SAN LUIS OBISPO COUNCIL OF GOVERNMENTS

STAFF REPORT

MEETING DATE:	**October 4, 2006**
SUBJECT:	**Roundabouts in lieu of Signalized Intersections & Interchange Expansion**

SUMMARY

Roundabouts are fast becoming the preferred alternative to stop/signal-controlled intersections for planners and engineers throughout the United States. They also have proven extremely effective in improving operations at interchanges at far less costs than interchange reconstruction. Countries such as England, France, Australia and Germany have long been using modern roundabouts (not traffic circles) to greatly enhance public safety and significantly reduce driver delay. Ubiquitous throughout Latin America, well designed modern roundabouts slow traffic, allow safe access for bicycles and pedestrians and have far fewer accidents than signalized intersections. States such as Colorado, Kansas, Wisconsin, Florida, Washington, Oregon and Maryland are all promoting roundabouts as the evidence is strong that safety and operations improve once they are implemented. Furthermore, while initially the public may question whether roundabouts will work, well-designed roundabouts on the ground are powerfully convincing of their utility. Most citizens who get the chance to use them regularly become staunch supporters.

RECOMMENDATIONS

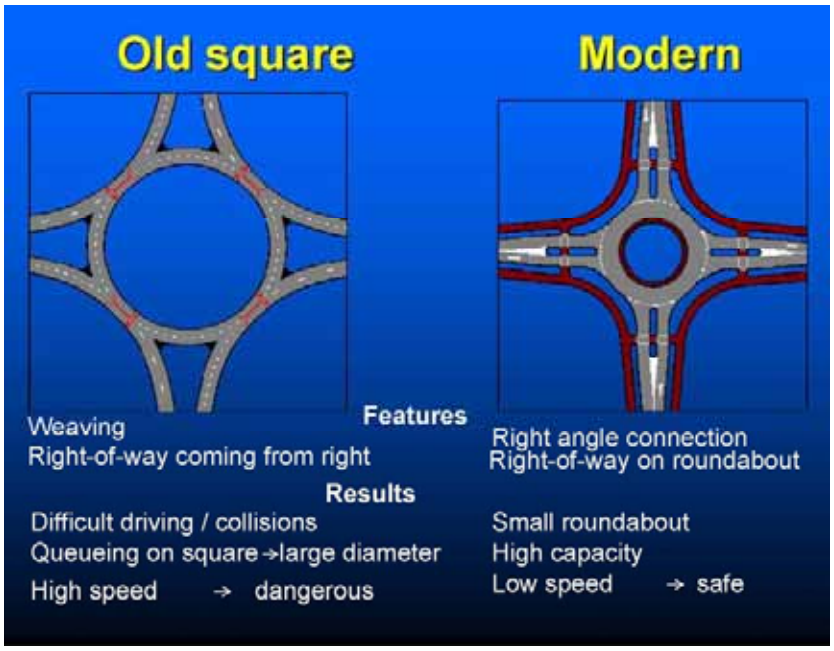
Staff: Receive information; build Roundabouts where appropriate; suggest presentations to local Planning Commissions and City Councils.

CTAC/TTAC: Reviewed and commented, general support.

BACKGROUND

What are Roundabouts? What are they not?

Modern roundabouts are intersection control devices, serving similar purposes as signals or stop signs. However, roundabouts eliminate high speed collisions (such as head-on and broadside) and require traffic to slow down on approach. While signage, roadway width and deflection angles are critical, what distinguishes modern roundabouts from old time traffic circles is that entering traffic must yield to circulatory flow. This is a critical feature. If a vehicle (or bicycle!) is already in the roundabout, the entering vehicle waits at the yield line for an appropriate gap to enter. Once inside the circulatory flow, vehicles proceed to their desired exit and, watching for bicycles and pedestrians, exit back onto the travelway in their desired direction.

