

MINNESOTA LTAP TECHNOLOGY EXCHANGE

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Minnesota Local Technical Assistance Program

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Demo Day finds audience eager for hands-on training



Brian Barott of MnDOT demonstrated cargo securement at the Demo Day.

Chains, blades, and fire have been among the most common and useful tools for centuries, especially for building and maintaining roads. But even with today's improvements, use of such tools can be ineffective or, at worst, turn deadly in a heartbeat without adequate training.

One place for local transportation agency personnel to get this important training is the Minnesota Roadway Maintenance Training and Demo Day, an annual offering from Minnesota LTAP.

Demo Day continued on page 5

Bye bye, boomers...Is your organization ready?

Half of the current workforce is or will become eligible for retirement over the next 10 years. Who will replace them? Has your organization been thinking about workforce recruitment, training, and retention?

Leaders from across the country developed a cohesive strategic framework for addressing these challenges at the National Transportation Workforce Summit held last year. A summary of the summit identifies four critical issues:

- Demographic changes: Baby boomers are retiring and taking specialized knowledge and historical perspective with them.
- Career awareness and training: Students often make decisions about which careers they will pursue before they learn about transportation.

Boomers continued on page 4



Long live concrete pavements!

"We can achieve the goal of pavements that last 40 years or more," said Shiraz Tayabji, a featured speaker at this year's TERRA Pavement Conference in February.

"The technology already exists," Tayabji said. "The challenge is to apply what we know consistently in design, materials, construction, maintenance, and rehabilitation. Pavements should not exhibit premature failures or materials-related distress. We should be able to maintain desirable ride and surface texture characteristics with minimal intervention; we shouldn't need to reseal joints every six or seven years. Pavement failure should result from traffic loading."

Tayabji, a senior consultant for Fugro Consultants, Inc. of Columbia, Maryland, and a member of FHWA's Advanced Concrete Pavement Technology Products Program team, outlined strategies for achieving long-life concrete pavements. He prescribed the more detailed goals for concrete pavements shown in Table 1.

Distress	Desired Value Near End of 40+ Years
Cracked slabs	Maximum 10 to 15%
Faulting	0.25 inch or less (some agencies now specify 0.15 inch, max.)
Smoothness	IRI of 150 to 180
Spalling	Minimal
Materials-related distress	None

Table 1: Goals for concrete pavements of 40+ years

Long live concrete continued on page 6



SAFETY

Getting smart about ITS

Intelligent transportation systems (ITS)—broadly defined, the application of technology to the transportation environment—are helping communities improve traffic safety, increase mobility, and boost efficiency, and at significantly lower costs than rebuilding or replacing transportation infrastructure, according to presenters at the annual meeting of the City Engineers Association of Minnesota in January.

From crosswalk enhancements to surveillance cameras to dynamic message signs and traffic detectors, intelligent transportation systems are helping to reduce the number and severity of crashes and capturing traffic data to keep systems flowing smoothly and safely, said Eric Minge, vice president of ITS Minnesota and a principal at SRF Consulting Group, Inc.

But the systems now in operation in Minnesota and elsewhere are just the beginning, Minge continued. On the not too distant horizon, travelers will see vehicles that communicate in real time with the vehicles around them, vehicles that drive themselves, adaptive traffic signals, and coordinated management of multimodal corridors that will enable users to take the most efficient route to a destination, regardless of mode.

Already, ITS technologies are improving safety on Minnesota highways and in local communities, Minge said. Intersection collision warning systems (ICWS) and deer detection systems are reducing collisions in rural areas, and dynamic curve warning systems are providing a wake-up call for drivers.

Intersection collision warning systems have proven effective at reducing crashes at several high-crash intersections around the state, Minge said. A variety of ICWS systems are already in use at more than a dozen intersections. The electronic signs operate in real time, monitoring oncoming traffic and alerting drivers when it is safe to turn onto or cross the highway. Under a MnDOT program, at least 20 and up to 50 additional rural intersections will be equipped with warning systems in the next several years.

