



When it comes to snow plowing in winter conditions, safe vehicle operation relies on the ability of the plow to see other road users and, in turn, the ability of motorists to see the plow. Cameras and lights play an important role in this.

A Snow Plow's Cameras & Lights: Keeping Them in Action

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Driving on an icy road in winter can be stressful enough as is. But, include operating a 30-ton truck, managing the position of multiple plow blades, and monitoring the rate of deicing chemical dispersion, all while keeping track of other drivers around you, these ingredients combined can be a challenge for any operator.

In the case of plowing snow, safety is a two-party task: both operators and other road users need to be fully aware of the other's position on the road in order to keep everyone safe. That's why Michigan's county road commission (CRC) shop teams are looking for new and innovative ways to make the task of plowing easier and safer for both parties. Motorists may find their way into the blind spots of snow plows and, if nothing is done to rectify those blind spots, it can prove hazardous for everyone involved. Blind-spot and back-up cameras provide operators with a clear view of their normal blind spots. However, if camera lenses become obscured, operators likely can't see other drivers.

Cameras: Detecting Others

Simply installing a blind-spot or back-up camera onto the rear or side of a plow can prove just as futile as having no camera on at all. According to Tim Trudell, the fleet and facilities manager of the Grand Traverse County Road Commission, a camera on a plow can become covered with snow and grime under normal plowing circumstances after as little as a half mile of plowing. That's why Michigan CRCs have been finding innovative ways keep their plows' safety systems clean.

The Grand Traverse CRC has been using a technology they call a "camera wash system", a combination of pressurized air and washer fluid that is sprayed on the plows' cameras. Trudell elaborates on the two-part system, saying, "The air lines seem to work pretty well when it comes to just blowing snow off the lens. But, the liquid really adds to that, it helps to keep them rinsed off. The compressed air during normal situations, when they're pushing fluffy snow around, is quite effective to keep a good majority of the snow off the lens." The trucks are outfitted with a reservoir for the washer fluid and the system is hooked into the trucks' controls. The washer fluid can be pumped individually, or it can be paired with the air to clean snow and debris off of the camera via a nozzle positioned usually either above or below the camera. The cleaning system can be used on an as-needed basis by the operators or programmed to run at regular intervals.

Lights: Being Detected

While cameras are a safety feature designed to help snow-plow operators see other road users, a system that allows snow plows to be seen by others ensures that safety remains a two-party task. This is the purpose for which plows' lighting systems are intended. Up to this point, technology such as additional lights located at strategic points around the plow (see "Superior Ideas for Winter Maintenance" in *The Bridge's* Fall 2015 issue) have been used and, with the passing of House Bill 5247, more-visible green lights are now being installed on plows. To



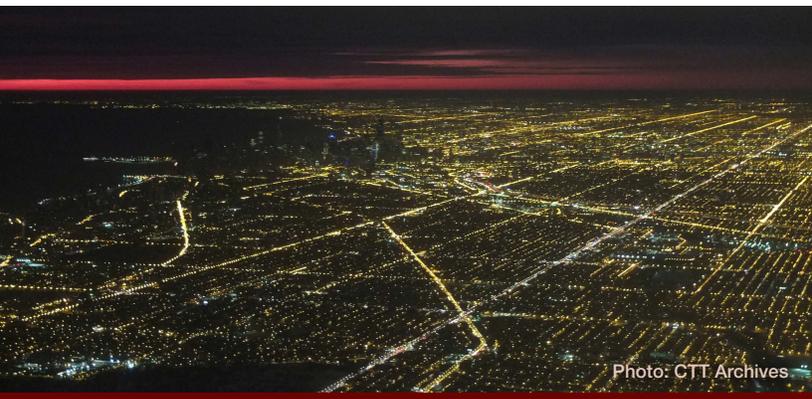


Photo: CTT Archives

A Conduit for Compliance: Tackling PA 51 Data Submission

Data Committee
Michigan Transportation Asset Management Council

Each year, state and local agencies encounter the Investment Reporting Tool (IRT) to help them meet their state-required investment reporting. Further assisting agencies with their obligatory investment reporting is the Act 51 Distribution and Reporting System (ADARS). Compiling and submitting one's data through these two web portals might seem formidable, but some agencies are showing that these applications are not as overwhelming as you might have heard.

While the reporting process does require a time investment, Linnea Rader, accountant clerk at Van Buren County Road Commission (CRC), encourages agencies that might have "anxiety" about the IRT to "not get overwhelmed". Last year, she submitted her data in "less than a day" in what she called a "simple" process. Mary Samuels, clerk for Mason CRC who assumed the responsibility of submitting data for the county's improvement projects last year using the two web portals, explained that "[i]t has to be done to be compliant with Act 51 reporting."

Public Act 51 obligates the Michigan Department of Transportation and all CRCs, counties, cities, and villages to report annually the scope and costs associated with their road and bridge improvements completed during the fiscal year. That requirement also encompasses the reporting of details for projects planned within the next three years. Similar reporting mandates were instituted under PA 499 in 2002 and PA 199, which amended the earlier act's requirements, in 2007.

Samuels and Rader tackle Act 51 reporting by using two different methods.

Two Conduits: Direct IRT Pipeline and the Roadsoft Route

Before Samuels began the Act 51 reporting process, she met with Mason CRC's manager to gather information like determining what the projected life of the new pavements would be. Samuels noted that "[t]he most important thing is to have all of your information together before you start."

The method that Samuels chose was entering her agency's project information directly into the IRT web portal, developed by the Michigan Transportation Asset Management Council (TAMC) in 2006. The IRT helps local agencies submit their Act 51 data to the TAMC, who collects the reports on behalf of the State.

"I got a hold of Roger Belknap," Samuels said. Belknap, the TAMC coordinator, provided support for her as she navigated the IRT's features like its interactive mapping for viewing and entering data,

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Letter from the Editor

Last week, we had a blizzard warning, here, in the Keweenaw Peninsula. The already snow-covered conditions in some areas received even more snow, which was combined with up to 40 mile-per-hour wind gusts. Needless to say, driving in to work with those conditions was an anxiety-ridden challenge for me. I felt vindicated about my anxiety level after speaking with a parking-lot plow driver who confirmed that the visibility made the driving conditions awful at times.

