Alternate Traffic Control: Roundabouts, by Michael J. Wallwork, P.E., Genesis Group, Inc., Jacksonville, Florida

Is there an alternate to traffic signals that has the safest form of conflict/intersection control, that has the lowest delay and can be landscaped? Roundabouts are all of these things and some information about them is below. Don't let other engineers send you around in circles!

Advantages of Roundabouts

Safety: roundabouts in the USA and other countries have achieved a 50 to 90 percent reduction in collisions compared to intersections using 2- or 4-way stop control or traffic signals. Pedestrian/vehicle and bicycle/vehicle collisions at roundabouts are rare.

This reduction in crashes occurs for several reasons:

- The number of possible conflict points between vehicles decreases from 32, at a 4-way intersection, to 8, at a roundabout. By reducing the number of conflict points the number of collisions is reduced.
- Vehicle speeds at roundabouts are much lower, generally less than 40 kph. Lower speeds means shorter braking distances and longer decision making time. Therefore, even if someone makes a mistake, a collision is easier to avoid.
- Easier decision making, a driver about to enter has one decision: "Is there a vehicle circulating in the roundabout blocking my path?" If not, the driver enters, otherwise the driver waits for a gap.

If a collision does occur at a roundabout the impact is much lower due to lower speed and angle of impact.

At signalized or stop controlled intersections about 53 percent of all collisions involve left-turn or right-turn collisions. They occur because a left turning driver misjudges the approaching gap in vehicles, and/or the speed of approaching vehicles. A right-angle collision occurs when a driver "runs a red light" or a stop sign and collides with a vehicle using the intersection legally.

Neither type of collision is possible at a roundabout. Fatal collisions are unlikely compared to other types of intersections because of lower speed and angle of impact.

Operating and Maintenance Costs: Simple signalized intersections cost about $3,000 (US) per year for electricity, maintenance of loops, controller, signal heads, timing plans, etc.. In addition, signal heads and controllers have to be replaced and completely rebuilt on a regular basis. Larger signalized intersections are more expensive to maintain. The only maintenance costs for a roundabout are for landscape maintenance and occasional sign replacement.

Construction Costs: Small roundabouts only cost several thousand dollars. Larger roundabouts can cost as much or more than a set of traffic signals. Even if the construction cost for a roundabout is higher than traffic signals, a life cycle economic analysis including construction, operation, maintenance and collision cost reduction of each type of control will usually show the roundabout has a higher benefit/cost ratio.

Capacity: The capacity of a roundabout will usually be higher than a signalized intersection because there are no yellow and red times (lost time). Vehicles can enter from each leg simultaneously. At signalized intersections, vehicles can only enter from one or two legs simultaneously as each movement or pair of movements are separated from each other in time.

Towards the end of a green phase gaps between vehicles increase. As the vehicle green phase times get longer, headways can get longer, and, as more and more signals are coordinated substantial gaps develop between vehicles. In each case, cross traffic cannot take advantage of these gaps. Whereas a driver waiting at a roundabout can enter any gap in circulating traffic that is large enough.

Although the usual assumed gap size for calculation purposes is 4 seconds, many drivers enter gaps as low as two seconds, thereby providing a better level-of-service than the calculated value. Conversely, as the design speed of roundabouts (and hence the speed of circulating vehicles) increases, drivers will wait for larger gaps. A single lane 4 leg roundabout in Daytona Beach, Florida handles 2,832 vph at a high level of service, which is beyond the theoretical value.

Delay: Because of the higher capacity of roundabouts, delays are always shorter. Often entering drivers do not stop. Many drivers adjust their speed to take advantage of approaching gaps in circulating traffic, particularly in the off-peak period. If there is no traffic in the roundabout, they don't have to stop.

Helps Control Excessive Vehicle Speeds (Traffic Calming): Enforcement of vehicle speeds in residential streets is not cost effective using already stretched police forces. A series of roundabouts will provide effective speed control along residential streets by physically reducing all vehicle speeds.

