Roundabouts

Roundabouts are a safer alternative to traffic signals and stop signs. The tight circle of a roundabout forces drivers to slow down, and the most severe types of intersection crashes — right-angle, left-turn and head-on collisions — are unlikely.

Roundabouts improve traffic flow and are better for the environment. Research shows that traffic flow improves after traditional intersections are converted to roundabouts. Less idling reduces vehicle emissions and fuel consumption.

Roundabouts generally are safer for pedestrians. Pedestrians walk on sidewalks around the perimeter and cross only one direction of traffic at a time. Crossing distances are relatively short, and traffic speeds are lower than at traditional intersections.

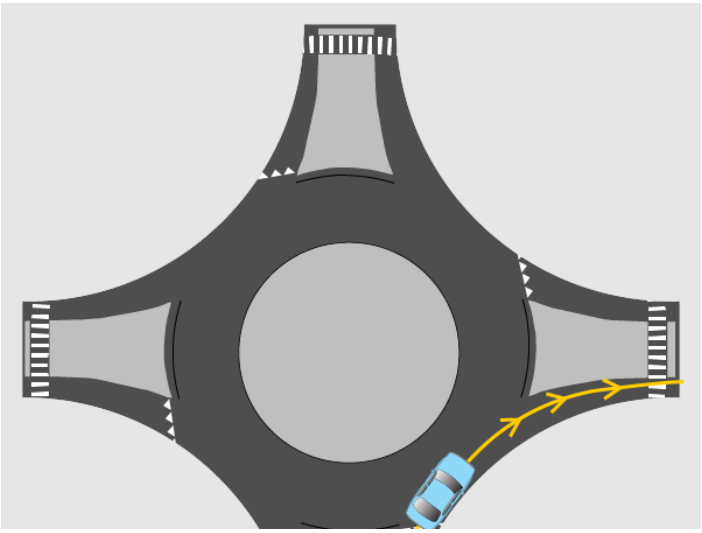
Roundabouts defined

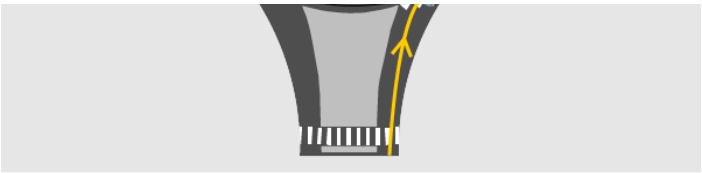
The modern roundabout is a circular intersection with design features that promote safe and efficient traffic flow. It was developed in the United Kingdom in the 1960s and now is widely used in many countries, including the United States, where its use is growing.

At roundabouts in the U.S., vehicles travel counterclockwise around a raised center island, with entering traffic yielding the right-of-way to circulating traffic. In urban settings, entering vehicles negotiate a curve sharp enough to slow speeds to about 15-20 mph; in rural settings, entering vehicles may be held to somewhat higher speeds (30-35 mph). As vehicles circulate within the roundabout, slow and consistent speeds are maintained by the deflection of traffic around the center island and the relatively tight radius of the roundabout and exit lanes.

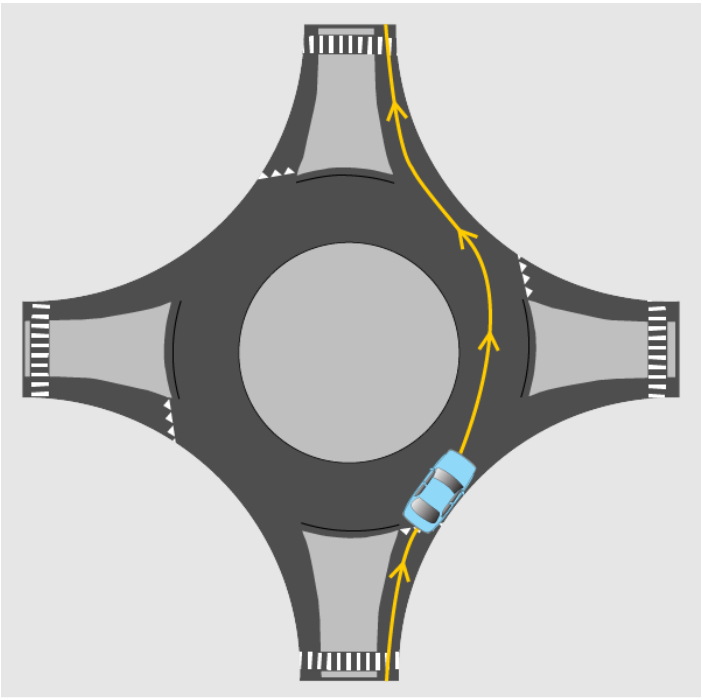
Slow speeds help vehicles move smoothly into, around, and out of a roundabout. Drivers approaching a roundabout must reduce their speeds, look for potential conflicts with vehicles already in the circle and be prepared to stop for pedestrians and bicyclists. Once in the roundabout, drivers proceed to the exits they need.