While preparing this issue's article on pavement markings and their relation to human factors research, MDOT's Pavement Marking and Delineation Engineer Mary Bramble made a comment that struck me: when considering what pavement markings to install, road-owning agencies need to find ways to "provide positive guidance in as many weather conditions as possible". Being in the throes of winter, I am reminded about her comment when I see weather conditions that challenge the guidance that our roads are supposed to provide to road users.

This issue of The Bridge looks at different winter maintenance and operations issues that can help minimize the impact of winter weather and provide positive guidance at some level for users of our road networks. To enable plow drivers to efficiently and effectively clear snow from roadways and parking lots while ensuring the safety of other motorists, this issue investigates technologies that help keep plow back-up camera lenses and rear lights clean. We also look at the increasing implementation of tow plows on the Michigan's road network; on roads that can accommodate a tow plow, tow plows can clear snow from the road surface faster and more efficiently than echelon plowing practices. Once cleared of any fresh snowfall, local agencies can combat snow and ice pack on road surfaces by using the right de-icing measures. In this issue, we look at the benefits that using salt pre-wetted with brine can have on clearing the road surface.

Plowing and de-icing are pivotal for providing positive guidance to road users. Through these two winter maintenance strategies, agencies can ensure the visibility of pavement markings and rumble strips, which are critical positive guidance measures. An article in this issue looks at how pavement markings—carefully chosen and wisely installed—can facilitate the act of safely driving from origin to destination.

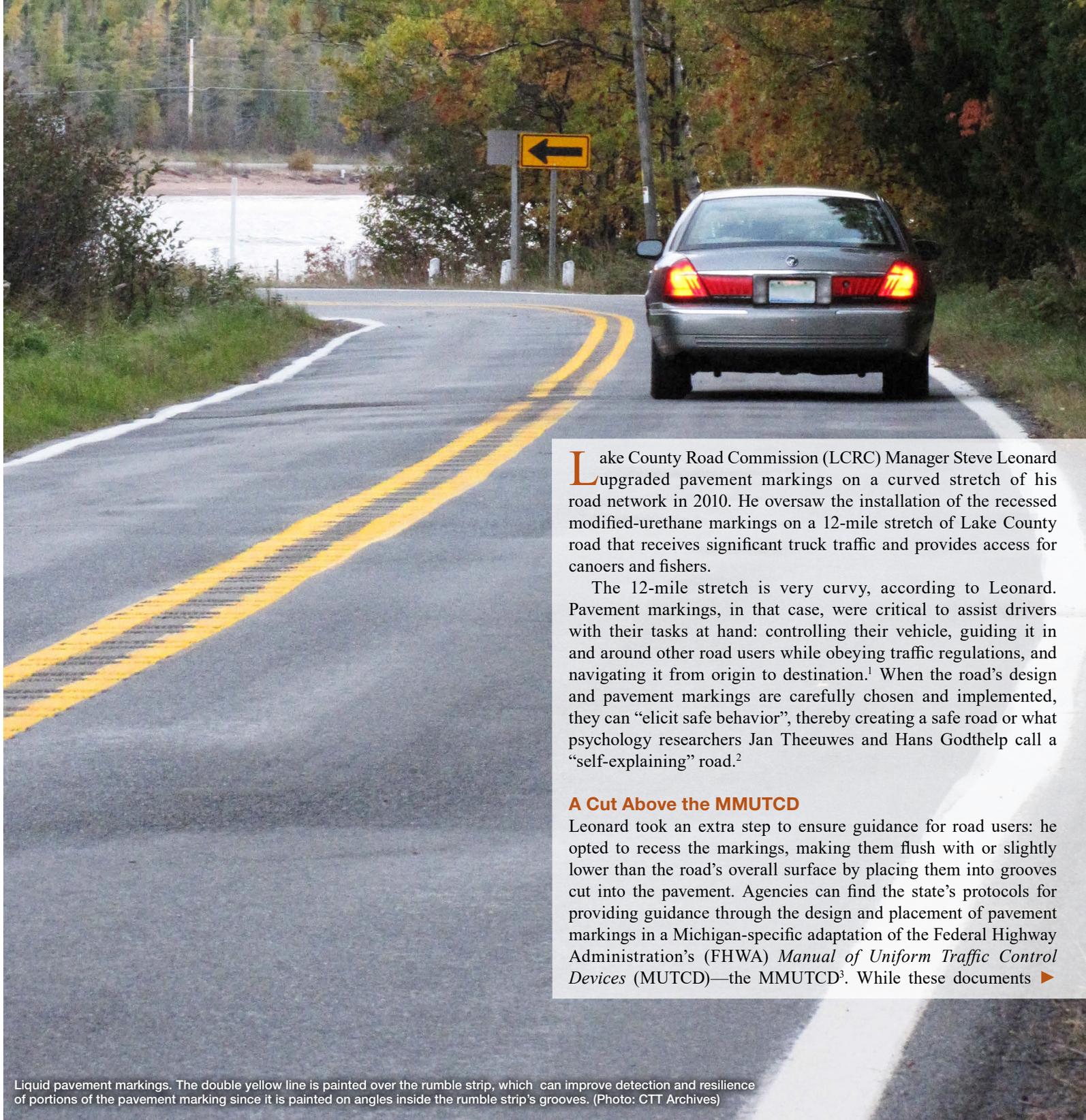
In the wake of winter, many of us are going to face roads that have deteriorated due to the weather. Having good asset management data and correctly reporting Public Act 51-required data can demonstrate the benefit state funding has had on our road networks. This issue also look sat how to submit that data to the Michigan Transportation Asset Management Council and how that data may be used to improve road conditions. With each road project comes the potential opportunity to employ better positive guidance on roads in our networks in spite of Michigan's diverse weather conditions.