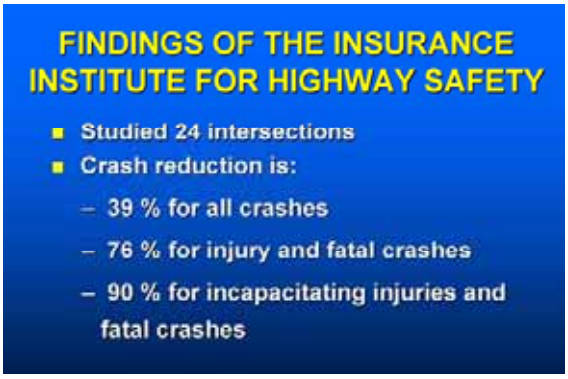


Modern roundabouts can be single lane, multi-lane or as many as 4 lanes of circular roadway. They are generally 70-200 feet in diameter, taking up about the same amount of space as a 4 way, signalized intersection. Old style rotaries or traffic circles were high-speed facilities, where circulatory traffic yielded to entering traffic and dimensions were more commonly 300-600 feet in diameter. Speeds were high, and accidents were frequent. Rotaries are

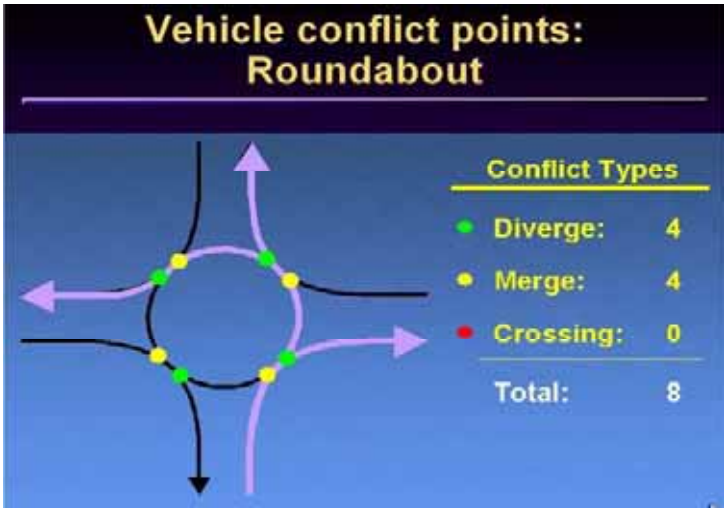
often confused with roundabouts by the lay person, and sometimes this misunderstanding can be the source for opposition. Roundabouts have long supplanted high speed, large diameter rotaries as a far superior traffic control device.

Safety

The single best reason to pursue roundabouts is simple; public safety. Public works departments and state departments of transportation around the country are realizing that they have a responsibility to pursue the safest transportation alternatives for the traveling public. For example, in Golden Colorado, four signals were converted to roundabouts. The city observed a 60% reduction in crashes and a 94% drop in injuries. There were no pedestrian accidents in the first 5 years of operation. The Insurance Institute for Highway Safety found that in 24 intersections that were converted to roundabouts, crash reductions were 39% for all types of collisions, 76% for severe injuries and 90% for incapacitating/fatal collisions.

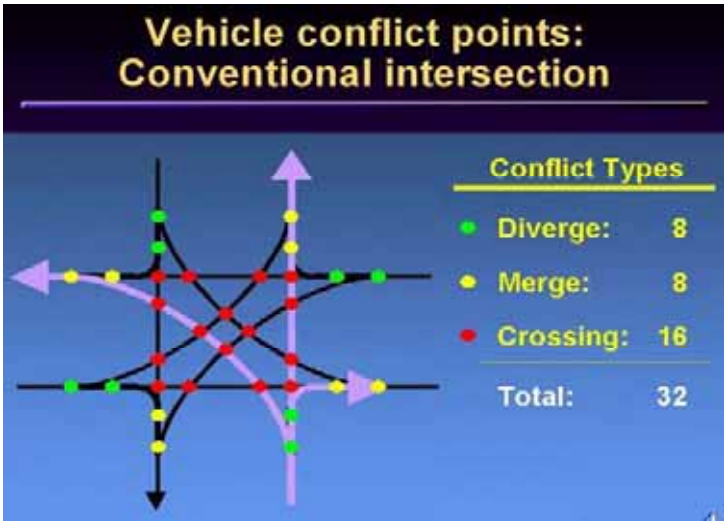


With four-way stop/signal controlled intersections, there is often an incentive to run yellow (or RED!) lights so as to not have to wait for an entire signal timing loop, roundabouts slow all traffic, so even if there are collisions, the vast majority are slow speed, fender-benders with little or no injury. Right angle collisions at high speeds are all too common at standard intersections. The Wisconsin Department of Transportation has gone so far as to require that a roundabout option be assessed and discussed in their project study reports prior to any decisions to pursue signalized intersections.