Deer detection warning systems are replacing some of the familiar yellow, diamond-shaped deer crossing signs on the state's rural roads. The warning systems use motion sensors to detect the presence of deer in roadside ditches; flashing beacons then alert drivers of approaching animals. MnDOT installed the first warning system six years ago just outside of the City of Marshall near Camden State Park, in an area with a high population of deer. The department reported a 57 percent drop in deer vehicle collisions in 2007 and a 33 percent reduction in 2008, Minge said.

On other roads, dynamic curve warning systems use radar to determine vehicle speeds; flashing chevrons then get drivers' attention, reducing crashes and rollovers. These solar-powered systems offer a relatively low-cost way to improve safety in high-crash areas, Minge said.

Pedestrians in several Twin Cities suburbs are getting a little extra protection thanks to in-pavement LED lights and radar-activated stop signs at crosswalks. The communities of St. Anthony and Bloomington are using the technology to improve crosswalk safety near schools.



Courtesy MnDOT

Intersection collision warning systems have reduced crashes at several high-crash intersections around the state.

Janelle Borgen of WSB Associates worked with the village of St. Anthony to install LED lights at a mid-block crosswalk used by middle and high school students. State law requires drivers to stop for pedestrian in crosswalks, but many drivers fail to stop, especially for mid-block crossings, Borgen said. A traffic count at a midblock crossing near the schools found as many as 49 percent of vehicles failed to stop.

To improve compliance, the city installed directional LED lights in the pavement at the crosswalk, much like lights in use at airports, along with a radar-activated blinking stop sign. The flashing yellow lights on the blinking stop sign are clearly visible in daylight and at night, Borgen said. Although no follow-up study has yet been done, anecdotal evidence suggests the lights are making a difference, she added.

In a similar situation, the City of Bloomington augmented pedestrian crossings with rectangular rapid flashing beacons (RRFBs) at two locations, near a high school and at a mid-block crossing used by middle and elementary school students near the I-35W corridor. The RRFBs are activated by a curbside push button that alerts drivers to the presence of pedestrians in the crosswalk. Studies by the Federal Highway Administration and the Texas Transportation Institute show RRFBs can boost driver compliance at crosswalks to more than 90 percent, said Amy Marohn, traffic engineer for Bloomington.

"It's a very vivid notification to drivers that there is a pedestrian there right now," she added.

For additional ITS resources, visit these websites:

- USDOT's Research and Innovative Technology Association: rita.dot.gov
- Intelligent Transportation Society of America: itsa.org
- U of Minnesota ITS Institute: its.umn.edu
- Minnesota GuideStar: dot.state.mn.us/guidestar

LTAP

—J. Trout Lowen, LTAP freelancer

AT LEAST

20

AND UP TO

50

ADDITIONAL RURAL INTERSECTIONS

will be equipped with collision warning systems in the next several years.

LTAP welcomes new Steering Committee member

Rich Sanders, the county engineer in Polk County, has joined the Minnesota LTAP Steering Committee, replacing Doug Grindall (see article on page 4 for Doug's words of wisdom).

Welcome, Rich, and thank you, Doug!



Rich Sanders

Technology Exchange

The **Minnesota Local Technical Assistance Program** is part of the Federal Highway Administration's Local Technical Assistance Program (LTAP). LTAP is a nationwide effort designed to foster and improve information exchange among local practitioners and state and national transportation agencies. Minnesota LTAP is administered by the Center for Transportation Studies at the University of Minnesota, and cosponsored by the Minnesota Local Road Research Board and the Minnesota Department of Transportation.

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Contact us

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Technology Exchange welcomes contributions and suggestions from its readers. Submit articles, news items, potential topics, and other comments to Pamela Snopl, managing editor.

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Laurie McGinnis, Center for Transportation Studies
Gary Pedersen, Minnesota Association of Townships
Tom Peters, Office of Maintenance, MnDOT
Rich Sanders, Polk County; Minnesota County Engineers Association
Linda Taylor, Research Services Section, MnDOT
Bert Tracy, City of Golden Valley; Minnesota Street Superintendents Association
Rick West, Otter Tail County; Chair, Minnesota LRRB

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OPERA Spotlight: skid Loader Bituminous Screed

Project leader: Lonn Jackels

Agency: Murray County Highway Department

Problem: Murray County was disappointed with the quality of its bituminous patching over large areas. Often, the patches had poor ride quality and uneven lane thickness. In addition, maintenance crews had to move large quantities of bituminous mix by hand when working on large patches. The county needed a better way to handle large, lane-width patching operations that would also improve the resulting ride quality.

