Washington Avenue (CSAH 152) Bike Signals

Tyler Krage | Alliant Engineering, Inc.

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

Washington Avenue Reconstruction Example
Source: Alliant Engineering

Hennepin County completed the Washington Avenue Reconstruction Project in Downtown Minneapolis in the Fall of 2017. Hennepin County and the City of Minneapolis, with assistance from Alliant Engineering, Kimley-Horn Associates, and Zan Associates, completed stakeholder engagement, design, analysis, and construction activities. The capital project included the reconstruction of the existing roadway and intersections and the introduction of bicycle facilities between Hennepin Avenue and 5th Avenue. The new bicycle facilities include a protected behind the curb design which provides separation between bicyclists and vehicles. This design element required the reduction from three to two vehicle lanes in each direction. On-street bicycle facilities were extended further east to I-35W to provide a logical connection; however, they do not consist of a protected design.

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## EXECUTIVE COMMITTEE

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## STUDENT CHAPTERS

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## MIDWESTERN ITE

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www.nc-ite.org
Mike Martinez, 2017 NCITE President

My last president’s message left off in Toronto, at the 2017 International Annual Meeting, where many NCITE members enjoyed a great combination of networking, socializing, learning and, culture in one of the world’s most diverse cities. We all took away ideas that we can apply to the planning of the 2018 event to be held in Minneapolis.

In September, we held our section meeting at MnDOT’s Waters Edge facility. We experienced the largest section meeting turnout in my five years on the board, with over 70 attendees! We followed this successful event a month later with our traditional joint section meeting with the Interdisciplinary Transportation Student Organization (ITSO) at the University of Minnesota’s Coffman Union.

This brings me to preparing for the Annual Meeting. As I prepared my presentation, I was able to reflect on the many personal and organizational highlights we experienced this year. Top on my list was working collaboratively with seven other wonderful individuals on our executive board. Other memories include an out and back trip to Fargo with Abby and Joe for our March Section meeting, the packed rooms at the September section meeting and summer social, and an election process that saw us name a 2018 executive board from a spectacular pool of candidates.

However, the most rewarding part of the year for me was NCITE’s recognition of three outstanding individuals. First, Jake Folkeringa has accomplished many important but under-the-radar contributions to NCITE, including improving an already successful advertising program, developing a detailed and forward-thinking communications strategy, and of course, serving as this year’s section treasurer. It’s only fitting that he was named NCITE’s Young Transportation Professional of the Year! Second, Scott McBride made what is sure to be a lasting impact on our section by clarifying MnDOT’s policy for supporting staff participation at NCITE events. His behind-the-scenes effort earned him the 2017 Transportation Professional of the Year. Lastly, NCITE recognized one our most active and dedicated members with the Distinguished Member status; Steve Manhart has done just about everything for NCITE over his lengthy career, and is showing no signs of slowing down. In addition to having served as NCITE president, Midwest District president, and District representative to the International Board, Steve has led the planning of several District and International Meetings, including serving as Vice-Chair for next year’s International meeting. Steve’s accomplishments embody the term “Distinguished Member” and NCITE is fortunate to call him one of our own.

In closing, I’d like to thank the 2017 board for a year full of positive memories. I’d especially like to recognize Joe Gustafson for his many years of thoughtful advice, grammar lessons, and unique perspectives that benefited the board and NCITE as a whole. I am also looking forward to 2018, where Scott Poska will surely raise the bar with his natural initiative and leadership skills.

Sincerely,
Mike Martinez, HDR
2017 NCITE President
Minnesota Future City Competition - Volunteer Judges Needed
January 20, 2018
Dakota County Technical College | Rosemount, MN

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

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

NCITE Calendar:
http://nc-ite.org/calendar.php
UPCOMING EVENTS

Minneapolis 18
Annual Meeting and Exhibit
August 20 – 23

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

Submit an abstract for
2018 ITE Annual & Midwestern District Meeting
Due December 1, 2017

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

NCITE Calendar:
http://nc-ite.org/calendar.php
The September Section Meeting was held on September 18, 2017 at MnDOT – Water’s Edge, in Roseville, MN.