Liability: Traffic signals are a substantial liability for the operating authority. Attorneys often try to prove traffic signals were faulty and therefore the cause of their client's accident. In other words, drivers are not responsible for their behavior because "the traffic signals cause accidents".

At a well-designed roundabout, liability for entry collisions rests with the entering driver: the driver failed to yield to the circulating vehicle. In the other common type of collision, the rear-end, the following driver is at fault for following too closely. At a multi-lane roundabout a merge type crash responsibility rests with the driver who incorrectly changed lanes.

Self Regulating: Traffic flows change with time and development. To provide optimum operation, traffic signals need to be retimed regularly. As traffic volumes increase, especially cross-traffic volumes, additional intersection lanes need to be added so the intersection capacity can approach that of the mid-block segment. In most cases the whole road is widened. In contrast, the capacity of a roundabout can approach the mid-block capacity of the intersecting roads. Although as the cross-traffic volumes increase, short approach lanes and/or an additional circulating lane may be added. The resulting roadwork and right-of-way requirements are much less than for the signal controlled intersection. Generally a well designed roundabout closely matching approach and mid-block capacity, rarely needs altering, except where the road is widened and the number of approach lanes increased.

Congestion Control at Urban Interchanges: The efficiency of roundabouts increases as left turn volumes increase. Vehicles turning left break up the opposing through flow and create gaps for the minor traffic to enter. Urban interchanges with high left turn volumes can be successfully controlled by either a roundabout at each set of ramps or by a large roundabout encompassing the whole interchange, usually within the normal right-of-way.

Low Cost Method to Increase Level of Service: Inadequate intersection capacity is the major cause of a road having a low level of service. A roundabout, because of its higher capacity, is a low cost way to increase level of service, especially where left turn volumes are high.

Provides Level of Service Without Signalized Intersection Spacing Losses: Traffic signals spaced closer than about one half mile apart create problems in maintaining smooth flow in both directions. A roundabout can sometimes reduce this problem by reducing the number of stops.

Provides Equal Access: The timing of traffic signals usually favors the major movement to the detriment of the minor flows. Roundabouts usually provide each driver with an equal opportunity to enter, depending on the availability of gaps, irrespective of the entry location.

Improves Perception of Trip Time: The psychological as compared to the actual trip time is perceived to be three times greater for a driver stopped than moving. Roundabouts can significantly reduce stops compared to stop signs and signalized intersections. Drivers will feel less frustrated with the reduction of stop time even if the total travel time is not reduced.

Improves Level of Service In Conjunction With Improved Access Management: Medians are an important strategy for access management. But they increase the number of left turn movements at signalized intersections and hence the likelihood of left turn collision. Increased left turn volumes will also decrease the intersection's level-of-service. Roundabouts, in contrast to signalized intersections, become more effective as left turn movements increase, providing a better level-of-service. Left-turn traffic breaks up the approaching traffic flows creating gaps for the minor flow.

Improves neighborhood appearance: Speed humps or other neighborhood traffic control devices can be an admission of a traffic problem in the neighborhood. Whereas roundabouts, particularly if landscaped, can be seen as streetscape improvements.

Disadvantages of a Roundabout

Roundabouts are very effective in many intersections but are not a panacea. They are another useful tool to be considered when designing an intersection or traffic-calming scheme.
They are not suitable under the following conditions:

- The major road carries a very high through volume, with a minimum volume of left turn traffic, and intersecting roads have a low volume.
- If there are insufficient gaps in the major flow the minor flow will have difficulty in entering the roundabout. In this case, the traffic mix between approaches is not high enough to force the necessary gaps in the major traffic flow. In some cases it may be useful to signalize one approach to a roundabout to create gaps for another leg for an hour or so in one of the peak periods.
- The traffic volumes are very high, say 6,000 vph. In this case a very large signalized intersection is necessary to separate vehicles in time. Alternatively, an overpass is probably more suitable and safer.

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