I, for one, am grateful for my local agency's efforts when I have positive guidance during my commute in spite of a northern Michigan winter storm event.

Victoria

Pavement Markings: Reflecting More than What Meets a Driver's Eye

Victoria Sage – Technical Writer
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Lake County Road Commission (LCRC) Manager Steve Leonard upgraded pavement markings on a curved stretch of his road network in 2010. He oversaw the installation of the recessed modified-urethane markings on a 12-mile stretch of Lake County road that receives significant truck traffic and provides access for canoers and fishers.

The 12-mile stretch is very curvy, according to Leonard. Pavement markings, in that case, were critical to assist drivers with their tasks at hand: controlling their vehicle, guiding it in and around other road users while obeying traffic regulations, and navigating it from origin to destination.¹ When the road's design and pavement markings are carefully chosen and implemented, they can "elicit safe behavior", thereby creating a safe road or what psychology researchers Jan Theeuwes and Hans Godthelp call a "self-explaining" road.²

A Cut Above the MMUTCD

Leonard took an extra step to ensure guidance for road users: he opted to recess the markings, making them flush with or slightly lower than the road's overall surface by placing them into grooves cut into the pavement. Agencies can find the state's protocols for providing guidance through the design and placement of pavement markings in a Michigan-specific adaptation of the Federal Highway Administration's (FHWA) *Manual of Uniform Traffic Control Devices* (MUTCD)—the MMUTCD³. While these documents ►

Liquid pavement markings. The double yellow line is painted over the rumble strip, which can improve detection and resilience of portions of the pavement marking since it is painted on angles inside the rumble strip's grooves. (Photo: CTT Archives)



Photo: CTT Archives

detail the design and placement of pavement markings, Pavement Marking and Delineation Engineer for the Michigan Department of Transportation (MDOT) Mary Bramble pointed out that “sometimes going above and beyond can really make a difference” in providing positive guidance for road users.

Leonard went above and beyond by giving attention to innovations—such as recessing of pavement markings and more durable materials like polyurethane—that don’t come under the purview of the MMUTCD. And, in Lake County, it’s really made a difference: After five years of substantial winters⁴, Leonard’s efforts have lasted five times as long as his other striping work. Winter plowing hasn’t “scratched the material off” yet since the markings were installed. Leonard noted, “We normally have to paint stripes on our roads yearly. To this day, the [stretch of road with recessed markings] hasn’t needed any pavement marking maintenance.”

Recessed markings have been demonstrating an increased resiliency to winter road maintenance, so much so that they’re now required on any major resurfacing or reconstruction project along the state trunk-line. “Underbody snow plows,” explained Bramble, “are very hard on our pavement markings and sometimes, come spring, there’s literally nothing left on the road.” Recessing the pavement markings reduces or eliminates “that period when we have no visible guidance”, Bramble said.

Providing Guidance with the Person in Mind

Finding ways to “provide positive guidance in as many weather conditions as possible” is a challenge for all road-owning agencies, contends Bramble. Demarcating lanes and the road’s edges well depends upon a layering of technology, science, and human factors, which form the discipline of traffic engineering when they’re used toward designing, maintaining, and managing roadways.⁵ A traffic engineer, when considering the human factors involved in adequate pavement markings, would ask: *Can drivers see it? Can they understand it? Can they react to it?*

As such, pavement markings designed with drivers in mind account for four key human characteristics and limitations that can

“reduce driver error and associated crashes”:

- drivers’ attention and the limits on the amount of information they can consume and understand at any given time,
- the physiology of drivers’ normal vision and age-related degeneration of vision,
- drivers’ ability to perceive situations and subsequently make decisions and respond, and
- how drivers’ speed choices are a response to perceptual cues of markings.¹

“The increased safety factor is more beneficial than anything.”

— Steve Leonard

Drivers typically perceive pavement markings a few seconds ahead of where they are going.

This is known as preview time. The National Cooperative Highway Research Program (NCHRP) Report 600 *Human Factors Guidelines for Road Systems* recommends a three-second minimum or a five-second optimal preview time for pavement markings⁶; that translates to the ability to see pavement markings between 108 and 180 feet ahead when driving at 25 miles per hour or between 240 and 400 feet ahead at 55 miles per hour. The research behind that recommendation suggests that this preview-time window allows drivers both to perceive and to process the information cues of the pavement markings.

Consequently, to be clearly seen, pavement markings must be bright enough and wide enough. On Michigan’s trunk lines, re-striping initiatives predominantly employ waterborne and sprayable thermoplastic in their effort to ensure bright pavement markings. “These are our one-year, or maintenance, liquids,” explained Bramble. “That’s because we re-stripe about 90 percent of our roadways every year using these two materials.” Other available liquid pavement markings are two-part systems—also known as plural components—comprised of a base and a catalyst; these systems include polyurea, methyl methacrylate (or MMA), modified urethane, and traditional epoxy.

Aside from liquids, a second category of marking materials is preformed. “If you look at intersection markings,” continued Bramble, “we have primarily cold plastic tape.” In addition to tapes, thermoplastics can also be preformed—they can be purchased as pre-cut shapes, placed on the pavement, and torched until molten to cause them to adhere to the pavement as they cool.

To enhance guidance in wet conditions, trunk-line striping efforts have tried pre-formed

tape containing larger glass beads or having a raised waffle pattern, both of which help shed water. “The preformed tape that gets used for freeways’ skip line is a wet reflective product,” noted Bramble. “We get several years of really good performance, but the coating eventually wears out and loses its wet reflectivity.” They’ve also tried adding wet reflective elements to the liquid pavement markings, but the larger beads don’t stay in place as well.

The FHWA points to “evidence that specifying and maintaining adequate pavement marking retroreflectivity can increase safety”⁷ In kind, the NCHRP-600 recommends a minimum reflectivity of 100 mcd/m²/lux for dark conditions, or 121 mcd/m²/lux when adjusted for dirt. These recommendations arose from various studies that had drivers, grouped by age, rate the adequacy of pavement marking retroreflectivity.