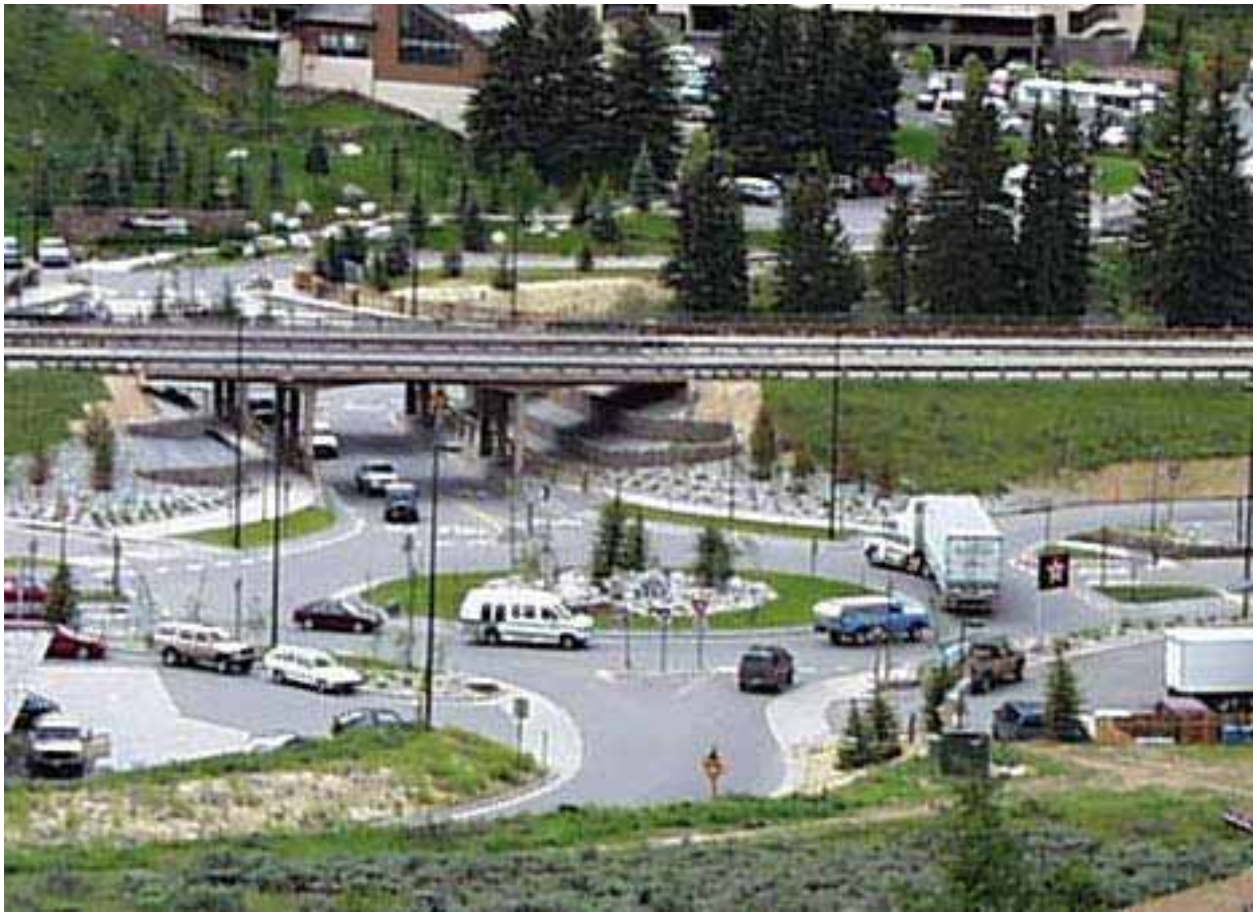
Reduced Conflicts

One of the reasons roundabouts are so much safer, in addition to lower speeds and reduction of angles, is that roundabouts have fewer possible conflict points. This means that for any given four-way intersection converted to a roundabout, the total number of locations and maneuvers that can result in collisions is reduced from 32 to 8. More importantly, the number of places where right angle (and often high speed) collisions where vehicles can “t-bone” one another drops from 16 to zero, as demonstrated in the pictorials at the right. Speeds drop, resulting in less severe collisions and due to the design of the roundabout, merge/diverge/crossing conflicts are greatly reduced. Public safety is enhanced since areas of potential collision decline.