The meeting topics included: general items and news on the October Section Meeting and November Annual Meeting. The benefits of memberships were also presented.

The presenter was Scott McBride of MnDOT, presenting on MnDOT’s funding outlook and upcoming projects. Highlights of the presentation included:

- Freight truck and rail traffic to increase 30 percent by 2030
- 850 bridges will require significant work by 2025
- Nearly 1 million new Minnesotans by 2050
- Local roads and bridges unfunded need=$18 billion over 20 years
- More than 600 identified state road and bridge projects go unfunded
- 50% state highway pavements over 50 years old; 20% have <3 years useful life
- 40% of MnDOT bridges over 40 years old

Sources of New Funding:
- Dedicating Vehicle Rental Taxes, Vehicle Rental Sales Tax, and remaining Motor Vehicle Lease Sales Tax
- Dedicating a portion of the Auto Parts Sales tax $2.628M/month ('18/'19), $12.137M/month ('20/'21)
- Motor Vehicle Lease Sales Tax (MVLST) split changed:
  - 38% Greater Minnesota Transit – net loss of $3.1M over 10 year in Transit Assistance Fund
  - 38% 5 Metro “Collar Counties” $3.3M/biennium but net loss over 10 years of $3M
  - 13% Local Bridge Program- $25M/biennium
  - 11% Highway User Tax Distribution Fund

FY2018 Projects:
- I-35, from 35E/35W split to US 8, pavement, replace 4 bridges $61M
- MN 149, redeck High Bridge over Mississippi, $43M & pavement repair (I-494 to MN 5 in St Paul) $8.6M
- US 169, MN 25 to MN 282, pavement ($15.7M) & from Belle Plaine to MN 19 ($18.6M)
- Replace I-35W bridge over Minnesota River. This project was advanced from 2020 to 2018 with Chapter 3 funding (year 1 of 3) $140M
- I-35W in Mpls from 43rd St to I-94, MnPASS completion, pavement reconstruction, bridges, Lake St Transit Station (year 2 of 4) $239M

FY2019 Projects:
- I-94/I-694/I-494 - East Area System Interchange, pavement, 2 bridges $19.5M
- I-35W, NE Mpls to Roseville, mill & overlay, $16.7M (precedes 35W N MnPASS)
- I-35, Harris to Chisago/Pine county line, pavement. This project was advanced from 2021 to 2019 with Chapter 3 funding, $27.1M
- I-494, South St Paul to Inver Grove Heights, pavement, auxiliary lane. $19.2M
- I-35W bridge over Minnesota River (year 2 of 3) $140M
- I-35W in South Mpls, MnPASS, pavement, bridges, transit station (year 3 of 4) $239M
- I-35W North MnPASS, pavement repair, bridges (year 1 of 3) $208M
The October Section Meeting was held on October 23, 2017 at University of Minnesota—Coffman Memorial Union – Mississippi Room, in Minneapolis, MN.

The meeting topics included: general items, news on the November NCITE Election, Annual Meeting, and NCITE’s new LinkedIn page. John Davis presented the University of MN (ITSO) with a plaque recognizing their achievement as the Midwestern District’s Representative to the International ITE Traffic Bowl competition. Congratulations and great job to the team.

The presenter was Tim Burkhardt of HDR, presenting on Automated and Connected Vehicles: Overview + Actions.
The October YMC event consisted of touring the Parking & Transportation Services building to observe how Gopher Football pre-game and post-game traffic operations are handled. We were able to see firsthand all of the effort that goes into the operations of the event to ensure people have a positive experience. There was supposed to be a tailgate prior to the game, but unfortunately the weather had other ideas. Instead the group met at Punch Pizza for some pregame grub. After a 30 min rain delay, the group made it into TCF Bank Stadium to watch the Gophers battle Michigan State! We will try again next year for an actual tailgate if the weather holds off!

