

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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Member News

Member Profile: Caterpillar

Caterpillar's Global Paving Division (Cat Paving) is a combination of several paving equipment companies purchased by Caterpillar Inc.—the world's leading manufacturer of construction and mining equipment, diesel and natural gas engines, and industrial gas turbines—over the past 20 years. As a designer and manufacturer of equipment used in road construction, Caterpillar differs from many other DOT, trade association, and university-related TERRA members. This diverse group of member organizations, however, was part of TERRA's appeal to the company, which joined TERRA in 2007.



Through TERRA membership, Caterpillar engineers are able to "participate in discussions about the latest ideas for new technology with a variety of sources we would not normally be in contact with," said Caterpillar senior engineering specialist Dean Potts.

Potts explained that working with universities and DOTs to conduct transportation research often allows Caterpillar to be part of projects that none of the partnering organizations could have completed individually.

"Managed well, (such) public-private partnerships and pooled-fund projects can provide a quicker means of accomplishing some important projects and disseminating the results of research," Potts said. "It is important to respect each other's expertise and intellectual property while collaborating to move projects forward that have broad benefits for all participants." For instance, Potts noted that Cat Paving provided free use of an intelligent compactor during the rebuilding of test cells at the Minnesota Road Research Project (MnROAD) facility, a valuable site for transportation research.

According to Potts, Caterpillar is always interested in research that will help facilitate development of the next generation of equipment and solutions for the company's customers. Currently, Caterpillar's key areas of research investment include emissions



Dean Potts

reduction, alternative fuels, automation and worksite solutions, and next-generation power trains. Caterpillar has also worked with GPS and automated control technologies to reduce the amount of materials used during road construction. The goal, Potts said, is to “make the process of building great, long-lasting, smooth roads more of a science.”

Caterpillar also participates in diverse research partnerships with a variety of organizations, including NASA and the Energy Technologies Institute (ETI). Caterpillar is working with NASA to expand the capabilities of soil digging equipment for use on the moon, and with the UK-based ETI to develop and demonstrate technology solutions that enable CO2 emissions reductions while also achieving customer and commercial market needs.

One of the largest challenges Caterpillar’s paving products business is currently facing is the uncertainty of funding for road construction and reconstruction. “Contractors cannot afford to buy equipment when they don’t believe that there will be enough work to make it pay,” Potts explained, which in turn makes it difficult for an equipment manufacturer like Caterpillar to justify the cost and time it takes to develop new technology.

Caterpillar has been vocal about the need for Congress and the Obama administration to act quickly to pass a robust multi-year U.S. transportation reauthorization bill. The company states that better infrastructure can have a positive and lasting impact on America’s competitiveness in the global economy while at the same time creating jobs and stimulating the economy today.

In spite of the challenges, Potts said, there are still possibilities for growth. Looking forward, Caterpillar sees the “green” construction currently being implemented in commercial buildings being used as a template for road construction. Because many smaller contractors may have difficulty meeting future sustainability and environment-friendly requirements, Potts noted the need to develop tools to make compliance with new standards easier and less costly.

“As new ideas come into play, we will be there with equipment that will meet these new emerging needs,” Potts said.

Member Highlights

NYS DOT seeks proposals for low-carbon transportation alternatives

The [New York State Department of Transportation](#) (NYS DOT), a TERRA member, is partnering with the New York State Energy Research and Development Authority (NYSERDA) in search of proposals that have the potential of reducing the carbon intensity of the existing multimodal transportation system in New York State. Carbon intensity is defined as carbon dioxide emissions per unit of passenger or freight transport. Total available New York State funding is \$1,500,000.

In funding this research, the sponsors seek to identify the key issues affecting transportation energy efficiency and economics, sustainability, and livability. In addition, it is hoped that proposals develop and/or demonstrate strategies, implementation measures, and innovative technologies to address the issues. The goal of reducing transportation carbon intensity focuses directly on reduced greenhouse gas (GHG) production.

Proposals for the [Low Carbon Transportation Alternatives: Pathways to Energy Efficiency, Enhanced Economics, Sustainability and Livability program](#) are due August 25, 2010.

The [Minnesota Department of Transportation](#) (MnDOT) Office of Maintenance is hosting three interns from Sweden for the summer. MnDOT also will host several visitors from Russia in August. Russia hosted a contingent from MnDOT two years ago. In addition, a group of representatives from a collaborative of European research laboratories will visit Minnesota in September. Their visit will include trips to Mn/ROAD and the University of Minnesota.

