Mini-Roundabouts

The benefits of roundabouts with a smaller footprint and lower cost

Will Stein, P.E. | FHWA—Minnesota Division

In each issue, the INCITER features an article coordinated by one of NCITE’s technical committees. This article is a contribution from the Geometric Design Committee.

The Minnesota Department of Transportation, Cities, Counties, and the consultant community have made great strides in utilizing a broader range of intersection types to solve transportation problems in Minnesota. By the end of the 2017 construction season, MnDOT and local agencies will have constructed 17 Restricted Crossing U-Turn (RCUT) intersections, six Diverging Diamond interchanges (DDI), two continuous Green T intersections, and over 100 roundabouts.

Another innovative solution that has gained a foothold in the State are mini-roundabouts. By the end of the 2017 construction season, eight mini-roundabouts will be in operation with several others programmed or in the planning stages.

(Continued on page 8)
# EXECUTIVE COMMITTEE

<table>
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<th>Role</th>
<th>Name</th>
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# STUDENT CHAPTERS

<table>
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<th>University</th>
<th>President</th>
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<tr>
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# MIDWESTERN ITE

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Mike Martinez, 2017 NCITE President

As I reflect on the first seven months of my term as NCITE president, I can summarize my tenure so far in one short sentence. This is fun! A few hours ago, I landed in Toronto eager to experience my first ITE International Annual Meeting. The meeting facilities are top notch, and I can’t wait to explore this worldly city with old friends and new.

My last message left off right before our May section meeting. Since then, we’ve had some fun. Our May section meeting was held at a new venue for NCITE, but familiar to many of you who have enjoyed drinking beverages out of a German boot. Gasthof Zur Gemutlichkeit was a great host, and NCITE members and guests packed the dining area. Feedback from the event was extremely positive and we will be adding this site to our recurring section meeting options.

The board continued to meet in June and July to ramp up towards our next big event. As some of you recall, we’ve previously held separate summer social and scholarship fundraising events. One of the two was usually very well attended and financially profitable, but it was sometimes difficult to break even financially or attract a full house at the second event. This year, we decided to put all our efforts into a combined event. I arrived a little late due to work commitments, and was a little anxious to see the turnout. While we were holding the event at the popular Fulton Brewery in downtown Minneapolis, rain was in the forecast and our members have many professional and personal commitments to juggle over the summer months. I was stunned by the attendance. We had packed the place! The trivia event was in full swing, and much fun was being had by all. I took one of only two available seats in the banquet room and was immediately introduced to two new (to me) colleagues. As trivia wrapped up, I mingled around the room and was enthused by the variety of attendees. Public sector, consultants, young professionals, engineers, planners, long-time members, potential new members - it was a great cross-section of our industry. And we had fun! Abby Rieckman was the lead director for this event and knocked it out of the park! With help from the trivia MC and his microphone, she sold every single raffle ticket. I would also like to thank everyone that purchased the raffle tickets and of course, the generous sponsors who supplied the door prizes.

Time to head off to the First-Timer Attendee Reception! I assure you that I and the many attendees from NCITE and MWITE will be taking good notes on how to make next year’s International Annual Meeting in Minneapolis a truly memorable (and fun!) event. Stay tuned for more details. Our Local Arrangements Committee will be kicking the planning into high year as soon as the event in Toronto has concluded.

Sincerely,
Mike Martinez, HDR
2017 NCITE President
UPCOMING EVENTS

TZD Stakeholders Breakfast
January 24, 2018
Minnesota Safety Council | St Paul, MN

2018 Minnesota Transportation Conference
February 27-March 1, 2018
Verizon Wireless Center | Mankato, MN

2018 ITE Annual & Midwestern District Meeting
August 20-23, 2018
Hilton | Minneapolis, MN

For professional development opportunities:
http://nc-ite.org/content.php?page=Professional_Development_Meetings

NCITE Calendar:
http://nc-ite.org/calendar.php
The May Section Meeting was held on May 10, 2017 at Gasthof Zur Gemutlichkeit, in Minneapolis, MN. The meeting topics included: general items, news on the upcoming Annual meetings for both International ITE and Midwest ITE. ITE is looking to amend its constitution to widen membership beyond Planners and Engineers to incorporate professionals working within the Transportation Industry.