The YMC recently held its last event of the year, which was a happy hour prior to the NCITE Annual Meeting at Pinstripes. There was a great turnout and everyone was able to socialize and discuss their strategies for bowling and bocce later in the night.

We’re thankful everyone made the first year of the YMC a success and we look forward to seeing everyone next year!
STUDENT CHAPTER UPDATE

University of Minnesota—ITSO

ITSO has had a busy fall planning and hosting events. We welcomed students back to campus in September with a lunch event featuring lawn games. At our next event, a Gopher Game tailgate hosted with the NCITE YMC, students and professionals participated in a tour of the University of Minnesota's Parking and Transportation Services game day event protocol followed by Punch Pizza and a Gopher Football game. Unfortunately the weather did not cooperate for outdoor tailgating as planned, but the evening was still a success.

Our first TranspoTalk seminar of the year was held in October and featured Brendan Murphy, lead researcher at the Accessibility Observatory on campus. Brendan spoke about the implications of bicycle level of traffic stress on accessibility calculations. We are still looking for TranspoTalk speakers this semester on Mondays or Wednesdays over lunch. Please get in touch if you have a project or concept you would like to share with students!

Lastly, ITSO has submitted a proposal to host ITE's 2018 Student Leadership Summit. Should we be awarded the event, it will take place immediately before the ITE Annual Meeting in Minneapolis. Speakers and sponsors will be needed, so stay tuned for more information.
Josh Tarr and I had the opportunity to attend this year’s ITE Midwest/Great Lakes District Student Leadership Summit held at Purdue University September 15th—17th.

The summit was both an amazing networking and learning opportunity. At the summit, I embraced the opportunity to meet with many students in the field of transportation from across North America and make connections. I also met several faculty members from Purdue as well as professionals in the field and shared with them the research I am currently involved in. I took a lot out of the conference. The conference workshops encompassed both technical and non-technical topics.

For me personally, the most important thing that I learned was the value of quality social skills in the workplace. Coming from a background where knowledge and technical skills are placed above social skills, this was a very enlightening piece of information for me about the work culture in the United States. Overall this was a fantastic opportunity for an undergraduate student to fall in love with the field of transportation as well as to grow as a professional.

Shaluka Samarasena,
Senior – Bachelor’s in Civil Engineering
University of Minnesota Twin Cities
In order to provide safe and efficient bicycle operations, an experimental bicycle phasing operation was included at each of the signalized intersections. These unique bicycle signal heads are the focus of this article.

The traffic signals feature bicycle signals equipped with flashing yellow arrows, exclusive green bike indications, and a flashing yellow indication. However, the bicycle signal heads posed some challenges in phasing operations. FHWA standards have requirements on phasing configurations, most notably that if a green bicycle phase is illuminated, then there shall be no other phases that may conflict with the movement. This same standard is used in cases of protected or protected-permissive left turns conflicting with pedestrians – a left phase will not come up with a pedestrian phase. The standard reaches another level of complexity with bike operations. If a bicycle phase is in operation, a right-turning vehicle is considered a conflicting movement. To mitigate this, Hennepin County and the City of Minneapolis sought a request to experiment with their phasing convention.

The experiment functions as follows: The exclusive bicycle phase is actuated by advanced detectors and stop bar detectors. These detectors use video technology and are calibrated to detect the average size of a bicyclist. When actuated, the bike phase comes up as a leading bicycle and pedestrian interval, in which the only allowed phases are the pedestrian and bike phases. This feature allows for pedestrians and bicyclists (higher risk users) to have a larger presence at the intersection by providing them a head start to enter the intersection prior to vehicles. These leading pedestrian and bike intervals are accompanied by concurrent blank-out signage which illuminate with the message “NO TURN ON RED” The duration of the leading pedestrian-bike intervals range from 4-7 seconds, depending on location. If no bicyclist is present for actuation, the leading pedestrian and bicycle interval is not enabled for that specific cycle. After the leading pedestrian and bicycle interval, the bicycle indication flashes a yellow bicycle symbol during standard vehicle phasing operations. This flashing yellow bicycle signal serves as the focal point of the request to experiment. The flashing yellow bicycle indication will notify bicyclists that their movement is no longer an exclusive bike movement and additional caution should be used while proceeding through the intersection, due to the possibility of right-turning vehicle and bicycle conflicts. Since the bicycle phase is operating under a condition similar to yielding operation, the vehicle flashing yellow left-turn arrow is permitted to operate, further encouraging caution by the bicyclists and left-turning motorists. During instances of a left-turn green arrow, the bicycle phase is red, similar to how the pedestrian phase would display the “DON’T WALK” message during a protected vehicle left-turn phase. With exception to the extra time provided from the leading pedestrian interval, the pedestrian phases operate under normal conditions.