The [Ready Mixed Concrete \(RMC\) Research & Education Foundation](#) announced publication of a self-consolidating concrete (SCC) formwork pressure study, titled Evaluation of SCC Formwork Pressure. The project was conducted by the Université De Sherbrooke, Purdue University, Northwestern University, and the CTL Group with co-funding from the American Concrete Institute’s Strategic Development Council (ACI-SDC). The final report, available on the foundation’s website, includes information, tools, and test methods to help predict and decrease formwork pressure. The report also examines the impact that materials constituents, mix designs, concrete placement factors, geometry of formwork, and temperature have on formwork pressure exerted by SCC.

Projects and Initiatives

SHRP 2 composite pavements research under way at MnROAD

Three new test cells were constructed this spring at the Minnesota Road Research Project (MnROAD) facility near Albertville on the 3.5-mile mainline test portion of Interstate 94. The cells are part of a second Strategic Highway Research Program (SHRP 2) project to investigate the design, construction, and performance aspects of composite pavements.

The project will be featured during an open house sponsored by TERRA and the Minnesota Department of Transportation (MnDOT) at MnROAD on Monday, August 23. In addition to the live test segment of I-94, MnROAD also has a two-lane, 2.5-mile closed-loop low-volume roadway



and a half-mile "farm loop." The three segments comprise more than 50 instrumented concrete and asphalt pavement test sections representing a broad range of materials and designs.

Field experiments at MnROAD are at the core of the four-year, \$4 million SHRP 2 project (R21), which is led by Applied Research Associates, Inc. (ARA), in partnership with their sub-contractors: MnDOT, the University of Minnesota, the University of California, and the University of Pittsburgh. Mike Darter, principal engineer with ARA and a member of the TERRA Research Committee, is principal investigator for the project. In addition, University of Minnesota civil engineering professor Lev Khazanovich and researcher Derek Tompkins have key roles in the project.

Two test sections (cells 71 and 72) were constructed with two layers of "wet-on-wet" portland cement concrete (PCC). Construction of the concrete surface layer before the lower layer has set creates an excellent bond between the two layers of concrete.

Three concrete mixes were used: a recycled concrete mix (using recycled concrete coarse aggregates from existing MnROAD test cells), a low-cost aggregate concrete mix for the lower concrete pavement layer, and a high-quality granite overlay that includes a brushed exposed aggregate surface.



The third test section (cell 70) was constructed of a PG64-34 Superpave hot-mix asphalt (HMA) overlay surface placed over a recycled concrete mix. The HMA pavement will incorporate saw and seal over the transverse PCC joints to control reflective cracking from the underlying recycled concrete mixture.

The research project is focusing on two promising applications of composite pavement systems: an asphalt layer over a PCC layer, and a PCC surface over a PCC layer.

While asphalt overlays over PCC are commonly used to rehabilitate a pavement, the use of a high-quality asphalt concrete layer over a new concrete layer is rare. This technique has great potential to provide a long-lasting pavement needing minimal maintenance. The concrete substructure provides a durable, strong, long-lasting base, while the asphalt concrete provides a rapidly renewable riding surface as well as protective layer from salts and other harmful substances to concrete.

This technique may be well-suited for meeting the goals of rapid renewal, one of four focus areas of SHRP 2 meant to develop design and construction methods that cause minimal disruption and produce long-lived facilities to renew the aging highway infrastructure.

Another promising strategy in the construction of new pavements is the use of a relatively thin, high-quality concrete surface atop a thicker, less-expensive concrete layer before the lower layer has set. The lower concrete layer includes high proportions of recycled or substandard materials that are not suitable for use in the surface layer. While the use of the wet-on-wet concrete technique is rare in the United States, these types of pavements have been constructed in Austria and elsewhere.

Because the structural performance and functional performance of asphalt/PCC and PCC/PCC systems are not well understood or documented in the United States, Darter led a SHRP 2 research team on a visit to the Netherlands, Germany, and Austria in 2008 to document the performance and construction techniques of in-service composite pavements. Their 61-page report, 2008 Survey of European Composite Pavements, was published electronically this month.



The report found that both types of composite pavements performed well under heavy traffic loading during the 10 to 20 years that they had been in service. Observations from this report were used to develop the field design, construction, testing, and evaluation plan for test sections constructed at MnROAD.

