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The Bridge

A quarterly newsletter from Michigan's Local Technical Assistance Program

From the first centerline to the "Michigan left", Michigan has had a rich tradition and continuing excellence in making its roads safer. Michigan is a leader in roadway safety and operations as a result of the partnering among state and local agencies. Several projects demonstrate how this continued cooperation will keep Michigan a leader and improve the safety of all residents.

Michigan Takes the Initiative in Traffic Safety

Dale Lighthizer, PhD, PE – Research Engineer
Shaughn Kern – Technical Writer
Center for Technology & Training

Wikimedia Commons

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Michigan's Local Technical Assistance Program

You'd be hard pressed to find someone who was unaware of Southeast Michigan's role in the emergence of the automotive industry in the US. Given the ubiquity and success of the automotive industry in Michigan, it should be no surprise that Michigan has also been a leader in the application and promotion of highway safety. Wayne County alone holds several notable firsts in highway safety:

- The first painted centerline (1911)
- The first stop sign (1915)
- The first three-color traffic signal (1920)

While other states have universally adopted these practices, others are newer and are just now being adopted outside of Michigan. For example, in 1960 engineers at the Michigan Department of Transportation invented the median U-turn intersection treatment with the goal of "avoiding interlocking left turns at intersections on divided roadways". More commonly known as the "Michigan left", this alternative intersection treatment results in increased traffic flow and capacity, and a typical total crash reduction of 20% to 50% according to the FHWA. Development of the Michigan left was soon followed with the addition of traffic signals, pavement markings and increased space for U-turns, all increasing the likelihood that other states will consider Michigan lefts.

Michigan continues to this day to be a national pioneer in traffic safety. Beginning in 2010, the FHWA began identifying "Roadway Safety Noteworthy Practices" in the US. Over the last five years, 40 states have had between zero and five Noteworthy Practices. When it comes to the five states with the most Noteworthy Practices, the breakdown goes:

Florida, Minnesota & Utah	8
New Jersey	9
Maryland	10
Ohio	14
Michigan	**17**

This shows that at the national level, Michigan is solidly in the lead when it comes to innovating new ways of preventing crashes and saving lives.

Aside from these federally-recognized practices, Michigan has increased the safety of its transportation infrastructure by creating partnerships between local agencies and state, federal and independent agencies. Since 60% of fatal crashes in Michigan occur on local roadways, significant improvements in safety and reductions in fatalities are only possible when local agencies take a role in state safety programs.

The remainder of this article is divided into short articles showing ways that local agencies are helping Michigan continue its tradition as a pioneer and standout in traffic safety:

AASHTO Subcommittee on Safety Management

Tracie Leix, the Safety Programs Unit Manager for MDOT, was recently selected as the Co-chair of a new AASHTO Task Group, TG6, which focuses on local road safety. TG6 was established to increase collaboration between states and local agencies on safety initiatives, with the objective of "reducing fatal and serious injuries on all public roads." In this regard Leix, who is known for working closely with Michigan's local agencies, was the logical pick as Co-chair. She points to the advantage of Michigan's participation at a national level: "Michigan is lucky. We have an excellent safety program here, and now we have an opportunity to exchange best practices with other states and learn about their programs."

Toward Zero Deaths (TZD) is one of the safety initiatives driven by TG6 that has been embraced in Michigan. Since 90% of fatal crashes result from driver behavior, the goal of TZD is to significantly reduce fatalities by raising awareness at the local level, particularly by driving home the message through dynamic message system (DMS) displays and social media. While this message is blunt, Leix maintains that it is the correct approach. "You have to ask yourself, how many deaths is acceptable for my family? Once you answer that, you realize that zero deaths is the only acceptable goal." Along with MDOT and Michigan LTAP, the road commissions at Branch, Clinton, Emmet, Kalamazoo, Kent, Lapeer, Lenawee, Midland, Oakland, Schoolcraft, Tuscola, and Van Buren counties have also partnered with TZD.

