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The Bridge

A quarterly newsletter from Michigan's Local Technical Assistance Program

Qualifications-based selection can aid in procurement of engineering services based on their qualifications—a process that allows engineers to focus on planning, designing, and recommending strategies that will enable successful execution of a project.

Photo: CTT Archives

Seeking the Qualified: Qualifications-based Selection

Victoria Sage - Technical Writer
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Michigan's Local Technical Assistance Program

"It is unwise to pay too much," contended John Ruskin, a social thinker and philanthropist from the 19th century, "but, it's worse to pay too little. When you pay too little, you sometimes lose everything because the thing you bought was incapable of doing the thing you bought it to do."

A project that lead to one of the deadliest structural failures in American history began with a focus on the bottom line. In 1976, the Crown Center Redevelopment Corporation awarded Gillum-Colaco, Inc. (later known as G.C.E. International, Inc.) with a contract for engineering services to design Kansas City's new Hyatt Regency Hotel based on their lowest bid. G.C.E. stamped their approval in February 1979 on a series of shop drawings that included a contractor's modification for an offset double—rather than in-line single—hanger rod box beam connections for a suspended walkway that would span the atrium. However, even as originally planned, the connections had a faulty load design. Just over two years later, that suspended walkway as well as the one beneath it collapsed, killing 114 and injuring approximately 200.[1]

Engineering service providers—like G.C.E.—crucially affect construction projects. They investigate the technical details; translate concepts and layouts into effective, reliable, and safe plans and specifications; and ultimately determine a project's execution.[2] When procuring the services of G.C.E., Crown Center Redevelopment Corporation relied on a frequently used method known as low bid, or accepting the engineering firm that proposes the lowest price in response to a project's needs, plans, or specifications.

Procuring engineering services isn't like "buy[ing] a commodity; rather, [it's] paying for technical expertise," explained Tom Blust, director of engineering for the Road Commission for Oakland County. Engineering services—much like trade work or medical practice—are a practical art. That means the profession compels the development of skill and, the more a person performs engineering services, the better he or she becomes at it. But, skilled engineering services might not offer the lowest costs. "You are paying a bit of a premium," said Tracie Leix, local agency program engineer for the Michigan Department of Transportation, about obtaining engineering services with strong skills or qualifications in a given area.

Crème de la Crème

So, how can local agencies navigate selecting the most qualified engineering services while also maintaining accountability to taxpayers for every dollar spent? Blust, Leix, and others compellingly argue for qualifications-based selection, or QBS. It's a process that "ensures the person or persons chosen is the most qualified," said Leix. And, it's opting for "good technical expertise—good design and solid engineering principles," according to Blust.

The federal and state governments do have regulations surrounding QBS although they're not all-encompassing. The Brooks Act of 1972 required only the branches of the federal government "to publicly announce all requirements for architectural and engineering services, and to negotiate contracts for architectural

▸ QBS, page 10

▶ **Michigan storms and stormproofing principles: pages 9-11**

Photo courtesy of D. Pionk

Letter from the Editor

"Destiny," said William Jennings Bryan, an American politician and orator, "is not a mater of chance, it is a matter of choice; it is not a thing to be waited for, it is a thing to be achieved." In other words, Bryan is saying that through our choices we shape our destiny.

I recently made a choice—a very big choice. I bought a new car to replace my dying buggy. For me, the process involved learning about every spec on every vehicle on the market. What were its capabilities? How would it handle driving in the common local weather conditions? What were its crash test ratings? I queried the LTAP engineers, friends, and family, gathering as much knowledge as I could from them about different vehicle options. While I was working with a limited budget, my preeminent concerns were reliability, suitability, and safety. My final choice has been shaping my life since then: I have taken a few more weekend road trips this summer since my car is much more reliable and I am not so anxious about driving on the snow-covered roads this coming winter.

This issue of *The Bridge* looks at choices we make, the effects of those choices, and guides for making better choices. As state and local transportation agencies, making decisions with regard to a road construction project can affect not only an agency's destiny but also the destiny of the citizens relying on that road network. In this issue, we look at qualifications-based selection, a process that chooses a qualified engineering service from amongst the candidates. By choosing a qualified engineering service rather than simply the lowest-bid engineering service for a project, agencies can anticipate an optimal structure for a specific site and can plan the most efficient execution of the project. Over time, a better structure can require less maintenance and last longer than a cheaper structure, saving money and further shaping the future needs of an agency. When it comes to maintenance though, this issue also features information about asset management, which is packaged in a re-vamped course for local elected officials.

Agencies can also make proactive stormproofing choices for their road networks. Herein, we examine those choices. While some storms—like the July 11th storm that hit Gogebic and Iron Counties—may be too over-powering for even the best-engineered road network, having stormproofing measures in place can help roads and bridges to withstand common storm events.

In these pages, we meet one road commission's superintendent/manager who is making choices to improve his local agency's transportation assets. He's choosing to implement innovative construction technologies to counter the challenges of his county's terrain. And, he's doing that in 'his own backyard'—the county roads around Sault Ste. Marie. And, we meet the employees of Ottawa County Road Commission who chose to share their innovation—a wing hinge bracket for a snow plow's wing—in the Great Ideas Challenge and won prizes for doing so.

Finally, we highlight a choice that every one of us can make for safer roads: When we get behind the steering wheel and drive while drowsy, we can actually be more dangerous on the road than an intoxicated driver. Michigan has been implementing rumble strips to help signal to drivers that their alertness is decreasing. This issue investigates how rumble strips work and whether that technology is effective.

Like Bryan suggested, our choices for building and maintaining our road network affects the lives of every citizen—resident or traveler. How much more important is it, then, to make those choices informed decisions!

Victoria

Robert Laitinen (photo courtesy of R. Laitinen)

Rising to the Challenge: Robert Laitinen

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Chippewa County's acidic and silty clay soils as well as its three large islands would pose a challenge to any road commission superintendent/manager. But, when Chippewa County Road Commission's (CRC) engineer/manager suddenly resigned in 2008, it was a surveyor-turned-project-designer who filled the gap. "I was absolutely unqualified for the job at the time," reminisced Robert Laitinen. On the day the former superintendent tendered his resignation, Laitinen found himself "rais[ing] his hand and ask[ing] for an opportunity." Chippewa County's board of road commissioners, to Laitinen's surprise, appointed him to the position.

