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: Minnesota Department of Transportation

As a founding member of TERRA, the Minnesota Department of Transportation (MnDOT) has always been a key player in developing innovative road research initiatives and collaborations through the alliance. MnDOT helped create TERRA in 2004 to provide a new governance structure for the Minnesota Road Research Project (MnROAD) facility and respond flexibly to the needs of many stakeholders for a large pavement research center.

MnDOT representatives on the TERRA board are: Julie Skallman, director of state aid; Bernard (Bernie) Arseneau, director of policy, safety, and strategic initiatives; Mike Barnes, director of engineering services; and Keith Shannon, director of the Office Materials and Road Research.

To date, TERRA has focused primarily on MnROAD capabilities, transforming the facility from a resource for Minnesota to a regional, national, and international research center. Now, MnDOT is leading the way to broaden TERRA's scope beyond just pavement research.

"It's important for us to be thinking in ways that are going to move us forward," said Arseneau, MnDOT's newest TERRA board representative. "There's been a lot of focus on pavements, and we need to consider expanding that focus to other areas, everything from traffic control to designs. There's a lot of room for growth."

While MnDOT remains the owner and operator of MnROAD and a major funder of pavement research in Minnesota, the value to the department of the research partnerships developed through TERRA cannot be overstated. MnDOT representatives on the TERRA board especially are committed to growing TERRA membership.

TERRA stakeholders are focused on improving transportation infrastructure through research innovations. To that end, MnDOT has a history of accomplishment through cooperative efforts such as the Minnesota Guidestar board and the Minnesota Local Road Research Board (LRRB).

MnDOT representatives on the TERRA board stress the importance of seizing every possible opportunity, making good decisions, and delivering results. The MnDOT Office of Materials and Road Research, for example, has been moved to the policy, safety, and strategic initiatives division because of its role in moving forward innovative solutions. Unlike other offices more traditionally organized by function, staff members at Materials and Road Research may shepherd a project from conception through to completion.

"There's been a melding from the research end to the outcome, and then actually implementing those

results—all by the same person," Arseneau said. "It provides the expertise to help us [work] more efficiently."

In fact, the new MnDOT Office of External Partnering is leveraging the lessons learned through the work of units like the Office of Materials and Road Research and the Office of Traffic, Safety, and Technology to demonstrate what can be accomplished through partnering relationships. The bottom line for MnDOT is better service and better roads.

"Through safety, innovation, transparency, and accountability, we really hope to rebuild that trust and confidence of the public and the rest of the transportation stakeholders," Arseneau concluded. "That's very important to us, and we're trying to make decisions that set us up for that kind of an outcome."

Member Highlights

Aggregate and 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 and Education Foundation to monitor and interpret research results from the pervious concrete cells that are being placed at MnROAD this year. (See related article.) Lev Khazanovich (Civil Engineering, University of Minnesota) and Kevin MacDonald (Cemstone) are co-principal investigators of the study. The research grant, which is due in large part to the efforts of TERRA board members Fred Corrigan (ARM) and Julie Garbini (RMC Research and Education Foundation), is in addition to the Minnesota Local Road Research Board (LRRB)/MnDOT project, titled Pervious Concrete Pavement Study.

American Concrete Pavement Association (ACPA) published a report prepared by Mark B. Snyder, Ph.D., P.E., about the research findings from the concrete test sections at MnROAD. The 100-page report, titled Lessons Learned from the MnROAD Concrete Test Sections (1992–2007) (2.4 MB PDF), discusses the following topics in terms of MnROAD design and performance data: mainline concrete pavement design and performance; low-volume road concrete pavement design and performance; the effect of drainage on concrete pavement performance; the effect of sub-base thickness on concrete pavement performance; 5-inch concrete pavements for low-volume roads; and design, construction and rehabilitation of whitetopping.