Common traffic maneuvers at roundabouts

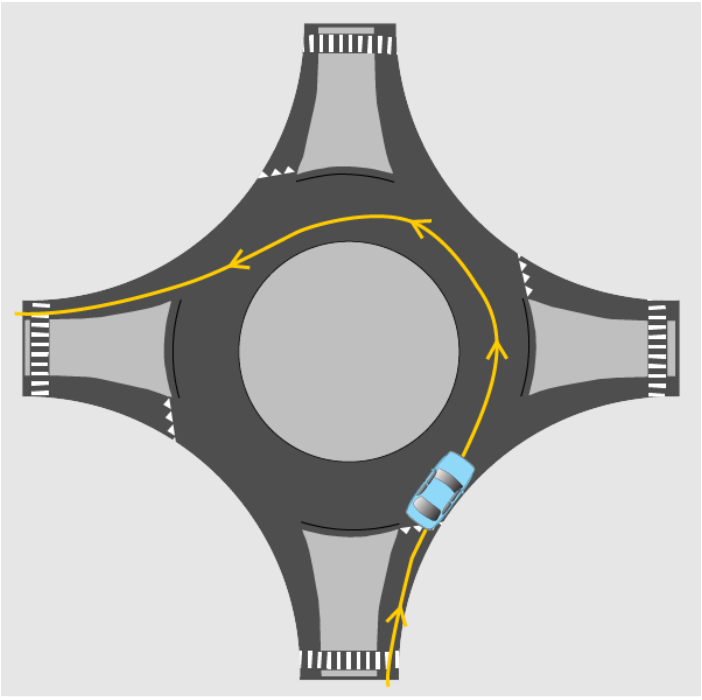




Right turn



Straight through



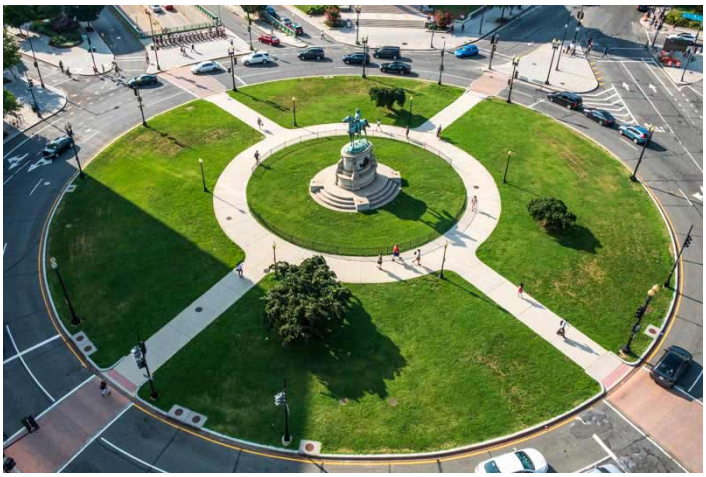
Left turn

Modern roundabouts are much smaller than older traffic circles — also known as rotaries — and require vehicles to negotiate a sharper curve to enter. As a result, travel speeds in roundabouts slower than speeds in traffic circles.

Because of the higher speeds in older traffic circles, many are equipped with traffic signals or stop signs to help reduce potential crashes. In addition, some older traffic circles and rotaries operate according to the traditional "yield-to-the-right" rule,

with circulating traffic yielding to entering traffic.