Solution: The county built a wide-screed skid loader attachment to bridge the patch over a wider area. The screed slides on hydraulically maneuverable skids that can be raised or lowered depending on the desired thickness of the patching material.

Procedure: The screed attachment is used after the hot mix has been placed in the area to be patched. Murray County uses the attachment to level the patch area—first by making a few passes back and forth to rough out the bituminous mix and then completing a final pass to leave the area just high enough to compact. To achieve the desired thickness for each side of the screed attachment, separate operators independently control the hydraulic skids. The skid loader operator maintains the proper angle for the attachment as well as speed and direction.



Results: Original findings indicated that the skids were too short to adequately support the weight of the screed, making it difficult to push. The county retrofitted the original skids with truck bumpers, resulting in longer, ski-like skids that carried the load more effectively. The new design prevented the screed from sinking into loose gravel or scuffing the warm, recently placed hot mix.

Overall, Murray County's patching quality improved greatly after the initial learning curve for screed attachment operation. The amount of needed physical labor has also been greatly reduced. The county has been able to place larger patches more effectively, and the resulting ride quality has improved.

Approximate cost: \$6,340

OPERA funding: \$4,000

Implementation: Murray County used the screed attachment effectively for a few large patches in the fall of 2012, and it expects proficiency to increase with additional time and use.

Status: Complete
LTAP

Fact sheets online

The Exchange regularly highlights projects completed under the LRRB's Local Operational Research Assistance Program (Local OPERA). Project fact sheets, along with the full project reports, are posted on the OPERA website as they are completed throughout the year. All are available at mnltp.umn.edu/opera.

AWARDS



Slagle receives NACE award

Cory Slagle, Washington County's engineering and construction manager, has been awarded the National Association of County Engineers (NACE) 2012 Project Manager of the Year Award. The award was announced April 24 at NACE's Annual Meeting and Management and Technical Conference in Des Moines, Iowa.

Slagle received the award in recognition of his work on the Broadway Avenue reconstruction in Forest Lake. The complex three-year project, which improved safety and mobility, was the largest ever undertaken in county history. Features include a new crossing over Interstate 35, two pedestrian bridges, and a roundabout. **LTAP**



Washington County Board of Commissioners Chair Lisa Weik with Cory Slagle

Courtesy Washington County

New LRRB video showcases stormwater management techniques

The LRRB has released a new video: *Choosing Stormwater Management Practices: A Decision Tree for Minnesota Cities and Counties*. It introduces seven management practices that local government agencies may use to meet state and federal stormwater regulations. Based on an LRRB guide to stormwater best management practices, the 14-minute video shows examples of various BMPs as local engineers explain how they have used them to keep stormwater pollutants out of Minnesota lakes and streams.

More resources:

- *Decision Tree for Stormwater BMPs* guide (2011RIC01), two-page technical summary (2011RIC01TS), and PowerPoint (2011RIC01PP)

Correction: CEAM Award

The spring 2013 *Exchange* article titled "Associations Announce Annual Awards" incorrectly cited the participating partners for the City Engineers Association of Minnesota (CEAM) Project of the Year Award. The correct information is:

City of Maple Grove's 2012 Bass Lake Road Reconstruction Project from CSAH 101 to Vicksburg Lane. Maple Grove was the lead agency and contracting authority throughout the project, while Hennepin County partnered in funding the project. In addition, SRF Consulting Group, Inc. prepared preliminary and final design plans and construction administration services.

We regret the error. **LTAP**

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WORKFORCE

Career advice from a Minnesota retiree

One local example of the wave of retirees is long-time Koochiching County Highway Engineer Doug Grindall, who retired in March. In the position for 36 years, Grindall was one of the longest-serving county engineers in the state. He is now working as a sales engineer for a consulting firm.