The presenter was Brad Estochen of MnDOT and Max Moreland of Spack Consulting, presenting on Median Acceleration Lanes (MAL). Highlights of the presentation included:

MAL Definition: Acceleration Lanes on the inside of main line to allow vehicles entering from the side street to accelerate and weave at full speed.

Key Questions:
- When are Median Acceleration Lanes used?
- What is the difference in usage between cars and trucks?
- Does the amount of traffic (during peaks, on the mainline, or on the side streets) influence their use?
- Do historic crash records show an improvement in safety?

Study Purpose
- Currently limited experience with MALs but position in Road Design manual encourages use...."where appropriate."
- Road Design Manual provides desirable lengths for MALs but are they appropriate?
- Can better guidance be presented on when and when not to consider MALs.

Safety Impacts:
- Fatal and serious Injury crashes decreased with use.
- Rear end crashes increased with use.
- Side swipe / same direction crashes stayed consistent.
- Right angle crashes stayed consistent.

Analysis
- Most vehicles use MAL.
- Most do not use entire length.
- MAL usage during peak hours higher than over course of day.
- Not a strong correlation between main-line AADT and MAL usage.
- 50% decrease in fatal and severe injury crash rate.
- 18% increase in the overall total crash rate.

Conclusions
- MALs are used by a majority of drivers.
- Some similar findings compared to previous study of MALs.
- Appear to decrease fatal/severe injury crashes.
- More work needed.
Thank you to those who attended the NCITE YMC bike tour around Minneapolis in June. The weather was beautiful the night of the tour as we biked from Northeast Minneapolis across the Stone Arch Bridge into Downtown Minneapolis. We hope you learned a couple new things about the bicycle transportation infrastructure around the Twin Cities, and enjoyed some local brews among the company of fellow young transportation professionals.

The NCITE YMC will have a September event that will consist of a tailgate for a Minnesota Gopher football game and tour of the event management facilities. Stay tuned for additional details!
ITSO has enjoyed an exciting summer so far with a first place finish in ITE’s Midwestern District Collegiate Traffic Bowl. Team members included Joshua Tarr, Kristin Carlson, Benjamin Nault-Maurer, Jacqueline Nowak, and Cameron Valuch. We are excited about our win at Midwest ITE, but even more excited that more students were involved from our chapter this year. We traveled to Toronto at the end of July to compete in the International Collegiate Traffic Bowl.

The University of Minnesota ITSO team didn’t make it to the finals, but we have had a lot of fun meeting other teams and competing at the international level. We are looking forward to helping plan student events for next year’s annual meeting in Minneapolis.
Characteristics of Mini-Roundabouts

Mini-roundabouts are most often used on urban and suburban collectors and should not be confused with small traffic calming circles that are sometimes used on residential streets. They can provide similar safety and operational benefits to standard roundabouts but on a much smaller footprint—normally within the area of the existing intersection. They are also more cost effective. Costs vary depending on the site, but a general cost for a mini-roundabout is around $200,000. Standard roundabouts can be $1 million or higher, particularly for multi-lane roundabouts and roundabouts with significant approach reconstruction.

Characteristics of mini-roundabouts include:

- Smaller size. The inscribed circle diameter is less than 90 feet. Acquiring additional right-of-way is normally not needed.
- Raised but traversable central island. A raised island provides physical channelization to reduce vehicle speeds. But the island is designed to be traversable, with no signs, landscaping, or other vertical objects. This allows trucks and other large vehicles to off-track over it, particularly for left turns.
- Splitter islands at the roundabout entrance are also normally raised, traversable, and free of vertical objects at the approach.
- Mini-roundabouts are used in urban and suburban locations where speeds are reduced. Most locations have speeds 35 mph or lower on the connecting roadways. Some have been installed in locations with 45 mph speeds.
- Volumes of large vehicles should be relatively low at mini-roundabout locations. Transit corridors with large buses or busy truck routes may not be the best site for a mini-roundabout.
- Early studies of mini-roundabouts in the U.S. indicate peak hour capacity of about 1500 entering vehicles per hour. Capacity will vary based on the proportion of left-turn, straight through, and right-turn demands from each approach. A higher proportion of left-turn demand results in lower intersection capacity. High right-turn demand results in higher capacity.

