

## Culverts: Strategies for Getting Started with Collecting Inventory and Condition Data

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Photo: Culvert (courtesy of Mecosta CRC)

Culvert inventory and condition data is a valuable resource for local road-owning agencies

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Michigan's  
Local Technical  
Assistance Program

Approximately \$1.48 billion. That's how much Michigan's local-agency-owned culvert assets are estimated to be worth. In 2018, the Michigan Transportation Asset Management Council (TAMC) funded a pilot study to uncover data on Michigan's culvert assets. That study found an estimated 196,000 culverts are lying below Michigan's road network with approximately 27 percent of the culverts being in good condition and 40 percent being in fair condition.

Culverts play a vital role in channelling water under ordinary flow conditions or during storm events even though some culverts may appear to have very little function. Culverts are "linear drainage conduits underneath a public roadway" that are open on both ends and do not contain intermediate drainage structures like catch basins or manholes. Even though they span—either as a single culvert or as multiple culverts placed side by side—up to 20 feet, culverts are often hidden in ditches and covered by vegetation.

Once found, however, collecting inventory and condition data on a single culvert takes an estimated 25 minutes. According to some local road-owning agencies, those 25 minutes are well worth the time and effort.

Dan Armentrout, director of engineering at Saginaw County Road Commission (CRC) says that having culvert inventory and condition data at "our fingertips, at our desk" has been a significant help to the agency. "I can quickly go to my app and see what we've got for facilities out there and what we need to go look at," he said.

For many agencies, being able to access cul-

vert data quickly makes roadwork planning easier. Culvert data can be "used for multiple things", emphasized Armentrout.

### Culvert Data: A Planning Tool

For the City of Farmington Hills, Karen Mondora, director of public services, says culvert data is used as a "preliminary tool in our planning for upcoming roadwork". She says the city gives culverts in fair or poor condition a "closer look" to determine whether it's "an appropriate time to make an investment" in the road over the culvert or whether the culvert needs to be replaced first. "It's critical that we do a complete analysis of the right-of-way conditions prior to making those investments, and it also helps build the case for additional budget requests," she explained.

Jon Firman, assistant superintendent for Mecosta CRC, says culvert data provides his agency with a rough idea of what's out in the field. "When we are trying to do estimates, we'll go into Roadsoft and get a ballpark idea as to how many culverts are on that stretch of road," he said. "We use Roadsoft as a baseline and we go out and field verify [the culverts] are there, so we use the data to help manage the system."

Bay CRC uses their culvert inventory and condition data set in a similar way. "We basically use our culvert data for requests, for our own maintenance, or whatever else we can apply it to," shared Jim Lillo, engineer-manager of Bay CRC. By storing their data in the work-order-based program CityWorks, they are able to record and review past maintenance or replacement work completed for

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## Letter from the Editor

I had to laugh when I saw this quote by Charles Dickens: “It was one of those March days when the sun shines hot and the wind blows cold: when it is summer in the light, and winter in the shade.” Sitting here on this early April day watching the sun peek out from behind the clouds while a fresh snowfall blankets the outdoors, I wonder: what Dickens would have said about April?

March, April, and May in Michigan are like Dickens described: they are a delicate balance between snow and spring, between a newly-revealed sleeping landscape and one bursting forth with foliage. They are also those months that provide the best opportunity of local road-owning agencies to inventory and rate the condition of their culverts, for the best time to gather this information on culverts is after the snow disappears and before the vegetation grows along the roadside and in ditches.

In this issue of *The Bridge*, we visit with five local road-owning agencies to get their insights on how to get started with culvert asset data collection. You’ll learn how these agencies went from nothing or very old data to having most of their culverts inventoried with up-to-date information and, in several cases, rated as well.

This issue of *The Bridge* also returns to new and innovative project sites that we previously featured. We return to Keweenaw County’s crumb rubber asphalt project, Wexford County’s and Kalamazoo County’s Texas underseal trials, and Delta County’s gravel road stabilization test strips. We share both how these projects have been performing over the past several years as well as early insights into how these projects are performing.

Also in these pages, we explore the one thing all vehicle operators at some point succumb to: tire troubles. Pointing to that fact, legendary singer and songwriter Roy Orbison once said, “I may be a living legend, but that sure don’t help when I’ve got to change a flat tire.” For those at local road-owning agencies who operate trucks and construction vehicles frequently, the risks of tire troubles are greater since those vehicles are often equipped with steel-cord radial tires that can cause severe or life-threatening injuries at the time of reinflation. Herein, we share some valuable practices to ensure safe handling of these types of tires.

Finally, we present an opportunity to our readers. In this issue, we’ll tell about a new app that is being designed to help Michigan road-owning agencies in their winter-maintenance decision-making processes. This app has a preliminary version that is now available for agencies to try. Through your feedback, the developers are hoping to create a useful tool for Michigan’s road-owning agencies.

In the meantime, if there are training topics or newsletter article topics that would benefit you and your agency, please let us know. In our webinars or virtual events, please share your suggestions with us in our exit polls or event evaluations. Or, share your suggestions with us by e-mail at [ctt@mtu.edu](mailto:ctt@mtu.edu), by visiting our conference pages and completing the Present tab form, or by visiting <http://michiganltap.org/TheBridge> and completing the Topic Suggestions form.

And, to all local road-owning agencies in Michigan: may your spring be one where the sun shines warm and the wind is not too cold!

Victoria

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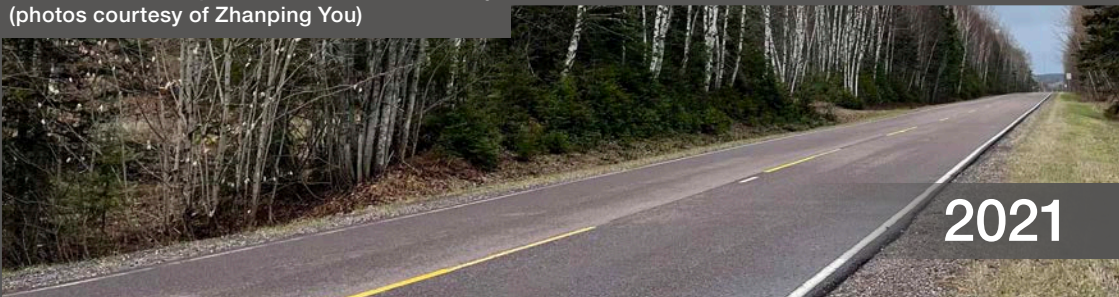
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Photo: Crumb rubber asphalt (courtesy of Zhanping You)



Crumb rubber asphalt in Keweenaw County (photos courtesy of Zhanping You)



# Where Innovations Are Now: Updates on Innovative Pavement Construction and Maintenance Projects

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Roadway innovation is exciting in its initial stages, but the test of time proves whether an innovation really is a viable solution to roadway-related problems. Past issues of *The Bridge* have featured innovations like crumb rubber asphalt, Texas underseal, and enzyme stabilization of gravel roads. Here's how these innovations have been performing:

## Crumb Rubber Asphalt

Every year, American motorists dispose of their car's tires creating a waste of 300 million tires. After their disposal, used tires have a few possible new homes: a landfill, an incinerator to create tire-derived fuel, or asphalt. Crumb rubber asphalt is created through the shredding of recycled tires, which is then blended with asphalt. This blend is then mixed with conventional aggregate materials before it is used as pavement. Crumb rubber asphalt has proved to be a sustainable way to give America's old tires a positive new purpose.