The TZD campaign in Michigan uses DMS displays to publicize annual traffic fatalities. These messages also appear on MDOT's website and social media accounts to raise awareness and encourage drivers to pay attention and drive defensively. For more information on TZD and how to become a partner, visit towardzerodeaths.org. To keep up to date with what's happening in Michigan, visit michigan.gov/zerodeaths.

While the Road Commission of Kalamazoo County has just begun their TZD partnership, Managing Director Joanna Johnson stated, "Any opportunity we have for additional information assists the organization and the public. TZD provides another resource and consistent messaging to expand our efforts to improve highway safety… and if a message saves one life, it is worth the effort."

Aside from furthering the goal of TZD, Michigan's local agencies are helping to actualize many of the other goals of the Safety Management Subcommittee, such as developing local road safety plans; participating in and contributing to the Strategic Highway Safety Plan; and adding systemic components to safety programs. ■

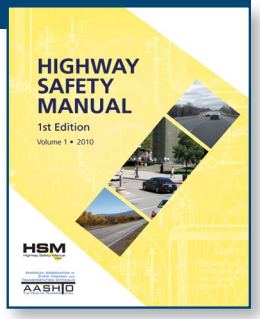
Local Agencies using the Highway Safety Manual

The FHWA considers Michigan to be a "Lead State" in using the AAHSTO Highway Safety Manual (HSM). The Lead State concept was created with the goal of shortening the learning period for those adopting new methods and technologies. Lead States are defined as agencies that "have played a major role in developing the technology, or they might have used the technology for many years before it was even tried in other states" (FHWA Focus publication FHWA-FA–96-022). Specifically, Michigan is known for its focus on local use of the HSM by providing access and incentive for local agencies.

For example, in addition to integrating the HSM into MDOT practices, MDOT's Safety Programs unit contracted Michigan LTAP to provide tailored HSM training to local agencies and consultants performing work on behalf of local agencies. Training covered procedures on how to use the HSM, and applications that would specifically benefit local agencies and their consultants. Over a two-year period, one- and two-day courses were offered around the state. The HSM was not required for the training, but those attending were given course notes with key concepts and examples from the HSM manual. Participants were also provided access to the HSM training spreadsheets and to the MDOT-specific HSM spreadsheets; furthermore, Michigan LTAP offers a loan program where local agencies can borrow a copy of the HSM. It can be found at

michiganltap.org/loan-programs

While using the HSM is optional for local agencies in Michigan, there is a significant advantage to using it that results in a more proactive approach to safety. Local agencies can use the HSM in place of or in support of an MDOT Time of Return (TOR) analysis for a safety project. The advantage here is that whereas a TOR analysis requires a crash history, an HSM analysis does not. This means that local agencies can use the HSM to develop a safety project even when the project site has no crash history. ■



Crash modification factors (CMFs) are one tool incorporated into the HSM. The CMF Clearinghouse—the organization that assigned confidence ratings and star ratings to the CMFs in the HSM—recently posted a recording of their 2014 webinar to their website. The webinar discusses selecting appropriate CMFs, common errors/misapplications of CMFs, and an example of how to evaluate and prioritize projects. This recording and those of previous years are available at

cmfclearinghouse.org/webinars.cfm

Noteworthy Practices: Roadsoft & Data-Driven Safety

Michigan's local and state agencies have received federal recognition for their practices in gathering, using and exchanging data in a way that creates safer transportation infrastructure. In fact, they received this recognition three times in 2014 alone: twice in the form of FHWA Noteworthy Practices, and once in a National Cooperative Highway Research Program (NCHRP) synthesis.

"Noteworthy Practices" are programs recognized by the FHWA as saving time and resources while reducing traffic fatalities. These are significant acknowledgements because the FHWA maintains a database of these practices as gathered from around the US, publicizing and making a state's best practices available to their peers.