"Some days," said Laitinen, "I wonder why…" Maybe Laitinen wonders why the commissioners chose him on days when he's tackling how to place a road on Chippewa County's uneven terrain, which materials to choose for culverts in the acidic soils, and how to construct bridges in plastic clay soils. "But," continued Laitinen, "it's overall been good."

Improving the Road Network

It's been good because Laitinen was not only qualified for the job, but he brought with him a diverse set of engineering- and construction-related skills as well as a deep familiarity with the road commission. The Laitinen family owned an excavating and well-drilling company, which inspired Robert to attain an associate's degree in Civil Technology and a bachelor's degree in Land Surveying from Michigan Technological University in Houghton. Although he initially hoped his career would enable him to travel, he returned to his home town—Sault Ste. Marie—and worked at Northwoods Land Surveying for about 10 years.

Laitinen joined the road commission in 2004. While acting as surveyor for Chippewa CRC, he increasingly assumed engineering work. For example, Laitinen became involved in the Bass Cove Road project on Drummond Island. The four-mile stretch of road originally serviced logging contractors and, thus, was a winding and narrow gravel road leading to a waterfront subdivision at the end. Laitinen and his team pursued an easement from the DNR to reposition the road across state lands in an effort to realign the road. "Even the mailman," Laitinen pointed out, "will say, just in our four-mile project, we took about 25 minutes off of his day. There's spots where the road today is about 1000 feet from where it was before. We took out 19 curves. It was a complete redo. You don't get the opportunity to do that often."

This year, Chippewa CRC—under Laitinen's direction since 2008—is confronting the county's acidic and plastic clay soils along the Charlotte River, over which passes 12 Mile Road. In fact, the local soil conditions significantly account for Chippewa CRC's usage of plastic or reinforced concrete pipe culverts. However, Laitinen is furthering the road commission's innovative practice by installing a 30-foot wide by 12-foot tall box culvert—"one of the first of its type…[with] a prestressed top and bottom slab in the precast box culvert section." Laitinen explained. "It's also a clamshell design. [Before putting] a top on it, we can actually install within the box a natural stream bottom with stone and cobble." The project is part of a cooperative agreement with the Lake Superior Watershed Group and Bruce Township along with Upper Peninsula Concrete Pipe Company in Escanaba.

Another complication in Chippewa County is the road network's assets on three islands—Drummond Island, Sugar Island, and Neebish Island. "Working on those islands is pretty tough," commented Laitinen, adding that island projects often involve environment-related factors and necessitate hauling construction equipment to the site via car ferry. Currently, the county is constructing its 56th bridge asset—an innovative five-span bridge—with funding from the Great Lakes Restoration Initiative. The new bridge and its effects on the spawning area in its path will be discussed at the 2017 Michigan Bridge Conference.

On the side, Laitinen has been an avid outdoorsman. He shot a "really nice 8-point buck" while pursuing his academics. Proving his diversity of skill again, he earned twentieth place in the 2007 Michigan Walleye Tour. "That's not too bad when they start the season with over a hundred boats," Laitinen chimed.

Hoped-for Legacy: A Better System

Laitinen's goal is to leave the road commission and its equipment, road network, and bridge assets in a better state than when he was entrusted with them. "We've refined our fleet management principles," he said. "For the road and bridge side, we're doing exploration of a lot of innovation." These methods help Chippewa CRC create the best possible system for its residents with its limited funding. Since he became superintendent/manager Laitinen has assumed many more roles: road commissions don't have a "concrete guy, a contract negiotiator, a PR specialist, or a staff attorney to answer our legal questions." Accordingly, road commission work requires a "willing[ness] to deal with a little bit of everything." Laitinen reflected, "To me, I find [that] very rewarding." ■


A northern pike that Laitinen speared through the ice.
Photo courtesy of R. Laitinen

Mumblings on Rumblings

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In 2015, 963 people died on Michigan roadways due to motor vehicle crashes. According to both the Federal Highway Administration (FHWA) and the Michigan Department of Transportation (MDOT), lane departure contributes to approximately half of Michigan roadway deaths.

To reduce lane-departure-related crashes, MDOT installed 5,400 miles of centerline rumble strips (CLRS) on its rural non-freeway highways between 2008 and 2010. When MDOT undertook the project, rumble strips were "still an emerging technology," according to Pavement Marking and Delineation Engineer Mary Bramble. "No one had done an extensive test [of their effectiveness although]…other states had put in a mile here, a couple miles there, and they were seeing good results." During a three-year period following the installation, MDOT observed a 51-percent decrease in fatal crashes involving a vehicle crossing over the centerline.[1]

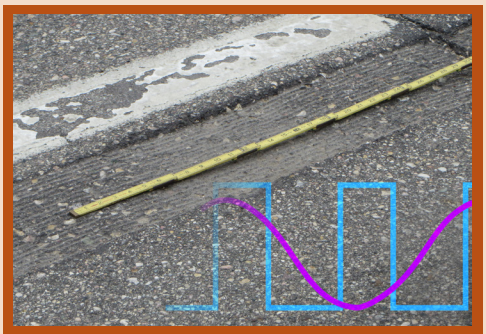
On the Road to Rumble Strips

To install rumble strips, local agencies can reference the FHWA's Guidance for the Design and Application of Shoulder and Centerline Rumble Strips at http://www.trb.org/Publications/Blurbs/162610.aspx. Many states have produced their own companion to this guidance. In 2015, MDOT also released proposed guidelines for use by local and state agencies in implementing centerline rumble strips on non-freeways. These guidelines were prepared by Wayne State University's (WSU) Transportation Research Group, a group that has been evaluating MDOT's CLRS initiative.