Related resources:

- [Construction for SHRP 2 project about new composite pavement systems scheduled](#) (*TERRA E-News*, October 2009)
- [TRB Strategic Highway Research Program 2 \(SHRP2\) Composite Pavement Systems project R21](#)
- [SHRP 2 2008 Survey of European Composite Pavements](#) (TRB, 2010 – 5.8 MB PDF)
- [SHRP 2 Renewal projects](#)
- [MnROAD projects](#)

Greenroads rating system promotes sustainability in road building and maintenance

The University of Washington and CH2M Hill have developed the first rating system for sustainable road design and construction. Titled Greenroads, the system is designed to promote sustainability best practices and spur construction decisions that go beyond regulatory requirements. The system, which is set to begin offering certification in late 2011, has been outlined in a new TERRA fact sheet about Greenroads.

The Greenroads system awards points for a list of sustainable choices and practices and can be applied

to new, reconstructed, and rehabilitated roads. Its rating system provides an evaluation of sustainability tradeoffs and decisions, encourages greener practices and innovation, and confers marketable recognition on projects.

Greenroads evaluates a road's overall environmental and social impact, taking into account everything from construction materials to habitat control.

Projects have to fulfill basic building, waste, pollution, lifecycle, and outreach plans, and can then earn extra points for practices such as reducing reliance on fossil fuels and implementing smart traffic management systems.



Four certification levels are offered within the Greenroads system: certified, silver, gold, and evergreen. The more points, the higher the certification level. For a project to be certified, it must meet 11 mandatory best practices in areas such as noise control, storm water mitigation, and waste reduction. In addition, a project must receive a minimum of 32 voluntary credit points out of a possible 118. Voluntary credits are awarded for such practices as minimizing light pollution, using recycled or locally produced materials, incorporating quiet pavement, and creating access for bicyclists and pedestrians.



This system's goals include recognizing companies already using sustainable methods, providing a catalog of ideas for greener practices, and offering an incentive for agencies and companies to build more environmentally friendly roads. Its creators also note that the Greenroads standard helps show the public that the construction industry can become more sustainable.

So far, there are no completed certified Greenroads projects, but a limited number of pilot projects are in the works. The Minnesota Department of Transportation, the Western Federal Lands Highway Division, the Oregon Department of Transportation, the British Columbia Ministry of Transportation, and other agencies are participating. Once Greenroads is fully developed, project teams will apply for points by submitting specific documentation in support of the project requirements or voluntary credits they are pursuing.

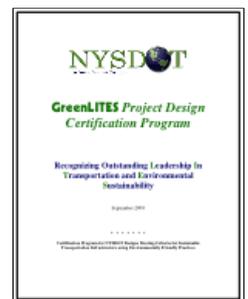
Related resources:

- [TERRA fact sheet about Greenroads](#)
- [The Greenroads Roadway Sustainability Performance Metric](#)

Green DOTs

TERRA members explore ways to evaluate sustainability

- The [Minnesota Department of Transportation](#) has a pilot project, scheduled for completion this year, informally using the Greenroads system. The project, in conjunction with the reconstruction of Highway 95 from Highway 97 to Stillwater, includes grading, signals, paving, and Americans with Disabilities Act of 1990 (ADA) improvements in both a rural and urban environment.
- The [New York State Department of Transportation](#) is developing a [GreenLITES](#) system based on ideas from an earlier version of Greenroads.
- The [Wisconsin Department of Transportation](#) (WisDOT) currently does not use the Greenroads rating system, but the department is working to develop a green roads rating system for use in the state. In addition, WisDOT is investigating the possibility of participating in the [U.S. Environmental Protection Agency WasteWise Program](#).
- The [Federal Highway Administration](#) green highways initiative is working towards a similar goal: incorporating sustainability into the nation's roads. The Greenroads team is currently working on a "self-evaluation tool and model process" for sustainable highway development for the FHWA, with a final product due at the end of 2010. The [Green Highways Partnership](#), initiated in 2005 by the FHWA and EPA, considers characteristics of a green highway that integrate transportation functionality and ecological sustainability rather than defining green highways by a list of requirements.



Infrastructure research highlights environmental and economic benefits

TERRA research projects featured at CTS transportation research conference

Using recycled construction materials in highway construction could reduce carbon dioxide emissions by an amount equivalent to annually removing 5 million passenger cars from the road, according to Tuncer Edil, a civil engineering professor with the Recycled Materials Resource Center at the University of Wisconsin Madison.