Roadsoft was one Noteworthy Practice identified in 2014. The FHWA listed Roadsoft's key accomplishments as:

- Improved location references for crashes on local roads.
- Consistent mapping and data standards for all local jurisdictions.
- Data sharing among local, regional, and state agencies.
- Efficient process for conducting safety analyses.
- Comprehensive asset management capabilities.

These capabilities are another example of state, regional, and local agencies working together. MDOT sponsors the Center for Technology & Training (CTT) to develop Roadsoft, which is then distributed to local road agencies along with framework base map of the agency's jurisdiction. Local agencies can then use the tools in Roadsoft to collect, manage, and analyze data on roads, culverts, signs, and other infrastructure.

To ensure that the Crash, Safety, Sign, and other modules in Roadsoft are truly helping make Michigan roads safer, the CTT hosts the Roadsoft User's Group, a quarterly meeting between local agencies who use Roadsoft and the engineers who develop Roadsoft. Local agencies give feedback on Roadsoft, and this feedback is incorporated into a list of improvements to Roadsoft on the next year's work plan. MDOT also contributes guidance and recommendations to this work plan, ensuring that Roadsoft is able to serve a wide range of transportation needs in Michigan. The CTT then updates Roadsoft throughout the year based on this guidance.

During the process of collecting and maintaining data, local agencies retain control of the data and the decisions which are made from those data. Meanwhile, they share condition and project data with state and regional agencies who can then use that data for large-scale planning and analysis. This efficiency in data sharing not only received mention in the FHWA Noteworthy Practice, but was also exhibited in a national safety scan in 2014 (NCHRP 458). The scan discusses technology that help ensure "effective and accurate safety analysis" while aiding the collection and exchange of data between local agencies and the state.

Michigan's other FHWA Noteworthy Practice of 2014 was MDOT's initiatives for data-driven roadway safety, specifically in "developing region-specific analysis tools, supporting local safety analysis, and providing tools and technical assistance to local agencies". In this case, the term "data-driven" refers to the fact that safety improvements are made based on quantitative evidence rather than factors such as resident complaints or institutional traditions.

Again, the real noteworthiness here is that local agencies are the ones effecting the safety improvements. The FHWA lists the initiatives guiding local agencies as:

- The Local Safety Initiative (LSI)
- Roadsoft
- Region-specific HSM spreadsheets
- Crash reporting

Initiatives like Roadsoft and local use of the Highway Safety Manual, as previously mentioned, are quite notable on their own. However, this particular Noteworthy Practice focuses on the fact that these safety tools aren't just intertwined: they synergize good safety practices. By continuing the partnerships that ensure local agencies have the data, tools, and training they need, Michigan will continue to improve the safety of its residents. ■

Links

Roadway Safety Noteworthy Practices:
rspcb.safety.fhwa.dot.gov/noteworthy

Information on Roadsoft:
roadsoft.org

NCHRP Synthesis 458:
tinyurl.com/nchrp458

Historic Traffic Safety Firsts in Michigan

When it comes to transportation safety in Michigan, the state has had more than a few historic firsts:

- The nation's first centerline separating streams of opposing traffic (Marquette County)
- The "crow's nest," a forerunner to the modern-day traffic signal (Detroit)
- The first synchronized traffic signal, replacing the "crows nest" above
- Development of the first snowplow
- Passing zone signs ("Pass With Care"/"Do Not Pass")
- The nation's first five-lane highway with a center left-turn-only lane
- The nation's first closed-circuit television monitoring system to monitor freeway traffic (John C Lodge Frwy, Detroit)

A full list of these firsts and a history of Michigan as a pioneer in traffic safety can be found at:

michiganhighways.org/historical_overview.html

Geogrid Projects in Houghton & Baraga

Shaughn Kern – Technical Writer
Pete Torola, PE – Research Engineer
Center for Technology & Training

Geogrid can be used in a pavement's subbase to stabilize and separate layers. Counties in Michigan's Upper Peninsula have used it successfully in roads that have weak-foundation soils.