Crumb rubber asphalt was mainly used in hot climates until 2014 when it was introduced to Keweenaw and Muskegon Counties. Zhanping You, PhD, a professor in the Department of Civil, Environmental, and Geospatial Engineering (CEGE) at Michigan Technological University, has advocated for crumb rubber asphalt, conducting studies and collaborating with many counties across Michigan and in other states. Dr. You worked alongside David Hand, PhD, currently a professor emeritus in the Department of CEGE at Michigan Tech, who monitored the asphalt plant emissions in

Keweenaw County in order to ensure they met air quality standards for the state of Michigan and evaluated the performance of crumb rubber asphalt in a colder climate.

"In the past," Dr. You explained, "people were concerned: if you put rubber in the asphalt, it's going to cause a lot of odors." He continued, "We gathered all the gas being released through the asphalt plant to check what chemicals were there or if there were any chemical compounds that are not good." Dr. You said they were looking to see if those chemicals or chemical compounds were present or had increased because of the addition of the rubber. "The end result is the emission requirements are meeting Michigan's standard," Dr. You shared. "It's not much of a difference compared to conventional asphalt."

It was important for Dr. You to see how crumb rubber asphalt compared to conventional asphalt especially in the face of Michigan's winters. "We wanted to make sure that in winter the [crumb rubber asphalt] roads were not going to crack easily," he shared. His other concerns were rutting and being able to handle heavy vehicles, adding that "if you have a lot of big trucks—for example, logging trucks—you're going to get major ruts on the roads".

He, therefore, developed crumb rubber asphalt test strips in Keweenaw County in order to monitor for cracking and rutting. Since installing the crumb rubber test strips in 2014, Dr. You claims that he hasn't seen any major cracks or ruts, a surprising result given that these two distresses are related to

opposing pavement features of flexibility and dimensional stability.

Aside from the Keweenaw County crumb rubber asphalt study, other Michigan counties with ongoing crumb rubber projects are Kalamazoo, Kent, St. Clair, Bay, Clare, and Dickinson counties. Agencies who want to use crumb rubber asphalt on a project should contact the Michigan Department of Transportation Local Agency Program during design since this material is not yet approved for use on projects receiving federal funding. ■ AL

**Learn more about this crumb rubber asphalt project in *The Bridge 29.3*:  
<http://michiganltap.org/bridge/293>**

## Texas Underseal in Wexford County

Michigan's wet-freeze climate combined with heavy traffic volumes can quickly lead to damaged roads. Wexford County has been employing Texas underseal as a preventive maintenance treatment due to an accidental discovery in 2012 by Karl Hanson, Wexford County Road Commission (CRC) highway engineer.

When Hanson was posed with the issue of heavy traffic being detoured on a county road with severe cracking due to road work on M-115, he decided to chip seal the county road as a temporary fix in 2011. After the M-115 road work finished and the detour concluded, Hanson paved over the county

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Wexford County Road Commission's Texas underseal on the M-115 detour—before (left) and after (right) (photos courtesy of Wexford CRC).

road and his previous year's chip seal with ►hot-mix asphalt (HMA) in 2012.

He later discovered his actions were a widely-used technique often referred to as 'Texas underseal.' "It's a chip seal on the road with an overlay directly on top of it," he explained. "If the road needs grade correction and wedging, then you do the wedging on the chip seal and then do the overlay." This technique creates a moisture barrier between the top pavement and underlying asphalt layers but also works to delay reflective cracking.

"I started playing with Texas underseal, doing a few more roads and seeing how they performed compared to roads that were paved at the same time," he shared. "The cracking came through quickly on some of the other roads that were not undersealed, so we decided to move forward with using Texas underseal on all roads if it was feasible."

With the Texas underseal appearing to perform satisfactorily, Hanson explains that Wexford County now tries to chip seal every road that gets an overlay.

He says that with the Texas underseal he has seen a significant reduction in cracking, particularly transverse cracking, wheel path cracking, and edge cracking on roads that were in poor condition.

"You're still going to get cracks, holes, or distresses that work through the pavement, but it's going to take longer for those to work [up to] the pavement surface," he said. But, he added, "If a road is in really poor condition and you're going to want to overlay it; a Texas underseal is a good place to start—chip seal it first because you can seal up cracks, fix potholes, and provide a bond breaker between existing pavements and the new pavement surface to help slow down some of those cracks."

Hanson says that placing a Texas underseal between a road in poor condition and a new surfacing for that road is a cost-effective

maintenance option, costing significantly less than a crush and shape or reconstruction. But, he says he needs more years of service to evaluate how well it is performing on roads that were in good condition when they were Texas undersealed as well as how cost effective it is on the roads. Hanson explained, "Obviously, concerns are how cost effective it is and how long term are the benefits you get out of it."

Nonetheless, Hanson is seeing good performance of Texas underseal on roads that were in very poor condition. Regarding the M-115 detour, he shared, "We just cracked sealed it a second time this year, so it's performing very well."

Hanson also cautions that care must be taken regarding the amount of tack—especially if it is conventional tack—being applied during a Texas underseal as the tack can adhere to tires and pull out aggregate from the new chip seal. He also says doing a Texas underseal has an added layer of complexity with it needing two separate contractors—one to lay the chip seal and, a few weeks later, one to pave with the HMA. "Some residents don't think we know what we're doing when we chip seal the road and come right back to pave over the new chip seal," he shared.

"It's not a 100-percent magic bullet, but it will gain a level of serviceability with your pavement that costs less than rehab, crush and shape, or full reconstruction," Hanson continued. "If a road has questionable subsoils underneath, recognize that you have muck underneath it, but the Texas underseal may help hold the road together longer than a conventional overlay."

in trying the technique, he suggested, "Talk to some people who have done Texas underseal and experiment with it if you have a chip seal program, and start on roads in the worst condition if you want to see the most benefit." ■ *AL*

## Texas Underseal in Kalamazoo County

Unlike Wexford CRC's happenstantial Texas underseal, the Road Commission of Kalamazoo County (RCKC) intentionally applied a Texas underseal to one of its roads.

In 2015, RCKC used Texas underseal to repair a 1.5-mile section of Portage Road in Schoolcraft Township. The road, which has an average daily traffic (ADT) count of 6,000 to 8,000 vehicles, had 6 to 8 inches of deteriorating concrete with multiple HMA overlays.

"This section had a long-standing history of large transverse cracks down to the concrete underneath the asphalt road surface... we were seeing reflective cracking from the old concrete road up through the new asphalt shortly after any type of HMA overlay," explained Travis Bartholomew, RCKC Operations Director. "The Texas underseal, its goal was to protect the bottom side of the new asphalt surface course from moisture wicking up through those large open cracks and to retard the reflective cracking from coming through to the surface course."

According to RCKC Engineering and Public Relations Director Mark Worden, the Portage Road Texas underseal project involved "milling off 4 inches of asphalt and put[ting] down our typical chip seal, which is a high-float, rapid set 2M emulsion and a 3/8-inch crushed stone for our aggregate... [directly] on top of the milled surface". They followed the chip seal with a first HMA lift of fine-gradation 36A asphalt along with bituminous binder and asphalt cement (binder) grade 58-28 that they hoped was rich



Road Commission of Kalamazoo County's Texas underseal—during Texas undersealing (left) and current (right) (photos courtesy of RCKC).

For local road-owning agencies interested

enough to minimize reflective cracking and a second HMA lift of Superpave™ mix and a polymer-modified binder that was designed to withstand the road’s ADT.

