

## TERRA E-News

TERRA E-News is a quarterly electronic newsletter of the Transportation Engineering and Road Research Alliance. TERRA E-News brings you the latest research on pavement, materials, and related transportation engineering challenges, including issues related to cold climates.

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[Current Issue](#) | [Previous Issues](#) | [Subscribe](#)

*In this issue:*

### Member News

- [New Member: Mathy Technology and Engineering \(MTE\) Services](#)
- [Member Profile: North Dakota Department of Transportation](#)
- [Member Highlights](#)
  - [Michigan DOT seeks pooled-fund partners for bulb T-beam study](#)
  - [MnDOT receives national IGGA award](#)
  - [Research could lead to a new standard in life-cycle assessment modeling](#)
  - [Collaboration produces webinar on composite concrete pavements](#)

### Projects and Initiatives

- [Pavement researchers present findings from pervious concrete cold-weather study](#)
- [Concrete overlays gaining attention as a cost-effective option for preserving pavement life](#)
- [TERRA-initiated projects grow in number, variety, and impact](#)

### Announcements

- [Registration still open for the TERRA Pavement Conference on Feb. 10](#)
- [TERRA publishes 2010 highlights](#)
- [TERRA publishes fact sheet about concrete overlays](#)
- [TERRA Innovation Series: MnROAD research conference scheduled for Aug. 16](#)
- [Mid-Continent Transportation Research Symposium abstracts due Feb. 28](#)
- [ATSSA annual convention and traffic expo, Feb. 13-17](#)
- [MAPA upcoming events](#)
- [CPAM annual concrete paving workshop, March 10-11](#)
- [NACE annual conference, April 17-21](#)

## Member News

### New Member: Mathy Technology and Engineering Services

Mathy Technology and Engineering (MTE) Services joined TERRA in November. MTE Services is a subsidiary of [Mathy Construction Company](#), a leading asphalt paving company based in Onalaska, Wisconsin. MTE president Gerald Reinke, also technical director of Mathy Construction, will represent MTE on the TERRA board. MTE is the first contractor to join TERRA.

### Member Profile: North Dakota Department of Transportation

The [North Dakota Department of Transportation \(NDDOT\)](#) joined TERRA in July 2009 through a pooled fund established to provide more state DOTs the opportunity to share in the benefits of the alliance. TERRA membership allows NDDOT to participate in discussions on important research topics and help guide the development of new research.



The North Dakota State Highway Department, established in 1917, became NDDOT in 1990. NDDOT oversees the development of surface transportation in the state of North Dakota, which has more miles of road per capita than any other state. The department's goals include improving the quality and efficiency of the state's transportation systems as well as increasing traveler and workforce safety. NDDOT's research program focuses on projects in three areas: internal research, partnerships with state universities, and pooled-fund studies.

Tom Bold, pavement design and research supervisor, and Ron Horner, materials and research engineer, represent NDDOT on the TERRA board.

"NDDOT sees the benefit of the research collaboration between the public and private sectors that TERRA

promotes," Bold said. Through TERRA, NDDOT is able to discuss the research findings of other regional states to address our local issues, he added.

One such issue that has presented distinctive challenges for NDDOT is the prevalence of agriculture in North Dakota, Bold said, as the abandonment of branch line railroads has shifted the loads to the state's highway and bridge system. "The state's economic engine has been agriculturally based," he explained, "and the agriculture industry depends on a transportation system to move equipment, supplies, and commodities to market." NDDOT continuously works with counties and local entities on strategies to provide safe roadways for both industry and the public.

Also of interest to NDDOT are the unique transportation challenges facing cold-weather states and the related research conducted at the Minnesota Road Research Facility (MnROAD). "There is no question that the transportation industry as a whole has benefited greatly from the work conducted at MnROAD," Bold said.

Another topic NDDOT hopes to explore through the TERRA partnership is warm-mix asphalt (WMA). "NDDOT sees a real opportunity for WMA research, particularly in cold region states," Bold said. NDDOT would like to conduct research on the effectiveness of various WMA additives and processes that could be used in future projects.

In addition to TERRA, NDDOT also participates in several other pooled-fund projects, including Aurora, Pacific Northwest Snow Fighters, National Concrete Consortium, and Clear Roads. "Like TERRA, these pooled-fund studies serve as an effective technology transfer forum and provide an excellent opportunity to network with other agencies and industry," Bold said.