Geogrid has been the subject of numerous research papers, findings, and demonstrations that go far beyond the scope of this article. For more information on geogrid and sources used by this article, visit ***MichiganLTAP.org/Geogrid***

During the winter of 2013-2014, the Keweenaw Peninsula experienced 340 inches of snow, undoubtedly winning a few converts to a common wintertime activity up north: snowshoeing. Snowshoes decrease pressure from bodyweight by increasing the area of distribution, keeping the snow stable enough to walk on without sinking through. This isn't a new technology, but it probably takes a little bit of faith before trusting in it. That said, it should come as no surprise that some of the northernmost counties in the state have completed road projects with a type of geosynthetic called geogrid, a powerful pavement material with properties quite similar to a snowshoe.

Overview of Geosynthetics

Geosythetics can be made into so many shapes, sizes, textures, and patterns that it is difficult to assess all of the properties and uses that they have. The common geosynthetics include geocells, geocomposites, geogrids, geomats, geonets, geopipes, geospacers, geosynthetic clay liners, geostrips, and geotextiles. There are also numerous patented geosynthetics, as well as geosynthetics that have not been assigned their own category yet (geo-others). This is by no means a complete list because the use of geosynthetics is quite extensive and ever growing. The many types of geosythetics can each be made to hold up to differing strength and durability properties and made from many different materials. They can even be combined to take advantage of qualities from different categories. In road construction they typically are used to stabilize the pavement structure by providing:

- Separation–Prevents underlying silt or clay layers from mixing in with aggregate layers
- Drainage–Removes water from the pavement by wicking it away from aggregate layers
- Filtration–Allows the passing through of water, but not particles larger than the aperture size
- Reinforcement–Adds horizontal tensile strength (lateral restraint) to aggregate layers when they are loaded vertically
- Confinement–Adds structural strength by confining soil into individual three-dimensional cells (i.e. geocells)

The most common types used in pavement construction are geotextiles and geogrids. Geotextiles are typically woven or non-woven and geogrids can be uniaxial, biaxial or triaxial (See Table 1 on next page).

How Geogrid Stacks Up

An ideal pavement material would add as little thickness as possible, significantly increase load-bearing capacity, and cost less overall than traditional materials. Geogrids attempt to do just that by increasing load-bearing stability while keeping larger aggregates from migrating down into underlying layers. Geogrid is a mesh-like material containing holes–known as apertures–that increase tensile strength and stabilize pavement layers when used anywhere between the subgrade and the base (Figure 1).

The apertures in geogrid prevent the movement of larger aggregates between the base layer and the subgrade layer, while still allowing for drainage through the geogrid. When an aggregate is compressed over an unstable subgrade, the layer does not have much tensile strength to resist being pulled apart. The apertures in geogrid lock in the bottom of the aggregate layer and prevent it from moving horizontally. This prevention of