Modern roundabout



Older traffic circle

The first modern roundabouts in the United States were constructed in Nevada in 1990. Since then, many more have been built, although the precise number is unknown. Roundabouts are much more common in some other countries, including Australia, the United Kingdom and France.

Although some states and cities have been slow to build roundabouts, they are gaining more popularity in the United States. Roundabouts are one of the evidence-based safety countermeasures recommended by the Federal Highway Administration.

Some states, such as New York and Virginia, have adopted "roundabout first" policies requiring that roundabouts be considered a preferred alternative when building new intersections or upgrading older ones if feasible (*New York State Department of Transportation, 2011*; *Virginia State Department of Transportation, 2009)*.

Roundabouts are appropriate at many intersections, including high-crash locations and intersections with large traffic delays, complex geometry (more than four approach roads, for example), frequent left-turn movements, and relatively balanced traffic flows. Roundabouts can be constructed along congested arterials and at freeway exits and entrances, in lieu of traffic signals.

Sometimes space constraints or topography make it impossible to build a roundabout. Geometric design details vary from one site to another and must take into account traffic volumes, land use, topography and other factors. Roundabouts often require more space in the immediate vicinity of the intersection than comparable traditional intersections. However, because roundabouts can reduce delays and queue lengths, they require less space on the approaching roads than comparable intersections controlled by stop signs or traffic signals.

An intersection with highly unbalanced traffic flows (that is, a very high traffic volume on the main street and very light traffic on the side street) may not be an ideal candidate for a roundabout. The same is true for isolated intersections in a network of traffic signals.

While the initial construction cost of a roundabout varies site by site, its maintenance usually is cheaper than for intersections with signals. The service life of a roundabout is significantly longer, approximately 25 years, compared with 10 years for a typical traffic signal (*Rodegerdts et al., 2010*).

Safety benefits

At traditional intersections with stop signs or traffic signals, some of the most common types of crashes are right-angle, left-turn, and head-on collisions. These types of collisions can be severe because vehicles may be traveling through the intersection at high speeds. With roundabouts, these types of potentially serious crashes are essentially eliminated because vehicles travel in the same direction and at low speeds.

The vehicle-to-vehicle conflicts that do occur at roundabouts generally involve a vehicle merging into the circular roadway. In the case of multilane roundabouts, conflicts may also occur as vehicles exit.

- Studies of intersections in the United States converted from traffic signals or stop signs to roundabouts have found reductions in injury crashes of 72-80 percent and reductions in all crashes of 35-47 percent (*Retting et al., 2001; Eisenman et al., 2004*; *Rodegerdts et al., 2007*).
- A study of 19 higher-speed rural intersections (speed limits of 40 mph or higher) that originally had stop signs on the minor approaches and were converted to roundabouts found a 62 percent reduction in all crashes and an 85 percent reduction in injury crashes (*Isebrands & Hallmark, 2012*).
- Studies of intersections in Europe and Australia that were converted to roundabouts have reported 25-87 percent reductions in injury crashes and 36-61 percent reductions in all crashes (*Rodegerdts et al., 2010*).
- Based on the results of a 2004 study (*Eisenman et al., 2004*), it's estimated that the conversion of 10 percent of the signalized intersections in the United States to roundabouts would have prevented approximately 51,000 crashes in 2018, including 231 fatal crashes and about 34,000 crashes involving injuries.

Most U.S. studies have focused primarily on single-lane roundabouts. When included, two-lane roundabouts have been associated with smaller reductions in crashes compared with single-lane roundabouts (*Retting et al., 2001*; *Eisenman et al., 2004*; *Rodegerdts et al., 2007*) or with increases in crashes (*Isebrands & Hallmark, 2012*; *Wang & Cicchino, 2022*).

A 2019 IIHS study, however, showed that the safety of two-lane roundabouts improves over time, as drivers become more familiar with them (*Hu & Cicchino, 2019*). The researchers looked at roundabouts built in Washington state between 2009 and 2015. They found that crashes at two-lane roundabouts decreased an average of 9 percent a year. At the same time, the odds that a crash at a two-lane roundabout involved an evident or incapacitating injury decreased by nearly one-third annually.