“Because chip seal is a preventive maintenance treatment and not structural, I didn’t initially have a lot of faith in it delaying reflective cracking,” shared Bartholomew. “I didn’t have a lot of confidence in the concept at first.”

Bartholomew’s initial reservations stemmed from his concerns about the cost of doing a chip seal prior to HMA paving, the timing of doing a chip seal on milled asphalt while still leaving the road open to traffic, and the delicate nature of paving with HMA over a brand new chip seal. The project cost \$732,915.80 but that was for both the Texas underseal section and a control section. “It wasn’t broken down by test section versus control section, so it’s difficult to calculate the cost of the Texas underseal treatment separately,” he explained. He also notes that doing HMA paving over a new chip seal has the risk of pulling the stone chips out of the new chip seal through the turning action of the paver or the hot trailer tires sitting on the surface and causing the stone chips to stick to them.

However, Bartholomew says that he is “pleasantly surprised” that, to this day, the Texas undersealed section of Portage Road has minimal cracking in areas where the transverse reflective cracking was once prominent. “Our Texas underseal...and then 4 inches of HMA constructed in two lifts in 2015 and

2016, that reset our Pavement Surface Evaluation and Rating (PASER) score to a 9 because it was a new surface,” he explained.

Within the first year of the Texas underseal repair, Bartholomew and Worden both say that the road experienced no cracking. “In 2016, our crew went through and chip sealed the year-old asphalt and fog sealed it, and that set the PASER score to an 8, so we adjusted it to an 8 in 2018,” Bartholomew added. Chip sealing on top of the Texas underseal created a “sandwich effect”, protecting the asphalt layer from moisture wicking up from the bottom or seeping down from the top. “To me, that’s optimum protection for long-term performance.”

He says that, even though Roadsoft predicts the pavement deterioration should have brought the pavement down to a PASER score of 7 in 2021, the pavement was still an 8 at its last rating in June 2021. “So, it has actually performed very well,” concluded Bartholomew.

RCKC has now used the Texas underseal in “numerous projects” where a composite pavement experienced aggressive reflective cracking coming up through the surface layer from the concrete pavement underneath, according to Bartholomew. Despite RCKC’s successes with Texas underseal on composite pavements, their experiment with using Texas underseal on asphalt pavements has not yielded good results, likely because the pavement is not as thick.

Nonetheless, Bartholomew concluded, “If you have a composite pavement, Texas underseal delays reflective cracking; for the

cost, just in our experience, we see the value in that return on investment.” ■ VK

**Learn more about these  
Texas underseal projects in  
*The Bridge* 30.4:  
<http://michiganltap.org/bridge/304>**

### Gravel Road Stabilization Techniques

In 2020, Delta County Road Commission (CRC) conducted a project to test gravel road stabilization techniques (see *The Bridge* 33.2). The project involved designing four consecutive quarter-mile test strips to test four different gravel stabilization techniques: chip seal over gravel, Perma-zyme, chloride mineral brine, and Delta CRC’s “usual” gravel road topped with 500 gallons of calcium chloride per quarter mile. The test strip was completed in August 2020 and has been monitored since then. Perma-zyme, an enzyme theoretically used to “cement” the gravel biologically, was of particular interest following an article in *The Bridge* 32.4 that covered the emerging practice of using enzymes to stabilize gravel roads.

When Jody Norman, manager of Delta CRC, learned about how enzymes are used in farming, he discovered their application for stabilizing gravel roads. “The first time I saw it was actually from a farming article that I had read and they used enzymes to stabilize the soils so that they could get into the field

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Delta County Road Commission’s gravel road stabilization test strips immediately after construction: top left—chip seal over gravel after construction (left) and the following spring (right); top right—gravel section stabilized with Perma-zyme after construction (left) and the following spring (right); bottom left—gravel section stabilized with chloride mineral brine after construction (left) and the following spring (right); bottom right—gravel section without stabilizing agent (photos courtesy of Delta CRC).

►after they had flooded it,” he remembered. “Then, when the windmills came into town, they used soil stabilization to build the roads through farm fields so that they didn’t have to strip the topsoil and build a good base, so that kind of sparked my interest.”

After looking into the technology, Norman decided to test it out on Delta CRC roads. “We paved the first quarter mile, the second quarter mile we used Perma-zyme in the base, the third quarter mile we added chloride mineral brine to the base to tighten it up, and then the last quarter mile we basically did what we would do with any other road,” he explained. “All of the road was built with fabric, three inch stone gravel on top.”

For the Perma-zyme section, clay had to be added to the gravel to meet the manufacturer recommendations for 15 to 20 percent clay fines lost by wash, or a measure of how many small particles—like dust, for example—are in an aggregate sample. Measuring fines by wash is done by recording the weight of a sample, rinsing away the dust, and then recording the final weight of the sample. Norman said they managed to get the clay fines up to 14 percent. “We were pretty hesitant to go much higher than that,” he shared. “When we get clay in our roads, the clay typically tends to explode in the spring when the thaw comes.”

Norman had high hopes for the test: “In a nutshell, we were hoping we could get the base to stabilize hard enough that we could use seal coat more often on some of our heavier-traveled roads, get away from the cost of asphalt, and get a road that would last 10 [or] 15 years without having any issues.” Looking back on the project roughly a year and a half after it was completed, Norman concluded, “You can’t beat asphalt.”

“The Perma-zyme failed miserably,” Norman continued. “We talked with the company several times about it and they had recommended that we use the minimum of 15% with the clay lost by wash, but we were just not willing to take that chance because of what we saw in the first year when it basically disintegrated in the spring.”

The chloride mineral brine section had two small failures since being constructed. And, the test section using Delta CRC’s “usual” gravel road stabilization with calcium chloride had “one small area where it disintegrated”. Norman said that, even though moisture came up through the road layers, the road base held up well in the chloride mineral brine section and the calcium

chloride section. However, he shared that the chip seal “released” so they needed to add drain tile to prevent that separation.

Through continually monitoring the test sections, Norman has concluded that the mineral brine section and the “usual” calcium chloride section are performing the best among the unpaved stabilization methods. In early November 2020, core samples were taken from the three unpaved sections “to see how the base was holding together, if it would come out in one solid piece or not”. Norman recalled, “It was definitely stabilized, but it did not come out in one solid piece on any of the test sections.” Additionally, Norman notes that the road surface of the mineral brine section looked like it was damp or wet compared to the other sections. “It was interesting for sure,” he said.

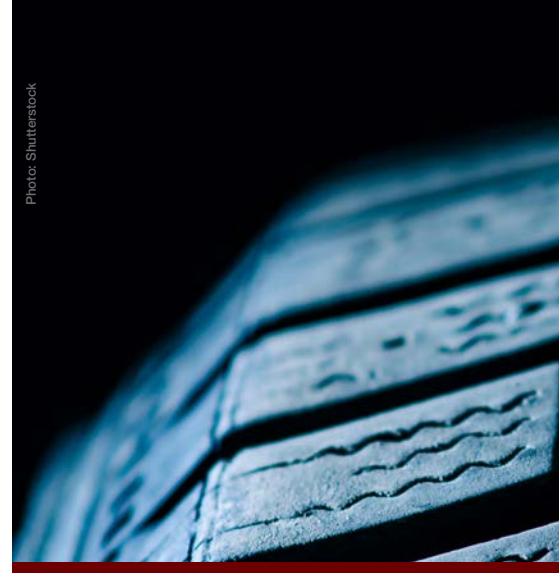
As for which of the test sections turned out to be the most cost effective, Norman concluded, “Honestly, the very last test section with the calcium chloride—dollar for dollar, it was probably the best.” But, in terms of longevity of each test section, Norman says it’s “too early to tell” for most sections with the exception of the Perma-zyme section which has already “failed”. Norman added, “This spring will be a determining factor on where these test strips are in terms of any type of longevity.” *The Bridge* newsletter will continue to follow Delta CRC’s findings on the performance of the different gravel road stabilization techniques.