Interchange Applications

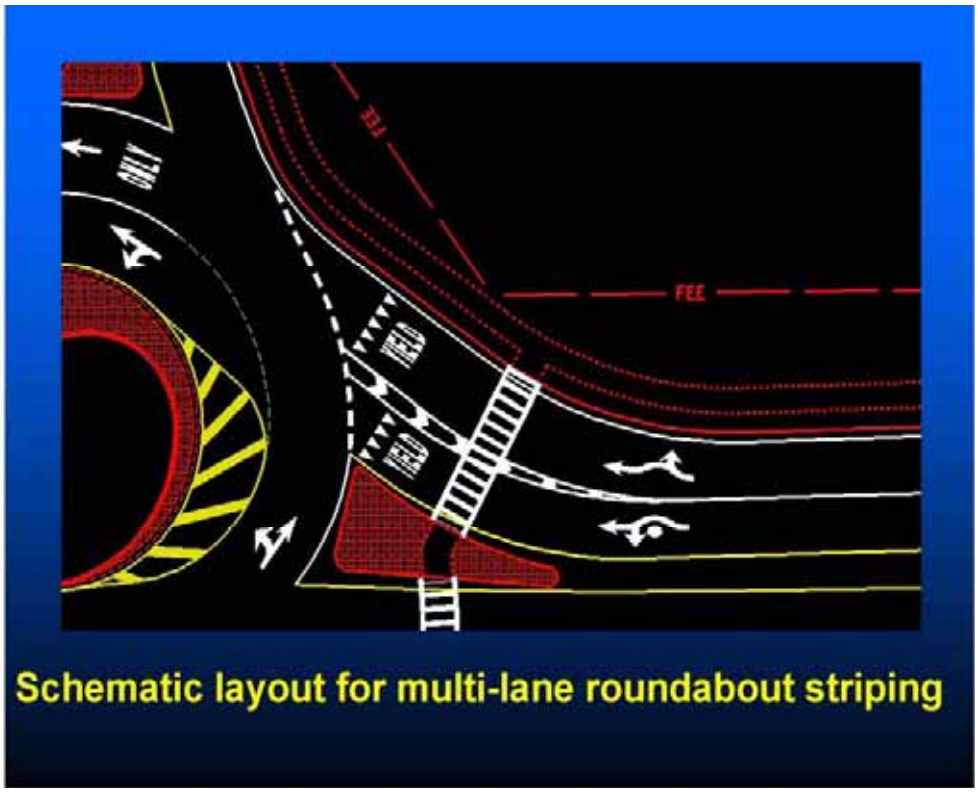
One of the best places to install roundabouts is at on/off ramps for highway interchange access. Interchanges and intersections near them are notorious for congestion problems. Roundabouts can solve this problem as they provide efficient movement of vehicles with minimal queuing. Often times, the use of signals and stop signs create long delays since so much time is needed to clear the intersections different movements. With roundabouts, most traffic gets a chance to flow through and out of the intersection. When use at ramp heads, due to “gap design”, whereby vehicles either flow slowly into the circulatory roadway or wait for a gap to form, roundabouts do a great job of dispersing cars onto the highway while getting them off the system onto the local road network. All of this has been done with great success in places like Golden, Avon, and Vail (below) Colorado as well as Truckee California.



Furthermore, using roundabouts at interchanges enables public works staff and transportation agencies to address increasing traffic volumes and congestion without the costly widening of bridge structures or the significant time delays. This saves the public millions of dollars, which in turn allows scarce transportation dollars to address a greater number of projects. Whereas a typical engineering approach would require deck or interchange expansion to allow for all turning movements on (or underneath) a bridge structure, using roundabouts at interchanges places those turning movements outside of the structure, as can been seen above. The result is efficient flow and maximal use of an existing narrow roadway.

Efficiency and Design

The FHWA publication “Roundabouts: An Information Guide” is undergoing revisions and is no longer the state of practice. It is being reviewed during 2006 with input from the MUTCD committee (Manual on Uniform Traffic Control Devices). Although the year 2000 publication is still used, many of its design guidelines are flawed. In just six years of proliferation of roundabout implementation, many lessons have been learned here in the U.S., most of which will be incorporated into the new FHWA guide. One thing that all practitioners recognize is that properly designed roundabouts are extremely efficient, and poorly designed ones can make matters worse.