Grindall also served on Minnesota LTAP's Steering Committee since 1995. He often livened up meetings with humorous tales of his experiences. Below he shares some advice for potential county engineers:

Why would I encourage young engineers to consider a career as a county engineer?

- "You can basically pick any place to live in Minnesota if an opening occurs and you are the most qualified.
- You have the satisfaction of guiding the improvement of the transportation system within a county (with the approval of the county board). Seeing a project reconstructed after years of planning is always a great feeling of satisfaction.
- There is so much variety in the job that time goes by very quickly. I can remember coming in the office in the morning with my "to do" list and finding that many, if not most of the items, didn't get completed or even started by the end of the day due to other issues coming up.
- You get to be outside as much as you can fit into your work schedule.
- You will have the opportunity to meet many great engineers during your career. You can count on them to keep you from reinventing the wheel, as many of them have been there, done that. Many of them will become your very close friends whom you will not only work with on committees, but you will also get together after hours for recreational activities with them and their families. The bond becomes almost as great as family. I cannot say enough good

"In our district, three out of the seven county engineers retire this year before the first of August, and another may retire next year. If the replacements are happy, there will not be another opening in these counties until the new engineer retires far into the future. This is a great time to be a young registered engineer with so many openings occurring."

—Doug Grindall

things about my fellow county engineers and their assistants, and I am pleased with the group that will take over the reins as us older engineers retire. They are generally more computer savvy than us old dinosaurs.

- You will have the opportunity to meet the community leaders in your county."

How can students/young professionals prepare to be a county engineer?

- "You have to enjoy math and science classes in high school. Next, get a good foundation in college with classes in soils, bituminous, concrete, hydraulics, hydrology, structures, etc.
- Passing the registration exam is mandatory for anyone serving the public.
- Paying your dues by working many years as an assistant engineer would definitely help. An option would be working for a consulting firm that does work for counties and/or cities. Also starting out in a state highway department and taking advantage of the opportunity to rotate through several divisions is a great way to gain experience. Initially you may not become a county engineer in an area you truly love until you have the years of experience to become

the most qualified for the position.

- Communication skills, both oral and written, are mandatory.
- Get used to the fact that not everyone is going to agree with your point of view, and be willing to compromise when necessary. Keep in mind that the county board may not always be right, but they are always the boss. Plan on updating your resume when you can no longer accept that fact.
- There will be peaks and valleys during your career, as there are with any jobs. Learn to roll with the punches. Some days you will be the dog, some days you will be the hydrant.
- If you don't like dealing with the public, you should continue searching for a job you really like."

Read more of Grindall's wit and wisdom—including what he found most rewarding about his job and how the job changed over the years—in the web version of this article. He also shares some humorous stories. "Every county engineer has similar stories that would make a good book for publishing if they were all put together," he says. **LTAP**

Boomers from page 1

- New technologies: More technologically savvy systems operators and managers are needed.
- Rising demand on transportation agencies: Broader responsibilities require a workforce with a wider range of technical and non-technical experience.

Because the transportation workforce requires a range of skills and abilities, a single approach to recruitment, training, and retention is not sufficient, the report says. For example, change management, interpersonal, and collaboration skills are a higher priority for workers in supervisory roles, while specific technical training is necessary for specialty occupations. Similarly, tactics for attracting single parents, immigrants, and the Generation Y workforce to transportation careers may vary from traditional recruitment campaigns.

Summit participants created a framework for action and set overarching goals for workforce development, including:

- Reaching out to the future transportation workforce.
- Increasing interest and training for second careers in transportation.
- Increasing transportation degree, credit, and skill portability.
- Expanding transportation workforce access to post-secondary education.
- Improving student readiness for the transportation workforce.
- Increasing transportation workforce retention in underserved populations.
- Accommodating an aging and multi-generational transportation workforce.
- Adapting to the constant technological advances in the transportation industry.

Leaders also recommended that the current workforce mentor students and new employees—not only to teach them valuable skills, but also to welcome them into the industry.

The 28-page summary is available at cutcworkforce.com/about. **LTAP**

Capturing boomers' knowledge

Not only are baby boomers leaving the workforce: they're taking their knowledge with them.