Norman notes that the test section has only been through only one season of freeze-thaw cycles at this point. “We’ll know a lot more here in the next couple months,” he predicted. “Now that we’ve got drain tile in those areas where we had issues, I think we should be good and I think we should have alleviated all of those issues.”

Norman comments that constructing the four test sections has “changed the way we think, as far as getting that water out of the road base”. He said, “It doesn’t matter what we do, the water is still coming through in the spring.” He calls the test sections “interesting” and says they “served their purpose”. He concluded, “It taught us a lot and shows us which direction we need to go, but I would be hesitant to do it again.” ■ *GT*

Learn more about the Delta County gravel road stabilization project in *The Bridge* 33.2:  
<http://michiganltap.org/bridge/332>

Photo: Shutterstock



**E**ver found pliers embedded in truck tires? Tom Thompson, district equipment and facilities supervisor at Kent County Road Commission (CRC) has. Vehicles used in road agency operations encounter many non-standard variables, such as driving on the shoulders of roadways and removing snow cover from roads during the winter, and lots of hidden debris along the way can destroy a tire.

However, damage to tires is not always as obvious as pliers lodged into them, especially when it comes to steel-cord radial tires. Steel-cord radial tires are used on light and commercial trucks, buses, and construction vehicles. Damage to these tires actually starts with things like underinflation or loose lug nuts. Running a tire soft—or underinflated—can cause significant damage to tires and can lead to serious injury or fatality if these tires are not handled properly at the time of reinflation.<sup>1</sup>

Mike Latta, equipment supervisor at Livingston CRC, shared “Tires can be dangerous if they’re damaged.” If a tire appears to be unrepairable or unsafe, it could be sent to a recap shop for a more in-depth or thorough inspection and can undergo recapping or highly-technical repairs, he suggests.

“Tires are the only thing keeping a vehicle on the road,” said Dave Crawford, lead trainer at Northern Michigan University truck driving school. His training courses include resources on safety practices for handling commercial vehicle tires in order to prevent these tire-related catastrophes.

### Risks Related to Underinflation

What then are some safe tire-handling practices that drivers themselves should know?

One of the most important safe tire-handling practices is to make sure a tire is properly inflated. Improper inflation can severely damage a tire. In fact, running a tire soft can lead to zipper ruptures.

“Zipper ruptures” are the more common



# Valuable Practices to Ensure Safety When Handling Truck Tires

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name for sidewall circumferential ruptures that occur when there is an over or under-inflation of a tire (Rubber Manufacturers Association, 2011). A 400-pound chunk of rubber with a skeleton of steel cable is not a piece of equipment to take for granted. A tire can be “like a bomb” if it explodes, says Thompson. Susanne Bahn, in an article about workplace hazards, wrote that “such explosions may result in severe injuries or even death”.

A search on YouTube for “zipper ruptures,” brings up numerous videos illustrating the serious injury and damage caused by improperly inflated or failing steel-cord radial commercial truck tires. One video, for instance, shows the injury that can result from a zipper rupture: a mannequin standing next to the exploding tire loses its legs.

Latta has seen first hand the effects of running a tire soft. He shared, “I’ve seen a bulge out the side of a truck tire that was the size of a volleyball.” The steel cables in the tire broke due to running a tire soft for too long a period of time. Of particular concern is damage to steer tires. “A steer tire blowing up at highway speed could cause you to lose control of the vehicle you’re in,” Latta explained.

While a ruptured tire can cause a vehicle to lose control, the steel cords inside radial tires can also cause significant injury and even death to anyone standing nearby in the event of a tire rupture. Steel-cord radial tires are prone to particularly dangerous failures if not properly maintained. This is not something that a driver wants to deal with, especially when “the motoring public is whizzing by at 80 miles per hour on the road,” notes Thompson. Trevor Bennett, director of operations at Livingston CRC pointed out, “As many have experienced when driving a car: if you have a tire failure, it never fails at a good time.”

## The Walk-Around (Drivers)

It can be easy to become complacent around

tires: checking air pressure with a swift kick of the tire or deciding to ‘run a tire soft’ in order to finish a shift. These common practices—this quick, easy check and this short-sighted decision, respectively—may overlook or cause serious damage to tires. “You don’t know what kind of damage happened to that tire on the inside,” Thompson noted. “In all my years of working with tires, there are so many different things that can happen to the inside of that tire that a person can’t see on the outside.” He points out that many people misperceive the appearance of a good tire as a tire being in good condition.

Crawford emphasized, “When you stop checking and you stop looking, you’re not going to catch small problems before they turn into bigger issues.”

Drivers can catch tire damage related to improper inflation during a vehicle walk-around if they know the signs of improper inflation or failure of a tire. Thompson, who has worked in garages for the past 30 years, says a thorough evaluation of the tire, beginning with the sensory assessment, can indicate if it is improperly inflated or failing. For example, the tire should have no distinctive smells or sounds during an air-up, no tactile distortions/bulges, and no visible wire cords, and the lug nuts should be on tight.<sup>2</sup>

Thompson emphasizes the sensory assessment is smell: he says if the tire’s rubber smells like it has been burnt, that smell could be a sign that the tire was run soft.

## Checking Tire Pressure

Doing a quick walk-around isn’t going to provide all the information needed to decide if a tire is in good condition, Crawford explains. A more in-depth assessment of tires is necessary for determining safe operation. A key element to safe operation of tires is to monitor tire pressure.

For drivers, it is important to know that

manufacturers of commercial and non-commercial tires will provide the recommended air pressure and weight limit for the tire, which can be found on the sidewall of the rubber casing. Matthew White, director of tire service at the Tire Industry Association (TIA), instructs those handling tires that there is a placard with “maximum pressure and weight for the piece of equipment or the vehicle”. However, White adds that it’s commonly thought that “the max on a tire is what you should run that tire at, and that’s not necessarily true”. Tire pressure recommendations don’t consider the vehicle’s load weight. Tire pressure should be adjusted to handle the weight of the load if hauling gravel, for example, back and forth to a construction project site.

“Sometimes vehicles come with tires that are not the best tires for us,” shared Bennett about the performance of stock tires during Livingston CRC road-work operations. Latta added, “Manufacturers don’t always take us and our work into consideration; we need a tire that’s a little more aggressive for our work, so we will often order our tires specifically for our needs.” Latta says he looks for features like a heavier-duty tire, which provides better traction in their work environment, and thicker sidewalls, which provides more resistance to potential punctures or wear and tear.

However, using non-manufacturer-provided tires may alter a vehicle’s tire pressure monitoring system (TPMS) sensors and provide inaccurate readings. Commercial vehicles generally have a TPMS. White explains that a “light comes on at 25 percent below what the placard pressure is”. Monitoring systems can make it easier to catch an issue before it worsens. Being aware of the tires on the vehicle is important for determining the reliability of the TPMS.