**Proposed Signal Pole and Mast Arm Configuration. Source: Alliant Engineering**
The main point of experimentation with the selected bicycle phasing operation lies in the redundancy of yielding conditions. By law, unless provided a specific phase overlap, a right-turning vehicle must yield to pedestrians and bicycles, and the new configuration has no distinct phasing for right-turning vehicles. The intent is that the vehicles will yield to bicycles, but the presence of uncertainty by who must yield will encourage caution amongst all transportation modes. The request to experiment intends to address the issue and determine if the current operation is feasible for future bicycle operations.

Additionally, the bicycle signal heads were also supplemented with yellow borders. These borders are MUTCD compliant, and are often used in flashing yellow arrow cases to increase visibility and reduce confusion. The borders were included on the bicycle signals to help distinguish vehicle signal heads from bicycle signal heads to minimize confusion while navigating the corridor.

Moving Forward

This request to experiment will expire in 2018, during which time the corridor will be evaluated in terms of safety, operations, usability, and other factors by Hennepin County. As a bicyclist and motorist, it may be confusing, but that may result in heightened awareness by users. The intent of the flashing bicycle indication is to encourage caution for the bicycle, and pending experiment results will determine behavior of right-turning vehicle movements. Although the behind the curb protected bikeway and bicycle signals were only installed on a short six-block stretch between Hennepin Avenue and 5th Avenue, the construction of the protected bikeway may prove as an effective treatment for safe and efficient bicycle operations.
Geometric Design Technical Committee
Committee Chair: Kelly Besser - kbesser@stonebrookeengineering.com
Recent Agenda Items: Presentation on mini-roundabouts led by Will Stein.
Future Agenda Items: Viewing “We Are the Champions: Roundabouts of the Future” presentation from the Joint ITE/CITE 2017 Annual Meeting.
Next Meeting: TBD

Intersection Traffic Control Technical Committee
Committee Chair: Tyler Krage - tkrage@alliant-inc.com
Recent Agenda Items: Regional ATMS discussion, Warlick Avenue Multi-Level Roundabout
Future Agenda Items: DDI Forum
Next Meeting: December 6th, 8:00am – 10:00am, SEH

ITS Technical Committee
Committee Chair: Todd Olson - tolson@alliant-inc.com
Recent Agenda Items: Enhanced Detection of Wrong Way Drivers
Future Agenda Items: TBD
Next Meeting: December 5th, 1:00pm – 3:00pm, MnDOT Water’s Edge, Conference Room A

Pedestrian and Traffic Safety Technical Committee
Committee Chair: Caitlin Wotruba - caitlin.wotruba@kimley-horn.com
Recent Agenda Items: 2010 AASHTO Bicycle Facility Design (as well as the 2018 updates) guidance on shared use paths and protected bikeway treatment presented by Hannah Pritchard. When to use warning signs and markings, crosswalk treatments, signalization, and geometric considerations.
Next Meeting: TBD

Planning Methods and Applications Technical Committee
Committee Chair: Steven Ruegg - ruegg@pbworld.com
Recent Agenda Items: Steve Ruegg presented the results of an on-line survey of committee members. A subcommittee was formed to develop a report framework/outline. Discussion of ABM.
Future Agenda Items: TBD
Next Meeting: December 2017 or January 2018, Location and time TBD