The guidelines define several installation methods, including milled, rolled-in, formed, and raised rumble strips. Milled rumble strips, for example, consist of grooves cut into the road surface by a milling machine that tend to produce the greatest sound and vibration.[2] Rolled-in rumble strips, on the other hand, involve grooves being pressed into hot asphalt by a roller with steel molds attached to its drum, which often produces less sound and vibration.[2] Each installation method in combination with its installation pattern generates different levels of sound and amounts of vibration when a vehicle passes over the rumble strips. Milled rumble strips "seem to be the best option," suggested John Cima, who is an assistant engineer for Houghton County Road Commission and receives an average of more than 175 inches of snow each winter on his road network. "They definitely alert you when you're leaving the lane, even in the winter when they can't be seen clearly." In fact, milled rumble strips are the most prevalent installation method.

While inclement weather is believed to mute rumble strips by clogging them with snow and ice[3], snow plow operators contend that rumble strips are helpful. "In a white out, [our snow plow operators] can feel where the centerline is," said Manager of the Keweenaw County Road Commission Gregg Patrick. "It helps them in the winter when it's snowy out there." Maintenance efforts are needed to keep rumble strips clear, but roads with rumble strips aid drivers when visibility is low more than roads without them.

Rumble strips may be improving safety, but they have been called noisy by landowners and residents adjacent to highways with rumble strips.[4] Both FHWA and states have recommendations for addressing this nuisance noise and, moreover, complaints about noise have spurred investigation into new technologies such as mumble strips that may counteract the noise problems. Taken from designs first seen in Europe, mumble strips reduce the sound that is heard outside the vehicle by smoothing out the profile of traditional rumble strips' divot-like cuts.[4] Pennsylvania, California, and Minnesota have experimented with the new design.[4] While some worry that mumble strips' sine-wave-like cut lowers the probability of a driver hearing or feeling it, research remains inconclusive about mumble strips' effects on crash reduction because current research focuses on noise levels rather than effectiveness.[4,5] Regardless, the WSU group concluded that the noise levels produced by cars contacting standard rumble strips were no greater than that of "tractor-trailer trucks traveling on normal highways."[6]



Mumble strips' sine-wave-like cut in pavement[7]; overlay shows profile of rumble strips (blue line) versus mumble strips (purple line).[4]

Photo and graph courtesy of MnDOT (with permission)

A Place on the Road?

MDOT's project focused on placing rumble strips along the centerline. In addition to CLRS, agencies may consider other types of rumble strips. Two of the types target motorists' lane departure: CLRS aid in preventing over-the-centerline, head-on collisions usually on two-lane, two-way roads whereas shoulder rumble strips, which are placed along the shoulder or edge line, aid in preventing run-off-the-road crashes.[8]

But, CLRS placement on along the longitudinal joint, which is susceptible to cracking, is often thought to expedite pavement deterioration. However, the FHWA states that joint failure concerns are "for the most part…unfounded." Furthermore, the Colorado Department of Transportation concluded that rumble strips didn't have a serious detrimental effect on new pavement life in a 2001 report.[8] Since pavement deterioration is of such concern, MDOT implemented extra measures to ensure Michigan roadways would stay intact during the rumble strip installation project. Pavement degradation was "one of the big concerns" during MDOT's rumble strip initiative, suggested Bramble. "One of the major things that helped was [MDOT] put in place a joint density requirement for the center line pavement joints. Our maintenance areas also came up with solutions and got special provisions out there for maintenance operations where rumble strips are present."

Rumble strips provide an audible and tactile guide for drivers trying to discern their lane's limits during inclement weather.

Photo: CTT Archives

An Effective Supplement

According to Associate Professor Peter Savolainen at Iowa State University, 93 to 97 percent of roadway crashes are due to driver error. A recent study has suggested that rumble strips have diminishing effectiveness after a drowsy driver's initial contact with a rumble strip; accordingly, each subsequent contact is less effective at keeping the driver alert.[9] However, rumble strips' "audible and tactile warning" can encourage both "sleepy and distracted drivers" to "correct their actions", suggested Savolainen.

More so, analyzing driver alertness may not be the sole best measure of rumble strip effectiveness. In their study published in the *Journal of Transportation Engineering*, researchers Bhagwant Persaud, Craig Lyon, Kimberly Eccles, and Jonathan Soika point to the crash reduction factor (CRF), which is "a multiplicative factor used to compare the expected number of crashes after implementing a given countermeasure at a specific site."[10] In general, rumble strips produce a CRF of 10-22 percent.[10]

Even if they have minimal ability to increase driver alertness, rumble strips still prevent crashes. The decrease in fatal crashes observed following MDOT's CLRS installation initiative showed that rumble strips "played a key role in reducing traffic fatalities and serious injuries on two-lane highways", noted Savolainen, who was formerly part of the WSU group. "It proved how effective the rumble strips were."

Costs of Doing Business

Rumble strips are relatively inexpensive to install, ranging in unit price between "$0.10 and $1.20 per linear foot (about $500 to $6000 per mile)," according to the FHWA.[8] Large projects, like MDOT's, have a lower unit price compared to smaller projects. A Wayne State University study found that the MDOT project saved $79 million in costs incurred by crashes after subtracting the $3.4 million it cost to have the rumble strips installed.[11]

Even though rumble strips are relatively cost effective, many local agencies lack the funds to integrate rumble strips into their road network. For this reason, MDOT has been able to provide some funding as outlined in the 2013-2016 Strategic Highway Safety Plan (SHSP) for local agency projects that include safety features like rumble strips. For more information on safety strategies and funding opportunities, visit http://www.michigan.gov/documents/msp/SHSP_2013_08_web_412992_7.pdf. An SHSP is one way that states can promote FHWA's Toward Zero Deaths, the national initiative aiming to reduce the number of fatalities on the nation's roads to zero, by incentivizing road surface safety features.