In addition to having fewer serious conflicts between vehicles than traditional intersections, roundabouts are generally safer for pedestrians as well. In a roundabout, pedestrians walk on sidewalks around the perimeter of the circular roadway. If they need to cross the roadway, they cross only one direction of traffic at a time. In addition, crossing distances are relatively short, and vehicle speeds tend to be low.

Studies in Europe indicate that, on average, converting conventional intersections to roundabouts can reduce pedestrian crashes by about 75 percent (*Brilon et al., 1993*; *Schoon & van Minnen, 1994*). Single-lane roundabouts, in particular, have been reported to involve substantially lower pedestrian crash rates than comparable intersections with traffic signals (*Brude & Larsson, 2000*).

Crossing at multi-lane roundabouts can be more difficult for pedestrians than crossing at single-lane roundabouts. A study found that motorists failed to yield to pedestrians 2-3 times more at multi-lane roundabouts than at single-lane roundabouts (*Rodegerdts et al., 2007*). Another study found that drivers exiting a roundabout were less likely to yield to pedestrians than drivers entering a roundabout (*Hourdos et al., 2012*).

Safety challenges

Despite the demonstrated safety benefits of roundabouts, some crashes still occur. An IIHS study of crashes at 38 roundabouts in Maryland found that four crash types — run-off-road, rear-end, sideswipe, and entering-circulating — accounted for almost all crashes (*Mandavilli et el., 2009*). Another common crash type involved a vehicle colliding with the central island. These crashes, which often involved unsafe speeds, accounted for almost half of all single-vehicle run-off-road crashes. Some drivers may not have seen the roundabout in time to slow down sufficiently.

A review of crashes at 39 roundabouts in the United States found that entering-circulating, exiting-circulating and rear-end collisions were the most common crash types (*Rodegerdts et al., 2007*). A large majority of crashes at the single-lane roundabouts were entering-circulating crashes. At multi-lane roundabouts, the majority of crashes were exiting-circulating.

A review of fatal crashes at roundabouts in the United States and injury crashes at roundabouts in Washington and Wisconsin found that motorcycle crashes, fixed object crashes, and crashes involving impaired driving were overrepresented (*Schroeder et al., 2015*).

Design features that encourage drivers to slow down are the key to optimizing roundabout safety.

Signs — including speed limits posted well in advance of roundabouts and larger "roundabout ahead" and yield signs — pavement markings and lighting help make sure drivers know they are approaching a roundabout and therefore need to slow down.

Center island landscaping can promote slower speeds and focus drivers' attention on the roadway close to them by limiting their through vision.

Islands separating the approach and exit lanes, known as splitter islands, should extend far enough from the roundabout to provide pedestrian refuge and to delineate the roundabout.

Other design features such as adequate curvature of approach roads far enough in advance of roundabouts and the alignment of approaching roads with the center island also may aid in reducing speeds.

Multilane roundabouts are more challenging. A study of a pair of two-lane roundabouts near Bellingham, Washington, found that confusion about some aspects of navigating the roundabouts persisted one year after the construction ended (*Hu et al., 2014*). More than 40 percent of drivers said it wasn't clear from signs and pavement markings what speed to drive, which lane has the right of way when exiting or that they shouldn't drive next to large trucks in the roundabouts.

At multilane roundabouts, signs and pavement marking should remind drivers of the correct yielding patterns and help them choose the appropriate lanes. At two-lane roundabouts, for example, signs need to convey clearly that entering traffic must yield to both lanes of traffic.

The photos below show sample signs and pavement markings used at roundabouts.

Guide sign

Roundabout sign

Yield sign

Pavement markings

Traffic flow benefits

Several studies conducted by IIHS and others have reported significant improvements in traffic flow following conversion of traditional intersections to roundabouts.

- 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 (*Retting et al., 2002*).
- A study of three locations in New Hampshire, New York and Washington state 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 (*Retting et al., 2006*).
- 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 (*Russell et al., 2004* PDF).
- An Institute study of two-lane roundabout conversions at two intersections near Bellingham, Washington, found substantial declines in vehicle delays on the minor roads (33 percent and 90 percent) and the proportion of vehicles waiting in queues (35 percent and 43 percent) (*Hu et al., 2014*). Overall intersections delays increased (12 percent and 22 percent), due to slightly longer delays on the major approaches as vehicles slowed to enter the roundabouts.