Traffic Operation and Maintenance Discussion Group
Committee Chair: Adam Bruening - adam.bruening@co.washington.mn.us
Recent Agenda Items: Tour of the new Washington County Public Works Building, DG3 on FYA heads, City of Woodbury’s new sign truck, Milling in loops vs. saw cut loops, How agencies manage locates, ROW and permit process, Sign inventory programs and what agencies are using.
Future Agenda Items: Tour of Carver County Sign Department
Next Meeting: December 6th, 11:30am, Location TBD (First Wednesday of each month)

Simulation and Capacity Analysis Technical Committee
Committee Chair: Joe DeVore - joseph.devore@kljeng.com
Recent Agenda Items: Tyler Krage presented on Synchro and Alternative Intersection Simulation in July, Paul Czech presented on MnDOT’s Experience with new Streetlight Data contract in September.
Future Agenda Items: TBD
Next Meeting: TBD
The Enhanced Speed Compliance for Work Zones (ESC4WZ) project was conducted by AECOM and supported under the Minnesota Department of Transportation (MnDOT) Intelligent Transportation System (ITS) Innovative Ideas program during the 2016 road construction season. The project goal was to deploy and evaluate a mobile system that could be used by state patrol officers to safely conduct manual on-site speed enforcement in work zones. The system provides value by making work zone enforcement possible since most work zone locations are typically very confined, not allowing for safe enforcement conditions. The work zone site selected was on Interstate 35E between Little Canada and Lino Lakes. A Systems Engineering approach was used to guide the planning, development, and deployment of the system.

The ESC4WZ system was designed to improve the safety and efficiency of state patrol speed enforcement in work zones by providing an advance notification of a vehicle traveling above an unsafe speed. The overall safety of the work zone for construction personnel can also be enhanced by improving the safety and efficiency of the speed limit enforcement process resulting in better work zone speed compliance. The overall goal of the system was not to increase the number of citations issued, but to complement and be consistent with existing state law that governs how speed enforcement is performed, as well as provide an advance notice for when state patrol should begin their regular enforcement procedures.

The system is comprised of an Autoscope Duo Unit provided by Image Sensing Systems (ISS), which combines a video camera and radar unit to measure approaching vehicle speeds and matches speed values to each vehicle. The field equipment included a solar panel for power and battery charging and a cellular modem for communication of data from the system, which enabled the system’s mobility to multiple field sites. The accuracy of the field equipment at estimating and displaying real-time vehicle speeds was also field-verified through the use of a handheld LIDAR gun used by State Patrol.

A web-based software interface was developed by a project partner – Iron Mountain Systems – with direct input from State Patrol on how vehicles traveling above a threshold speed limit could be identified, and how State Patrol could be alerted to the need for speed enforcement. Vehicles that were detected as traveling above the “trigger” speed set by State Patrol were tagged with red speed values to stand out from other traffic traveling through the work zone. An audible tone served as the advance alert for officers to prepare for performing speed enforcement on an approaching vehicle. Each violation detected by the software interface created a five second video recording of the vehicle that displayed its speed of travel through the work zone.
Data on vehicle speeds in the work zone was collected by the system during multiple one-week periods of time to understand the before and after effects of the presence of State Patrol at varying locations within the work zone on speed compliance with the posted work zone speed limit. The graph below displays the number of speed violations above the trigger speed recorded by the system in August, the week of the 8th MSP enforcement was onsite. During that week, MSP was parked one half-mile north of County Road J, where the system was installed. The data helps to verify that MSP’s presence did serve to deter a number of vehicles from traveling in excess of 75 MPH through the work zone.