In terms of efficiency, typically measured in average vehicle delay, reductions between 50% and 200% are not uncommon as waiting times are dramatically reduced with the elimination of long signal timing cycles and the ability for cars using roundabouts to insert themselves into gaps between other vehicles. Caltrans estimated for the Hwy 41/El Camino Real intersection, as part of the Hwy41/101 interchange Value Analysis, that using roundabouts rather than a signal could take some of the worst vehicle delay (which approached a 70 seconds per vehicle with the “ultimate” build) and drop that down to around 8 seconds for the average vehicle.

Regarding design, roundabouts have a great track record for reducing the number and especially severity of crashes. In the few instances where collisions go up, they are usually attributed to poor design. Appropriate design is the most important component of building a safe and efficient roundabout. Small geometric changes in entry/exit deflection angles, lane width, circle diameter/shape, striping, signage, etc, can cause major changes in efficacy of roundabout.

Roundabouts are typically more expensive to design than signals, but that cost can be made up over the life of the project. It is also important to have experts involved in the design process. Licensed, qualified engineers from the DOT will need to approve any plans on the State system. If hiring a designer from a consulting firm, be sure to select one with an established track record in various types of roundabout implementation; near interchanges, 5- and 6- legged approaches, various multilane designs, urban, rural, high-speed roadways, residential, etc. It becomes clear that there are many instances where roundabouts can work, and each requires a detailed design that caters to local conditions. As might be expected, cities are encouraged to start out with single lane roundabouts, as they are much easier to get right than larger, more complex dual and multi-lane roundabouts.

Entry volumes are critical to dictating design. Use of hourly peak volumes (NOT ADT) and paying attention to directional volumes, turning movements, etc. will influence design. As a rule of thumb, single lane roundabouts can handle up to 2,000-2,500 vehicles an hour. As an example, what some consider to be a congested intersection at Hwy 41 and El Camino Real in Atascadero currently handles just over 2,000 vehicles in the peak hour, with that number expected to climb to about 2,600 by the year 2030, well within the design parameters of a two lane roundabout. Between 2,000 - 4,000 entering vehicles an hour, most designers would suggest a multi-lane roundabout. Again, heavy right or left turn movements will influence design and roundabout type needed. Volumes, although perceived as such, are not in practice a limitation. Rules of thumb; Single lane roundies can handle up to 2,000 VPH, adding 2,000 more Vehicles per roundie lane up to 4 lane roundies handling 8,000 VHP. Multilane (1.5-2 lane) can handle up 50,000 ADT!

Pedestrians and Cyclists

One of the first questions that arises regarding multimodal use of roundabouts is what happens to pedestrians and cyclists, especially since they no longer have the ability to use signals to stop cross traffic? Most studies have shown significant safety improvements for all users of roundabouts, including bikes and pedestrians. Since all collisions tend to be at lower speeds with fewer impacts, serious injuries and fatalities drop dramatically. Pedestrian collisions typically drop when intersections are converted to roundabouts, and while bicyclist collisions can vary, cyclists do have options on how they negotiate roundabouts. Pedestrians and cyclists are not much of issue in practice, rather in perception they can be seen as problematic, especially by citizens unfamiliar with roundabout design.

Pedestrians should cross roundabout legs in two stages, using splitter islands as refuge areas. Striping and signage design for motorists and pedestrians are critical. Establishing eye contact with approaching, decelerating drivers is important. Often times, they can stop prior to the pedestrian crossing or, in the case that some queuing occurs as vehicles yield to traffic inside the circle, pedestrian crossing becomes easier. Bicyclists may chose to use the roundabouts as a car would, entering and exiting in the travel lane at similar speeds to vehicles. Or, for less experience cyclists and children, the option exists to leave bike lanes and negotiate the roundabout on pedestrian crosswalks and pathways.

Resistance… at Least at First

Getting politicians and the public to accept the idea of roundabouts can be a significant obstacle to implementation. However, once on the ground, users tend to love roundabouts as they significantly reduce delay and enhance safety. As with any new approaches, especially in the fields of design, planning, and engineering, changes to the status quo are often met with resistance. Ironically, there is little that is “new” about roundabouts. They have been used for decades and have evolved over the years, as old style rotaries and higher speed traffic circles have given way to modern roundabouts. The fact of the matter is that in most parts of the world, especially Europe, South America, and Asia, roundabouts are the most

preferred intersection control device. So why the resistance? What have states such as Wisconsin, Kansas, Colorado, Maryland, Washington and Oregon done to take the lead in implementing roundabouts?