Rumblings from Non-Motorized Vehicle Users

Even though rumble strips benefit motorists, they may pose problems for those traveling by bicycle, buggy, wheelchair, or similar devices. Many rumble strips are installed on roads without the adequate shoulder width, thus forcing non-motorized vehicles to ride on the road with motorized vehicles. An advocacy group, the League of Michigan Bicyclists, hopes to collaborate with road agencies in finding solutions that better accommodate non-motorized vehicles in these situations.[12]

Conclusion

"Rumble strip installations definitely have their place in local agencies," suggests Cima. They are currently the best option for reducing lane-departure-related crashes. In fact, because of the lives saved through its rumble strip project, MDOT received FHWA's 2015 National Roadway Safety Award. Despite some disadvantages, rumble strips are proving to be a low-cost option for preventing fatalities. They're an engineering decision that has the potential to create safer roads with limited drawbacks. ■

1. From: http://www.michigan.gov/mdot/0,4616,7-151-9620_11057-355866--,00.html
2. For more information on rumble strip types, visit http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_641.pdf
3. From: http://safety.fhwa.dot.gov/roadway_dept/research/conts_rumble/page3.cfm
4. From: MnDOT report MN/RC 2015-07 — http://www.dot.state.mn.us/research/TS/2015/201507.pdf
5. From: https://mntransportationresearch.org/2015/03/16/minnesota-are-you-ready-to-mumble/
6. From: http://www.michigan.gov/documents/mdot/MDOT_Research_Administration_Non-Freeway_Rumble_Strips_397765_7.pdf
7. Mumble strips photo courtesy of Minnesota Department of Transportation (Dave Gonzales, MnDOT staff photographer)
8. From: http://safety.fhwa.dot.gov/roadway_dept/pavement/rumble_strips/
9. From: http://onlinelibrary.wiley.com/doi/10.1111/jsr.12359/epdf
10. From: http://ascelibrary.org/doi/pdf/10.1061/(ASCE)TE.1943-5436.0000821
11. From: https://www.michigan.gov/documents/mdot/RC1627_489159_7.pdf
12. From: http://tinyurl.com/LMB-RumbleStrip-Proposal

Rumble strips' divot-like cut in pavement (Photo: CTT Archives)

2016 Great Ideas Challenge

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The Ottawa County Road Commission (OCRC) has won this year's Michigan LTAP Great Ideas Challenge with their wing hinge bracket. Randy Nagelkirk, equipment supervisor for OCRC, and Tom Langeland, mechanic technician, submitted the idea. Nagelkirk states about submitting the entry "I think it is a challenge. Ottawa County has adopted other ideas that were seen in the past. I look at the Great Ideas Challenge book every year and we use some of the other ideas as well. [Submitting an entry] is a personal challenge, I enjoy it and I'm thinking of what to send in next year."

Wing bracket

Photo courtesy of R. Nagelkirk

The Challenge for OCRC

Almost all road commissions use wings for part of their snow fighting equipment. OCRC quickly noticed that the wings take a lot of abuse by hanging out of the side of the truck. Eventually, they noticed that the hinge would start to bow, making it impossible to remove the hinge pin and the wing would lose its stability, causing damage to the mounting center hole of the wing.

The Solution

Langeland at OCRC's Grand Haven Garage came up with a swivel mounting system that still allows for wing mobility while giving stability to the mounting system. Since they introduced this change, they haven't had any mounting bracket issues. "We try to make everything better and safer for everyone—us and the public. Because it is a problem, the hinge pin shatters and breaks and the whole wing comes off. We're all in the same boat and, if we can help out and make it safe for the public, that's what we're here for," says Nagelkirk.

The Materials & Benefits

Materials needed include steel, which most municipalities already have as scrap around the shop: ½" thick flat stock around 15" X 23" and 5/8" flat stock about 5" X 10". Costs include the time to cut and weld the steel. Tools needed would be a torch or plasma cutter, a welder, and a drill.

The benefits of using this technique are that the wing bracket is more stable and the wing mounting bolt stays tight. With the wing hinge bracket, less "egg-shaping" occurs in the mounting center hole which gives the hinge bracket less of a chance of the wing breaking off and creates a safer environment for both the public and the driver. The life of the wing is also increased with a double-support mount.

The Prizes

Nagelkirk is "happy and proud of the (OCRC) guys [especially since Michigan] LTAP thinks that it's something to congratulate, and makes a point of identifying their hard work and ideas." OCRC's first place prize includes $600 toward registration or travel costs for any transportation-related event and an additional $200 in LTAP Bucks toward attending any event sponsored by the Center for Technology & Training. OCRC will also be entered in the National LTAP/TTAP Association Build a Better Mousetrap competition.

Nagelkirk with award plaque

Photo courtesy of R. Nagelkirk

Second Place and Honorable Mention

The Berrien County Road Commission won second place in the Great Ideas Challenge with an automated road maintenance spreadsheet that uses an Excel spreadsheet that calculates a master road list for generating a road maintenance project list. The Grand Traverse County Road Commission earned honorable mention for their application of a cyrogenic treatment to mower blades. For write-ups and photos of all Great Ideas Challenge entries for 2016, visit http://www.michiganltap.org/GreatIdeas. ■

Preventing Drowsy Driving

Each year, an estimated 100,000 crashes result from drowsy driving, according to the National Sleep Foundation. Those crashes account for approximately 1,550 fatalities and 71,000 injuries. What can you do to combat drowsy driving? The National Sleep Foundation recommends:

Get a Good Night's Sleep Before a Long Drive

According to the National Institutes of Health (NIH), sleep contributes to "healthy brain function." That includes "how well you think, react, work, learn, and get along with others." When it comes to driving, being able to react is important.

Get Off the Road if Signs of Fatigue Occur

It has often been said that drowsy driving is worse than driving drunk. Discovery Channel's MythBusters tested that claim and experienced equally impaired driving between driving while drowsy and driving after consuming alcohol.

Take a 15- to 20- Minute Nap

A 15- to 20-minute nap can increase both alertness and motor learning skills, according to WebMD. Taking a power nap is more effective than caffeine for improving alertness while not adversely affecting other cognitive processes

Consume Caffeine—Equivalent to Two Cups of Coffee

In a 1990 study published by the NIH, researchers found that caffeine did improve alertness when compared to a placebo. However, caffeine will decrease memory performance, making a person more prone to mistakes (WebMD). ■

Photo: Pixabay (Creative Commons License)

Visit http://drowsydriving.org/ for more information about drowsy driving and visit http://www.nhlbi.nih.gov/health/health-topics/topics/sdd/why to learn more about healthy sleep.