▸ Continues next Page

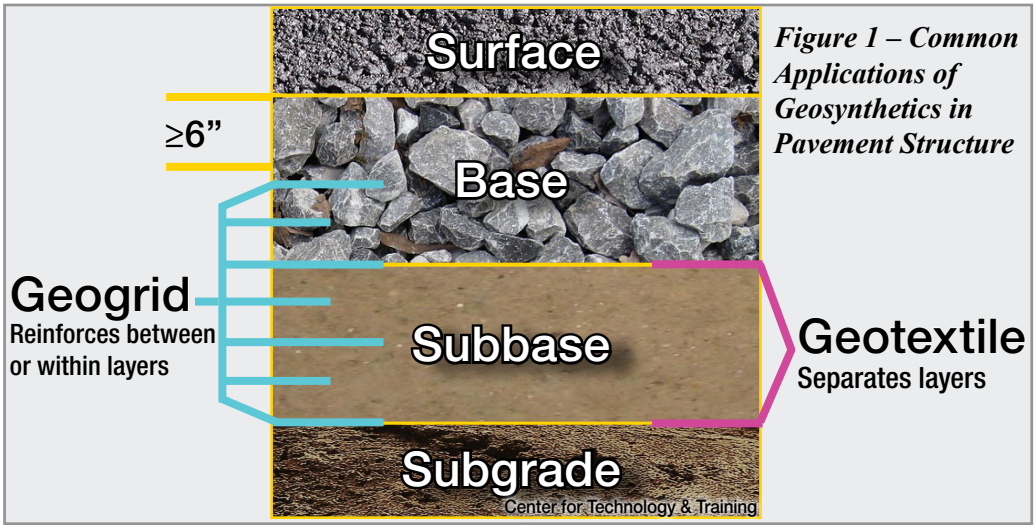


Figure 1 – Common Applications of Geosynthetics in Pavement Structure

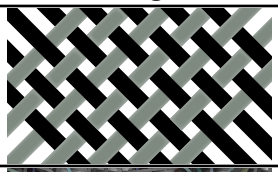
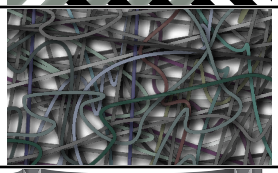
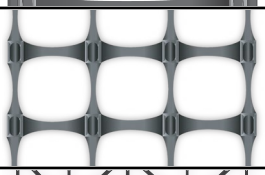
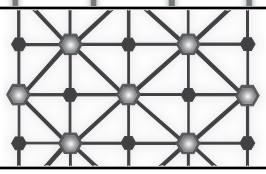
Category	Type(s)	Image	General Characteristics	Separation	Drainage	Filtration	Reinforcement
Geotextile	Woven		Fibers are woven together	Yes	No	Yes	No
	Non-Woven		Fibers are bonded using heat or chemicals	Yes	Yes	Yes	No
Geogrid	Uniaxial		Tensile slope reinforcement in one direction of a flat plane	No	No	No	Yes
	Biaxial		Tensile pavement reinforcement in two directions of a flat plane	No	No	Yes	Yes
	Triaxial		Tensile pavement reinforcement in three directions of a flat plane	No	No	Yes	Yes

Table 1 – Geotextiles and Geogrid with respect to Subgrade Stabilization

Note: These applications are an overview based on the usage defined in this article; because of the versatility of geosynthetics, there are cases that are contrary to this list

horizontal movement causes the "snowshoe effect", where lateral restraint from the geogrid distributes the load over a larger area of the subgrade. This decreases the vertical pressure in layers above and below the geogrid, strengthening and stabilizing the pavement structure. The pressure (force per unit area) is therefore reduced by transferring the load (force) to a greater area, improving the load bearing capacity of the road (Hanes Geo Components, 2014). This property makes geogrid extremely helpful for weak-foundation soils, in particular.

Increasing pavement life by stabilizing soil is a quality shared by all geosynthetics. According to a study by the Minnesota Department of Transportation, soil stabilized with either geotextiles or geogrid reduced pavement cracking in the three to four years following installation (Leu, 2001). However, a more recent study done by the Iowa Department of Transportation compared woven and non-woven geotextiles to biaxial and triaxial geogrids (Boone County Expo, 2013). This study found that a subbase reinforced by geogrid had a CBR that was 66% to 100% greater than the subbase stabilized by geotextiles. Since geosynthetics are so different, attention needs to be given when determining the correct application for each product.

In addition to stabilizing pavement, geogrid can help save on money and materials required for pavement rehabilitation. The strength of geogrid means that one layer of geogrid can be substituted in the place of several inches of aggregate. Furthermore, since geogrid can stabilize the existing subbase and subgrade below it, those layers do not have to be dug up or replaced to achieve stabilization. These advantages have been apparent to Houghton County and Baraga County as they've undertaken projects using geogrid.