Increasing the width of pavement markings to six or eight inches also boosts preview time when compared to normal-width markings (four to six inches). Even though studies on pavement marking width have had some inconsistencies, wide pavement markings have been shown to improve navigation on horizontal curves and to yield “a positive safety relationship...[and] high benefit-cost ratio” on two-lane two-way highways.⁷

Most often, it’s human factors alone or human factors in combination with roadway and vehicle factors⁸ that lead to crashes. Applying sufficient or additional guidance measures can be an effective pavement marking strategy to make roads safer and more “self-explaining” for drivers.

Battle Between Resources and Best Practices

Although some policies for design and placement of pavement markings are defined in the MMUTCD as well as AASHTO’s *A Policy on Geometric Design of Highways and*

*Streets*⁹, road-owning agencies have latitude regarding where and when to install pavement markings as well as the type of marking material to use.

For many agencies, much of those choices comes down to cost. “We can get waterborne for about 5 cents a foot in our annual contracts,” said Bramble. “But, if you look at a product like polyurea in our construction projects, you’re talking more like 80 cents a foot. Even with getting five years out of it, we just can’t afford to do that with the program budget that we have right now.”

Those choices depend upon identifying critical locations and installing optimal solutions when time and funding permit. “We place durable markings like polyurea whenever we can in a construction project... [although], when it comes time to stripe back over them, we can’t replace them that way.”

For Leonard, installing the recessed modified urethane markings was part of a Highway Safety Improvement Program (HSIP) project that he proposed. His project was selected to receive funding from the HSIP, which distributes monies to selected local agency projects that focus on safety-related highway improvements.

“We do require that [HSIP projects] place new pavement markings whether it’s required by the MUTCD or not,” explained Pamela Blazo, safety program engineer for MDOT Local Agency Programs. To qualify for HSIP funding, proposed pavement markings must exceed

“the minimum requirements set forth in the MMUTCD,” she said.

From his experience, not only striping the Lake County road in excess of the MMUTCD protocol but also implementing innovative technologies yielded reduced maintenance needs as well as better guidance for his road users at night on the curvy road. Leonard emphasized, “The increased safety factor is more beneficial than anything.”

Good asset management would suggest that agencies look for “low-cost, systemic” solutions. Blazo explained that, for example, installing edge lines across the network on a class or type of roads that doesn’t require edge lines per the MUTCD would be a low-cost, system-wide—or systemic—application. These applications, she noted, score more points with the HSIP selection team. “Systemic solutions allow us to spend our limited safety dollars over a wider area and have a larger impact.”

How to apply for safety funds?

To apply for HSIP funding, agencies need to submit a complete application packet during an open application period. An application consists of:

- a cover form
- a cover letter
- a detailed cost estimate
- a location map
- a time of return (details the time it takes to see a reduction in terms of crash cost and society cost if the proposed project were implemented.

Monies are dispersed to the highest scoring projects first. Application details can be found at <http://tinyurl.com/MichiganGov-HSIP>.

Conclusion

Pavement markings might seem like a simple, ‘cut-and-dry’ technology. But, they beg strategic choices—concerning what type of pavement markings to install and how to install them—that consider ways of providing optimal guidance for road users in as many conditions as possible. Those strategic choices may promise an economic

advantage and increased safety benefits.

For Leonard, the upfront costs for providing the best possible guidance on his Lake County road were worth it. “I would do it again in a heartbeat,” he said. ■

Did you know?

Wet pavement conditions contribute to 1.2 million crashes each year in the United States. Although the durability of different wet reflective materials is still under investigation, a 2015 study by FHWA in Wisconsin found that wet-reflective lane markings reduced wet-road crashes by 36.87 to 51.59 percent, revealing a positive cost/benefit for wet-reflective lane markings. Learn more at: <http://www.fhwa.dot.gov/publications/research/safety/15083/15083.pdf>.

REFERENCES

1. AASHTO. *Highway Safety Manual*, 1st Edition, 2010. pp 2-1 and 2-17 (<http://www.highwaysafetymanual.org/>). Available for loan from the Michigan LTAP.
2. Theeuwes, J. and Godthelp, J. *Self-Explaining Roads*. Safety Science: 19. 1995. pp 217-225.
3. MMUTCD is available from http://www.michigan.gov/mdot/0,1607,7-151-9623_26663_27281---,00.html.
4. Baldwin—the seat of Lake County—has an average annual snowfall between 77-86 inches. It ranks 249 out of 999 Michigan cities for its average snowfall, according to usa.com.
5. Institute of Transportation Engineers. *Traffic Engineering Handbook*, 5th Edition (Editor: James L. Pline). Institute of Transportation Engineers, 1999.
6. Campbell, J., et al. *NCHRP Report 600: Human Factors Guidelines for Road Systems*, Second Edition. Washington, DC: Transportation Research Board, 2012. Available: <http://www.trb.org/Main/Blurbs/167909.aspx>
7. Carlson, Paul J. *Synthesis of Pavement Marking Research*. Federal Highway Administration: Report No. FHWA-SA-15-063. June 2015.
8. Treat, J.R., et al. *Tri-Level Study of the Causes of Traffic Accidents*. Washington, DC: National Highway Traffic Safety Administration, 1979.
9. AASHTO. *A Policy on Geometric Design of Highways and Streets*, 6th Edition. 2011.

Pre-wetted Salt: Making Sense of New Salting Solutions

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Center for Technology & Training



City of Farmington Hills de-icing truck (Photo: CTT Archives)

Mike Delph, an equipment operator for the City of Farmington Hills, sprays the driveway at his home with a weed sprayer. It's filled with beet-juice brine, a concoction tweaked for optimal de-icing performance by the City of Farmington Hills. Employees like Delph are encouraged to take samples to try at home. "They're using it on their driveways," explained the City's Superintendent of Public Works, Kevin McCarthy, "and they're sure as heck going to use it on the roads. Basically, taking two gallons of brine home is costing us 14 cents."