Future deployments of the system will be reviewed with MnDOT and State Patrol upon completion of system updates to improve overall system operation and review of potential sites where the system would enhance speed compliance in work zones or other confined roadway sites.
Two-Roundabout Solution Solves Business Access Challenge

Mark T. Johnson, P.E. | MTJ Roundabout Engineering

Background/Context

Finding an acceptable access solution for a proposed commercial development in the northwest quadrant of the USH 18 and STH 83 (Wales, WI) signalized intersection proved problematic due to spacing requirements for the existing signal and proposed access for the new development.

Solution Highlights

The innovative two-roundabout design solution provides excellent access to the new commercial site, while maintaining all existing business access locations. The roundabout project began with a single, compact 125’ hybrid, flared two-lane, with segregated Yield RT lanes to enhance non-motorized safety via improved speed control at the primary access to the proposed commercial development at the US 18 and Blackwood Dr. intersection which opened in 2006. This first roundabout was expressly designed to complement a second, future roundabout at the US 18/STH 83 intersection. The goal of the second roundabout was to replace the existing traffic signal at Highway 83 and US 18 as part of a separate STH 83 widening project that opened in late 2015. These innovative, site-specific designs enhance business visibility and access for the new commercial site, while maintaining all existing business access and preserving space for attractive landscaping.
Roundabouts are Good for Business

This project illustrates how application of traffic engineering principles that utilize the unique operational characteristics of roundabouts can facilitate improved traffic flow and safety, while enhancing community aesthetics and access to businesses. To achieve the equivalent traffic performance of these two-lane roundabouts, a two signalized intersection design would have required wider roadways, more impacts, and fewer access opportunities. Research has shown that business areas that combine good vehicular flow and access and safe pedestrian access will prosper and grow. Successful roundabout projects incorporate the traffic operational benefits and can lead to significant community benefits and business vitality.

Safety and Community Acceptance of High Flow Roundabouts

Multi-lane high flow roundabouts introduce increased complexity from a driver comprehension perspective. Therefore, to ensure optimal safety performance and community acceptance once open to the driving public it is necessary to have a thorough understanding of roundabout design principles and traffic planning – to include geometrics, signing, and pavement markings.

Optimal Design Requires:

- Bringing all of the geometric elements together into a coherent whole.
- Staging information delivery such that a roundabout is easily interpretable by the driver.
- The geometry, visual cues, signage and other elements to be delivered in a way that conforms to the driver’s knowledge, experiences, and understanding.
With some of the highest wildlife vehicle collisions in Colorado, La Plata County implemented a unique approach that’s keeping people and animals safe.

More than 9,000 vehicles travel the 20-mile stretch of U.S. Highway 160 between Durango and Bayfield, Colorado every day. What do they encounter most often? Animals crossing the road. A large number of crashes and single-vehicle rollover accidents along this stretch of highway result from animals crossing. According to the Colorado Department of Transportation (CDOT), this highway has the highest number of vehicle-animal crashes in the state. CDOT says 306 reported wildlife-vehicle collisions occurred along this stretch in 2014. That number was up from 252 the year before. The state had find a way to keep both people and animals safe.

Why so many animals in this area? The stretch is a major migration corridor for animals moving from upper wilderness elevations to lower ones. Highway 160 acted as a barrier between the animals’ summer and winter migrations. The crossing is designed primarily for mule deer and elk, but coyote, black bear, raccoons, mountain lions and bobcats also use it.
The Solution

CDOT implemented a wildlife crossing solution that created a private road for the animals to cross, keeping the animals from the roadway. The design included an archway passing beneath the highway. According to Sue Walan, senior project engineer who provided construction administration, the under-the-road crossing was made of pre-cast concrete structures. The structures were assembled one-by-one across the highway, then backfilled over. The project team then constructed a new highway over the crossing.

The big question was: Will the animals find their way to use the under-road crossing. Approximately 10,700 feet of fencing was installed along the adjacent highway which funnels the animals safely into the crossing. The space for the animals to cross is 13 feet tall and 37 feet wide with a natural earth bottom. The natural bottom is easier on animals’ feet than pavement and better mimics their natural terrain.