Houghton County

The Houghton County Road Commission has used geosynthetic material to improve their roadbed's efficiency for at least three road subgrades, one of which was Salo Road in Hancock. "Its condition was very poor," according to Houghton County Assistant Engineer John Cima. "Pavement was really broken up, there was severe rutting, and the existing aggregate base below the pavement appeared to be pit-run gravel and in some areas there was no aggregate base at all." When Houghton County could no longer postpone work on this road, they decided to use geogrid to repair the two-mile stretch of road.

Cima worked with the geogrid manufacturer/supplier to write his own special provisions for the geogrid and to create a pavement design to determine the aggregate base and HMA thickness. The contractor first removed the existing pavement and six inches of the material beneath it with a milling machine, which jammed several times with large rocks, demonstrating how poor the pavement's structure was. The milling machine made two passes on each side of the road starting at the centerline, and milling at a 2% cross slope. Using geogrid

▶ Geogrid, Page 6

2017 Category F Grant Applications now being Accepted

(March 17 - June 1)

On March 17, 2015, the Michigan Department of Transportation Office of Economic Development began accepting Transportation Economic Development Fund Category F applications for Fiscal Year 2017.

Eligible applicants include cities, villages, and county road commissions. Proposed projects must be on federal-aid designated routes within federal-aid urban areas located in a county with a population of 400,000 or fewer. Higher consideration is given to applications that propose improving all-season capabilities on routes having high commercial traffic or those that improve access to state trunklines.

The application deadline for Category F grants is Monday June 1, 2015. The application and instructions are available at

http://michigan.gov/tedf

For questions, please contact Matt Wiitala at 517-241-2152 or wiitalam@michigan.gov.

Geogrid (from Page 4)

eliminated the need to excavate and replace the existing poor subgrade, which would have been an expensive fix for a very low volume road. "The biggest benefit of using geogrid," according to Cima, "is that it performs by load transference, so less of the poor subgrade has to be excavated; it is very cost effective." Once the old HMA and aggregate base had been removed, the crew rolled the triaxial geogrid over the existing subgrade and covered it with a minimum of six inches of new aggregate, depending on the location.

The construction on Salo Road lasted approximately two weeks, and was $300,000 to $400,000 less expensive than removing the poor existing subgrade and replacing it with an additional quantity of aggregate. Depending on design and installation, geogrid can be extremely useful for roads like Salo Road. It significantly increases the resiliency against deformation, and can reduce cost and effort of road construction crews.

Baraga County

Baraga County Road Commission has also used geogrid for construction applications, including two different stretches of road and numerous bridge approaches. According to Scott Swanson, Surveyor and Assistant Engineer at Baraga County, their oldest geosynthetic project was for a bridge approach in 2003 and it is still functioning well, demonstrating the durability of geosynthetic products.

For the projects in Baraga County, the road commission has used biaxial and triaxial geogrids; however, triaxial was the preferred type of geogrid because it is easier to place and move due to its sturdiness. Overall the triaxial pattern is more rigid, flattens easier, and has higher tensile strength.

The construction method depends on the road pavement design and what specifically is underneath the pavement. The two projects for Baraga County last summer differed slightly due to the thickness of the existing pavement and aggregate base. One project did not have much existing structural aggregate in the road bed, and so they crushed and milled the road, placed geogrid over the sand layer, and overlaid this with the pulverized road material and new aggregate to create a six-inch aggregate layer. For the second location, Baraga County pulverized and removed six inches of the roadbed layer, placed the geogrid, then placed the pulverized material back on top. In Swanson's experience, geogrid adds the equivalent stability of six inches of aggregate to the pavement structure.