Tom Bold



Ron Horner

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## Member Highlights

### Michigan DOT seeks pooled-fund partners for bulb T-beam study

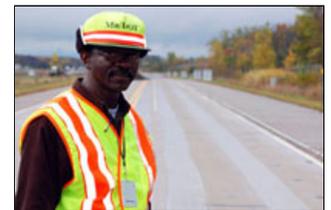
The [Michigan Department of Transportation](#) (MDOT) is seeking partners to join Transportation Pooled Fund (TPF) Solicitation 1264, [Bulb T-Beam As Alternate ABC to Side-By-Side Box Beam](#). Michigan is the sponsoring and lead agency for the study. The Minnesota and Oregon DOTs already have joined as interested partners. The primary objective of the study is to analyze and evaluate decked bulb T-beam (or decked I-beam) as a viable replacement for the side-by-side box beam bridge structure.

The bulb T-beam section's bottom provides enough space to ease inspections and maintenance of critical elements, eliminating inherent problems associated with inspection and repairs most common in side-by-side box beams. The use of non-corrosive materials, such as carbon fibers, stainless steel, and stainless clad, will improve the durability and sustainability of the bridge structure in harsh environments. Another valuable attribute is that this type of beam can be built using accelerated bridge construction techniques, which are a key part of the [Federal Highway Administration Every Day Counts](#) initiative to shorten on-site construction times relative to conventional construction.

MDOT hopes to expedite the proposed research project to possibly use the results in future design and/or construction of prefabricated bridge elements and systems in Michigan. Organizations that have potential interest in this study are asked to respond directly to MDOT. For more information, please contact Dave Juntunen, MDOT Engineer of Bridge Operations, at [juntunend@michigan.gov](mailto:juntunend@michigan.gov) or 517-322-5688, or André Clover, MDOT Administrative Engineer, at [clovera@michigan.gov](mailto:clovera@michigan.gov) or 517-335-5320.

### MnDOT receives national IGGA award

The [Minnesota Department of Transportation](#) (MnDOT) was selected in November as the Government Official of the Year by the International Grooving and Grinding Association (IGGA) for efforts in implementing the first Next Generation Concrete Surface (NGCS), which was installed on a stretch of Interstate 35 in Minnesota. The award recognizes leadership in transportation activities with special emphasis on grooving, grinding, and concrete pavement rehabilitation. MnDOT concrete research operations engineer Bernard Izevbekhai accepted the award on behalf of the project team. "MnDOT has long been a leader in advancing pavement technology in the U.S.," IGGA executive director John Roberts said. "The collaborative work between MnDOT and the IGGA exemplifies public/private sector partnering and demonstrates why they are so deserving of this award."



Bernard Izevbekhai

### Research could lead to a new standard in life-cycle assessment modeling

The Concrete Sustainability Hub (CSH), a research center established at the Massachusetts Institute of Technology (MIT) in collaboration with the [Ready Mixed Concrete \(RMC\) Research & Education Foundation](#) and the Portland Cement Association, issued preliminary research findings in December that will help set a new standard in life-cycle assessment (LCA) modeling. The studies will quantify the cradle-to-grave environmental costs of paving and building materials, and will ultimately result in the most comprehensive LCA model produced to date. MIT is set to release a follow-up study in 2011 that will examine the economic costs to provide the most comprehensive analysis of the total costs of building and paving materials.

### Collaboration produces webinar on composite concrete pavements

MnDOT collaborated with the Transportation Learning Network (TLN) on January 13 to present a [webinar on composite concrete pavements](#). The webinar, presented by MnROAD operations engineer Tim Clyne, summarized the [SHRP 2 \(Strategic Highway Research Program\) composite pavement study](#) as well as information on the [pooled-fund study on composite pavements](#). Clyne's presentation covered the basic

definition of composite pavements, test section construction at MnROAD, early lab and field performance results, performance predictions using the Mechanistic Empirical Pavement Design Guide (MEPDG), and a cost-estimating scenario by the contractor that showed composite pavements are cost-competitive with traditional PCC pavements. TLN, a distance learning partnership among organizations in the western United States, links together DOTs in North Dakota, South Dakota, and Wyoming and the Mountain-Plains Consortium universities of Colorado State University, North Dakota State University, South Dakota State University, University of Utah, and University of Wyoming.