McCarthy and Maintenance Supervisor Bryan Pickworth developed the brine take-home program to get more employee "buy-in" for using the new de-icing technologies like the beet-juice brine. Such an initiative reduces the time and money that agencies must put forth to train employees since using the brine on their personal driveways gets the employees up close to the product. They can experience how the brine works most effectively and how it might exceed other more common de-icing products. That's something they can't do when they putting down de-icer from a truck "They take it home and spray their driveways and watch it work," McCarthy said. "And, they'll see how [the snow and ice] peels off, and that's how we get buy-in." From this experiential education opportunity provided by McCarthy and Pickworth, Delph is able to say "I know it works, ... it's easier to put down, it's less messy. I can see the difference."

Delph is "open to everything" and always "willing to try and see what works best". However, getting his colleagues on board with these new products and "getting them to actually use it the proper way: that's the battle", he noted.

What made the most sense for de-icing at one point has been eclipsed by new materials

and techniques. "These guys have been driving trucks for 20 or 30 years, and [there is] just [a] way they did it before", said McCarthy.

Challenging Old School Mentalities with New Street Sense

Agencies like the City of Farmington Hills and Emmet County Road Commission (CRC) have made decisions that challenge what McCarthy and Pickworth call the "old-school" mentality: the belief that "more" salt means the road is being well maintained. Up till recently, dry rock salt (sodium chloride, NaCl) was the most prevalent deicer. Salt effectively de-ices roads by breaking the bonds that have already developed between snow or ice and the pavement: it melts snow and ice by forming a brine with a lower freezing point than water's 32°F (0°C), a process that can continue to occur as long as the temperature remains above -6°F (-21°C) in laboratory settings or 12°F (-9°C) in actual use and if, at that temperature, it achieves a concentration in solution of 23.3% by mass, its maximum effective concentration.¹

With the old-school way of throwing dry rock salt on road surfaces, the salt relies on mechanical action to help it find moisture in the snow and ice and then facilitate the formation of brine. Delph explained, "When cars drive over [the salt] a couple of times, they're just crushing it and making it into brine."

The problem is, according to the engineer-manager at Emmet CRC, Brian Gutowski, that rock salt "takes 5 to 10 minutes before it starts working".

Gutowski, McCarthy, and Pickworth questioned the common 'street sense': what if there was a way to close that gap between application and the time it takes for the granular de-icer to start working? If road agencies could put down pre-moistened salt, then the salt doesn't have to find moisture

in the snow and ice; in other words, it's "hot" or already working, according to McCarthy. For Gutowski, McCarthy, and Pickworth, challenging the old-school mentality means adopting new, effective, and efficient techniques, like putting down pre-wetted salt when de-icing road surfaces.

The Sense of Pre-wetted Salt

Pre-wetting the salt is part of a "whole new mind-set", said McCarthy. But, with this new approach of throwing rock salt pre-wetted with a brine on snow- and ice-covered road surfaces has come resistance from some employees at the City of Farmington Hills. Delph commented, "You are going to have that [resistance] everywhere. It's just that some people get something in their head or don't like changes."

Likewise, Gutowski came face to face with "hardened employees" who "just didn't realize" the benefits of pre-wetted salt. After tracking Emmet CRC's salt expenditures, Gutowski could show that his budget remained the same even though the cost per ton of salt had doubled over time. When he factored in the additional costs for brine, he said that Emmet CRC has "saved about 35 percent in costs by doing a pre-wet system". And, those hardened employees? Gutowski said, "Over four or five years of doing pre-wet, [they] realized it actually has cost savings and that it makes the roads wetter quicker."

Pre-wetting agents include sodium-chloride, calcium-chloride, magnesium-chloride, and beet-juice brines, which are the most common liquid treatments for granular de-icers. Typically, each ton of dry rock salt is mixed with between 8 and 12 gallons of brine. Whereas dry rock salt has been shown to bounce and scatter off of the road surface's driving lane area, pre-wetted salt—regardless of the type of liquid treatment applied—helps

the salt to stay in place when it's put down on the road, further allowing the salt to penetrate snow and ice pack significantly deeper after 20 minutes.^{2,3} Beet-juice brine, in particular, enhances the ability of the salt to stick to the road surface because of its high sugar content; the sugar is an organic that can also have a “softening effect on ice when it starts forming”, noted McCarthy.

All three chloride brines—sodium chloride, calcium chloride, and magnesium chloride—are hygroscopic, meaning they attract moisture “freely from the air”. It's the hygroscopic nature of these chloride brines helps the rock salt enter into solution quickly. This makes them especially hard on metal since the formation of rust, or the corrosion process, is expedited by the high amounts of dissociated ions in salt water⁴; hence, the chlorides brines have led to increased maintenance needs for agencies' trucks and other de-icing equipment.

Sodium chloride—dry or wet—lowers the temperature at which water will freeze; in other words, snow and ice will melt at temperatures lower than 32°F (0°C). The melting process on a road treated with sodium chloride is endothermic⁵: it requires heat in order for the sodium chloride to go into solution and depress the freezing point of water. The benefit of pre-wetting salt with a sodium chloride brine salt is not a heat-generating capability; *rather*, it's that the salt is more apt to stay in place on the road surface, where mechanical action of the traffic crushes the salt and integrates it with the moisture-containing snow and ice on the road surface. Heat for the melting process must still come from the surrounding environment.

On the other hand, calcium-chloride and magnesium-chloride brines are exothermic, meaning they produce heat as they go into solution with water; this gives rock salt immediate access to the two key ingredients it needs to start working—moisture and heat. Applying sodium-chloride, calcium-chloride, or magnesium-chloride brines to rock salt further lowers the lowest possible temperature at which the salt can melt snow and ice (the eutectic temperature of the salt). However, these chlorides brines are more expensive than sodium chloride brine.

Challenging the “old school” mentality also means that agencies have been tweaking the methods they use to pre-wet their salt. Emmet CRC, for example, began pre-wetting their salt by “set[ting] aside a little stockpile

▶ [Pre-wetted Salt, page 8](#)

Making Ice Cream!