An August 5, 2011, article in *BusinessWeek*—"Intelligence Lost: The Boomers are Exiting"—encourages leaders to ensure that all that experience and intellectual capital doesn't leave along with retirees.

The article gives tips for extracting and archiving key information from older workers, such as:

- Setting up a database for collecting information.
- Encouraging interaction between the generations.
- Hosting formal and informal events to bring people together.
- Using social media and online tools.

LTAP



Minnesota LTAP is offering a "From Line to Leadership: Transitioning from Operations to Supervision" workshop with Hennepin Technical College this fall. Stay tuned to mnltp.umn.edu for news.

50%
of the current workforce is or will become
ELIGIBLE FOR RETIREMENT OVER THE NEXT
10
YEARS.



Roads Scholars honored at graduation ceremony

*Roads Scholar Class of 2012**

The latest graduates of the Roads Scholar program received a certificate of achievement during a ceremony at the 2013 Minnesota Roadway Maintenance Training and Demo Day in Rochester. "We value and appreciate the time and energy they've invested," said Jim Grothaus, Minnesota LTAP's director. "Today we honor students who have recognized the value and benefit of sharing transportation knowledge, improving skills, and putting research and new technology into practice."

Comments from our new Roads Scholars:

"I used ideas from the Roads Scholar program for storm pods. We were able to bring these ideas to our bosses and lay it out there for them. The ideas we got from this program were the most helpful for me. Because of this program, we also started using geolinking fabric that we never used before."

—Keith Raines, City of Shakopee

"I was able to take away a lot of things from the program to use in my work life. I really liked the GPS class, for trucking. It was very practical. I'd highly recommend the program. There were many different classes, and the program covered a lot of subjects."

—Todd Majerus, Goodhue County

"The blacktop classes helped me the most. They were relatable to what I do. It's a good program, and a lot of information is in the classes."

—Jamison Theis, City of Shakopee



Jeffrey Evens,
Carver County
Public Works
Department



Todd Majerus,
Goodhue County
Public Works
Department



William Neeck, City
of Coon Rapids
Public Works
Department



Keith Raines, City
of Shakopee Public
Works Department



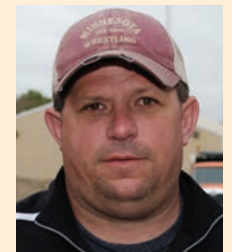
Kelly Rux, City of
Shakopee
Public Works
Department



Michael Sable, City
of Rogers Public
Works Department



Jamison Theis,
City of Shakopee
Public Works
Department



Kelly Wagener, City
of Waconia

*Students who completed their coursework by December 31, 2012, are considered the Class of 2012.

ROADS SCHOLAR GRADUATES FROM 2005 TO 2013:

90
NUMBER OF STUDENTS NOW ENROLLED:
2,276

The Roads Scholar Program

The Roads Scholar Program combines a range of training options into a structured curriculum. To become a Roads Scholar, participants must earn eight credits within five years from a combination of required and elective courses. Training options include LTAP workshops, Circuit Training and Assistance Program workshops, and other events. For more information, contact Mindy Carlson, Minnesota LTAP program manager, at 612-625-1813, mnltap@umn.edu, or visit mnltap.umn.edu/RoadsScholar.

Demo Day from page 1

This year's event, held at the Olmsted County Fairgrounds in Rochester on May 1, focused on education and technology exchange through classroom sessions and outdoor demonstrations. Topics included chainsaw safety, gravel road maintenance using a motor grader, prescribed burning on prairies, asphalt pavement maintenance, and cargo securement of heavy loads, equipment, and machinery.

About 150 attendees divided into smaller groups for short demonstration sessions repeated at designated sites around the fairgrounds during the second half of the daylong event. Each demonstration followed up on a presentation of an earlier general session indoors.

It was not unusual, for example, to see onlookers mesmerized as a chainsaw abruptly halted after starting to rip into a pair of protective chaps or as a fully suited firefighter nearby set a patch of straw aflame to simulate a controlled burn of prairie grass—an age-old technique to manage roadsides and other non-native areas.