## Projects and Initiatives

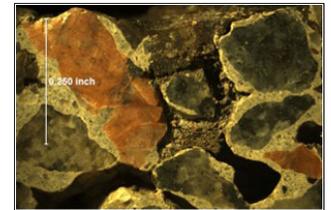
### Pavement researchers present findings from pervious concrete cold-weather study

University of Minnesota civil engineering professor Lev Khazanovich, who has been studying the drainage properties and durability of pervious concrete, presented some of his team's findings at a seminar in October sponsored by the Center for Transportation Studies, in cooperation with TERRA.



The Aggregate & Ready Mix Association of Minnesota (ARM) partnered with the University of Minnesota Department of Civil Engineering to obtain a research grant from the Ready Mixed Concrete (RMC) Research & Education Foundation for a study of the cold-weather performance of pervious concrete. Khazanovich was the principal investigator of the study along with co-investigator Kevin MacDonald of Cemstone. Much of the research has been conducted using pervious concrete systems at MnROAD.

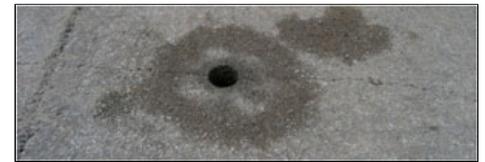
Among the most important issues related to pervious concrete, Khazanovich explained, are drainage capacity and durability. Because pervious concrete is not completely solid like conventional concrete, it has different physical properties including higher flexibility. Khazanovich's research looked at how pervious concrete stands up to wear over time and how its drainage properties are affected by environmental conditions.



Most fines and organic material remain in the top quarter inch of pervious concrete.

The effect of freeze-thaw cycles on pervious pavement is a particularly important question for paving projects in cold-weather climates like Minnesota. The researchers asked whether water freezing within the concrete matrix could damage the pavement, leading to cracking or a reduction of its drainage performance. But even without freeze-thaw damage, the porous nature of pervious concrete could, the researchers hypothesized, render it less resistant to repeated mechanical stress from heavy vehicles.

Although testing the mechanical properties of paving materials using small samples in the laboratory is a useful technique, Khazanovich noted that long-term monitoring and testing of real-world pavements is the best way to ensure accurate results. "What we see in the laboratory is not always how things are in the field," he noted, due to the many environmental variables that affect pavement performance.

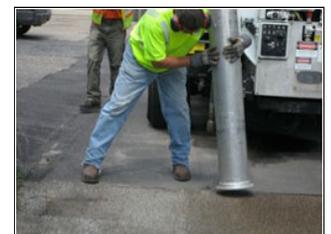


Non-viscous epoxy improves core sample collection from pervious concrete.

The researchers constructed several pavement sections at MnROAD using pervious concrete and monitored the pavement over time as it was exposed to precisely controlled vehicle traffic on the closed-loop low-volume test road.

Analyzing the wear and deformation of the pervious concrete proved problematic, however, because conventional pavement-coring techniques damage the porous matrix of the pervious material. The problem was solved by Cemstone's MacDonald, who realized that the concrete's structure could be preserved by saturating it with a clear, non-viscous epoxy while taking the core sample. The epoxy fully penetrates the concrete's porous structure and supports the pervious material as the coring bit cuts out a sample.

The researchers analyzed the pavement samples to determine how much permeability was affected by the accumulation of fine particles in the porous concrete matrix. They found that most fine particles accumulate within the top quarter-inch of pavement, and that even a small volume of particles can significantly degrade the concrete's ability to drain water. Cleaning pervious concrete using vacuum devices is an important maintenance task that can restore much of the material's ability to drain water; however, such cleaning methods are most effective in the uppermost one-eighth inch of pavement, making the removal of deeper particles a significant maintenance concern.



Maintenance helps restore the permeability of pervious concrete.

The majority of pervious concrete sections studied proved resistant to freeze-thaw damage, while a few fared significantly worse. However, the researchers were unable to identify consistent factors that made certain pavements more durable in the Minnesota climate. Khazanovich noted that the implications of freeze-thaw damage are not limited to pervious concrete—non-pervious pavements may experience similar effects but manifest damage in different ways due to the higher strength of standard concrete.

One unusual finding from the study was that pavements constructed later in the summer performed better than those constructed early in the season. Previous research had established that conventional concrete pavements tend to perform better when they are constructed earlier in the summer.