Edil extrapolated conclusions to a nationwide scale as part of a comparison of the use of recycled

materials with conventional materials in pavement design. He also estimated that the use of recycled construction materials would save the equivalent of:

- the annual energy use of 3.67 million households
- water for daily showers for 1.4 million persons
- the average annual salary for 1.5 million Americans

Edil was one of several researchers featured during two days of presentations about infrastructure at the 21st Annual Center for Transportation Studies (CTS) Transportation Research Conference, held April 27 and 28 in St. Paul, Minnesota. The conference acts as a forum for researchers and practitioners from Minnesota and the Upper Midwest to share their research findings in a variety of transportation-related areas. CTS is a TERRA member.

Edil's presentation, which focused on a pooled-fund study of recycled unbound base materials from MnROAD test sections, was part of a conference session on innovations in pavement recycling. Other conference infrastructure sessions involving TERRA-related research featured useful pavement tools and University of Minnesota pavement design research.

Jill Thomas, associate director of the Minnesota Asphalt Pavement Association, and Mary Vancura, a civil engineering research assistant at the University of Minnesota, also made presentations during the pavement recycling session. Thomas said rubblization with a hot-mix asphalt overlay can be a cost-effective in-place, long-term alternative to full-depth construction. Vancura gave an overview of research examining the use of recycled concrete as aggregate in portland cement concrete pavement. Vancura, who is working with University of Minnesota civil engineering professor Lev Khazanovich and researcher Derek Tompkins on SHRP 2 composite pavements research at MnROAD, said recycled concrete can be a valuable source of high-quality aggregates.

During the session on pavement design, Shongtao Dai, research operations engineer with MnDOT's Office of Materials, provided preliminary findings from a TERRA-initiated project at MnROAD about the impact of farm equipment on pavement typical of rural roads. Dai, speaking on behalf of Khazanovich, principal investigator of the study, said the pavement of a typical 7-ton rural road is not strong enough to support repeated applications of heavy loads, and restrictions may be needed to prevent damage. The study, which began in 2008, is in its final year.



Mary Vancura

The pavement design session also included presentations by University of Minnesota civil engineering professors Joseph Labuz and Mihai Marasteanu. Labuz, who discussed soil modulus testing and full-depth reclamation (FDR), said: "Full-depth reclamation is a wonderful way of making sure we do not just toss out this very valuable material. This material can perform very well with respect to strength and stiffness when it is put back as base that has been well-compacted." Marasteanu, together with Jim McGraw from the Minnesota Department of Transportation (MnDOT), discussed asphalt binder research, much of which is being conducted at MnROAD.

In the session about pavement tools, MnDOT senior research engineer John Siekmeier talked about the importance of soil mechanics in assuring quality pavement construction, especially because such analysis often makes it possible to use soil from the site rather than hauling it from distant locations. David Rettner, from American Engineering Testing, gave an overview of a two-year falling-weight deflectometer (FWD) data collection project on Minnesota county roads in which the MnDOT Office of State Aid has teamed with the Minnesota County Engineers Association. In addition, Kyle Hoegh, a civil engineering research assistant at the University of Minnesota, described an automated procedure for analyzing non-destructive testing of concrete pavements using a new ultrasonic tomography device that dramatically reduced the time needed for analysis from weeks to hours.



Joseph Labuz

Related resources:

- [2010 CTS Transportation Research Conference presentation slides and video](#)
- [Rubblization: A Cost-Effective Option](#) (Minnesota Asphalt Pavement Association, 2009, 98 KB PDF)
- [Preliminary findings in farm roads study implicate repeated heavy loads](#) (*TERRA E-News*, February 2010)
- [Kyle Hoegh Pavement NDT](#)

Announcements

TERRA Innovation Series: Sustainability in transportation, Aug. 20

Event in conjunction with regional transportation research forum

TERRA, in cooperation with the Wisconsin Department of Transportation, is hosting a fourth [TERRA Innovation Series event in Madison, Wisconsin, on August 20](#). The event, held in conjunction with the 9th Annual Mid-Continent Transportation Research Forum, scheduled for August 19–20, 2010, in Madison, will focus on sustainability in transportation. Session topics include the environmental review process, best management practices, construction practices, and beneficial reuse. In addition, attendees will tour a hot-mix asphalt (HMA) plant to observe the incorporation of postconsumer shingles and recycled asphalt pavement into HMA pavement. There is no cost to attend the TERRA event, but

separate registration is required for the Mid-Continent Transportation Research Forum. To register for the TERRA event, please send your name and full contact information by August 6 to Stephanie Malinoff, malinoff@umn.edu, 612-624-8398.