Because roundabouts improve the efficiency of traffic flow, they also reduce vehicle emissions and fuel consumption.

Installing roundabouts in place of traffic signals or stop signs has been found to reduce carbon monoxide emissions by 15-45 percent, nitrous oxide emissions by 21-44 percent, carbon dioxide emissions by 23-34 percent and hydrocarbon emissions by 0-40 percent (*Hu et al., 2014*; *Várhelyi, 2002)*.

Constructing roundabouts in place of traffic signals or stop signs reduced fuel consumption by an estimated 23-34 percent (*Hu et al., 2014*; *Várhelyi, 2002*; *Höglund & Niittymäki, 1999* PDF).

A 2005 Institute study documented missed opportunities to improve traffic flow and safety at 10 urban intersections suitable for roundabouts where either traffic signals were installed or major modifications were made to 10 intersections with signals (*Bergh et al., 2005*). It was estimated that the use of roundabouts instead of traffic signals at these intersections would have reduced vehicle delays by 62-74 percent.

Based on the results of that study, we estimate that the conversion of 10 percent of the signalized intersections in the United States to roundabouts would have reduced vehicle delays by more than 981 million hours and fuel consumption by more than 654 million gallons in 2018.

Public opinion

Drivers may be skeptical of or even opposed to roundabouts when they are proposed. However, several IIHS studies show that opinions quickly change when drivers become familiar with them.

- In three communities where single-lane roundabouts replaced stop sign-controlled intersections, 31 percent of drivers supported the roundabouts before construction, compared with 63 percent shortly after (*Retting et al., 2002*).
- In three other communities where a one- or two-lane roundabout replaced stop signs or traffic signals, 36 percent of drivers supported the roundabouts before construction compared with 50 percent shortly after (*Retting et al., 2006*).
- Follow-up surveys conducted in these six communities after roundabouts had been in place for more than one year found the level of public support increased to about 70 percent on average (*Retting et al., 2007*).
- When two intersections near Bellingham, Washington, were converted to two-lane roundabouts, support for the roundabouts went from 34 percent before construction to 51 percent six months after and 70 percent more than one year after (*Hu et al., 2014*).

Effect on older drivers

Older drivers are more likely than other drivers to be wary of roundabouts, but they also are particularly likely to benefit from them in terms of improved safety. Relative to other age groups, senior drivers are over-involved in crashes occurring at intersections. In 2021, multiple-vehicle crashes at intersections accounted for 39 percent of fatal crash involvements among drivers 80 and older, compared with 22 percent for drivers ages 16-59.

Older drivers' intersection crashes often are due to their failure to yield the right-of-way (*Mayhew et al., 2006; Braitman et al., 2007*). Since all traffic flows in the same direction at roundabouts and more slowly than at traditional intersections, the consequence for failing to yield is likely less severe at roundabouts. Particular problems for older drivers at traditional intersections include left turns and entering busy thoroughfares from cross streets. Roundabouts eliminate these situations entirely.

Although safety effects of roundabouts specifically for older drivers are unknown, a 2001 IIHS study of 23 intersections converted from traffic signals or stop signs to roundabouts reported the average age of crash-involved drivers did not increase following the installation of roundabouts. This suggests roundabouts don’t pose a problem for older drivers (*Retting et al., 2001*).

A study in six communities where roundabouts replaced traditional intersections found that about two-thirds of drivers 65 and older supported the roundabouts (*Retting et al., 2007*). A study of two intersections converted to roundabouts near Bellingham, Washington, found that about two-thirds of drivers 70 and older favored the roundabouts one year after construction (*Hu et al., 2014*). In both studies, the older drivers were less likely to favor roundabouts than younger drivers.

In another study, signs and pavement markings that improve the path and operational guidance were found to increase the comfort, confidence and perception of safety for drivers ages 65 and older (*Lord et al., 2007*). For example, a yield sign could have a plaque underneath reading "to traffic in circle," and an advance warning sign could have a plaque with the word "roundabout."

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