### Mini-roundabouts in Minnesota

**Constructed or Scheduled for 2017 Completion**

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<tr>
<th>Mini-roundabout Location</th>
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<tr>
<td>MN Highway 4 (1st Ave) and Armstrong Blvd, St. James</td>
<td>2017</td>
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<tr>
<td>MN Highway 4 (1st Ave) and 7th Street, St. James</td>
<td>2017</td>
</tr>
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<td>18th Ave NW (County Road 112) and 48th St NW, Rochester</td>
<td>2017</td>
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<tr>
<td>Washington Street/4th Avenue/Military Road, Anoka</td>
<td>2017</td>
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<td>Louisiana Avenue and South Park Drive, Savage</td>
<td>2016</td>
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<td>Gilmore Avenue, near US 61, Winona</td>
<td>2016</td>
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<td>Spencer Street (County Road 79) and Vierling Drive, Shakopee</td>
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<td>Railroad Drive/3rd Street NW/Irving Avenue NW, Elk River</td>
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**Programmed**

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<td>Roselawn Avenue and Edgerton Street, Maplewood</td>
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### Shakopee—An Early Minnesota Success

The first mini-roundabout constructed in Minnesota at a location with significant traffic was in Shakopee at the intersection of Vierling Drive and Spencer Street (County Road 79). The pre-construction intersection was All-Way STOP control with a four-lane cross section on Vierling Drive and two-lanes on Spencer Street.
The intersection experienced poor operations, particularly in the AM and PM peak hours, with backups as long as 6 minutes along the north leg of the intersection during the PM peak. Before and after video clips of the Shakopee mini-roundabout are available from the FHWA—Minnesota Division, upon request.

**St. James—Mini-roundabouts in a Constrained Urban Setting**

Two mini-roundabouts are part of an urban reconstruction project along MN Highway 4 in St. James. The context is much different than the Shakopee location as the mini-roundabouts are in a more constrained location through a small City downtown area. The intersections were previously signal controlled, connecting a street with a wide cross section and parallel parking.

During development of this project, the District worked very hard on outreach to the public and local elected officials. Several options were explored with the City and the public prior to choosing mini-roundabouts. The primary reasons for selecting the mini-roundabout option included:

- Reduced vehicle delay through the intersections compared to signals or all-way STOP control.
- Shorter pedestrian crossings.
- The proven safety performance of roundabouts.
- $600,000 lower construction cost compared to constructing new signals.
- On-street parking for adjacent businesses could be maintained. Parking was maximized by incorporating back-in, angle parking on one side.
A graphic of the proposed design, including aesthetic treatments is shown below. MnDOT and the City of St. James received a $864,000 Federal Accelerated Innovation Deployment grant for this portion of the project.

In addition to the more urban context, another challenge at this location are grain trucks that use this section of Highway 4. Using traditional design tools like AutoTurn, the District striped out the geometry of the mini-roundabout design in a parking area and tested it with a WB-62 and a school bus to ensure that the design was feasible from that perspective.

With construction of the mini-roundabout block almost complete, a public event is scheduled for Thursday, August 31, 4 - 7 p.m. at the City Park on 1st Avenue. A video on how to drive the mini-roundabouts and use the back-in, angle parking can be viewed here: http://www.dot.state.mn.us/d7/projects/hwy4stjames/howto.html.

Anoka—Handling Difficult Geometry

Similar to Shakopee, the City of Anoka is installing their first mini-roundabout near a middle school. As shown on the next page, the geometry at this location is challenging. The intersection has 5 legs, some significantly skewed, and the south leg of 4th Avenue is slightly offset. There are two entry points in the eastbound direction, one serving drivers on Washington Street and one serving drivers on the south leg of 4th Avenue. Washington Street is one-way on one side of the intersection and two-way on the other. The pedestrian crossings are long and also skewed.
The City is reconfiguring the intersection with a mini-roundabout that will introduce similar and more intuitive approach geometry at each leg. Of particular note, are the much shorter pedestrian crossings that are perpendicular to the approaches, especially beneficial near a heavy pedestrian location.

The City’s schedule is to have the mini-roundabout constructed before the beginning of the school year.

**Intersections that are No Longer “Alternative”**

Mini-roundabouts and several other less common intersection types have been proven in Minnesota and should no longer be viewed as “alternative” or “innovative”. Rather, they should be viewed as standard designs that should be a routine part of intersection control evaluation. In addition to roundabouts and mini-roundabouts, RCUT, DDI, and continuous Green T intersections all fall into this category.