The [9th Annual Mid-Continent Transportation Research Forum](#), this year hosted by the Wisconsin Transportation Center, 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. The TERRA Innovation Series event is part of the agenda on the second day of the forum.

MnROAD open house features SHRP 2 composite pavements, Aug. 23

TERRA and the Minnesota Department of Transportation (MnDOT) are partnering to host another behind-the-scenes look at MnROAD on Monday, August 23. Attendees will see how road and pavement engineering innovations are developed, tested, and prepared for implementation on Minnesota roads, as well as learn preliminary results of ongoing projects. An afternoon session will focus on lessons learned from the SHRP 2 (Strategic Highway Research Program) composite pavement project (see [related story](#)). During morning sessions, TERRA and MnDOT representatives will discuss a variety of asphalt- and concrete-related projects currently under way. In addition, two guided one-hour bus tours will loop through the facility, making stops at various project locations. Visitors may participate as their schedules allow, either for a brief stay or for the entire day. There is no fee to attend the event, but registration is requested. Attendees are responsible for their own lunch. To register, send your name and contact information to Kaydee Kirk, kkirk@umn.edu, 612-626-5854. [More about the MnROAD open house.](#)

TERRA publishes fact sheet about Greenroads

TERRA has published another fact sheet, this one featuring the [Greenroads](#) system developed by the University of Washington and CH2M Hill. Greenroads, the first rating system for sustainable road design and construction, is described in a separate [article](#) in this issue of TERRA E-News. All TERRA [fact sheets](#) are available for download from the TERRA website.



MIT Concrete Sustainability Hub hosts industry day, Aug. 31

The Concrete Sustainability Hub (CSH) at the Massachusetts Institute of Technology (MIT) will unveil its initial research findings and progress at the [2010 Concrete Industry Day](#) in Cambridge, Massachusetts, on August 31. The two inaugural work plans of the CSH are: "The Edge of Concrete: A Life-Cycle Investigation of Concrete and Concrete Structures" and "From Liquid to Stone: The Genesis of Concrete." Lead investigators for both projects will be on-hand to present their findings, answer questions, and hear industry feedback on the future direction of CSH. The event is an opportunity for stakeholders in the concrete industry to see first-hand the progress being made at MIT and to meet the lead researchers. The registration fee of \$100 covers cost of meals and meeting facilities.

CSH was established by the Portland Cement Association and RMC Research & Education Foundation. For questions about registration, contact Jessica Moore at 888-846-7622, ext. 1152, or jmoore@nrmca.org.

International conference about sustainable concrete pavements, Sept. 15-17

The [International Conference on Sustainable Concrete Pavements: Practices, Challenges, and Directions](#) is scheduled for September 15-17, 2010, in Sacramento, California. The conference, organized as a part of technology transfer activities under the Advanced Concrete Pavement Technology Products Program that operates within the Federal Highway Administration, will provide an international forum to discuss the sustainable attributes of concrete pavements. Featured presentations will cover existing technologies, emerging research, approaches to measuring energy and environmental impact, user considerations, and international practices and experience. The forum will present improved and innovative processes for achieving sustainable concrete pavements throughout the pavement's life cycle.

Green streets and highways conference, Nov. 14-17

The American Society of Civil Engineers and the Transportation & Development Institute have scheduled the [2010 Green Streets & Highways Conference](#) on November 14-17, 2010, in Denver. This conference is being held to address the rapidly growing interest and activity in sustainable transportation. In addition to opening and closing plenaries, the conference offers seven sets of concurrent technical sessions.

MAPA asphalt events planned

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

- MAAPT 57th Annual Asphalt Conference, December 8, 2010

Northland Inn in Brooklyn Park, Minnesota

Info: info@mn-aapt.org

- NAPA 56th Annual Meeting, February 6-9, 2011
Waldorf Astoria & the Hilton at Bonnet Creek, Orlando, Florida
Info: www.hotmix.org
- AAPT 86th Annual Meeting, March 27-30, 2011
Marriott Waterside, Tampa, Florida
Info: aaptinfo@gmail.com

ATSSA annual convention and traffic expo, Feb. 13-17, 2011

The [American Traffic Safety Services Association \(ATSSA\) Traffic Expo](#) 41st Annual Convention and Traffic Expo is scheduled for February 13-17, 2011, at the Phoenix Convention Center in Phoenix, Arizona. The 2010 convention included roundtable sessions designed to facilitate a peer-to-peer exchange, workshops delivered by industry experts, and nearly 100 hours of training and certification programs.

CPAM annual concrete paving workshop, March 10-11, 2011

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

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.

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