Thompson and others believe that running

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▶ a tire soft is one of the worst scenarios since it is not always easy to spot the signs of underinflation-related damage during a walk-around.

If Thompson's mechanics are unsure about whether drivers operated their trucks with their tires properly inflated, he teaches them to "pull the valve cord in order to let the air out and deflate the tire". This essentially turns the tire into a "big chunk of rubber"; otherwise, with the air pressure in the tire, further inflation can be fatally dangerous. Additionally, he notes if mechanics hear a sound like "chicken bones snapping" during inflation of the tire, it could indicate the tire's skeleton is no longer intact.

Damaged tires can be costly. "It doesn't take long to wreck a tire," commented Thompson. Improper inflation or failure of a tire can cause injury and even death.

## Changing Tires

Another key factor in safe tire-handling practices is proper mounting and demounting of a tire and securing lug nuts. In an article in *Heavy Duty Trucking*, Jim Park wrote, "It's one thing to wrestle the tire onto a wheel, air it up, and mount it on the truck. It's quite another to make sure that it's concentrically mounted, and that the hub mounting face and the disc face of the rim are clean and rust-free, and the fasteners are properly torqued."<sup>3</sup>

OSHA has resources for proper mounting and demounting of tires available on their website (<https://www.osha.gov/sites/default/files/publications/3402tube-type-truck-and-bus.pdf> and <https://www.osha.gov/publications/bytopic/tire-charts>).

Crawford added, "Not properly torquing your lug nuts when the tire is installed is probably the worst of the practices to avoid." Diligent pre- and post-trip inspections are critical for catching issues related to lug nuts. Polk County Highway Department in Minnesota has an innovation that indicates if lug nuts are tight (see *The Bridge* 28.3). The innovation is an arrow-like plastic device to put on lug nuts that shows if they are loose or not based on the arrow's direction. This innovation helps to notify drivers of something that may not be as directly detectable during a walk-around of the vehicle.

One indication of loose lug nuts is the presence of rust streaks. "The tire has a nut with a washer on the back that's attached to it," Crawford explained. "If it is not properly tightened, there's going to be a gap in there where water can get in and cause rust, and you can see rust coming out between the nuts." If the tire isn't properly secured to the vehicle, it can separate from the vehicle. If this happens when a driver is out on a roadway, the tire could potentially hit another motorist, suggests Crawford. "Those tires are big enough and heavy enough that they can cause loss of life."

## Importance of Education

"We can't assume that the driver has the same eye for looking at tires as a mechanic—someone who is trained to look for tire-related issues before they happen," shared Latta.

For anyone who works with commercial truck tires, training is important. Crawford, in his courses on commercial truck driving, helps students understand the importance

of good tire handling practices but also emphasizes the dangers related to improper or incorrect handling of tires. He displays a blown-out tire for students to see the aftermath up close, sharing that the tire is "what's left of a rim where the lug nuts were loose and had come off the vehicle". Even though he's fortunate not to have any personal experiences of tire failures, Crawford shares what he knows about hazards and illustrates tire failures with "remnants of tires on the side of the road where the tires have failed".

White echoes Crawford's passion for education on safe tire handling practice. "I was never trained with the industry standards and was just given the keys to a service truck, and asked to change the tires," shared White. "I could have gotten severely injured because of that, so my goal is to promote safety through training."

Mentorship or communication with experienced drivers or mechanics can be an effective approach for less-experienced employees learn how to check and handle tires safely. Thompson shares that his agency encourages communication in their garages and that "saves a lot of aches, pains, and heartache—and even death".

White stresses the use of resources and training to feel comfortable with handling tires. "Tires have their limitations, tires can be dangerous if not properly inspected, so it's best to practice awareness because a lot of people get complacent on [checking] tires and that's how accidents occur," he said. "At the end of the day, having an awareness of safe-handling practices is one of the most important take-aways."

"Your tires are the foundation of a truck," Latta noted. "Just like a house, you have to have a good foundation that the rest of your truck sits on." ■

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Photo: Shutterstock





Culvert in Benzie County

► any culvert in their road network.

Mondora, Lillo and Matt Skeels, manager of Benzie CRC, all use their culvert data to determine whether road projects are a good investment as is or whether the underlying culverts need to be addressed first. “Nobody wants to put a nice coat of asphalt on something and then have to tear it up in a year or two to replace the culvert,” explained Skeels. “That doesn’t look good.”

Skeels continued, “I can’t say that anybody here is an expert on Roadsoft but, if you have that data there, it just makes things a lot easier when you are developing projects or you want to talk to your townships about where to invest the money... It’s just a good source of information and I am very thankful for it.”

Asset management is where culvert inventory and condition data pays off, according to Armentrout. “It’s the concrete data we need to make decisions,” he said. “And, it’s nice to have that [data] right at your fingertips, no matter where you are...it’s right there at your desk.”

## Collecting and Updating Culvert Data

To get started with culvert data collection, Saginaw CRC set a goal of capturing locations and inventory elements of their culvert assets. “We didn’t necessarily do a condition rating on every one,” said Armentrout. “You had to push

a couple extra buttons; it would have been nice to do that, but we didn’t, and I wish we would have.”

The City of Farmington Hills tackled their 33-square-mile jurisdiction by dividing the area into sections and creating map books and nomenclatures for each section. Mondora says they sent out an advanced team that located and staked culverts and a second team that collected inventory and condition data on the culverts.

While the City of Farmington Hills was able to send out teams of its own staff members with a consultant to inventory and rate culverts, Benzie CRC wasn’t able to commit staff time to collect culvert inventory and condition data. “We picked a consultant because frankly we didn’t think we had the staff time to do the data collection,” shared Skeels. Benzie CRC enlisted their consultant who also performs their bridge load ratings to collect culvert inventory and condition data for them. “We had kind of an existing contractual relationship with him, so we knew him and his capabilities and just amended or added another work task to his contract and sent him off on his way.”

Skeels says they concluded their initial data collection effort by looking to the future. They had their consultant also train Benzie CRC’s foreman on how to use the laptop to rate culverts. “[We did that] just for some consistency in rating,” he explained.

Saginaw CRC, Mecosta CRC, Bay CRC, and the City of Farmington Hills have continued their culvert data collection efforts as well. “When we go out to replace a culvert, we update the inventory,” shared Armentrout about Saginaw CRC’s ongoing efforts. “It’s just an update on the existing data, so we are able to have that continuity.”

While Firman says that Mecosta CRC does update culvert data when a culvert is replaced just like the other road-owning agencies do, Mecosta CRC also adds new culverts to their data set. “As we come across culverts that are not in Roadsoft, we try to get the laptop that we use with the GPS built in and locate the culverts to keep our system as up to date as possible,” he said.

Currently, the City of Farmington Hills is only focusing on adding critical culverts to its inventory. “With upcoming road projects and critical crossings where we have only one entrance into a neighborhood, we’ve been collecting that data



Culvert data collection in Roscommon County during the 2018 pilot study (photo: CTT archive).

and updating it,” Mondora said.

“I guess we were surprised that we had more [culverts] than we thought,” she added. “Not really surprised about the condition...”

Culvert condition was a surprise for both Bay CRC, but not in an anticipated way. Lillo says he expected the majority of Bay CRC’s culverts to be in poor condition; while some were, there were not as many as he had expected. “We didn’t have to replace a whole bunch of them even though they were 40 years old...we expected it to be worse,” he said.