"Fire is probably one of our best tools," said Tom Eckdahl, a manager with the Olmsted County Parks Department, demonstrating a prescribed burn. "We can utilize fire as a tool to cover more acres with less costs and actually have a better application. We're not out there applying herbicide."

Not far away, John Okeson, an instructor for Minnesota LTAP's gravel road maintenance and design workshop and a retired Becker County maintenance supervisor, kept an eye on assorted piles of gravel as a part of a demo involving materials identification. "We find over the years that a lot of operators are running that piece of machinery [a motor grader] with no formal training. They really don't have an idea what they should be doing," he said. "There's a lot of good training available out there. Go get it and you'll be well rewarded for it."

The Minnesota Department of Transportation, the Minnesota Local Road Research Board, and the Federal Highway Administration, along with Minnesota LTAP, sponsored the training in partnership with the Minnesota Chapter of the American Public Works Association and the Minnesota Street Superintendents Association. The University of Minnesota College of Continuing Education facilitated the event.

Next year Minnesota LTAP plans to bring the training to the central or northern part of the state, as part of its mission to bring cost-effective training across Minnesota. **LTAP**

—Michael McCarthy, LTAP editor

VIEW VIDEO AND MORE PHOTO HIGHLIGHTS FROM THE DEMO DAY:

mnltap.umn.edu/training/roadway/2013

THANKS TO OUR HOST!

A big thank-you to Mike Sheehan and his staff at the Olmsted County Highway Department for providing the venue and helping plan and staff the event. "We are so grateful to everyone who helped with the Training and Demo Day," says Mindy Carlson, Minnesota LTAP training manager. "Mike's crew worked with us for many weeks to make the event a success."



John Okeson was part of a demo involving materials identification.

PAVEMENT

Long live concrete pavements!

from page 1

He then discussed how these goals can be achieved through coordinated efforts in design, construction, maintenance, and rehabilitation.

Design

"We are done with the previous AASHTO Design Guide and its nomographs and charts," Tayabji declared. Instead, he said it is important that designers adopt the NCHRP-developed *Mechanistic Empirical Pavement Design Guide* (MEPDG) in order to integrate the effects of all design elements. The MEPDG-associated software, Pavement ME Design, is available from AASHTO.

One of the most important changes that should occur to achieve sustainable 40-plus-year pavements is to reduce the overall volume of concrete in our pavements. "One way to achieve this without compromising performance is to reduce slab thickness. And to do that, you need to improve the pavement base support," he said. Europeans replace native materials with high-quality base materials, so "they need just 10 to 11 inches of concrete for the most heavily loaded highways. You can't go back and rework the base, so you need to address the foundation and drainage first."

Tayabji added that drainage must be a high priority and recommended daylighted permeable bases. He does not trust edge drainage systems because they tend to become clogged and damaged. He said these changes will reduce slab stress, deflection, and truck rolling resistance. Finally, he recommended treated base materials on roads that see high-volume truck traffic, adding that untreated granular bases should be reserved for lower-volume roads.

Another strategy that will help in the construction of sustainable pavements is the use of composite pavements "with PCC+ for the upper 3 inches and PCC- for the lower 7 to 9 inches," Tayabji said. He explained that "PCC- is not marginal concrete; it is good concrete but made with locally available marginal or recycled aggregate." He also recommended continuously reinforced concrete pavement, and noted that Georgia and California are reevaluating that idea.

Better dowel bar design

Tayabji also advocated wider lanes and shorter joint spacing—15 feet maximum—for most highway applications: "With a 12-foot-wide lane, if you have a 10,000-pound axle load, you are transferring 5,000 pounds at each wheel set as the vehicle crosses the joint. Of that, almost 3,000 pounds are being handled by the dowel bar at the edge (dowel bar #13 in Figure 1 above). But if you widen the lane, you reduce the load to a maximum of about 1,200 pounds. So now you can reduce the dowel bar structural requirements. You can use smaller dowel bars and actually eliminate some of the interior dowel bars altogether—from 12 per lane down to 9 or 10—because they're only handling 200 or 300 pounds."