The easiest answer is that both citizens and politicians who oppose roundabout implementation either have little knowledge about how they function, or perhaps they are unfamiliar with what appropriate design features entail. Often it is simply a fear of the unknown or a bad experience in an old style rotary which may cause initial resistance. Fortunately for planners and engineers seeking to utilize these traffic control devices, the statistics on safety, efficiency and public opinion are heavily in their favor. Without exception in communities throughout the country, once roundabouts are given a chance, as in Vail Colorado, Bend Oregon, or Golden Colorado, they are so greatly preferred over signalized intersections that a public opinion reversal occurs, snowballing into an acceleration of roundabouts implementation. In the case of the Wisconsin Department of Transportation, they went so far as to *require* that any Project Study Report in the state addressing intersections assess the feasibility of implementing roundabouts. That move may be coming for California DOT in the near future as public safety and escalating costs will likely be influencing factors. Public works directors from cities such as Manhattan and Lawrence Kansas, Bend Oregon, Truckee California and Vail Colorado have all gone out of their way to publicly express how pleased their communities are with the use of roundabouts. Greatly reduced accident rates, sharp drops in vehicle delay, traffic calming and lowering energy/maintenance costs are all measurable benefits that are difficult to argue with.

Why Not Roundabouts?

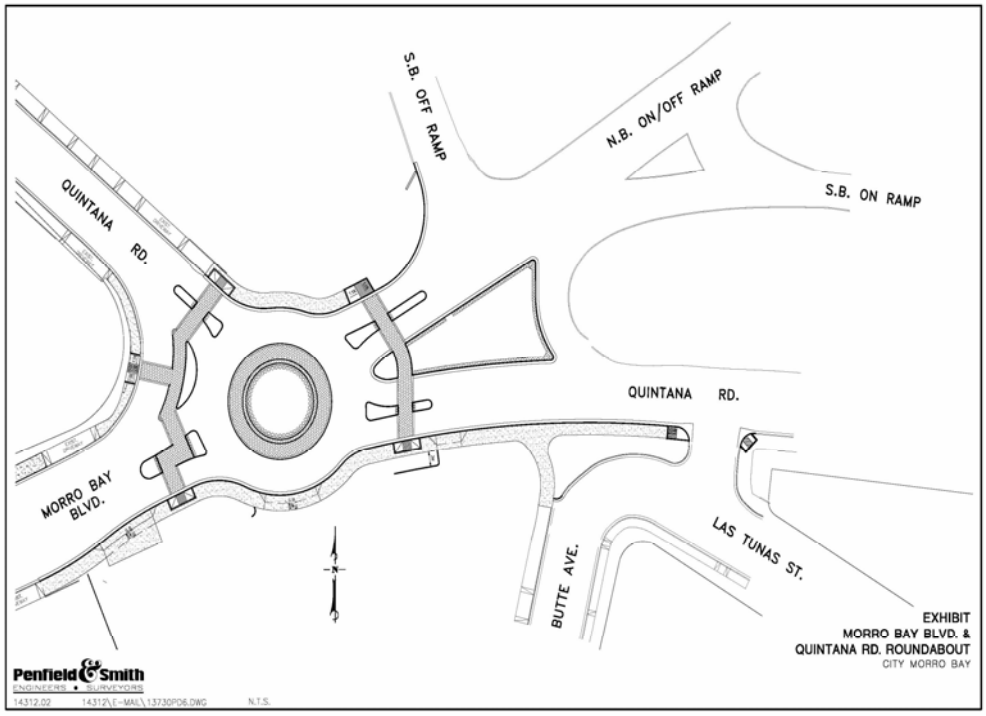
While roundabouts can be excellent alternatives to signalized intersections in urban and rural settings, as highway on/off ramps, or in residential areas, there are places where roundabouts may not be the best alternative. Locations with vertical sight distance issues are not good places for roundabouts. They tend not to work at the top of hills since drivers can't see approaching traffic. Nazir Lalani, a licensed civil engineer and deputy director of Ventura County Transportation Commission notes that there are areas for concern, such as extremely high volume intersections with peak hourly flows greater than 8,000 vehicles. In San Luis Obispo County, we don't have any intersections approaching this level of flow, and for the higher volume areas, two lanes roundabouts normally have more than enough capacity to handle up to 4,000 vehicles per hour.