Ready Mixed Concrete (RMC) Research and Education Foundation announced the publication of new report, New Technology-Based Approach to Advance Higher Volume Fly Ash Concrete with Acceptable Performance. The study, conducted at the National Ready Mixed Concrete Association's Research Laboratory, received funding from the U.S. Department of Energy through its Combustion Byproducts Recycling Consortium in addition to the foundation. The study discusses the potential for the concrete industry to integrate a greater amount of recycled material within mixtures while maintaining strength and performance, and the resulting positive environmental implications. The publication, also available as a CD, may be downloaded from the foundation's website.

Projects and Initiatives

Rehabilitating roads with thinner concrete overlays may thin out costs

In the never-ending quest to optimize pavement life and minimize costs, the Minnesota Department of Transportation (MnDOT) is partnering with the American Concrete Pavement Association (ACPA) and the Portland Cement Association (PCA) to study thin concrete overlays by implementing the rehabilitation technique on two Minnesota highways.

In September, Shafer Contracting Company reconstructed the southbound side of the Highway 53 Expressway, from Pike Lake to Independence just north of Duluth, with more than 8 miles of a thin unbonded concrete overlay. In addition to a 5-inch layer of unbonded concrete pavement on top of an inch of high-density asphalt, the $5.4-million project also included grading, culvert replacement, and bridge repair.

The Concrete Paving Association of Minnesota (CPAM), a member of TERRA along with MnDOT and ACPA, hosted a project open house in early September at the town hall in Twig, Minnesota, to feature the innovative work on Highway 53, which was in-progress at the time.

In early October, a crew from Progressive Contractors Inc. (PCI) placed a similar thin unbonded overlay atop four MnROAD mainline test cells of cracked 7.5-inch-thick portland cement concrete (PCC) from 1993. The objective of this experiment is to test the performance of thinner unbonded concrete overlays (4- to 5-inches thick) subject to interstate traffic and Minnesota's extreme climate. The design of traditional unbonded concrete overlays may be thicker—and therefore higher in cost—than perhaps necessary for good performance.

Thin unbonded overlays are a departure from most concrete overlays in use, which are typically 7.5 to 9 inches thick and placed on top of a porous asphalt bond breaker layer and constructed with edge drains for runoff. With the traditional overlays, dowel bars are used to strengthen the connection between the surface panels of concrete and help transfer the traffic load to adjacent panels. With the thin overlays, however, there is insufficient thickness to use dowel bars at the joints between concrete panels, so the load from traffic is transferred to the original concrete pavement below.

The Highway 53 overlay project was constructed with 12-foot-by-12-foot panels, though a short test section was constructed with 6-foot-by-6-foot panels. In addition, the saw-cut joints between panels

were not sealed, unlike most traditional overlay projects. After a little more than one month of traffic and weather, of the 3520 concrete overlay panels along the 8-mile stretch, there have been fewer than 10 mid-panel cracks, according to Ted Sexton, MnDOT District 1 resident engineer.

"I'm encouraged by what we've seen so far," Sexton said. "We may get a few unwanted cracks, but we think we can live with that."

Sexton explained that the next big test for the Highway 53 project will be how the pavement responds to the freeze-thaw cycle next spring. MnROAD researchers have instrumented the road similarly to the test cells at their facility to monitor how well it holds up. The 10-ton road, averaging about 12,000 vehicles each day including heavy commercial traffic, is sure to be well-tested in the coming months of a northern Minnesota winter. By comparison, major highways in the Twin Cities can average around 100,000 vehicles per day.

"If the load transfer works the way we hope, it could easily have a design life of 30 years or more with regular maintenance," Sexton said.

Besides the substantial savings in material costs with the thin unbonded overlays by using about 30 percent less of concrete and aggregate shouldering, no dowel bars, no edge drains, and no joint sealing, Sexton estimated the Highway 53 project may have shaved 20 percent from the time it might have taken to place a traditional overlay. Of course, only time will tell if those savings prove their worth.