*Photos courtesy of University of Minnesota Department of Civil Engineering*

*Related resources:*

- [CTS Webinar: Performance of Pervious Concrete Pavement in a Cold Weather Climate](#)
- ["Upside-down" concrete intrigues pavement researchers](#) (*CTS Research E-News*, November 2010)
- [TERRA members collaborate to fund research into cold-weather performance of pervious concrete](#) (*TERRA E-News*, February 2009)
- [Will pervious concrete work in Minnesota?](#) (*TERRA E-News*, November 2008)

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## Concrete overlays gaining attention as a cost-effective option for preserving pavement life

For more than 70 years, concrete overlays have provided one option to help extend pavement life at a reasonable cost. Because of the growing emphasis on pavement preservation and the rising cost of alternatives, interest in concrete overlays is increasing.

The work of TERRA members and others nationally is helping advance the research and implementation of concrete overlays. A new TERRA fact sheet about concrete overlays briefly highlights recent and emerging research, innovative projects, and resources for additional information.

Concrete overlays fall into two main categories: bonded overlay systems and unbonded overlay systems. Both bonded and unbonded concrete overlays can be placed on existing concrete pavements, asphalt pavements, or composite pavements.

Bonded overlays help add structural capacity to and eliminate surface distresses on existing pavements that are in good to fair structural condition. From 2 to 6 inches thick, these overlays generally provide resurfacing solutions for routine or preventive pavement maintenance or for minor rehabilitation. As a minor or major rehabilitation strategy, unbonded overlays help restore structural capacity to existing pavements that are moderately to significantly deteriorated. Unbonded overlays are typically 5 to 11 inches thick and include an interlayer to prevent bonding, provide drainage, and relieve stress.

Concrete overlays offer several benefits. According to CP Tech Center at Iowa State University, concrete overlays consistently provide cost-effective solutions and are one of the most effective long-term preservation options for existing pavement. Concrete overlays also can be constructed quickly and conveniently without removing the existing pavement. In addition, concrete overlay repairs tend to be much easier than repair of a conventional pavement section. Finally, the wide range of concrete overlay types offers a solution for almost any pavement type and condition, desired service life, and anticipated traffic load.

As a result of their long history of use, many concrete overlays have been in service for decades. Throughout the years, concrete overlay thickness has evolved from thicker to thin or very thin. Current research continues to evaluate the use of thinner concrete overlays and the effectiveness of differing interlayer materials, as well as the further development of design guidelines.

Evaluating the condition of an existing pavement is a crucial first step before selecting and implementing a concrete overlay solution. Information from a pavement evaluation helps determine whether to use a concrete overlay and which is the optimal concrete overlay type.

Emerging research is focusing on further evaluation of concrete overlays and the effectiveness of interlayer (unbonding) materials. For example, the Michigan Department of Transportation is sponsoring the project "Improved Performance of Concrete Overlays" to conduct a comprehensive field investigation of representative overlay projects, develop new or modified overlay designs and related construction practices, and analyze the cost-and-time benefit of modifications. In addition, a potential pooled-fund study is in development for the selection and design of interlayer materials.

*Photos courtesy of CP Tech Center*

*Related resources:*

- [Concrete Overlays](#) (TERRA fact sheet)
- [Guide to Concrete Overlays](#) (CP Tech Center, 2008)
- [National Concrete Overlay Explorer](#) (American Concrete Pavement Association)
- [Rehabilitating roads with thinner concrete overlays may thin out costs](#) (*TERRA E-News*, November



Dual-lane stringless paving operation



Geotextile bond breaker between paver and ready-mix trucks

2008)

- [Concrete overlays may provide effective solution for damaged roadways](#) (*TERRA E-News*, August 2008)

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### TERRA-initiated projects grow in number, variety, and impact

During the past year, TERRA greatly expanded the number of projects considered (17, up from 3) and initiated (5, up from 1). New collaborative research and implementation projects include accommodating non-permitted trucks in roundabouts, studying the impact of farm equipment on bridges, evaluating guide sign fonts, and developing warm-mix asphalt for use in cold regions.

The main objective of the roundabouts truck study, a joint effort of the Wisconsin Department of Transportation (WisDOT) and the Minnesota Department of Transportation (MnDOT), is to provide better guidance to designers on how non-permitted trucks should be accommodated at roundabouts. A primary focus is evaluating whether roundabouts should be designed so trucks can stay in their own lane to be more "freight friendly" or designed so trucks will encroach into the adjacent lane.