Endothermic Reactions

Patty Phillips — Teacher

Minneapolis Public Schools

Excerpted from MnSTEP Science Resource Education Center at Carleton College

½ cup milk
½ cup whipping cream (heavy cream)
¼ cup sugar
¼ teaspoon vanilla or vanilla flavoring)
½ to ¾ cup sodium chloride (NaCl) as table salt or rock salt
2 cups ice
1-quart Ziploc™ bag
1-gallon Ziploc™ bag
Thermometer
Measuring cups and spoons
Cups and spoons for eating your treat!

1. Add ¼ cup sugar, ½ cup milk, ½ cup whipping cream, and ¼ teaspoon vanilla to the quart Ziploc™ bag. Seal the bag securely.
2. Put 2 cups of ice into the gallon Ziploc™ bag.
3. Use a thermometer to measure and record the temperature of the ice in the gallon bag.
4. Add ½ to ¾ cup salt (sodium chloride) to the bag of ice.
5. Place the sealed quart bag inside the gallon bag of ice and salt. Seal the gallon bag securely.
6. Gently rock the gallon bag from side to side. It's best to hold it by the top seal or to have gloves or a cloth between the bag and your hands because the bag will be cold enough to damage your skin.
7. Continue to rock the bag for 10-15 minutes or until the contents of the quart bag have solidified into ice cream.
8. Open the gallon bag and use the thermometer to measure and record the temperature of the ice/salt mixture.
9. Remove the quart bag, open it, serve the contents into cups with spoons and ENJOY!

Explanation: Ice has to absorb energy in order to melt, changing the phase of water from a solid to a liquid. When you use ice to cool the ingredients for ice cream, the energy is absorbed from the ingredients and from the outside environment (like your hands, if you are holding the baggie of ice!). When you add salt to the ice, it lowers the freezing point of the ice, so even more energy has to be absorbed from the environment in order for the ice to melt. This makes the ice colder than it was before, which is how your ice cream freezes. Ideally, you would make your ice cream using ‘ice cream salt’, which is just salt sold as large crystals instead of the small crystals you see in table salt. The larger crystals take more time to dissolve in the water around the ice, which allows for even cooling of the ice cream. ■



Photo: Pixabay

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A Snow Plow's Cameras and Lights (continued from Page 1)

ensure that these lights are an effective safety feature, certain road commissions have also begun using a technology similar to the camera wash system to keep the plows' lights clean of snow and grime.

Newly broken-up snow or dirt can get caught up in the vortex that is created by the air that a plow displaces when it is in motion. It is the main cause for the build-up that occurs on the plows' entire back side. Van Buren County Road Commission uses an air foil to help break up this rear vortex and reduce the amount of snow that accumulates on the tail lights. The foil's use is inspired by those installed on some school buses, and it works by redirecting air that is streaming over the top of the plow to flow down the back and break up the vortex. The air foil does an effective job of keeping the back side of plows clean, and the Van Buren CRC is satisfied with its results.

But to further address the problem of keeping lights visible, Gary Rohacs,

Safety is a two-party task: both operators and other road users need to be fully aware of the other's position on the road in order to keep everyone safe.

equipment superintendent at the Van Buren CRC, has had his trucks outfitted with a tail light air puffer system for the past four years. The air nozzles, reminiscent of windshield wiper nozzles, are placed above the tail lights and hooked into the trucks' controls, similar to the camera wash system, and use pressurized air to regularly clear the lights of snow. Rohacs explains that, "the entire backs of the trucks can regularly become covered with snow after just twenty to forty minutes of plowing... and LED lights on the trucks produce minimal heat, so the snow won't melt off... the air puffer system does a good job of keeping the lights clean and the trucks visible [to others]"

Cameras and Lights: Taking Action

Other CRCs across Michigan have relied on in-the-shop innovation to keep their own

trucks' safety systems clean. The City of Wyoming's Motorpool created a shop-built air system using an air valve, timer, a truck protection valve (protects the air break system), nozzles, tubing, and a switch with override control. They paired it with washer fluid, similar to the camera wash systems, to wash snow and dirt off of their plows' tail lights. Barry CRC also found a way to keep their plows' tail lights clean. They developed a "tail light snow deflector", a metal plate that redirects air and airborne snow or dirt away from the plow's tail lights. It's a similar concept to Van Buren CRC's air foils that keep the entire back of the trucks clean, but Barry CRC's deflectors are targeted for the tail lights exclusively. Both of these in-shop solutions were featured in the Michigan LTAP's Great Ideas challenge in 2014, and in-shop improvements such as these make for excellent submissions for the challenge. Other innovations to snowplow safety systems would make a prime submission opportunity for the 2017 Great Ideas challenge (www.michiganltap.org/GreatIdeas).

While innovative technologies can seem impossible to produce due to limitations in technology or funding, occasionally great improvements can originate from enhancing even the smallest parts of a system. And at the end of the day, regardless of whether innovation comes from inside or outside of the shop, winter road safety will always be something road-owning agencies are striving to improve. ■



Pre-wetted Salt (continued from Page 6)

of salt and...pre-mix[ing] it with a front-end loader". Gutowski called the process "cumbersome", but it did manage to wet with brine thoroughly. Now, they use saddle tanks—two 175-gallon tanks mounted underneath each side of the dump body—on each of their 21 sanders. The saddle tanks have nozzles that wet the salt as it is coming off the conveyor belt and hitting the spinner.

In a similar fashion, the City of Farmington Hills has transitioned its pre-wetting methods. When Pickworth began working for the city, they were pre-wetting salt. But, at that time, he said, "The old-school method was to just drive the truck [filled with salt] underneath a shower head... and douse the whole load down." Since then, their agency has moved to using "tanks slipped into the v-boxes in the back of trucks or tanks underneath the dump bed", filled with brine, to pre-wet the salt at the

spinner or in the auger trough, according to Pickworth.