## Start Small & Equip Yourself

Getting started in collecting culvert inventory and condition data may seem daunting for agencies that have thousands of culverts. “Start small with a pilot area,” suggested Mondora. She says that by establishing a pilot area, an agency can create repeatable measures and a nomenclature that will be a benefit if the data is integrated into a GIS database. “Start small and expand when you can,” she added.

Even though Mondora, Armentrout, and Lillo use GIS and/or work-order-based software, Roadsoft continues to be a good option for storing and analyzing culvert inventory and condition data. Armentrout noted, “Absolutely, Roadsoft is the software for most counties to use [for their data].”

Having the right equipment also helps. Firman said, “Get a good tablet with a built-in GPS.”

Erik Dziurka, IT manager for Bay CRC, added, “Bring an extra set of clothes with you.” He says members of Bay CRC’s culvert

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## Did You Know?

Having an up-to-date inventory of your agency’s culvert assets is now considered a best practice by the Michigan Department of Transportation Local Agency Program. Agencies can use this inventory information to make temporary or permanent emergency repairs in the event of damage caused by weather-related events. ■

# Culverts (continued from page 9)

► inspection team have gotten wet in the process of locating and rating culverts.

## Collect in the Spring

“The best time to collect would be early spring, right after the thaw,” continued Firman. “The vegetation is not grown up yet, and everything is matted down and you can see the spots where the water is flowing so it’s easier to find the culverts.” He says once the vegetation starts to grow, finding the culverts becomes more difficult.

Skeels added, “Right after the snow goes away and before the vegetation starts to grow, you can see the flowing streams, so we hit it pretty hard to pick up the culverts on our local system that have been missed.”

## Know What to Look For

While collecting culvert data in the spring makes the process easier, Dziurka indicates that it’s also important to know what to look for when trying to find culverts. “Look for low points in the road, and look for patches in the road where we’ve done a replacement,” he explained.

“There’s some knowledge that needs to go out,” Dziurka continued. He emphasizes the value of a good training program, saying that Bay CRC’s training included, “pictorial diagrams, what good-fair-poor was, what a condition was, what the different [culvert] materials were”. He added, “I wouldn’t say just get two kids hired and say go collect cross-culvert data; they’re going to be confused.”

Armentrout agrees with Dziurka on the importance of good training. “Talk to them about things like shapes and sizes and materials,” he said, noting that Saginaw CRC’s culvert data shows that there was some confusion in classifying culverts. “The bridge-type, giant culverts weren’t inventoried, for example, because they didn’t look

Culverts in Mecosta County (top left), City of Farmington Hills (top right and bottom left), and Bay County (bottom right) (photos courtesy of Mecosta CRC, City of Farmington Hills, and Bay CRC).



like a culvert but a bridge.”

“Talk about the different entrance treatments—whether there’s wingwalls or headwalls or flared inlets or nothing,” he continued. “Culvert lengths: if it’s a concrete pipe and you measure it and it comes out an odd number, check your measurement again because concrete pipe comes in even-numbered-increment pieces. Little things like that increase the accuracy of the data.”

Armentrout also notes that including a condition rating increases the usability of the data. “Give it a condition rating,” he said. “That’s definitely something you need to do.”

## Maintain Your Data

But, warn Lillo and Dziurka, maintaining the culvert data set is just as important as creating it in the first place. “You need to commit to it,...it’s a living, breathing document,” said Lillo. Dziurka added, “If you don’t maintain it, the confidence level drops in the data accuracy really quick and, once you

lose confidence in it, you might as well scrap it and start over.”

Maintaining culvert data, according to Lillo, is “part of the job, part of the culture, part of the road commission’s mission—it’s not an afterthought.”

## Culvert Data: A Valuable Resource

“If you don’t have a culvert inventory, you should get one,” encouraged Armentrout. “It is so handy to have...it is incredibly convenient to have.”

Skeels concurs. “Once you get started, I think you realize the value of having this data in the office so you can do some pretty preliminary engineering on your road system without having to walk both sides of the road,” he shared. “I think it’s a very valuable thing to have.”

Michigan local road-owning agencies can find guidance in the Michigan Transportation Asset Management Council’s *Michigan Non-NBI Culvert Structure Inspection Guide*, available at <https://www.ctt.mtu.edu/sites/default/files/resources/paser/tamc-culvert-inspection-guide.pdf>. ■

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Culvert in Mecosta County  
(photo courtesy of Mecosta CRC)

# When Winter Maintenance Meets Artificial Intelligence

Grace TenBrock – Engineering Intern  
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Road agencies across Michigan have been performing winter maintenance since their inception and will continue to do so for some time. Winter maintenance practices and innovations have developed over the years through research, the use of new materials, and the development of new equipment and techniques. Currently, road agencies use air temperature, humidity, pavement temperature, and weather forecasts to plan winter maintenance responses.

These factors help people like Brian Gutowski, engineer-manager of the Emmet County Road Commission (CRC) decide “what rates per mile that we want our salt and sanders putting down material, and how much liquid and what type of liquid that we are putting out there”. Gutowski is responsible for making sure the foremen of the Emmet CRC are equipped to handle county road and state highway maintenance. He is also a leader in innovative winter maintenance practices and helped develop the Michigan Winter Operations Conference, having been a conference committee member since the committee formed.

Gutowski and Emmet CRC are looking to the future of winter maintenance and are in the process of installing camera systems to

give the foreman “eyes on the road 24 hours a day” so he can monitor the current state of many spots throughout the county.

Emmet CRC has also advanced their winter maintenance practices by optimizing salt and sand use by using liquid anti-icing agents and limiting the use of sand. In developing the Michigan Winter Operations Conference, Gutowski contacted winter maintenance experts throughout the country. He shared, “We really promoted, after hearing from the experts: never to put dry salt and sand down and use as little sand as possible because it really doesn’t benefit the melting of ice off the road”. Implementing these new methods has saved Emmet CRC money and provided better service for the traveling public because, as Gutowski indicated, “the overall cost savings by using less salt and adding more liquid is lower than what we used to pay for our salt purchases”.

## Artificial intelligence

Gutowski’s approach to innovation in winter road maintenance came about from researching and testing materials and techniques suggested by other experts in the field. Now, Michigan local road-owning agencies have a unique opportunity to mimic Gutowski’s

approach to innovation in winter road maintenance by researching and testing a new tool: a “smart” app that uses artificial intelligence (AI) for making winter maintenance decisions and strategies.

John McCarthy, the Stanford University computer scientist who coined the term, defined artificial intelligence as “the science and engineering of making intelligent machines, especially intelligent computer programs”<sup>1,2</sup>

Dr. Zhen (Leo) Liu, PE, associate professor at Michigan Technological University in the Department of Civil, Environmental, and Geospatial Engineering, started looking into data-driven research and AI about seven years ago, coming from a research background of multiphysics. The discipline of multiphysics uses unchanging physics-based equations, or models, to find relationships between variables in a data set. Liu explained that physics-based models “use data to run the model but the model does not change no matter the data that we use” because the model is based on the laws of physics.

In contrast, data-driven models are not based on the laws of physics; instead, data-driven models start with a data set and

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► a model is found to fit the data set, which essentially makes a best-fit equation from the data that can be used for making predictions. Liu said, “In a simple way, data-driven models can be understood as ‘curve fitting’ although prevalent data-driven models are much more complex.” The power of such models is that they can grow or improve as more data is obtained, thus enabling a continuous gain of intelligence from data, he suggests.