The use of a thin unbonded concrete overlay is also being tested this year on Route D near Kansas City, Missouri. In that late summer project, quarter-inch geotextile fabric was used as the bond breaker instead of asphalt. The Missouri Department of Transportation, encouraged by findings so far, plans greater use of the road rehabilitation technique.

Related resources:

- MnROAD Phase Two projects
- Concrete overlays may provide effective solution for damaged roadways
- APCA
- PCA

Researchers discuss expanding use of intelligent compaction

As part of the ongoing Center for Transportation Studies seminar series at the University of Minnesota, Joe Labuz, Bojan Guzina, and John Siekmeier were on hand September 30 to discuss new research and recent developments about intelligent compaction. Though intelligent compaction has been used for construction of roadways across Minnesota, it's still a fairly new idea.

Also known as continuous compaction control, intelligent compaction is a quality-control system used in pavement construction to continuously monitor the stiffness of materials. The stiffness data can be linked to machine controls, which then adjust the compaction accordingly to avoid over- or under-compaction.

Siekmeier, a senior research engineer at the Minnesota Department of Transportation (MnDOT), opened the seminar by discussing some of the intelligent compaction projects around the state. Siekmeier explained that the soil and asphalt intelligent compaction systems used by MnDOT are able to create maps that keep track of the compaction taking place and archive the results for later. This results in increased uniformity, documentation of every lift, and improved worker safety.

Siekmeier also noted that intelligent compaction is helping MnDOT move away from sand-cone testing and toward mechanistic performance-based testing for quality assurance during construction. Since 2004, MnDOT has used intelligent compaction on 15 projects across Minnesota. "We'll be doing more within MnDOT and hopefully within many more counties. There are several counties that have expressed interest in doing this next year," Siekmeier added. "We'll continue to participate in national projects as well."

Labuz, a civil engineering professor at the University of Minnesota, reviewed previous research that has been influential in the development of intelligent compaction. According to research from as far back as the 1960s, energy input has a great effect on the density and stiffness achieved by compaction. Key factors such as these that were identified in older reports have been significant tools for exploring intelligent compaction uses on roadways today. Labuz went on to discuss the University's involvement in intelligent compaction planning as well as explain the process for identifying potential intelligent compaction project areas in Minnesota.

Labuz shared information about a few of the intelligent compaction project areas, including Highway 36

in Maplewood, Highway 10 in Staples and Detroit Lakes, and Highway 60 in Bigelow. Guzina, an assistant professor of civil engineering at the University of Minnesota, discussed some of the challenges to obtaining data from these projects. "At this time, technology in intelligent compaction is ahead of our understanding of the problem," he said. "We can obtain these wonderful measurements but the question is, how do we interpret them?"

Related resources:

- View "Intelligent Compaction Implementation" seminar
- TERRA fact sheet: Implementation of New Technologies
- IC Pooled Fund website

Will pervious concrete work in Minnesota?

by Joseph Clendenen, EIT, *LEED AP*

Pervious concrete is described as a zero-slump, open-graded material consisting of hydraulic cement, coarse aggregate, little or no fine aggregate, admixtures, and water. These systems are typically used to control storm water runoff for parking lots, low-volume roads, and walking trails, and have been used in applications such as swimming pool decks, greenhouse floors, and boat ramps. The systems have been adopted as a best management practice (BMP) by the U.S. Environmental Protection Agency (EPA) for mitigating storm water runoff and also may help to earn credits within the LEED Green Building Rating System.

While these types of systems have been used for decades in the southern U.S. regions, the available literature indicates that information on the use of pervious concrete in severe environments—those exposed to severe cold temperatures and deicing materials—is limited.

For this reason, the Aggregate and Ready Mix Association of Minnesota (ARM) has been conducting research with pervious concrete systems at MnROAD. The goals of these projects are to evaluate the use of these systems in the harsh Minnesota environment as well as to exhibit placements for area contractors. In addition to these research projects, ARM hosts certification courses for pervious concrete construction. The two pervious concrete projects to date at the MnROAD facility are a driveway slab in front of the storage garage and a sidewalk with three different mixes in the front of the MnROAD office building. Reports for these projects are available on the MnROAD website.