There are several intersection types that have not yet been tried in the State that would have similar benefits. Signalized, urban expressways with safety and operational problems are excellent candidates for the Superstreet concept. The first signalized RCUT is scheduled for construction in 2018 at the intersection of Mn Highway 65 and Viking Boulevard in East Bethel. See this website for some excellent animations that were created for this project: [http://www.dot.state.mn.us/metro/projects/hwy65rci/](http://www.dot.state.mn.us/metro/projects/hwy65rci/). Other intersection types that would be good solutions at certain locations include the median u-turn (Michigan Left) or thru-turn intersection, the quadrant roadway, the displaced left turn intersection, and others.

Minnesota should continue to lead the way in using a broad range of intersection types, including mini-roundabouts, to design projects that deliver high performance at reduced cost.
Geometric Design Technical Committee
Committee Chair: Kelly Besser - kbesser@stonebrookeengineering.com
Recent Agenda Items: Roundabout Design Roundtable led by MnDOT Roundabout Steering Committee.
Future Agenda Items: TBD
Next Meeting: TBD

Intersection Traffic Control Technical Committee
Committee Chair: Tyler Krage - tkrage@alliant-inc.com
Recent Agenda Items: FYA-pril: Flashing Yellow Arrow Workshop.
Next Meeting: Wednesday September 6th, 8:00am – 10:00am, SRF’s Saint Paul Office

ITS Technical Committee
Committee Chair: Derek Nieveen - dnieveen@alliant-inc.com
Recent Agenda Items: Enhanced Speed Compliance in Work Zones, Dan Nelson – AECOM.
Future Agenda Items: SMART Cities Proposal Update, Jon Wertjes – City of Minneapolis.
Next Meeting: TBD

Pedestrian and Traffic Safety Technical Committee
Committee Chair: Caitlin Wotruba - caitlin.wotruba@kimley-horn.com
Recent Agenda Items: Stop For Me campaign presentation from Jeremy Ellison and Kevin Gallatin.
Future Agenda Items: TBD
Next Meeting: TBD

Planning Methods and Applications Technical Committee
Committee Chair: Steven Ruegg - ruegg@pbworld.com
Recent Agenda Items: Methodologies for subdividing TAZ in ABM models, Uses for streetlight data, Liaison with Iowan and Wisconsin modeling groups and academic links, Summary of the TRB planning Application Conference.
Future Agendas Items: TBD
Next Meeting: TBD

Traffic Operation and Maintenance Discussion Group
Committee Chair: Adam Bruening - adam.bruening@co.washington.mn.us
Recent Agenda Items: Demo by GEVEKO Markings, preformed thermoplastic, installation of pavement markings.
Future Agenda Items: Signs, pros/cons of making your own signs, fabricating vs. buying.
Next Meeting: TBD

Simulation and Capacity Analysis Technical Committee
Committee Chair: Joe DeVore - joseph.devore@kljeng.com
Recent Agenda Items: Blue Line Extension: Formalizing result formatting, new CORSIM freeway modeling guidelines, and calibrating roundabouts in VISSIM to the new HCM 7 capacities.
Future Agenda Items: TBD
Next Meeting: TBD
A Safe Routes to School (SRTS) Plan, was previously prepared for the South Washington County School District in 2013 to address pedestrian and bicycle access to Cottage Grove Elementary School (CGES). The County partnered with the Minnesota Department of Transportation (MnDOT), to conduct a sample review of the 2013 SRTS planning process as part of an overall program to achieve the following:

- Refine and enhance infrastructure recommendations based on rigorous traffic engineering analysis.
- Improve the level of implementation of effective pedestrian safety strategies – with a focus on strategies considered to be either PROVEN effective or TRIED and where the preponderance of evidence indicates documented crash reductions.

The review of the SRTS planning process included gathering information of the operational and physical improvements to the infrastructure surrounding CGES. From this CH2M developed a concept-level design from implementable engineering and infrastructure recommendations for the area surrounding CGES. This new effort is not intended to replace the original plan, but would help to enhance the process for future SRTS plans around the state by providing independent traffic engineering review of the 2013 Plan to generate a priority list of upgrades such as crosswalks, signals, additional actions and suggest other improvements that the original plan did not contemplate.