Hossein Tavakoli Dastjerdi, graduate student and core research member at Liu’s lab—the LiuRG lab, says that a physics-based approach to modelling “defines specific states, and each state requires an action”. He says, for example, if the winter maintenance model defines the “state” as “if we have ‘snow’ weather conditions and a ‘pavement temperature’ is between 25 and 30” and defines the “action” as “apply ‘salting for 100 lbs/two-lane-road/mile’”, the model—while valid—“lacks consideration of other variables, such as snowfall intensity, wind velocity, traffic flow, timing, humidity, and air temperature”. Dastjerdi concluded, “If all of these variables are considered, it will be a very complex model and include hundreds of different states and actions.”

That’s why Liu and the LiuRG are turning toward the data-driven model found in AI.

Liu and his research team believe Michigan winter road maintenance can benefit from the “power of AI”. So, Liu says he wanted to “do something with AI to improve the current practice”.

Seeing the intersection between a need for winter road maintenance decision support tools and the amount of data available on Michigan roads prompted Liu and his colleagues to write a proposal for their latest project: an online application designed to help road agencies make decisions regarding winter road maintenance with the help of AI. Liu reflected, “I think that it is a very high potential area, there’s a lot of data, and it can be done”.

## Developing the “Smart MDSS” App

Liu and the LiuRG generally focus their research work on AI and other data-driven approaches to solving engineering problems. They previously worked with the Michigan Department of Transportation (MDOT) on a project for spring load restrictions (SLR) and developed a prototype decision making tool, MDOT SLR (<https://mdotslr.org>).<sup>3</sup> “I tried to see what can really be done with transporta-

tion data for the many jobs that state departments of transportation need to do,” shared Liu about the spring load restrictions project. “I found one particular area—the application of transportation data for improving winter road maintenance—it’s a very high potential area, there’s a lot of data.”

Liu and LiuRG’s are now working on a project that uses AI to make decisions about winter road maintenance. The team’s project was selected as one of four projects to receive funding in the Federal Highway Administration’s (FHWA) call for proposals from a pool of over 120 applicants. Liu reflected, “We have a good idea, we have great resources, we have a great team, and the potential for this project is really high”.

The three-year project started at the beginning of 2021 with the team already producing a beta-version of an app over the past year. “The primary goal is to develop a web-based app for the road-owning agency personnel who are making decisions about winter road maintenance”, said Liu.

The app, which they are calling the “Smart” Maintenance Decision Support System (Smart MDSS), uses data, AI, and deep learning to determine the status of the road, such as how much snow is on the road or how fast traffic is currently moving. Liu explained “Deep learning is the use of deep neural networks, and it works for classification or regression so that we can get from x to y.” This means researchers “can use deep learning algorithms to classify images... with a success rate that is much higher than other machine learning algorithms”. Liu and his team are planning to use this technology to analyze pictures of roads in order to determine the weather-related condition of the road’s surface. The app uses the results of this analysis and synthesizes it with many data sources into one dashboard so users can see a roadway’s weather conditions and pictures in one app.

Liu ultimately aims to see if AI integrated in the app is able to recommend maintenance responses to winter road conditions. More so, he commented, “I hope it does not just repeat what human beings can do, but that it improves the decision making so that we can get better outcomes.” For this to happen, the solution must be adaptable, and Liu already has a plan to make adaptability a reality. “We are trying to develop a whole system,” he added, “Not just one AI algorithm, but a system of AI algorithms that can help us

understand what’s going on in the field.”

The app being developed by Liu and his team is similar to an app used by MDOT, also called the Maintenance Decision Support System, or MDSS. James Roath, roadway operations engineer at MDOT in the maintenance services section manages the MDSS contract, among other duties. MDOT’s MDSS tool synthesizes information collected from their plow fleet, such as plow location, photos, material usage, and blade position, along with radar, weather data, maintenance alerts, weekend outlooks, and the ability to save and rewatch storms. While Liu does not promise all of the features of MDSS in his “smart” app, he says it will give local agencies access to a similar tool. Roath opined, “That is really a crucial thing that is extremely helpful for winter maintenance.”

## How AI Might Improve Winter Road Maintenance

Liu also plans to leverage deep learning to improve the app. Deep learning is a subfield of AI used to learn and recognize patterns in data and does not require human intervention to process data, making it a very powerful tool.<sup>2</sup> Liu plans to use deep learning to have the app learn from field experts. “If we’re going to do [some chemical application or plowing], we need to know where the trucks need to go, how frequently the plowing needs to be done, and how [much of the chemical application] we need to spread,” he shared. “All those things rely on the decisions of experienced engineers in the past but now, in a simple way, we are trying to see if AI can help us make decisions.”

While Liu is hopeful that his AI tool will help with winter maintenance decision making, he also wants the tool to learn from real experienced engineers. Liu appreciates “field experts who have 20 or 30 years of experience in winter maintenance and know how to make optimal decisions for winter maintenance”, but he also hopes his AI can learn from these experts.

AI can learn from experts simply by being used by experts. Liu explained, “Some expert gets the app and sees what they need to do for the next 24 hours but, if they find that that’s not the best option in their experience, they can instead do something based on their own judgment.” He continued, “The app knows in this specific scenario that the user did not take the recommendation made by the app but took their own actions, and it will ob-

serve the outcome of the action.” This will be done by comparing the actual conditions and the results of experts’ actions to the conditions recommended by AI and the theoretical results. An algorithm will determine which approach was more effective and store the data, essentially learning how to approach the situation in the future. Road condition and, therefore, the effectiveness of a certain response is determined by using ice sensors, image data, and traffic speed data.

Even if AI tools like “smart” app don’t completely automate winter maintenance decision making, they will still compile data necessary for decision making in one location, making viewing the data easier for decision makers. Roath said, “MDOT’s MDSS tool is not the ‘be all and end all’, there’s always going to be that human factor—operators out there doing their job will more than likely know the best application and what they need to do.” He added, “But, I do think that MDSS is a huge asset for a department.”

Roath notes that one of the challenges of winter maintenance is knowing how long

winter maintenance preventative measures will hold up. He says, “residual on the road is something that is kind of difficult to judge, so you can have a road that’s returned to its normal service level and is clear of ice and everything, but how long will that hold up?” MDSS tools can help with this challenge, as they are able to analyze photos, sensor, and speed data to determine when a road requires maintenance and communicate that to the user through the dashboard.

Liu hopes the project “creates a data-driven tool that can assist the road engineers in making winter maintenance decisions so that we can be more proactive, so that we can get better winter maintenance outcomes”. For example, “we spread less chemicals, less salt on our roads, and that can help protect the pavements and help reduce the cost, and in winter maintenance the cost is a big thing.”

Liu continued, “Money is often wasted by spreading salt on roads when it’s not necessary and it can even harm the service life of the pavement if we overdo it.” The cost savings from this targeted response

could extend to many industries that rely on transportation. Improved winter maintenance responses would improve mobility, ensuring that people are able to travel and that goods can be delivered to their destinations.

Winter maintenance decision tools also help decision makers plan for the weather-related events in advance. Roath explained, “[Decision makers] can go on the [MDSS] when they first start their shift and see, ‘for my eight hour shift, it looks like [the]...MDSS is predicting or recommending that we will need to...perform some actions’, and so they can plan their day accordingly.” He continued, “Realistically, if they didn’t have this [tool], they’d look at a weather forecast or something and say ‘they’re saying that it should snow’, [but] it’s hard to know for sure what [decisions to make] without knowing road temperatures and humidity and dew point, [and all of] that is roped into the [MDSS tool].”