Once in a Thousand Years—A Michigan Storm Event

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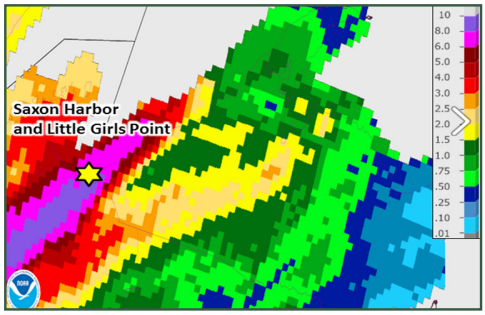
Blown-out culvert on Lake Road in Gogebic County (photo courtesy of D. Pionk)

Michigan Governor Rick Snyder declared a state of emergency in Gogebic County, in the westernmost part of Michigan's Upper Peninsula, following a storm that hit the area on July 11th. That storm washed out 20 culverts—nine of which have required DEQ emergency permits—along a six-mile stretch of Lake Road in addition to 10 other culverts on the local road system. The devastated portion of the road follows the Lake Superior shoreline from Little Girls Point County Park to the Michigan-Wisconsin border.

"It was well over a once-in-a-thousand-year storm event," remarked Darren Pionk, engineer/manager of Gogebic County Road Commission (CRC). The strong to severe thunderstorms hit the area around 11:00 p.m. and, according to NOAA National Weather Service radar reports and ground observations, the storms stalled and allowed "6 to 10 inches of rain to fall in less than 6 hours."

The storm, which generated flash-flood conditions, left disaster in its wake. "Every major stream crossing on Lake Road was blown out completely," said Pionk. Calamities like this impact transportation infrastructure, disturbing both quality of life and travel for local residents and visitors. Further, such calamities can also raise issues concerning both the financial and time resources needed to rebuild infrastructure.



Gogebic County's total rainfall over six hours, July 11th, 2016. From NOAA National Weather Service.

Destitute and Stranded

The storm event stranded 80 to 100 residents due to obliterated culverts along Lake Road. Where culverts were washed away were gullies in the roadway, ranging from 12- to 35-feet deep and 60- to 70-feet wide. John Gustafson, an environmental quality analyst for the Department of Environmental Quality's (DEQ) Water Resources Division, joined Pionk to review Lake Road shortly after the storm event. Gustafson expressed shock at the magnitude of the destruction: "It was just amazing, the utter devastation that was caused by the flooding. ...The amount of water that must have been backed up to blow these things out [must have been great]."

Accessing residents, according to Pionk, was a "logistic nightmare." He explained that residences along Lake Road have "only one way in and one way out." Pionk and the Gogebic CRC have been networking with emergency management coordinators, the sheriff's department, and State police. They re-established access to residents within five days of the storm. "The communication," Pionk said, "has to be 24-7 when you have stranded residents for that long of a time period."

Rebuilding

With residents' safety secured, Gogebic CRC has now turned to rebuilding efforts. Those efforts along Lake Road would cost millions of dollars, and several times more than that if constructed to withstand a repeat of July 11th's flash floods. "I had to make sure that the DEQ understood we are not going to design for what [they saw]," Pionk said. "[We're going] to replace them to handle the one-hundred-year storm event." Gogebic CRC is working to secure emergency relief funding for their reconstruction efforts.

But, Gogebic CRC is also faced with the impending onset of winter in about three months' time. "Replacing the culverts is ten-years' worth of planning, design, permitting, and construction, and Gogebic County is trying to take care of that in a very short window before snow flies here...and before spring runoff," explained Pionk. So, Gogebic CRC has been working with the Michigan Department of Transportation, the Federal Highway Administration, and the DEQ in a concerted effort to secure funding and design adequate replacements. Pionk said, "The team has been great to work with."

Because permits are needed for reconstruction efforts along the Lake Superior shoreline, Gustafson said the DEQ "got involved as early as we could to try to assist with that. [That's what] we recommend,...especially if it's early in the design process." The DEQ provides online resources for the wetlands permits on their website http://www.michigan.gov/deq under the Water Management > Transportation Review tab.

While stormproofing measures would not have prevented the damage to Lake Road, implementing a stormproofing plan can mitigate the type of damage to a road network caused by lesser, more common storm events. On the next page, Gordon Keller, a USDA Forest Service geotechnical engineer, provides guidelines to enhance a road network's stormproofing. ▶

Stormproofing Principles Applicable to Local Roads

Gordon Keller – USDA Forest Service Geotechnical Engineer
Reprinted from *Storm Damage Risk Reduction for Low-Volume Roads* as excerpted by WV LTAP, with permission

Michigan's climate can experience sudden and significant variation due to the surrounding Great Lakes. Thus, it's imperative for Michigan counties to be aware of stormproofing and to have a stormproofing plan for their local roads. Stormproofing means implementing measures to lessen the potential damage to roads. It can help to reduce efforts and costs necessary for rebuilding in times of misfortune. Gordon Keller outlines the principles of stormproofing for local road networks.

Photo: CTT Archives

Identify areas of historic or potential vulnerability.
Certain high-risk sites are well known, others may be more subtle. Chronically undersized culverts will have a history of plugging or failure. Geologically unstable materials or slopes, roads on steep slopes with sidecast fills, roads that cross steep channels subject to debris flows, wet slopes, areas subject to flooding, or areas of high soil erosion near streams (inner gorges) all have increased vulnerability to storms.

Use appropriate minimum design standards.
Road standards, particularly road width, should be minimized, while still considering traffic safety and road user needs. Because storm damage risk reduction (SDRR) treatments involve existing roads, road standards are already in place. However, SDRR treatments may be used to lower the standard as appropriate and result in less earthwork, lower cuts and fills, and less concentration of runoff, all of which reduce risk of damage or failure during storms.

Employ "self-maintaining" concepts into the selection and implementation of treatments.
Resources for road maintenance are often severely limited and the road systems are extensive. Implementing those treatments that reduce the amount of road miles that need frequent and costly maintenance will allow limited resources to be applied to more of the road system where it is needed. Examples might include **outsloping** (on appropriate soil types), additional cross drains, and redundant (back-up) or larger drainage structures.