Evaluation of Walking and Crossing Suitability

An evaluation component was added to the inventory based on the level of safety elements that are in place. The evaluation for segments and crossings was divided into three qualitative categories: GOOD, FAIR, and POOR. The notion is that it is more acceptable for pedestrians and vehicles to interact in the roadway if traffic speeds and volumes are low, and less acceptable for this interaction if speeds and volumes are high. Segments and crossings considered POOR, due to traffic speeds and volume, would be identified as being deficient for accommodating pedestrian activity and candidates for deployment of improvement strategies.
The figure below shows the pedestrian routing to CGES with segment suitability and crossing suitability.

Potential Solutions

To address the identified deficiencies associated with high speeds, the lack of a complete sidewalk system, and the absence of pedestrian amenities at potential crossing locations, a broad list of potential alternative strategies was developed.

Three main opportunities for project options were presented:

1) A choice of one to three off-street trails with no other improvements, which would provide pedestrian or bicycling access with no highway crossing.

2) A sidewalk constructed along the south side of 65th Street between CGES and the intersection at 65th Street/Hinton Avenue.

3) Improvements along 65th Street, that would involve constructing a sidewalk extension and highway crossing.
The result of this analysis is that NO child from any of the more than 2,000 residences in the 10 walking zones can currently walk or bike to CGES along designated walking paths adjacent to area roadways or using crossings rated entirely as GOOD. Upon evaluation of the deficiencies encountered and then creating a suitability rating process enables the community and county to review a range of options that encourage students to walk or bike to school with increased safety.

### Project Options and Effectiveness

*Cottage Grove Elementary School Safe Routes to School Engineering Plan*

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<td>1 &amp; 1A</td>
<td>• Build sidewalk along south side of 65th Street</td>
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<td>432 Medium</td>
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<td>• Off-street trail extending from existing off-street trail (located between Hadley Ct and Timber Crest Dr) to School</td>
<td>High</td>
<td>Low</td>
<td>224 High</td>
<td>High</td>
<td>Stand Alone</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>468 Medium and Low</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5 &amp; 5A</td>
<td>• Sidewalk extension along 65th St west of Hedgecroft Av; with improved 65th St crossing</td>
<td>Medium</td>
<td>High</td>
<td>432 Medium</td>
<td>High</td>
<td>Option 1A</td>
</tr>
<tr>
<td></td>
<td>• Combine with 3-lane configuration added to Project</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6 &amp; 6A</td>
<td>• Extend sidewalk along 65th Street from Homeward Ct trail spur to Hadley Av</td>
<td>Medium</td>
<td>High</td>
<td>174 Medium and Low</td>
<td>Low</td>
<td>Option 4</td>
</tr>
</tbody>
</table>
Utah Traffic Signals Depends On Battery Backup to Keep the Power On

Q & A with Mark Taylor, P.E. | ZincFive

DOT's are Rapidly Adopting the Green Alternative to Traditional Lead-Acid Batteries for Intelligent Transportation Systems

Departments of Transportation and traffic engineers are making some of the most important decisions in the country that affect our safety and livability—now and in the future: How to fund and repair crumbling roads, yet build out intelligent transportation systems for automated vehicles and better mobility. How to keep those systems connected and powered on, even when the utility power dies—especially during emergencies. How to manage the nitty gritty, every day hazards of massive traffic congestion.

The 2002 Olympics ignited a population explosion that is still fueled by the Utah’s natural beauty and friendly business climate. UDOT created a goal to build out a “world class traffic signals program.” Fiber optic installations connected over 90 percent of the state-operated traffic signals (1,200), enabling UDOT to remotely monitor and adjust each signal. UDOT launched innovative programs such as Automated Traffic Signal Performance Measures and an Emergency Response Plan, which includes establishing when and where to deploy battery backup.

To learn more, we talked with UDOT’s Mark Taylor, a highly regarded Professional Engineer and Professional Traffic Operations Engineer. Mark has worked for UDOT for 17 years and, as Traffic Signal Operations and Maintenance Engineer, and oversees most of the state’s traffic signals.

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(Continued on page 17)
Q: What did you look for in a battery backup system and how is what you’ve adopted helping?