The downside? Both agencies noted that pre-wetted salt will sometimes clump in the spinner. Solving that problem is typically simple: decrease the amount of brine used in colder weather and increase the amount in warmer weather.

Buying in to New Street Sense

The palpable benefits for their agencies is why the City of Farmington Hills and Emmet CRC continue to use pre-wetted salt and look for ways to improve upon it. Pre-wetted salt is a tool they can use to create a "safer situation for the travelling public", noted Gutowski. Along with the safety, the reduced amounts of dry salt needed to make the roads safer mean that agencies can save money on their de-icing agents and

Tow Plows in Michigan

Kelsey Fournier – Engineering Intern
Center for Technology & Training



Photo: CTT Archives

This winter season, the Michigan Department of Transportation (MDOT) will employ the tow plow in a city with a large volume of traffic: Metro Detroit. In anticipation of external interest, Maria Silver, the associate region engineer with MDOT Metro Operations, explained that part of their implementation strategy involved partnering with Wayne County Department of Roads. As part of MDOT's effort to equip local-agency supervisors and operators with knowledge that would help in responding to questions about tow plows, Silver noted: "We did have an operator-to-operator type of forum, where professionals in the winter maintenance business [supervisors and winter operators] had a chance to understand the workings of [tow plows] and the differences related to [tow plows]."

What is a Tow Plow?

A tow plow is a steerable plow that is pulled directly behind a traditional snow plow truck, similar to a trailer, and is able to swing out to one side; this doubles the width of the plow. By having this capability, one-pass clearing is possible on ramps as well on two-lane two-way roadways with a shoulder that needs to be cleared simultaneously. Silver pointed out that agencies who are planning to buy a tow plow should consider the towing requirements when making plow truck purchasing decisions. AASHTO Innovation Initiative details the recommended truck

specification in their brochure at <http://aii.transportation.org/Pages/TowPlow.aspx>.

Michigan saw the first appearance of the tow plow in Brighton on the state trunk lines back in 2013. This location was chosen based on the ease of operation rather than the amount of snowfall in the area. Since then, the usage of the tow plow continues to spread throughout Michigan, reaching Saginaw, St. Ignace, Grand Ledge, and, now, Detroit. As these locations are very different from Detroit, Silver explained that the strategy of bringing the tow plow to Metro Detroit "considered the high volume roadways that we have within Detroit."

Benefits of the Tow Plow

A two-winter study—Evaluating the Use of Tow Plows in Michigan—collected operational data for MDOT. The study showed that the "tow plow cleared the roadway nearly the same as our underbody blades," according to Willard Thompson, MDOT's Lansing Transportation Service Center Manager. The winter study revealed many other benefits, such as an increase in efficiency, reduction of manpower and equipment needs, use of less fuel, less time spent reloading salt (tow plows in the study were modified to include a poly tank for pre-wetting the salt resulted in decreased salt use and, as a result, cost and time savings), and a potentially longer service life. All of these benefits signal that the introduction of the tow plow may be a movement in the direction of

creating more sustainable fleets, more mobility for the public, and more cost-effective winter maintenance options.

A Tow Plow and You

While elements like plowing frequency, locations, and echelon formation operations are part of MDOT's implementation strategy in Detroit, partnering with local agencies may play a role in a wider use of the tow plow in Michigan. "MDOT has worked closely with County Road Commissions [that are] look[ing] at the possibility of adding tow plows to their fleets," said Thompson. "MDOT has not only taken tow plows to their garages, but has also provided basic training and let them ride along with us so they could gain familiarity with them." Agencies interested in one one of these training opportunities should contact their local MDOT Transportation Service Center.

Although the sweeping pattern of the tow plow restricts their use to six-lane freeways, four-lane freeways, four-lane boulevards, and two-lane roads with passing relief lanes, Silver inputted that a tow plow "could be very useful for any winter operator." When thinking about adding a tow plow to your fleet, Silver advises to "have an operational plan for its use." She adds, "We find [the tow plow] an efficient and excellent tool for us." When the next snow plow needs to be replaced at your agency, will your road network benefit by acquiring a tow plow? ■

Read about the two-winter study here: Bandara, N., Jensen, E., Holt, F. *Evaluating the Use of Tow Plows in Michigan*. SPR-1623. Michigan Department of Transportation. 2016. Available at https://www.michigan.gov/documents/mdot/SPR1623_TowPlows_537649_7.pdf

can decrease the environmental impact of winter road maintenance. These benefits are also why McCarthy and Pickworth let employees like Delph take home some beet-juice brine.

Despite the benefits, McCarthy and Pickworth are aware of one crucial fact: "you can get all of the best equipment and all of the brine you want but, if [employees are] not going to put it down the way [a manager] wants, then the whole program is shot."

Whereas McCarthy and Pickworth respond to this conundrum by providing employees with a hands-on approach to using new de-icers, Gutowski's solves this problem through training programs. He points out that it's a lack of understanding that leads to "a bad attitude," about new approaches. "Fortunately, I try to get my employees trained at every chance that I can get," he said. "And, my guys actually go out

and tell other road commissions that they should try it."

Pickworth emphasize, "Your staff is going to make you or break you...so, buy-in is number one." ■

REFERENCES

1. FHWA. Manual of Practice for An Effective Anti-icing Program. Publication N.: FHWA-RD-95-202. 1996. <http://www.fhwa.dot.gov/publications/research/safety/95202/005.cfm>
2. Wisconsin Transportation Information Center. *Pre-wetting and Anti-icing—Techniques for Winter Road Maintenance*. Wisconsin Transportation Bulletin, N. 22. <http://tic.engr.wisc.edu>
3. Salt Institute. *Pre-wetting Salt*. Saltinstitute.org. <http://www.t2center.uconn.edu/pdfs/prewetting.pdf>
4. <http://scienceline.ucsb.edu/getkey.php?key=552>
5. <http://www.kentchemistry.com/links/Matter/EndoExo.htm>

its modules for data entry, and its report-generating functions. In addition, Samuels made use of the video tutorials offered on the TAMC's website (<http://tamc.mcgi.state.mi.us/TAMC/#/training/irt>). "These show you what steps to take and how to enter the data into the IRT," she stated. "I went over the videos a couple times."

