Escalating Roundabouts: Cutting Corners to Save Lives

By Phil Rust and Lindsey Van Parys

Roundabouts save lives. The more severe the collision, the less likely it is to occur with a roundabout in place. According to the American Association of State Highway and Transportation Officials (AASHTO) Highway Safety Manual, roundabouts reduce the most severe crashes by about 80 percent when compared to conventional stop-controlled and signalized intersections.¹
For vehicles and cyclists, the magic behind roundabouts’ life-saving abilities lies in the self-enforced low speed entry and elimination of right-angle interactions. For pedestrians, it is the low speeds, separation between crosswalk and circulatory roadway, the crossing refuge (which allows people to cross only one direction of traffic at a time), and the direct interaction between driver and pedestrian. The ability for a roundabout to save lives depends on these features being present and well-designed.

Compared to a traffic signal, a roundabout is also usually more efficient, longer lasting, and better looking. (Okay the last one is a bit subjective.) A roundabout can cost more than a traffic signal, but still competes well on value, and costs are dropping.

**Key Message**

As more roundabout designers learn how to reduce costs without sacrificing performance, almost every roundabout will be competitively priced. Did new roundabouts outnumber new traffic signals in your jurisdiction last year? Will they next year? Combined with their outsized value, a competitive price will set roundabouts on a path to eventually replace most traffic signals in the United States, even before those signals reach the end of their lives. As quickly as this turnover occurs, severe injury and fatal intersection collisions will become as rare in the United States as they are in Sweden.²

**San Diego, CA, USA Vision Zero Project Example**

The City of San Diego, CA, USA is a Vision Zero city. The city’s first Vision Zero infrastructure project—selected by the California Department of Transportation (Caltrans) and the Federal Highway Administration to receive highway safety funds—is a set of three roundabouts in a half-mile corridor that moves more than 20,000 cars every day. This corridor has one of the worst pedestrian safety track records in the city, and the three roundabouts (replacing two traffic signals in a coordinated system) will slow traffic without hurting travel times and make it significantly safer for pedestrians to cross.

The corridor is completely built out, so acquiring surrounding property to accommodate the roundabouts is pricey and would have delayed the project by at least a year—not exactly compatible with the urgency of Vision Zero. The roundabouts therefore will all have to fit within existing right of way. The intersections measure about 100 feet diagonally, so only a single lane will fit. They also have to accommodate semi-trailers. Many hours were spent measuring trucks on the corridor to learn what size trucks need to turn, and which ones only go straight. The resulting layout will comfortably accommodate all design vehicles, and the side street splitter islands are fully mountable for unexpected semi-trailers (see Figure 1 of a King County, Washington mini-roundabout that also uses fully mountable splitter islands). Most of the vehicle traffic goes straight, and the side streets are already low-speed, so side street deflection is compromised in order to allow better speed control on the major street than would otherwise be possible in these cramped quarters.

The three critical performance measures for this design are major street speed control, major street capacity, and comfortable accommodation of all design vehicles. The ability to compromise less critical measures (like side street speed control and side street capacity) allowed the design to meet the critical ones and fit in a very tight space, costing far less and saving a year. Without this, the project would not have included any roundabouts, hobbling its ability to improve safety.

**Other Cost-reduction Examples**

Savings aren’t limited to urban settings. This section provides a wide range of examples of how designers can reduce roundabout costs without sacrificing performance.

Pervious areas within the center island, splitter islands, and sidewalk buffers can be used to handle storm water runoff, reducing the cost of off-site mitigation measures if required.

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**Figure 1. Example of a mini-roundabout at SW 100th St & 10th Ave SW, Seattle, WA, USA that uses fully mountable splitter islands.**

[King County]
Curbs are used to control speeds at roundabouts. The outer curb can often mean adding a drainage basin to the cost of a rural roundabout. One option that doesn’t compromise speed control is to provide cuts for drains every so often along the outer curb line. The intersection of Best Road and McLean Road in Skagit County, WA, USA is a great example of this (see Figure 2).

While a reverse curve is used to slow a high-speed approach, this feature is expensive. Without a reverse curve, designers can still slow the approach using a conspicuous center island profile (daytime visibility) combined with illumination, reflective stripes and signs (nighttime visibility), and a well-designed entry curve.

Extra-wide lanes are used at two-lane roundabouts to allow semi-trailers to stay in their lane. This is also expensive. Narrower lanes reduce speeds, further improving the safety of two-lane roundabouts, especially for pedestrians and cyclists. Using narrower lanes that require semi-trailers to straddle both entry lanes can significantly reduce cost while also improving performance for all users including semi-trailers. Turning semi-trailers don’t stay in their lane at traffic signals, and they prefer to straddle both lanes at roundabouts as well.1

Some roundabouts have more lanes than they need. This is expensive—and tricky. Estimating how long a single lane roundabout could last and designing it to expand later can help. Bypass lanes or metering during rush hour can also extend the life of a single lane roundabout. Just because the volume-to-capacity ratio (v/c) reaches some magic number during a future hypothetical rush hour doesn’t mean another lane is needed right away. How many traffic signals exceed that magic number today? The v in v/c can be quite fuzzy. A lot depends on the planning model. The c can also be fuzzy. To start it depends on v, but it also needs to be calibrated to local conditions. This is true whether a micro-simulation or a deterministic equation is used. Caltrans offers a great example of calibration for local conditions in the final report of its Roundabout Geometric Design Guidance.4

There are many more examples like these. Roundabouts are inherently flexible, and experienced, creative designers can fit them around quite tricky constraints while keeping them safe, efficient, and delightful to drive through.