The team knew the solution was the right one, even before it was completed. According to Corey Kendall, CDOT engineer, during construction the project team would arrive at the construction site in the morning and see animal tracks going through the crossing.

This underpass is part of a larger project with a total of 24 crossings planned along Highway 160. The project was done in phases, with detours in place while the first half of the crossing was built. Once the first half was up, traffic was routed along that path while the other half was built. The completed structure and roadway also allows for future expansion of the roadway.

Similar crossings have popped up around the state and have seen similar success. According to the Associated Press, wildlife crossings along a 10-mile stretch of Highway 9 in Colorado have resulted in an 87 percent reduction in collisions.

“I think success is seeing it working,” Kendall said. “Knowing the animals are using it and we’re avoiding collisions and contact with vehicles, it makes it all worthwhile.”

Wrapping it up

To reduce the number of animal vehicle collisions along Highway 160 in Colorado, CDOT built crossings underneath the highway. Adjacent fencing also funnels migrating animals through the crossing — the result? A safer roadway for both humans and animals.
Among most traffic engineers and planners, roundabouts have become a trusted tool in the toolbox to provide both safety and, in some cases, higher capacity compared to stop sign- or traffic signal-controlled intersections. Many studies have documented the potential safety improvements and shown how operations can benefit. In fact, an October 2017 report by the Minnesota Department of Transportation (MnDOT) documented a 61 percent reduction in the injury crash rate where single-lane roundabouts replaced traditional intersections. As Minnesota, and everywhere else for that matter, continues to plan for and construct new roundabouts, MnDOT asked the natural question, 

What is the upper limit of roundabout capacity?

More specifically, what’s the capacity of a single-lane roundabout? As we have learned more about roundabouts, multi-lane and dual-lane roundabouts appear to be distinct from single-lane ones. With a single lane, drivers appear to understand the circular intersection better. And the driving decision is easier – go if it’s clear and stop if it’s not. There’s no ambiguity where a motorist misunderstands where the car on the inside or outside lane of a multi-lane roundabout is going and makes a poor decision that results in a crash. That’s not to say multi-lane or dual-lane roundabouts aren’t safe, it’s just single-lane roundabouts are safer at this particular time.

Knowing the capacity of a single-lane roundabout is therefore very important. Where the volumes are less than the capacity, intersections can then operate with a single-lane roundabout for as long as possible.
Spack Consulting, through its sister company Traffic Data Inc (TDI), naturally answered the call for assistance and worked with MnDOT to devise a plan to measure roundabout capacity. In this case, WE Fest (an annual country music festival) provided the opportunity to examine two single-lane roundabouts experiencing higher than normal volumes—Highway 59 intersections with Willow Street/Long Lake Road and with Becker County State Aid Highway 22. This annual event located in Detroit Lakes, Minnesota attracts over 150,000 people over the three-day country music festival. Having lots of drivers in a short timeframe suggested we might hit the roundabout capacity. And here’s how the project went.

Using our own camera technology, we set up COUNTcams traffic video recorders at multiple locations. One camera captured the intersection itself to provide the turning movement counts. One or two more cameras were pointed down each approach to each capture vehicle stacking. We could see queues to approximately 600 feet (24 passenger cars) using the video recorders. In all, 15 video recorders were needed to capture the volumes and stacking at the two intersections. Since we only had one chance to collect the traffic data, we chose to deploy 30 cameras, doubling up to avoid catastrophe if any video recorder failed.

As with any special event, people arrive early and leave late. To give us the best opportunity for capturing the roundabout traffic at capacity, we, therefore, used the cameras to record operations for six days. After initial set-up, our field personnel completed a mid-week check to ensure everything was still working as expected. To our relief, no vandalism, unusual weather (high winds, etc.), or other special circumstances disrupted things. After pick-ups, we had 15 (30 if you count the doubles) 144-hour-long videos to review.

The analysis included several different components. After counting the volumes over the study time period, we compared the event volumes to the typical volumes through the roundabout intersections. This work included reviewing daily volumes, peak hour volumes, and the percentage of turning movements on each approach. After all, the percentage of left turning traffic makes a difference in capacity at any type of intersection.