Another potential drawback to roundabouts is related to right of way impacts. In today's climate of escalating land prices, roundabouts sometimes necessitate greater R/W takes than other intersection designs, especially at higher volume locations. In areas where roundabouts may be a part of future developments, it may be wise to secure R/W well in advance of construction. Depending on the terrain, a roundabout may not be suited for every location. Vertical approaches for example limit sight distance and are problematic for roundabout implementation. As mentioned in the discussion on design above, "cookie cutter" approaches will not work with roundabout layout. Since there are more ways to get it wrong than right, it is very important that the flexibility a roundabout allows not be misused, especially with multiple lane roundabouts. Small changes in design, flaring, approach deflection, striping, signage, diameter, and exit can all have serious impacts on the success or failure of a roundabout.

Local Applications

Milpas – Santa Barbara. Most locals are at least somewhat familiar with the Milpas Street roundabout in southern Santa Barbara just east of Hwy 101. This roundabout was hotly debated prior to its inception and now that it is up and operating, Caltrans is giving it mixed reviews. It definitely functions well in that it has significantly reduced delay and increased safety, but it is not without its complications. Some have criticized the oval design in that it complicates use for autos exiting and entering the circulatory roadway. A more problematic issue has been the allowance of several business driveways to remain open within 100 feet (i.e. Trader Joes) of the roundabout entrance. For large trip generators, this tends to cause problems for through traffic using the roundabout in the peak hours, as cars queue coming in and out of the driveway, especially those needing to make left turns. This can cause backups into the circulatory travelway. One other feature of the roundabout that caused some difficulty (and has since been redesigned) was the center island treatment. Originally, it did not contain any tall, solid features, and as a result some night drivers could see through the roundabout the upstream signal. This caused several accidents as drivers focused on the signal ahead and were surprised to be entering the roundabout. The center island treatment has been improved to eliminate this visual conflict. It can be done with pillars, art, mature, non-deciduous vegetation, or other features so that drivers can not be confused by lines of sight. Lessons learned; design is critical to operations and safety, be careful with high volume driveways very close to approach and exit, and the center island treatment matters.

Quintana – Morro Bay The first roundabout in San Luis Obispo County on a major arterial will be built in Morro Bay on Quintana Road just west of Hwy 1, at one of the primary gate-ways into the city. SLOCOG awarded STIP funds for this project in 2002, and after much debate within the community, it was decided that the project should move forward. At the intersection of Quintana and Hwy 1, spacing, awkward road alignment, frontage road access and commercial access currently create for a non-standard, complicated and hazardous traffic pattern.

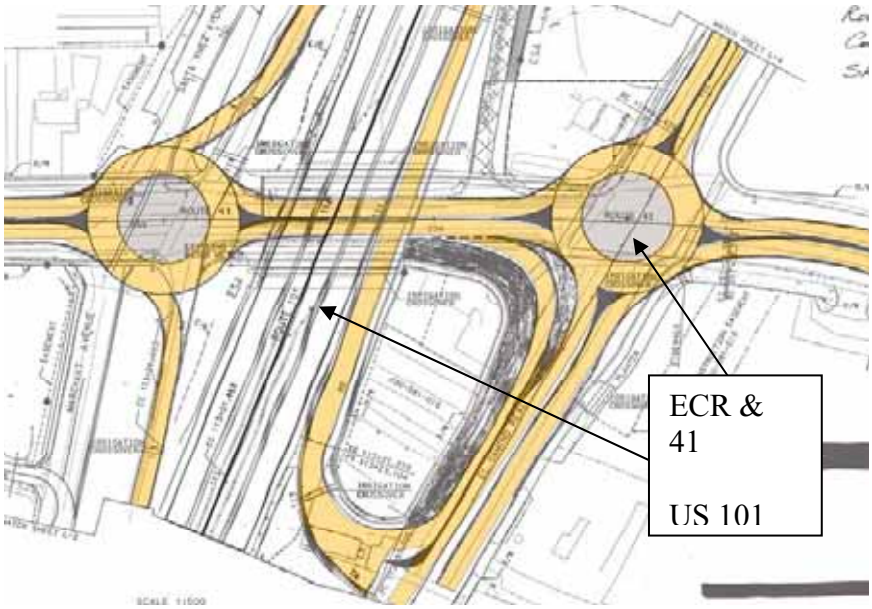


With the installation of the roundabout, drivers will have a short learning curve on how to negotiate the traffic control device, but it is hoped that safe, slow, efficient movements will soon become the norm while unneeded delays and complicated through and turning movements will be eliminated. Morro Bay's public works staff, SLOCOG, and even the California Transportation Commission (CTC – who released needed funds in 2006), are excited to see the project implemented.