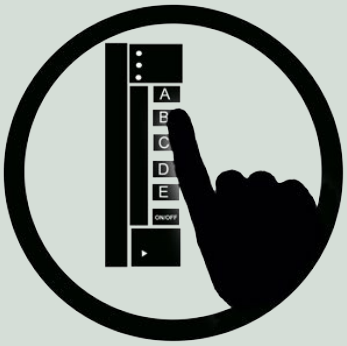
Swanson describes the largest challenge of geogrid as the placement, as this is labor intensive and brings the full cost of the geogrid at $4 per square yard on his projects. Regardless, he continues to experiment with the material: "We do different trial sections from year to year and monitor those."

With the snow almost gone for the season, most have hung up their snowshoes by now. But, with construction season beginning, it pays to remember that the same technology we use to walk on the snow can be used to stabilize our roads ■

Geogrid in Five Stages

1. After asphalt and aggregate are removed, crews smooth and grade the road and compact the soil.
2. Construction crews roll out geogrid on top of the road bed, align it, and pull it taut to remove wrinkles.
3. Aggregate is placed on top of the geogrid, graded to planned slope, and compacted.
4. A minimum of six inches of compacted aggregate fill is required. Standard compaction methods may be used.
5. The road is then ready for asphalt, or may remain unpaved.

New Technology at CTT On-site Workshops



This year, the CTT began using the i>clicker for its on-site PASER Training. The i>clicker is a remote control that acts as an audience response system, allowing instructors to involve attendees in the training session. The instructor asks a multiple-choice question, and the audience selects the corresponding option on the i>clicker. The instructor is then able to share the results and modify the course of the training to provide better education for the class. During the PASER Training in February, 96% of participants responded positively about the i>clicker experience and indicated that they were more engaged in the training.

Pete Torola, one of the instructors for the first round of PASER Trainings that used the i>clicker, enjoyed using the technology. "The polling gives the instructor instant feedback on how well the students are grasping the material. Everyone has a voice, even the quiet ones in the back!" He points out that aside from the immediate response, the answers collected over multiple trainings also result in better content long term. "After a few sessions, we looked at collective responses and analyzed what areas of our training needed improvement."

If you would like to share your experience with using an i>clicker at one of our workshops, or give input on how we can incorporate them into our future training events, please send an email to **ctt@mtu.edu**. ■

The Bridge

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Michigan's Local Technical Assistance Program
Center for Technology & Training
Michigan Technological University
309 Dillman Hall
1400 Townsend Dr.
Houghton, MI 49931-1295

Telephone 906-487-2102
Fax 906-487-3409
E-mail ..... CTT@mtu.edu
On the web ..... www.MichiganLTAP.org

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About LTAP

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Center for Technology & Training

Michigan's Local Technical Assistance Program

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

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Michigan's Local Technical Assistance Program
Michigan Technological University
309 Dillman Hall
1400 Townsend Drive
Houghton, MI 49931-1295
906-487-2102

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Upcoming Events

Register at ctt.mtu.edu/training

FieldManager & Contract Management Conference
Apr 1 – Howell

PASER Training (On-site)
Apr 7 – Gaylord
Apr 8 – Escanaba
Apr 9 – Ispheming

Constructing Pedestrian Facilities for Accessibility
Apr 14 – Okemos

What's New in Roadsoft Version 7.8
Apr 16 – Webinar

Asset Management Guide for Local Agency Bridges Training Course
Apr 28 – Cadillac

2015 Spring Asset Management Conference
Apr 30 – Grand Rapids

2015 Great Ideas Challenge

Do you...

- **have a creative solution to a problem?**
- **want to share your idea with others?**
- **enjoy winning prizes?**

Michigan LTAP is coordinating its third annual Great Ideas Challenge, where we identify, share, and reward new inventions and practices from Michigan's road agencies.

Entries will be featured in Michigan LTAP publications so that other road agencies can learn from your idea. A winning entry will earn your agency funding towards any transportation-related training, workshops, or conferences.

Entry forms, prizes, and other details are available at:

MichiganLTAP.org/GreatIdeas