The Tipping Point
When roundabouts reliably cost less than traffic signals, the decision to implement them becomes simple. It is far easier to go with the cheapest option than it is to ask for more money and defend it, especially when that defense is complicated, includes assumptions and estimates, and the majority of the added value benefits users and doesn’t show up on the agency balance sheet. Roundabouts will soon reliably compete on price. The goal is for all roundabout designers to achieve this cost parity without sacrificing performance.

Accelerating the Implementation of Roundabouts
The trend toward lower cost is primarily driven by roundabout designers’ continuous improvement and lifelong learning from experience, but we can help and accelerate this trend, leading to broader roundabout implementation. Here are a few ways the following groups can help save lives through implementing roundabouts.

Planners:
- Include specific roundabout locations and layouts in community and master plans. Even if they are only potential locations, agencies can leverage developers to set aside the right land early, greatly reducing cost when it is time to build the roundabout.
- The Ada County Highway District in Idaho offers a great example of right-of-way preservation in its Roundabout Preservation Map, Final Report.5

Public Agencies:
- Integrate the roundabout option fairly into your existing intersection alternative selection process using some form of intersection control evaluation (ICE). Caltrans offers a great example of this on its ICE website.6 Evaluate the roundabout option fairly before deciding whether or not to rule it out.
- Create a roundabout program or policy that ensures roundabouts are a healthy part of your capital improvement program.
- Designate a single person to be the subject matter expert for the agency. Invest in their roundabout education, and take their advice.
- Enlist the help of experienced roundabout designers during the earliest conceptual stages to ensure the roundabout option meets your performance objectives with an accurate cost estimate prior to making a comparison/decision.
- Keep standards flexible. Roundabouts can be molded to fit the needs of many unique sites, and don’t even need to be perfect

Figure 2. Example of providing cuts for drains at Best Road & McLean Road, Skagit County, WA, USA.
circles. Focus on safety and performance metrics like speed, design vehicle accommodation, and path alignments, not on individual elements like lane widths, curb radii, entry angles, etc.

- Seek experienced roundabout consultants/designers/reviewers who embody lifelong learning and teaching. Challenge them to help you cut cost without cutting performance. They will often get to a higher-performing design with fewer iterations and respond to comments in a way that allows everyone to learn comfortably.

Researchers and Educators:
- Study the wide range of design strategies used to cut roundabout costs, in order to clarify their effects on Vision Zero-related performance measures.
- Collect data on the disparity between average roundabout and traffic signal costs (excluding outliers) stratified by agency. This will help counter the perception created by multi-million dollar roundabouts.
- Teach your students the basic principles of modern roundabouts.

Designers:
- Improve continuously. Learn relentlessly and share what you learn generously.
- Make the effort to obtain data before the project is built, then measure the performance of your design once it is built. What can you learn that will make your next design better?
- Listen carefully to other designers, make sure you understand the less obvious constraints they were bound by when measuring the performance of their designs. What can be learned that will make your next design better?
- Take the initiative to share what you are doing and learning through webinars, workshops, community posts, and professional meetings. Your work may even become part of the next iteration of design guidance. (Keeping this valuable information to yourself slows progress toward cost parity with traffic signals and ultimately shrinks the size of the roundabout market you will be able to compete for over your lifespan.)

Fine Print
There will always be resistance to change from a variety of sources, so the shift to implementing more roundabouts won’t come overnight or without effort and losses.

Traffic signals and roundabouts have different footprints, so even when average roundabouts are cheaper than average traffic signals, individual outliers will continue to exist, and those roundabouts will continue to compete well on value.

Regardless of cost, there will always be intersections where a roundabout is not the best form of intersection control. These intersections don’t lend themselves to the rules of thumb that some lists suggest, but they do exist. When in doubt, please consult an experienced roundabout design engineer.

Conclusion
With the Vision Zero movement, public agencies are seeing that roadway infrastructure change is urgently needed to save lives. Roundabouts make a great part of any long-term strategy for achieving Vision Zero.

Many roundabouts are currently being over-designed and over-built. This leads to greater costs and fewer safety benefits (due to higher speeds), which is slowing the shift from roundabouts being an alternative to them being the norm. As engineers continue to learn and refine the balance needed to create low-cost, high-performing roundabouts, they will soon reach cost parity with traffic signals, and eventually most traffic signals will end up becoming roundabouts. itej

References
6. www.dot.ca.gov/trafficops/ice.html

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