Further investigation includes 500 feet of pervious concrete placed in the low-volume road at the MnROAD facility. This placement, completed as the 2008 construction season draws to an end, consists of pervious concrete placed on a clay subgrade as well as a sand subgrade. Instrumentation will monitor items such as pavement reaction under load, permeability, effect upon rainfall curve, and durability under normal maintenance and environmental conditions.

Will pervious concrete work in Minnesota? It is difficult to conclude at this point based upon the limited research and field use in the area beyond three winter seasons. But the results from these and other studies seem to support that properly designed and implemented pervious concrete systems can function here very well. The sidewalk study, as described above, yielded results indicating that pervious concrete mixes resistant to the harsh effects of freezing and thawing can be produced. And, just as important, this research—along with ARM training efforts—continues to provide valuable data on the best techniques for placing quality pervious concrete products.

Joseph Clendenen, a technical service engineer with Holcim (US) Inc., serves as co-chair of the Technical Service Committee with the Aggregate and Ready Mix Association of Minnesota (ARM).

Related resources:

- TERRA fact sheet on pervious concrete
- MnDOT pervious concrete research (192 KB PDF)
- MnROAD Phase Two projects
- ACI Committee 522 Pervious Concrete
- *Pervious Concrete Research Compilation* (472 KB PDF)
- NRMCA
- PCA
- CP Tech Center report on pervious concrete mix design (3.2 MB PDF)
- Contact Joseph Clendenen

Announcements

TERRA publishes fact sheet about pervious concrete

TERRA published the fourth in its series of fact sheets this month, this time focusing on pervious

concrete. Pervious concrete, which allows water to flow relatively unobstructed through it, is used primarily as a pavement system to control storm water runoff for parking lots, low-volume roads, and walking trails. The fact sheet lists several pervious concrete projects that have been implemented in Minnesota, including two new test cells on the MnROAD low-volume road. In addition, the document lists more than a dozen resources for further information about pervious concrete.

Work exchange program brings Swedish engineer to MnDOT

Mats Wendel, a Swedish engineer who has worked 20 years with pavements, is participating in a work exchange program between MnDOT and the Swedish Road Administration. Wendel will be in Minnesota for a year to learn and share information. His primary interests are warm-mix asphalt, contracting systems, cost-effectiveness, and MnROAD. He is being is hosted by the MnDOT Office of Materials and Road Research. In addition, Wendel's wife and three children have joined him to experience the life in Minnesota.

Mats Wendel

TERRA among sponsors of upcoming pavement conference

TERRA is again one of several sponsors for the 13th Annual Minnesota Pavement Conference, scheduled for February 12, 2009, at the Continuing Education and Conference Center, University of Minnesota, St. Paul, Minnesota. This one-day conference looks at current practices that implement new pavement research and technology. National and local trends and innovations will be examined to expand understanding of pavement challenges and solutions. The conference is intended for city engineers, county engineers, public works officials, maintenance superintendents, design engineers, consulting engineers, and others interested in pavement issues. For more information about the Minnesota Pavement Conference, contact Shirley Mueffelman at 612-624-4754, cceconf2@umn.edu.

2009 Concrete Technology Forum to focus on performance prediction

The National Ready Mix Concrete Association (NRMCA) is now accepting abstracts for the 2009 Concrete Technology Forum: Focus on Performance Prediction. This symposium and product expo, May 13-15, 2009, in Cincinnati, will bring researchers and practitioners together to discuss the latest advances, technical knowledge, continuing research, tools and specifications that involve test methods and modeling to predict concrete performance and service life of concrete structures. The deadline is November 28, 2008. For online submissions, registration, or more information, visit www.ConcreteTechnologyForum.org, or contact Lionel Lemay, 847-918-7101, LLemay@nrmca.org.

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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