"Our participation in TERRA allowed us to realize that more than one state was interested in doing research in this area," said Steven Krebs, chief materials management engineer with the WisDOT Materials Management Section and the WisDOT representative on the TERRA board. "It then helped us facilitate a solution to a common need."

The Iowa Department of Transportation and Iowa State University, with support from a pooled fund, are studying the impact of farm equipment on Iowa bridges. Specifically, the project examines how loads from tractors and farm implements differ from those of trucks. The ultimate goal is to revise bridge restrictions in the state to include larger farm equipment, which had not been considered in determining load capacity. Over the past few decades, significant changes in both farm size and farm equipment have prompted the farm equipment industry to produce larger application equipment. A similar study of the impact of farm equipment on rural roads is in its third year at MnROAD.

The objective of the guide sign fonts study, a pooled fund led by MnDOT, is to evaluate a new font developed by SignCAD Systems, Inc., a Minneapolis-based sign software developer. Researchers will compare the new SignCAD Enhanced font to the Series E (Modified) and Clearview 5WR fonts currently in use. The Clearview font family is a proprietary font requiring a sizeable investment to a state agency adopting the font. The SignCAD font, which is designed especially for older drivers, is available for free.



SignCAD Enhanced font

Researchers plan to test the effectiveness of the new font against the current standard by having study participants drive an instrumented vehicle along a closed course at night. "Though the retroreflective materials used for guide signs have changed dramatically in the last 50 years," the project proposal states, "the fonts used on these signs have not." The California and Florida DOTs are partners with MnDOT in the study. MnDOT, WisDOT, 3M, and Avery Dennison are providing the signs.

TERRA conducts an annual process for collecting project ideas from partners and friends as part of a comprehensive program for research on pavement, materials, and related transportation engineering challenges. Though TERRA currently does not have dedicated research funding, members already have helped secure funding for a \$10 million program of TERRA-initiated research.



Series E (Modified) font

Once introduced, project ideas are honed through a communication process to prioritize objectives according to the needs of each partner involved. Through this process, TERRA hopes to build research project partnerships by utilizing the combined resources of the participants to move important projects forward.

This spring, the TERRA board and committees will begin a review of the year's project ideas to facilitate opportunities for collaboration among those with similar interests, needs, and resources.

#### *Related resources:*

- [TERRA Project Proposal Form](#)
- [TERRA research](#)
- [MnROAD research](#)

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### Announcements

#### **Registration still open for the TERRA Pavement Conference on Feb. 10**

Registration is still open for the TERRA Pavement Conference, scheduled for February 10, 2011, at the University of Minnesota Continuing Education and Conference Center in St. Paul, Minnesota. This one-day conference provides practical information to practitioners and others interested in pavement design, construction, rehabilitation, and maintenance. This year's conference will highlight sustainability, innovative construction practices for better pavement performance, alternatives to paving, best practices for in-place recycling, and PCC pavement rehabilitation.

The conference is intended for researchers, city engineers, county engineers, public works officials,

maintenance superintendents, design engineers, consulting engineers, and others interested in pavement issues.

For more information about the 2011 TERRA Pavement Conference, including the complete agenda, visit the [event web page](#) or contact the College of Continuing Education, [cceconf2@umn.edu](mailto:cceconf2@umn.edu), 612-624-4754. To view information from previous conferences, visit the [TERRA events page](#).

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### TERRA publishes 2010 highlights

TERRA has published a two-page report highlighting the organization's activities and accomplishments during the past year. The document provides a brief overview of research and implementation, engagement, and communications efforts, crediting the committed service of its members, the TERRA board, and three active committees structured around the organization's strategic directions. TERRA 2010 Highlights and other TERRA news are available for download from the [TERRA website news page](#).



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### TERRA publishes fact sheet about concrete overlays

TERRA has published another fact sheet, this one featuring concrete overlays. The work of TERRA members and others nationally is helping advance the research and implementation of concrete overlays, which provide an increasingly attractive option to help extend pavement life at a reasonable cost. The [TERRA concrete overlays fact sheet](#), described in a separate article in this issue of TERRA E-News, briefly highlights recent and emerging research, innovative projects, and resources for additional information. All [TERRA fact sheets](#) are available for download from the TERRA website.