A: We wanted to find a system that can be quickly deployed by our signal technicians, is low maintenance, and where the batteries can handle climate extremes and where its system can fit inside most of our existing traffic signal cabinets. We installed Battery Backup Systems at sites where we have frequent power bumps. Most of the time, when this happens, the intersection comes out of flash just fine. However occasionally, the MMU (conflict monitor) will latch, requiring a reset in the field. The battery backup is definitely doing its job. As funding and resources allow, we plan on expanding our battery backup systems deployment each year so we can meet the prioritized locations we have identified in our plan.

Q: Your Emergency Response Plan deals with traffic problems that cannot be solved remotely. Tell us how that works.

A: Yes, UDOT has a detailed Emergency Response Plan for traffic signals that helps to define when an immediate response is required, guidelines where battery backup systems should be deployed and a plan when action should be taken for generator power. Our response time to emergencies has improved, we have started to deploy more battery backup systems and our signal technicians are working overtime to equip all of our signal cabinets with generator plugs and transfer switches. This will make it easier and faster for our non-technical personnel to install generators when needed. We can then better leverage other resources at UDOT, such as available personnel, particularly the maintenance sheds, which are located closer to the traffic signals than our signal maintenance personnel.

Q: How specifically did you decide where to include the battery backup?

A: A comprehensive traffic signal management plan should always include how and when to deal with power outages, so mobility is optimized and conditions are safe. Once all traffic signal cabinets are equipped with a generator plug and transfer switch and generators (approximately three) provided to each maintenance shed, our plan calls for us to respond to restore power that is expected to be down for more than one hour. However, with our vision of “Keeping Utah Moving,” waiting one hour to restore power is not acceptable at some of the busier and sophisticated intersections where power is needed for both optimizing mobility and improving safety. Those intersections must be powered all the time.

We believe battery backup systems should be part of every agency’s traffic signal management plan. Battery backup systems are installed on a case-by-case basis, at carefully chosen locations to keep traffic moving and provide safety to the traveling public. For rural areas, the ADT can be reduced by 25 percent. Here are our priorities for where and when to deploy:

- Intersections with railroad preemption or coordinated with flashing-light signal systems (Utah MUTCD 4D.27).
- Freeway interchanges.
- Complex intersections including but not limited to SPUIs, CFIs, DDIs, THrU Turns, Flex Lanes, and Light-Rail.
- Intersections closer than 1000 feet from another intersection with UPS.
- Intersections where the ADT is greater than 40,000 (30,000 rural) for a single corridor.
• Arterials crossing arterials where the ADT is greater than 30,000 (22,000 rural) for a single corridor.
• Intersections with approaches 50 mph or higher with an ADT greater than 20,000 (15,000 rural) for a single corridor.

Other factors we consider include:
• Intersections with a history of signal malfunctions due to power quality or reliability issues.
• Intersections near fire stations (within 1200 feet).
• Intersections over capacity during peak hours with a heavy directional traffic flow.
• Intersections with split phasing or where the right-of-way assignment is difficult for a four-way stop operation.
• Intersections where CCTV coverage during power outages is important. However, all of the network switches at the intersections along either the primary or secondary channel will also need to have power.
• Intersections with high pedestrian and/or bicycle traffic.
• Intersections where the signal repair response time is excessive.
• Intersections along critical routes to hospitals.

This strategy has allowed UDOT to do more with less and give us a better focus on our resources.

Results from UDOT's deployment of Battery Backup System:
• Reducing vehicle delays and crashes.
• Powering traffic signals without having to call the utility company.
• Maintaining power in temperature extremes where lead-acid batteries do not perform well.
• Powering signals long enough for UDOT crews to switch on generator power. Saving time and resources not dispatching emergency crews.
• Intersections stay fully functional until battery gets below 30 percent, then go into flash mode, rather than black.
• Text messages are sent when battery power is below 80 percent and again when estimated run time is below 40 minutes.
• Seamlessly connecting to and working with UDOT's system wide communications, showing real time function and offering the ability to make instant changes.

For more information on environmentally safe battery backup used by the Utah DOT, visit: zincfive.com
Highway safety is a national concern that affects everyone’s daily lives. Safety at horizontal curves is particularly important as drivers are required to change direction and even speed to navigate through safely. In 2009, the Federal Highway Administration (FHWA) released updated guidance on advanced curve warning in the new MUTCD (Section 2C.6). The FHWA mandated highway agency compliance with the guidance by December 31, 2019. Section 2C.6 of the MUTCD states that “In advance of horizontal curves on freeways, on expressways, and on roadways with more than 1,000 AADT that are functionally classified as arterials or collectors, horizontal alignment warning signs shall be used in accordance with Table 2C.5 based on the speed difference between the roadway’s posted or statutory speed limit or 85th-percentile speed, whichever is higher, or the prevailing speed on the approach to the curve, and the horizontal curve’s advisory speed.”