Following the IRT submission, agencies' financial professionals—like Dean Bott, finance manager at Grand Traverse CRC—are responsible for "go[ing] online to submit" the project cost information. They submit that data to TAMC using ADARS' new Asset Management page, a web portal that allows TAMC to gather meaningful project cost information.

"The Asset Management page is populated based on what [our engineering department] submitted ...," explained Bott about his engineering team's submission of data through the IRT. "I work very closely with my engineering department here."

Bott's agency, however, uses a different method to report their Act 51 data. The engineering department at Grand Traverse CRC maintains information on their road and bridge assets using Roadsoft, a software suite produced by the Center for Technology & Training (CTT) to assist agencies in managing their asset data. The CTT, upon being approached by TAMC, developed a solution to simplify the reporting process for Roadsoft clients that enables them to export their Act 51-related asset data in a format compatible with the IRT. This export makes the most sense for agencies, like Grand Traverse CRC and Van Buren CRC, that already store their data in an asset management tool such as Roadsoft.

For Rader, who handles all Act 51 data

"We want to make sure the information is as accurate as possible to benefit Michigan's road network..."

"We're all in this together."

— Dean Bott, Grand Traverse CRC

submission for Van Buren CRC, the export file easily transferred Act 51 data into the IRT. "We put our road rating data, road and bridge treatments, and planned construction treatments into Roadsoft," she explained. "We export the data from Roadsoft, and then I import it to [the IRT] to submit it to the TAMC." Rader learned the export technique through webinar trainings offered by the CTT (ctt.mtu.edu/training).

"Most agencies have an engineering person that does the IRT part and then they have an accountant that does the ADARS part," Rader noted. But, she handles the ADARS cost-reporting as well. Since the submitted IRT data also populates the ADARS Asset Management page, Rader advised that agencies make sure that projects have a unique identification number, underscoring that agencies should choose an identification structure that makes the most sense to them and store it in their Roadsoft database. "We use good project numbers [in Roadsoft]; that way, when it pops through on ADARS, I can make sure the project IDs correspond to the right amounts. Then, literally, it's just plug in the dollars and hit 'Save' on ADARS."

Although Samuels does direct data entry into the IRT whereas Bott and his colleagues create an export file from their Roadsoft data to populate the IRT, both say it's important to

begin working as soon as possible. Samuels said that her agency has "a lot of HMA projects", so she's planning to "get a head start" on IRT reporting to ensure her agency remains compliant by reporting their data. And, Bott is "hoping" to do the ADARS data submission sooner this year.

The Cost of Compliance

The first place that reviewers look to determine if an agency has completed the reporting requirements is the IRT's Status Page. Each year, agencies need to certify that they have completed the reporting of road and bridge projects on the IRT's status page. If agencies update the Status Page to indicate that they did no projects during the reporting year, then they may indicate on ADARS that "No projects/data exist for the reporting period"; otherwise, they'll need to make sure all fields on the ADARS Asset Management page are completed to be Act 51 compliant.

This year—2016—marks the first year that PA 51 compliance reviews will take place. Non-compliant agencies will receive a letter from MDOT alerting them of their non-compliance with the asset management reporting requirement MCL 247.659a(7). Accompanying this letter is a notice of postponement of Michigan Transportation Fund payments until the requirements have been completed. Threatened withholding of MTF payments might compel some agencies into compliance, but there's more at stake than that.

In a few weeks, agencies will start receiving funds for their transportation infrastructure as a result of the State Legislature plan that increased Michigan's gas and diesel taxes and vehicle registration fees. While some of the money will be dispersed immediately, \$500,000 will be released by the Legislature at their discretion. It's in agencies' best interests to be able to show the benefits of their funded projects in order to access the discretionary funds. Having asset management data—including the information required by Act 51—in a usable format gives agencies a way to demonstrate the impact of these dollars.

"We want to make sure the information is as accurate as possible to benefit Michigan's road network," Bott explained. "I am going to do my part to see that that happens," he continued, "and, I'm just a walk down the hall and work closely with my engineering team...We're all in this together." ■



Photo: iStockPhotos

Highway Maintenance Conference



A new conference focused on maintenance training for operators, mechanics, and other front-line workers as well as foremen, supervisors, and superintendents



May 2, 2017 – Shanty Creek Resort, Bellaire, Michigan

Selecting Pavement Marking Materials

How to select pavement marking materials?

The FHWA has been driving the development of a pavement marking selection tool. Their top two suggested materials are:

	Suggested Marking Material	
	#1: Water-borne Paint	#2: High Build Paint
Expected unit cost (\$/ft)	\$0.200	\$0.360
Expected service life (months)	28	29

From Carlson: Synthesis of Pavement Marking Research (http://safety.fhwa.dot.gov/roadway_dept/night_visib/pavement_marking/pvmnt_mrkng_synth.pdf)



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.

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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.

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Register at ctt.mtu.edu/training

2017 Materials Acceptance Process Seminar

March 8 — Prudenville

2017 Introduction to Roadsoft Two-day Webinar

January 24-25

2017 Michigan County Engineers' Workshop

January 31 - February 2 — Sault Ste. Marie

2017 Transportation Asset Management for Local Officials

February 16 — Marquette

2017 Constructing Pedestrian Facilities for Accessibility

Feb. 16 — Okemos; Mar. 7 — Lansing; Mar. 14 — Okemos;
Apr. 20 — Okemos

2017 Michigan Bridge Conference

March 21 & 22 — Lansing

2017 Road Safety: Traffic Safety Training for Local Officials

March 21 — Saginaw; May 10 — Kalamazoo

SAVE THE DATE: 2017 Michigan Highway Maintenance Conference

May 2, 2017 — Bellaire

SAVE THE DATE: 2017 Spring Transportation Asset Management Conference

May 25, 2017 — Mount Pleasant

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