Incorporate relevant, cost-effective technology.
Apply current, appropriate technology to improve identification of priorities and for planning, design, and reconstruction practices. This includes the use of GIS and GPS technology; geosynthetics for filters, separation and reinforcement; mechanically stabilized earth retaining structures; current riprap sizing criteria for bank stabilization; soil bioengineered and biotechnical slope stabilization/erosion control measures, etc.

Perform scheduled maintenance.
Scheduled maintenance should be performed at a regularly planned frequency, to be prepared for storms. Ensure that culverts have their maximum capacity, ditches drain well, and channels are free of excessive debris and brush that can plug structures. Keep the roadway surface shaped to disperse water rapidly and avoid areas of water concentration. There may not be sufficient time to do the routine work as a storm is approaching.

Use simple, positive, frequent roadway surface drainage measures and use restrictions.
Good roadway surface drainage should be provided so that water is dispersed off the road frequently and water concentration is minimized. Where soil properties are insufficient to support traffic when wet, restrict use during wet seasons to prevent running and gullying. Outslope roads whenever appropriate and practical and use **rolling dip cross drains** for surface drainage rather than a system of ditches and culverts that require more maintenance and can easily plug during major storm events. Frequent cross drains, **insloping** and outsloping, and rolling road grades all need to be in good working order. Failed cross-drain culverts are very common after major storm events.

Properly size, install, and maintain culverts.
Improperly installed, undersized, and plugged pipes are common reasons for culvert failure during storms. Improper alignment or grade relative to channels and ditchlines, excessive woody debris in the channel, excessive channel constriction and headwater elevation, excessively wide inlet areas, and inadequate capacity all contribute to pipe plugging and subsequent failure. Concrete or masonry headwalls greatly improve the resistance of culvert to failure during overtopping. Another common cause of culvert failure is a lack of proper maintenance. Maintaining inlet configurations and removing debris that may plug the pipe are essential for proper function during storms.

Stabilize cut and fillslopes.
Unstable fillslopes should be removed or treated as necessary to improve stability. Cut and

fillslopes should be well covered (stabilized) with vegetation, to minimize surface instability problems as well as minimize surface erosion. **Uncompacted sliver fills** and settling or cracking fills are a high priority for stabilization or removal. Fillslopes may also be undercut and over-steepened by a stream or channel. Failing over-steep slopes from road construction where material enters a stream can cause downstream problems, both to the watershed and by promoting plugging of structures.

Use deep-rooted vegetation to "anchor" soils.

Promote slope stability by using deep-rooted vegetation for soil bioengineering and biotechnical treatments. Combine deep-rooted plants with a mixture of shallow-rooted grasses for good ground cover and erosion control on slopes; preferably **using native species**.

Design high risk bridges and culverts with armored overflows.

High risk bridges and culvert structures can often be designed with **armored overflow areas** near the structure in case of overtopping, or they have a controlled "failure" point that is easy to repair and minimizes environmental damage. Alternatively, over-sizing the structure and allowing for extra **freeboard** on bridges will maximize capacity and minimize risk of plugging. Do not constrict the natural channel. Consider culverts with a span at least that of the bankfull channel width and bridges that span the floodplain.

Eliminate diversion potential.

All stream crossings, especially culvert crossings, should be designed and constructed (or upgraded) to have NO diversion potential. Stream crossings in steep stream channels that are subject to debris flows should be designed and constructed (or upgraded) to withstand such debris flows without being washed out or resulting in subsequent stream-flow diversion. Structure damage from a plugged culvert may be minimal, but road damage from a stream diverted down the road can be extensive!

WV LTAP's *Country Roads & City Streets* excerpt from materials prepared by Gordon Keller for the Transportation Research Board's 11th International Conference on Low-Volume Roads, Pittsburgh, Pennsylvania, July 2015. *Storm Damage Risk Reduction Guide for Low-Volume Roads*, available at: http://www.fs.fed.us/t-d/pubs/pdfpubs/pdf12771814/pdf12771814dpi100.pdf.

Did you know?

Outsloping

Outsloping involves shaping a road's surface toward the fill shoulder, or downhill side, and enables diversion of water perpendicular to the flow of traffic. This prevents a backup of water on the road's surface, which would result in rilling, gullying, and rutting. While outsloped roads minimize costs by reducing the need for road width and eliminating the need for inside ditches, they sometimes require a berm to facilitate water dispersion. From: USDA Forest Service at http://tinyurl.com/USDA-SurfaceShape and US Bureau of Land Management's Chapter 7 in http://www.blm.gov/bmp/field guide.htm.

Rolling dip cross-drains

Rolling dip cross-drains, also known as broad-based dip cross-drains, are gentle dips in the road surface that allow water to drain off of the roadway. They shed water from the road's surface quickly and have minimal impact on traffic since they are constructed over a lengthy distance. From: US Bureau of Land Management's Chapter 7 in http://www.blm.gov/bmp/field guide.htm.

Insloping

Roads with an inslope drain water toward the back slope and away from road fill material, thus frequently requiring a system of ditches, cross-drains, and extra road width. While roads with inslopes are subject to overflow during heavy rain, they can prevent run-off-the-road crashes when conditions are slippery. From: USDA Forest Service at http://tinyurl.com/USDA-SurfaceShape and Chapter 7 of http://www.blm.gov/bmp/field guide.htm.

Uncompacted sliver fills

Sliver fills are fill slopes that are constructed on steep slopes, where ground slope and fill slope angles are small, usually less than 7°. Due to the steepness of the slope, constructing sliver fills is difficult and the sliver fills are often prone to instability and erosion. If the fill material is uncompacted or minimally compacted, the foreign soil will not stick well naturally, further enhancing the instability of the fill. From: Food and Agriculture Organization of the UN's *Road Construction Techniques* at http://tinyurl.com/fao-sliverfills and US Bureau of Land Management's Chapter 11 in http://www.blm.gov/bmp/field guide.htm.

Armored overflow areas

Armored overflow areas can be a shoulder or berm that is "armored" with geotextiles (rocks) or paving. They provide smoother transitions for diverted water, thereby preventing erosion. From: http://tinyurl.com/USDA-BAERCAT.