The MUTCD requires a curve analysis engineering study to evaluate the advisory speed. This can be done through various methods including:

- Evaluation of original design plans
- In field evaluation of in-place conditions measuring radius and superelevation
- Accelerometer
- Ball Bank

The North Dakota Department of Transportation (NDDOT) began an engineering study to come into compliance with the MUTCD mandate. NDDOT determined that approximately 1,500 curves on the state system would require further evaluation of advisory speed. To support the engineering study, NDDOT selected WSB to collect data on the selected curves across the state.
As the project involved covering a vast area and collecting data on a large number of curves, WSB proposed implementing GIS tools that were used successfully on previous similar data collection projects to improve efficiency and data quality. The GIS tools used included an internet connected GPS-enabled tablet with an online GIS application developed. The curve measuring device selected for this project was a GPS-enabled accelerometer; however, a ball bank device would also have worked successfully. Prior to field data collection, all curve locations were entered into the GIS application and included available information such as reference point location, curve type, and posted advisory speed. As field technicians approached the curve, the WSB online GIS application would utilize the tablet’s GPS to have the appropriate curve pulled up and ready for data entry. As the vehicle passed through the curve at the appropriate speed, the vehicle speed and g-force would be read from the accelerometer’s digital display and entered into the GIS application, which would then immediately be saved to the online curve database. The accelerometer data was downloaded weekly and compared to the GIS database to ensure data was entered correctly.

The project did encounter some interesting issues during the course of the field data collection. At some curve locations, the technicians could not collect data for various reason such as construction zones. The field staff entered notes into the GIS database for those curves that could be later searched. This made identifying curves that needed to be redone much simpler than field notes on paper. GIS database notes were also useful for documenting those curves where either the posted advisory speed did not match the GIS data or the posted speed was much higher than expected. In particular, interchange ramps surprised the field staff at how slow they needed to go on these types of curves to meet the g-force requirements, so the notes helped later justify why the measured speeds were lower than required by the MUTCD. Another issue that was encountered was loss of internet data service in certain areas of rural North Dakota. The work-around was to revert to traditional data collection methods of tracking locations and data on paper, and then manually entering the data to the GIS database once back in an area with internet service.

The data collection effort was substantially completed in approximately 3 weeks which covered nearly 10,000 miles and 1,500 curves, with missed curves evaluated at a later date when construction was completed. The post-processing of the data was simplified as the data was already entered into an online database formatted according to NDDOT’s specifications. The online GIS tools provided an effective way to manage issues encountered in the field. NDDOT was successful in taking the data gathered and performing the engineering study to make final recommendations on curve locations that would require updated curve warning signs to be in compliance with the 2009 MUTCD.
MEMBERSHIP UPDATE

New Members

Thomas Nyangweso - City of Saint Paul

Anna Claire Potter – Kimley-Horn and Associates

Fay Simer – City of Saint Paul

Muhammad Asif Khan – Student at North Dakota State University

Jim B. Henricksen – MnDOT

Babak Mirzazadeh – Student at North Dakota State University

Joshua Tarr – Student at University of Minnesota

Alieu Kamara – Hennepin County, Public Works

Moves

Ajaykumar Patil – AECOM, formerly with University of Texas Arlington

Joseph DeVore – KLJ Engineering, formerly with SRF Consulting Group

Brian Gibson – Saint Cloud APO, formerly with Oahu MPO

If you or a friend has changed jobs or moved, we would like to stay in touch. Members, please update your information by visiting http://www.ite.org/membership/index.asp. To access this area, you will need to know your membership number. Your “username” is your membership number, and your “password” is the first 6 letters of your last name (e.g. Johnson=Johnso). Non-members please contact Morgan Hoxsie via phone (612.294.9726) or email (Morgan.Hoxsie@kimley-horn.com) for assistance. Please provide you name, title, employer, complete street address (including mailstop, if applicable), telephone number, fax number, and email address.

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