Hwy 46 West – Paso Robles The city of Paso Robles is strongly considering using roundabouts to save costs, improve safety, and dramatically enhance operations at the Hwy 46 West – US 101 junction south of town. The city also has considered the standard bridge widening approach, however, that appears to have less of a return in terms of operations and may be prohibitively expensive. A Value Analysis study was performed during the environmental review phase (PAED) and it concluded that roundabouts should certainly move forward as a desired, low cost, time saving solution which could address the traffic circulation of the area. Hwy 46 West tends to experience marked peaks as travelers access the coastal areas on the weekends. With current and planned development near the interchange, a traffic solution is needed that can carry the needed volumes, keep costs low and eliminate unneeded delays as can been witnessed when cars back up onto the mainline US 101. SLOCOG staff is excited to see this alternative move forward, especially given the current trend of scarce, dwindling regional resources. It is hoped that the best engineering solution is the one pursued, and if that happens to be the one that saves the region the most money, everyone benefits since there is more money left to go around to other regionally significant projects.

Hwy 41-101 – Atascadero Originally designed as a interchange reconstruction project, once faced with severe cost escalations, the city of Atascadero, along with SLOCOG and Caltrans considered using roundabouts on either side of Hwy 41 at El Camino Real and Santa Ynez. Back in the 1990's all three agencies recognized that high volumes, a problematic left turn onto the northbound US 101 onramp and primary access into the downtown created the need to improve the interchange. Further complicating matters is the lack of spacing on the west side of the interchange between the ramps and Marchant/Santa Ynez.

A combination of delays, redesigns, CTC policies, severe construction escalations and falling regional revenues pushed this project into dire straights in late 2005 and early 2006. Estimates rose from $14 million up into the $30m+ range in a matter of a couple of years. When a value analysis team got together to determine how best to meet the project need while saving costs, not surprisingly, roundabouts came to the fore. Caltrans projected that the ultimate interchange rebuild project, 20 years outs, would result in an average delay of over 60 seconds per vehicle at El Camino Real and Hwy 41. By using roundabouts, that number was projected to fall into the 8 second range, an 86% reduction. As it turns out, the community and its elected officials didn't know to much about the roundabout functionality and were understandably a bit weary of pursuing an alternative that to them, was unproven. A greater obstacle may have been the time needed to fully redesign the construction plans (since the project was at 99% PSE) coupled with some right of way needs on a tricky site – a former gas station. In the end, cutting costs on the current design was pursued; however, all parties involved acknowledged that had the roundabouts been pursued from the onset, they would have likely provided the best solution to the congestion and circulation issues in central Atascadero.



Next Steps

The SLOCOG region will be seeing its first roundabout in just a couple of years. Morro Bay, at Quintana Road will be implementing a roundabout to deal with an awkward, multi-leg intersection that currently has spacing issues with a nearby approach street. The roundabout alternative will make this intersection function much more efficiently. The City of Paso Robles is also considering implementing roundabouts at the Hwy 46 West interchange on both the east and west sides of US 101. Far cheaper the rebuilding the existing bridge and widening roadways, it is hoped that the roundabout alternative can save costs (millions of dollars), right of way, and improve operations while minimizing construction impacts. These should be some exciting changes in transportation engineering for San Luis Obispo County, and a sign of things to come.

The research on the topic of roundabout is quite convincing, with organizations such as the American Institute of Certified Planners, the Transportation Research Board (TRB), and the Institute of Traffic Engineers all in agreement about the benefits of roundabouts and the likelihood of their proliferation. One critical step, of course, is public education. Until citizens and elected officials become more aware of the benefits of roundabouts, their low cost and high return on safety and operations, they are likely to withhold the needed political support to get them on the ground.

Of course there will be some locations where roundabouts may not be the best solution. In those cases, our local expertise should be more than capable of coming up with feasible alternatives. But with a list of benefits ranging from improved safety through fewer and less severe collisions, improved circulation, reduced delay, to time and money savings and improvements in air quality, implementing roundabouts is likely to become the wave of the future in the U.S. SLOCOG staff hopes to be working with Caltrans District 5 and all member agencies to further explore the potential for roundabouts as traffic control devices for our region.