### Viewing the App and Getting Involved

Although Liu’s “smart” app is still in the devel-

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The screenshot shows the Smart MDSS web application interface. On the left, there is a dashboard with several data sections:

- Road Information:** US-127 Isabella County Go to @ Deerfield, Last Update: Feb. 22, 2022, 1 p.m.
- Road Maintenance Table:**

Need Salting	Start Salting in	Need Plowing	Start Plowing in	Comment	Alarm
No	None	No	None	None!	None!
- Road Condition Table:**

Traffic Speed (MPH)	Free Flow Speed(MPH)	Closure Status	Road Surface condition [Machine Learning]	Road Surface condition Accuracy
50	50	No!	No. Snowy.Road	99
- Surface Temperature Table:**

Nearest RWIS station	RCPT Now	RCPT 24 hours	RCPT 48 hours	RCPT 72 hours
28 °F	31 °F	22 °F	17 °F	20 °F
- Weather status and Forecast Table:**

	Temp °F	Humidity (%)	Wind Speed (MPH)	Visibility (Miles)	Description
Now	31	96	6	6.437	light rain
6 hour	31	98	0	10.0	overcast clouds
12 hour	20	86	14	8.643	overcast clouds
24 hour	19	67	13	10.0	overcast clouds
48 hour	9	66	14	-	light snow
72 hour	13	72	14	-	snow

On the right, a map of Michigan is displayed with numerous blue location pins indicating data points across the state. A callout box on the map identifies 'US-127 Isa'. At the bottom left, there is a small inset image of a road with the text 'US127S/US127BLS'.

Screenshot of “Smart MDSS” being developed by Dr. Zhen Liu and his research group, LiuRG



► opment phase, it is accessible to the public at <https://smartmdss.org>. Liu notes that it's "just a prototype so there is limited functionality". He and his team are working to "improve the appearance and functions people can access". Improvements will be done gradually over the duration of the project, and the first official version is planned to be released later in 2022.

The current version of the app is a basic interactive map that shows users the conditions through surveillance cameras, traffic speed, and weather data at points of interest throughout Michigan. Despite its prototypical nature, Gutowski says he likes the app and thinks the use of AI to help make decisions about winter road maintenance "would be great as long as it's programmed correctly". Gutowski added, "I believe we would use the 'smart' MDSS app here at Emmet CRC quite extensively once the app is up and running."

Gutowski reflected, "The more help that road commissions and cities and MDOT can get, the easier it will be for us to go out there and make sure the traveling public can get from here to there safely; so, if artificial intelligence can help us do that I think it's a great tool."

In the future, the app will use an improved AI technique to process this data and recommend a winter maintenance operation based on the conditions and future forecast. Interested parties can view the app and provide feedback to Liu and his team. To give general feedback or inquire about collaborations or outreach, contact Leo Liu at [zhenl@mtu.edu](mailto:zhenl@mtu.edu). For more technical questions, contact Hossein Dastjerdi at [mtavakol@mtu.edu](mailto:mtavakol@mtu.edu).

Feedback is a big part of the project, according to Liu. He pointed out, "We are researchers, we are developers, but we don't know the practice as well as the real field experts."

Later this year, Liu is looking to recruit road-owning agency personnel to use the

first official version of the app and provide feedback. He plans to offer demonstration opportunities so potential users can see how to use the app; alternatively, potential users can explore the demonstration tools embedded in the app itself.

Liu is also interested in customizations of the app that might be beneficial to local road-owning agencies by allowing the app to adapt to specific procedures, knowledge, or features. He plans to integrate customizations in future versions of the application. He said, "We will try to customize the app because, in the different counties, different local road agencies may have their own rules and their own policies that vary from one to another."

Liu is excited for people to learn about the app. However, he emphasized, "The current version of the app is a very simple demonstration of the whole idea; we are continuously adding more functionality to it, especially on the back end to make sure that the AI is correct, the AI reflects reality, and the AI really

gives meaningful, optimal decisions for what we need to do on a real road."

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# Motor Grader Training

## Training Opportunities by Request



Maintaining unpaved road surfaces requires operators to use specialized skills, abilities, knowledge, and applied techniques that are only acquired over time.

Operators must continually improve upon their skills and knowledge through practice and by learning new insights about unpaved road maintenance.

The Center for Technology & Training offers Motor Grader Training for local road-owning agency employees.

Learn more at  
[ctt.mtu.edu/training-request](http://ctt.mtu.edu/training-request)  
or contact [ctt@mtu.edu](mailto:ctt@mtu.edu).

# The Bridge

The Bridge is published quarterly by the Center for Technology & Training (CTT) through Michigan's Local Technical Assistance Program at Michigan Technological University. Subscriptions are free of charge. To request a subscription, contact the CTT.

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The Bridge is printed with soy-based ink on recycled, acid-free paper (50% recycled, 10% post-consumer waste). 4,000 copies mailed this edition.

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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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**Federal Highway Administration**



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 [ctt.mtu.edu](http://ctt.mtu.edu).



Michigan Technological University  
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# The Bridge

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- ▶ Where Innovations are Now: Updates on Innovative Pavement Construction and Maintenance Projects
- ▶ Valuable Practices to Ensure Safety When Handling Truck Tires
- ▶ When Winter Maintenance Meets Artificial Intelligence



## Michigan's Local Technical Assistance Program

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## Upcoming Events

REGISTER & MORE INFORMATION AT [ctt.mtu.edu/training](http://ctt.mtu.edu/training)

### 2022 PASER Training

Part 1 – Webinars: January 25, April 12, June 15  
Part 2: January 26 & 27 – webinar, February 23 – Kalamazoo,  
February 24 – Ann Arbor, April 13 & 14 – webinar, April 20 – Gaylord,  
April 21 – Marquette, June 16 & 17 – webinar

### 2022 Inventory-based Rating System™ Training

Webinars: February 2, March 8, June 21

### 2022 Culvert Asset Management Training

Webinars: February 2, March 1, August 30

### 2022 Bridge Load Rating Spring Series

Webinar Sessions: From Plans to Load Rating – April 12, Theory & Policy –  
May 3, Advanced Topics Part 1 – June 27, Advanced Topics Part 2 – June 28  
Workshop: May 18 – Dimondale

### 2022 Roadsoft Webinar

Utilizing Roadsoft for Asset Management – May 10

### 2022 Asset Management Trainings

Pavement Asset Management Plan Training Workshop (virtual) – May 24-26  
Bridge Asset Management Training: Webinar 1 – May 3, Webinar 2 –  
May 4, Workshop (virtual) – May 11, 12, 18 & 19  
Compliance Plan Training Webinar – June 14

Mark Your Calendar: 2022 TAM Conference & 20-year Celebration  
September 28 – Traverse City

Mark Your Calendar: 2022 Michigan Winter Operations Conference  
October 18-19 – Bellaire

## More training opportunities!

Visit [ctt.mtu.edu/webinars-and-workshops](http://ctt.mtu.edu/webinars-and-workshops) to learn about other events offered by the Michigan LTAP/Center for Technology & Training

# Engineering tech assist

## We're here to help you!

- Tim Colling, PhD, PE – traffic safety & asset management
- Chris Gilbertson, PhD, PE – bridges/structures
- Pete Torola, PE – paved & unpaved road design, construction, maintenance
- Zack Fredin, PE – bridges/structures
- Ingrid Sandberg – PE, geotechnics

Learn more at [ctt.mtu.edu](http://ctt.mtu.edu)  
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