Freeboard

Freeboard is the vertical distance between a body of water's normal reservoir and the crest of the embankment or dam. From: http://tinyurl.com/aboutcivil-freeboard.

Using native species

MDOT most often relies on grasses for erosion control because "blade[s] of grass have a higher stem density than other vegetation, creating a greater resistance to runoff and a fine 'filter' to filter suspended sediment." When possible, native species are used for this process. However, due to high cost and lack of availability, MDOT has turned to some other plant species that can be planted without threatening the natural habitats in the state (see MDOT's I-696 slope restoration project at http://tinyurl.com/MDOT-sloperestore). For a list of Michigan Department of Natural Resources' native plant species, visit http://tinyurl.com/DNR-NativePlants. ■

Accompanying material compiled by Theresa Tran–Technical Writing Associate, Center for Technology & Training; Jordan Dagenais–Technical Writing Intern, Center for Technology & Training; and Victoria Sage–Technical Writer, Center for Technology & Training.

and engineering services on the basis of demonstrated competence and qualification for the type of professional services required and at fair and reasonable prices." Inspired by the Brooks Act, forty-seven states have implemented "mini-Brooks" acts.

In Michigan, the legislature adopted a "mini-Brooks" in 2002 that mimics federal requirements closely by assessing qualifications like "past performance,… reputation, technical competence, and financial stability."[3] Other states have statutes that allow procurement methods like best-value selection, which considers some matrix of qualifications or technical expertise in combination with costs and other factors.[4] "Rather than just looking at the amount, it seems like a more intelligent nod at a low bid," Leix reflected.

Last year, however, the federal government prescribed that state or local agencies must use QBS for procuring engineering services on projects with design fees exceeding a threshold and receiving federal funding. In Michigan, that threshold is $100,000; less than that is considered a "small purchase", explained Leix, and allows agencies some flexibility for procurement strategies. Not receiving federal funding for design fees on large purchases relieves agencies of having to assess engineering firms' qualifications.

Despite only being required on a specific range of projects, QBS can benefit all agency projects regardless of size or funding sources. Leix believes QBS offers cost-saving and time-saving benefits. "It's so much easier to change a line on paper," she said, "than to rip out a curb and put it back. By having a qualified engineer on the project, you're going to be able to go through the process faster, [and] there will be fewer problems."


Photo: CTT Archives

"Innovation, expertise, and know-how at this stage can save so many headaches later." — Tracie Leix and Kurt Zachary

Blust has experience using QBS and modified QBS processes on about 99% of Oakland County's projects, which ring in at $50 million annually. He echoed Leix' belief, contending that the "end product…ends up costing you less and getting done quicker because of the quality of the plans, the quality of the engineering principles that are applied, and the completeness of the plans." Although QBS may have a higher price tag up front for engineers, both Blust and Leix agree that QBS paves the way for overall savings during construction.

QBS also presents a way to streamline the procurement process. By using a QBS process to pre-select engineering services, agencies can reduce up-front costs and time for procurement. For instance, Oakland County modifies a full QBS process by generating a list of qualified engineering services. "We do an extensive QBS process—full advertisements, full interviews, rankings, qualifications packages, requests for qualifications," explained Blust, "and, out of however many respondents we get, we select up to five or so consultants that would work for us over the next three years. Then, we assign the projects themselves based on another qualifications matrix." Local agencies hoping to use QBS on more of their non-federally-funded or smaller projects can access and take advantage of MDOT's pre-qualified vendors list.

QBS: A Proven Strategy

Is there any proof to back claims about QBS advantages? Paul S. Chinowsky and Gordon A. Kingsley undertook a study in 2009 on behalf of the American Council of Engineering Companies and the American Public Works Association analyzing QBS. They also established a cost and schedule growth comparison between QBS and other procurement approaches, including low-bid and best-value source selection. What they found is that QBS projects rank "lower than the national average in terms of both cost and schedule growth" while attaining "excellent quality ratings with a quality acceptance of over 90%." Furthermore, the satisfaction levels of both owner and designer were high or very high, suggesting that "the final solution is meeting the criteria set forth in the project statement." Another study by the American Institute of Architects assessed Maryland's Department of General Services best-value selection for procuring architectural and engineering services in relation to the QBS method used by Florida's Department of General Service and State University System. The study concluded that best-value selection was "significantly more time-consuming and expensive" and required "a significantly larger administrative staff and budget" than QBS.

In other words, QBS promises to reduce project costs in the long run by engaging the most qualified candidates in engineering. The most qualified engineering service should be not only able to build something right and well, but should be able to act on their experience and foresight to implement optimal methods that will attain the best solutions for infrastructure needs. Is that worth the expense?

Over a hundred years after Ruskin, film producer Peter Lord similarly lamented: "The cost and inconvenience of poor quality lingers long after the thrill of a bargain is forgotten. But, we, as Americans, very often make everyday purchases based on price alone. Our desire for cheap goods sometimes ends up costing us more in the long run." Crown Center Redevelopment Corporation paid too little at first. In the end, Crown Center Redevelopment Corporation lost everything and more: the disaster resulted in revoked engineering licenses, over $140 million for victims and their families, and tremendous loss of life.[1] Unlike low-bid options, selecting engineering services based on skills and knowledge, innovation and foresight anticipates more reliable and cost-efficient solutions for our transportation-network construction projects. ■

1. For more information on this case, visit ACEC's *Bidding is Not the Solution* on http://www.acec.org/advocacy/qbs. Also see http://tinyurl.com/TAMU-edu-HyattReg and http://tinyurl.com/thinkreliability-HyattReg for additional details.
2. From : Nghi M. Nguyen 's "An Overview of How to Execute Engineering Procurement Construction Commissioning (EPCC) Projects": http://tinyurl.com/Nguyen-EPCC.
3. From: http://tinyurl.com/PennState-Wardani-Procurement
4. https://www.nspe.org/resources/issues-and-advocacy/take-action/issue-briefs/qualifications-based-selection

Digitizing the Rumble Strip?