The vehicle queues were observed on each approach to each roundabout. The goal was to find the worst, or longest, queue of vehicles for each approach. The stacking exceeded our video recorder’s view on only one approach for only a four-minute period out of the 144 hours. In addition to the number of vehicles or length of vehicles in the queue, we determined the time needed to go from the back of the queue into the roundabout. We also compared the data to the Intersection Control Evaluation (ICE) reports for each intersection – a sort of how did we (or our colleagues at another firm in this case) do in forecasting volumes and operations.

We attempted to find a correlation between the vehicle queues and the intersection volumes. Using the approach volumes as well as the combined approach plus conflicting volumes, the thought was to see if an easy equation could be determined for future use of roundabout analysis.

Lastly, we completed determinations of volume-to-capacity (v/c) ratios and operational analyses using the Highway Capacity Manual’s (HCM) 6th Edition methodology. Essential, this work allowed us to compare calculated results against observed results.

So what did we find?
The results were decidedly mixed. We determined the roundabout traffic did not reach the capacity of the intersections even though the event traffic was 60 percent higher than non-event days. Other important conclusions included:

- **Queue Length.** Although the maximum queue was relatively long on multiple approaches, the stacking cleared quickly with comparable delay times to that of a traffic signal with a 120-second or longer cycle length.
- **ICE Report.** The ICE report did a relatively good job in predicting future acceptable operations.
- **Hourly Approach Volume.** The hourly approach volume graphed against the observed maximum queue showed the highest correlation.
- **HCM Predictions.** The HCM predicted vehicle queues were less than observed, significantly so in some cases.

While the study did not observe roundabouts at capacity, it did confirm the intersections are operating acceptably during appreciably higher volume event traffic with queued motorists moving rapidly into the roundabout. The HCM calculations provide a good initial review of single-lane roundabout operations in terms of a simple pass-fail grade. This evaluation tool is important, but more detailed simulations or other analyses may be necessary to review any impacts of vehicle queues.

As with how many research projects seemingly end, further research could be completed on this data set. Modeling simulations could be developed to test the maximum and 95th percentile queues for comparison to the observed and HCM queues. A higher level statistical analysis may also produce a better correlation between vehicle queues and approach volume or another metric and the observed delays could be calculated for comparison to the HCM or other simulation results.

With so much data, there are seemingly endless ways to spin the numbers and find more interesting gets about roundabout operations in Minnesota. Want to read more? Check out our final report completed in cooperation with MnDOT here.

Hiwy 59 and Willow Street West, Detroit Lakes, MN
MEMBERSHIP UPDATE

New Members

Victor Darias - Global Traffic Technologies
Lance R. McQueen - HDR Engineering
Allison Kate Futhey - Scott County
Keelee Roggenbuck - Kimley-Horn
Derek M. Lehrke - Minnesota Department of Transportation
Eric Bauer - University of Minnesota

Moves

Vernon E. Swing - Swing Traffic Solutions, LLC - Formerly with Spack Consulting
Sam C. Budzyna - City of Rochester - Formerly with City of Columbia
Jordan J. Schwarze - Alliant Engineering, Inc - Formerly with SRF Consulting, Inc.
Miguel Andrews - Stantec - Formerly with the University of Minnesota
Benjamin Nault-Maurer - SRF Consulting Group - Formerly with the University of Minnesota
Haifeng Xiao - HFTE Inc. - Formerly with SEH, Inc.

In Remembrance

Stephen Alderson (Transportation Planner, MnDOT), died October 17, 2017. Survived by wife Annette, sons Stephen Jr., David, Robert, and Keith; and 4 grandchildren. Steve was a geographer by education and worked as a transportation planner with Barton-Aschman Associates, the Metropolitan Council and MnDOT. Stephen was a long standing member of Institute of Transportation Engineers and was active in NCITE. We extend our deepest sympathy to Stephen’s family – he will be missed.

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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