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### TERRA Innovation Series: MnROAD research conference scheduled for Aug. 16

TERRA is hosting another [TERRA Innovation Series](#) event on August 16, 2011, at MnROAD. The one-day research conference will highlight the results of several pooled-fund and single-state research studies initiated during the facility's Phase Two Initiative. The event will provide pavement practitioners with information on pavement materials, design, construction, and rehabilitation that is ready to implement in Minnesota and around the country. Sessions will focus on recycled materials, pavement rehabilitation, preventive maintenance, long-life pavements, surface characteristics, and other research innovations. The conference, which will feature a tour of the facility, will emphasize how lessons learned from MnROAD have been and can be implemented to build better, more cost-effective pavements. A TERRA board meeting is scheduled for Monday, August 15, and TAP meetings for all of the pooled-fund projects will be held on Wednesday, August 17. For more information, please contact Tim Clyne, MnROAD operations engineer, [tim.clyne@state.mn.us](mailto:tim.clyne@state.mn.us) or 651-366-5473. Complete details will be posted on the [TERRA events page](#) as they become available.



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### Mid-Centinent Transportation Research Symposium abstracts due Feb. 28

Researchers wishing to present a paper at the [2011 Mid-Centinent Transportation Research Symposium](#) (August 18–19, 2011, Iowa State University, Ames, Iowa) are invited to submit an abstract of the paper by February 28, 2011. Symposium organizers are especially interested this year in promising, implementation-ready solutions for federal and state departments of transportation, cities, and counties. The symposium covers a broad spectrum of transportation issues, ranging from current advances in infrastructure design to transportation policy. Several concurrent sessions will be offered, each focused on a specific topic. More information is online about potential topics, review criteria, and formatting. Symposium registration will be available in May.

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### ATSSA annual convention and traffic expo, Feb. 13-17

The [American Traffic Safety Services Association \(ATSSA\) 41st Annual Convention and Traffic Expo](#) is scheduled for February 13-17, 2011, at the Phoenix Convention Center in Phoenix, Arizona.

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### MAPA upcoming events

The [Minnesota Asphalt Pavement Association](#) calendar includes three upcoming events:

- 55th Annual Asphalt Contractors' Workshop/Quality Initiative Workshop, March 2  
Earle Brown Heritage Center in Brooklyn Center, Minnesota

- Info: [info@mn-aapt.org](mailto:info@mn-aapt.org)
- **CONEXPO-CON/AGG**, March 22-26  
Las Vegas Convention Center, Las Vegas, Nevada
  - **AAPT 86th Annual Meeting**, March 27-30  
Marriott Waterside, Tampa, Florida  
Info: [aaptinfo@gmail.com](mailto:aaptinfo@gmail.com)
  - **MAAPT 58th Annual Asphalt Conference**, December 7  
Doubletree Hotel, St. Louis Park, Minnesota  
Info: [info@mn-aapt.org](mailto:info@mn-aapt.org)

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### **CPAM annual concrete paving workshop, March 10-11**

The annual [Concrete Paving Association of Minnesota](#) (CPAM) Concrete Paving Workshop is scheduled for March 10-11, 2011, at the DECC in Duluth, Minnesota.

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### **NACE annual conference, April 17-21**

The [National Association of County Engineers \(NACE\) 2011 Annual Meeting and Management & Technical Conference](#), "North Star NACE 2011 – Guiding with Vision," will be hosted by the Minnesota County Engineers Association in Minneapolis, Minnesota from April 17-21, 2011.

*TERRA E-News* is produced quarterly by the Center for Transportation Studies at the University of Minnesota.

#### **Comments?**

We would like to hear what you think of *TERRA E-News*. Please e-mail us at [mpmccarthy@umn.edu](mailto:mpmccarthy@umn.edu).

#### **Contacts for more information about TERRA**

- Chris Kufner, Manager, Road Research Section, MnDOT Office of Materials, 651-366-5507, [chris.kufner@state.mn.us](mailto:chris.kufner@state.mn.us)
- Stephanie Malinoff, Director, Outreach Services, Center for Transportation Studies, University of Minnesota, 612-624-8398, [malinoff@umn.edu](mailto:malinoff@umn.edu)

#### **TERRA publications staff**

- Editor: Michael McCarthy, [mpmccarthy@umn.edu](mailto:mpmccarthy@umn.edu), 612-624-3645
- Contributing Editors: Christine Anderson, Pam Snopl

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