections to roundabouts.

WisDOT reports the following efficiency highlights on its website through the following studies:

- A study of three intersections in Kansas, Maryland and Nevada, where roundabouts replaced stop signs, found that vehicle delays were reduced 13-23% percent and the proportion of vehicles that stopped was reduced 14-37 percent.
- A study of three locations in New Hampshire, New York, and Washington, where roundabouts replaced traffic signals or stop signs, found an 89 percent average reduction in vehicle delays and a 56 percent average reduction in vehicle stops.
- A study of 11 intersections in Kansas found a 65 percent average reduction in delays and a 52 percent average reduction in vehicle stops after roundabouts were installed.

Roundabouts move traffic through the intersection quickly. When compared to an intersection with stop signs, roundabouts can process traffic more quickly since traffic is required to yield rather than stop completely. Roundabout intersections, especially at off-peak times, also see traffic flow benefits. The wait for a green light at a signalized intersection is eliminated with the roundabout.

**Roundabouts are Environmentally Friendly**

Because roundabouts improve the efficiency of traffic flow, they also reduce vehicle emissions and fuel consumption. The Federal Highway Administration notes that vehicles continue to advance slowly rather than coming to a complete stop, resulting in reduced noise and air quality impacts and fuel consumption.

The Wisconsin Department of Transportation and many other state DOTs cite studies pointing to emission reductions. In one study, replacing a signalized intersection with a roundabout reduced carbon monoxide emissions by 29 percent and nitrous oxide emissions by 21 percent. In another study, replacing traffic signals and stop signs with roundabouts reduced carbon monoxide emissions by 32 percent, nitrous oxide emissions by 34 percent, carbon dioxide emissions by 37 percent and hydrocarbon emissions by 42 percent.

Constructing roundabouts in place of traffic signals can reduce fuel consumption by about 30 percent. At 10 intersections studied in Virginia, this amounted to more than 200,000 gallons of fuel per year. *(Continued Reliance on Traffic Signals: The Cost of Missed Opportunities to Improve Traffic Flow and Safety at Urban Intersections 2005)*
While a roundabout doesn’t eliminate vehicle emissions, it does significantly reduce them. The roundabout also brings landscaping and green space to the intersection, creating an aesthetically pleasing and welcoming intersection.

**Education is Key**

Since many members of Wisconsin’s traveling public learned to drive, cross the street and bike long before roundabouts made their appearance in the state, there is a portion of the population that may not fully understand how to navigate a roundabout. Many new and unfamiliar concepts are sometimes met with concern and require an adjustment period. Additional education on how to travel through roundabouts and their benefits is necessary. The safety benefits, traffic flow efficiencies and reduced environmental impacts are compelling reasons to welcome roundabouts to Wisconsin communities.

Education is vital to the acceptance and success of a roundabout. As cited in the introduction, public opinion on roundabouts changes quickly once users become familiar with the process. Proactive education through public meetings, community events and media is vital to the success of a roundabout in a community. Creative and effective roundabout education campaigns have been implemented across the country. The Federal Highway Administration’s website houses a [Roundabout Outreach and Education Toolbox](#), full of great education campaigns. The Wisconsin Department of Transportation has a “How Roundabouts Work” section of its website with effective brochures, animations and videos, which can be accessed by interested citizens, civic groups and others.

Professional engineers and the Wisconsin Department of Transportation should partner to better educate Wisconsinites on the rules of roundabouts. Media outreach can help maximize community education about roundabouts.

**Conclusion**

When infrastructure functions properly, it blends into the background or simply becomes a part of our daily reality. The newness and the resulting unfamiliarity of roundabouts has pulled this intersection design into the forefront.

As in any profession, new tools, techniques and technologies become available that make processes safer, more efficient, reduce waste and make lives easier. The roundabout is just another tool in the intersection tool box. The professional engineer is trained to use the right tool for the job, and sometimes this tool is a roundabout. When a roundabout is designed for a particular intersection, it is only done so after careful analysis through a methodical process.

Any time the risk of accidents and fatalities can be reduced, the public should take notice. Not only does the roundabout offer compelling safety benefits, but it also efficiently processes traffic flow and offers reduced environmental impacts. With an open mind to learning a new way to travel through intersections, the public can navigate a roundabout with ease and confidence, and all the benefits of the roundabout can truly be realized.
Works Cited


Fleming, Patrick. "Roundabouts - Frequently asked questions (FAQs)”. Wisconsin Department of Transportation. Web. 18 November 2013.