Jordan Dagenais – Technical Writing Intern
Center for Technology & Training

Can rumble strips eventually become a stream of bytes? Recent technological advances have resulted in lane departure warning systems—a safety feature available on newer vehicles that acts by detecting the edge and center lines of the road and warning the driver when they are getting too close to them. Warning systems can produce sound, vibrations, or both. Some models even come with an optional guidance feature, in which the car will slowly correct its trajectory. Despite the advance in technology, these warning systems do encounter difficulty detecting the lines on the road in conditions such as snow, rain, fog, and even darkness, making them less effective. ■

From: https://www.aaafoundation.org/lane-departure-warning-system

Photo: Pixabay

Free Transportation Asset Management for Elected Local Officials

Pete Torola – Research Engineer II
Center for Technology & Training

We use asset management every day for things like our cars, our houses, and even our office spaces! Asset management is about choosing the best-quality and most-cost-effective maintenance effort or corrective solution directed at the right place at the right time in order to preserve the integrity of our belongings. Our transportation network similarly needs to be maintained in the most cost-effective way possible.

Local agencies have access to many systems for managing their transportation assets. Some systems require large amounts of data on the condition of assets; others are simple enough to sketch out on the back of a napkin. Deciding on the right system, however, can be daunting for local officials. Good asset management practice requires elected officials and road-owning agencies to understand factors that cause pavement failure and to identify optimal preventive and treatment solutions.

The Center for Technology & Training can help with this by providing the class *Transportation Asset Management for Local Officials*—a class that equips new and seasoned local officials in your area with information on why asset management is important for managing transportation assets and how asset management data can benefit your area's constituents. To learn more about how your agency can host this class, please contact the Center for Technology & Training at ctt@mtu.edu or (906) 487-2102. ■

Center for Technology & Training

Michigan's Local Technical Assistance Program

The Center for Technology & Training (CTT) is a part of the Department of Civil & Environmental Engineering at Michigan Technological University in Houghton, Michigan. The mission of the CTT is to develop technology and software, coordinate training and conduct research to support the agencies that manage public infrastructure. In support of this mission, the CTT houses Michigan's Local Technical Assistance Program, which is part of a national effort sponsored by the Federal Highway Administration to help local road agencies manage their roads and bridges. For more information, visit ***www.ctt.mtu.edu***.

The Bridge

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About LTAP

The Local Technical Assistance Program (LTAP) is a nationwide effort funded by the Federal Highway Administration and individual state departments of transportation. The goal of the LTAP effort is to foster a safe, efficient, and environmentally sound surface transportation system by improving skills and increasing knowledge of the transportation workforce and decision makers.

Steering Committee

The LTAP Steering Committee makes recommendations on, and evaluations of, the activities of Michigan's LTAP.

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Upcoming Events

Register at ctt.mtu.edu/training

2016 Bridge Load Rating Webinar Series & Workshop
~~*Sept. 8, Sept. 15,*~~ *Sept. 29, Oct. 6 (Dimondale), Oct. 27*

2016 Preventing Runovers & Backovers
Sept. 26 – Midland; 27 – Prudenville; 28 – Mason; 29 – Grand Rapids

2016 Local Concrete Seminar
October 4 — Livonia; October 5 — Okemos

2016 Fall Transportation Asset Management Conference
October 13— Marquette

2016 Winter Operations Conference
October 18-19 — Bellaire

2016 RUCUS Conference
November 1 — Lansing

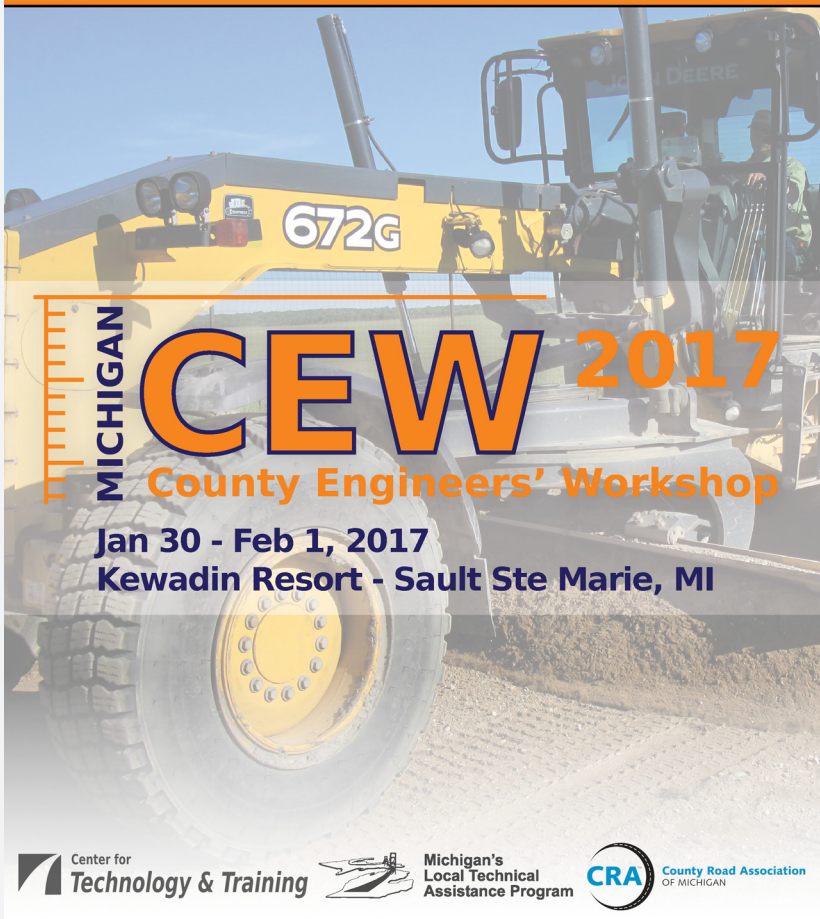
2017 County Engineers' Workshop
January 31-February 2 — Sault Ste. Marie

2017 Michigan Bridge Conference
March 21-22 — Lansing

SAVE THE DATE: 2017 Michigan Highway Safety Conference
May 2, 2017 — Bellaire

MARK YOUR CALENDARS!

ctt.mtu.edu/CEW for registration information.



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A quarterly newsletter from Michigan's Local Technical Assistance Program

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