Tayabji added that the elimination of some dowel bars in each lane will allow agencies to afford the cost of more durable and innovative dowel bar materials. "We should be using non-corrosive dowel bars," he said. "We have tried epoxy-coated dowel bars, but in some cases they have not delivered the performance we wanted. So we need to try other alternatives such as zinc-clad steel, stainless steel, micro-composite steel, and fiber-reinforced polymer." However, he said research results have been mixed on the performance of fiber-reinforced polymer dowel bars.

For a truck-loaded highway with a slab thickness equal to or greater than 8 inches for a pavement that will endure more than 5 million ESALs, Tayabji said designers should specify dowel bars at least 1.25 inches in diameter. He also advocated round dowels, saying they will meet our needs and are more economical. Finally, he said load transfer efficiency at joints should be greater than 70 percent over the pavement's service life. If these changes are made, he said

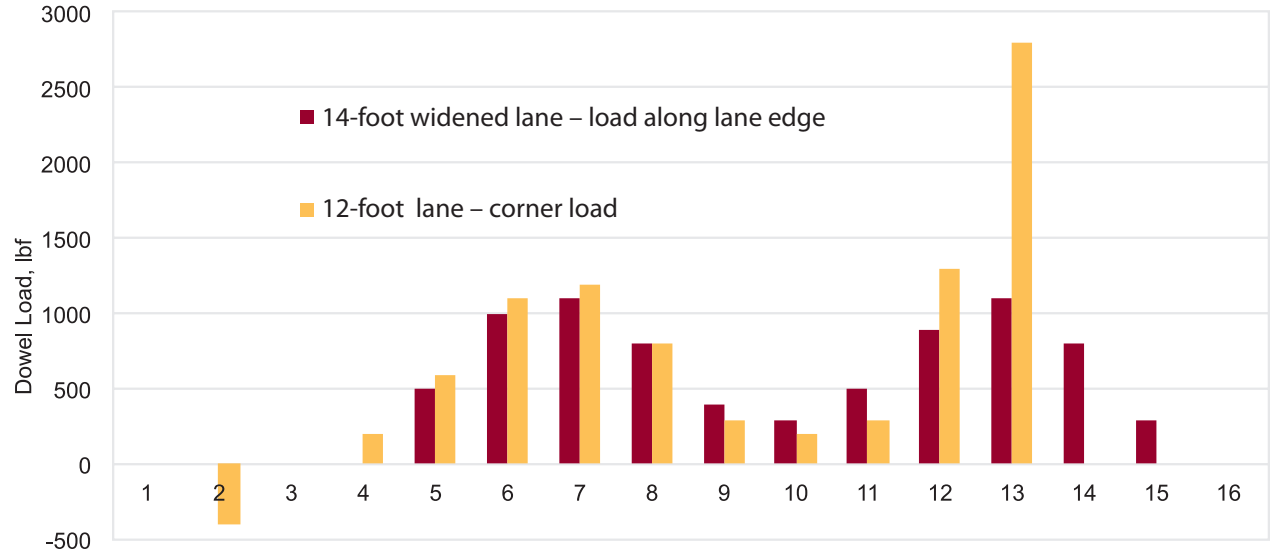


Figure 1: Dowel bar loading (in lbf) across 12-foot and 14-foot lanes. Gold bars show loading of dowel bars on a 12-foot-wide lane; maroon bars show loading of dowel bars on a 14-foot-wide lane.

"We can achieve the goal of pavements that last 40 years or more."

—Shiraz Tayabji

there should be no need for retrofitting dowel bars over the 40-plus-year life of a concrete pavement.

Better paving materials

Tayabji said the goals for paving materials must be durability and sustainability. "We don't want the materials to fail before they reach their expected service life because we cannot fix materials problems easily without reconstructing or resurfacing," he added. "We can fix structural problems, such as joint cracking and faulting." To achieve this objective, he said we must use:

- Dense, well-graded aggregates—three or more sizes.
- Less cement and more supplemental cementing materials such as fly ash and slag.
- A two-lift paving process—together with the previously mentioned composite pavement concept (PCC+ /PCC-).

Construction

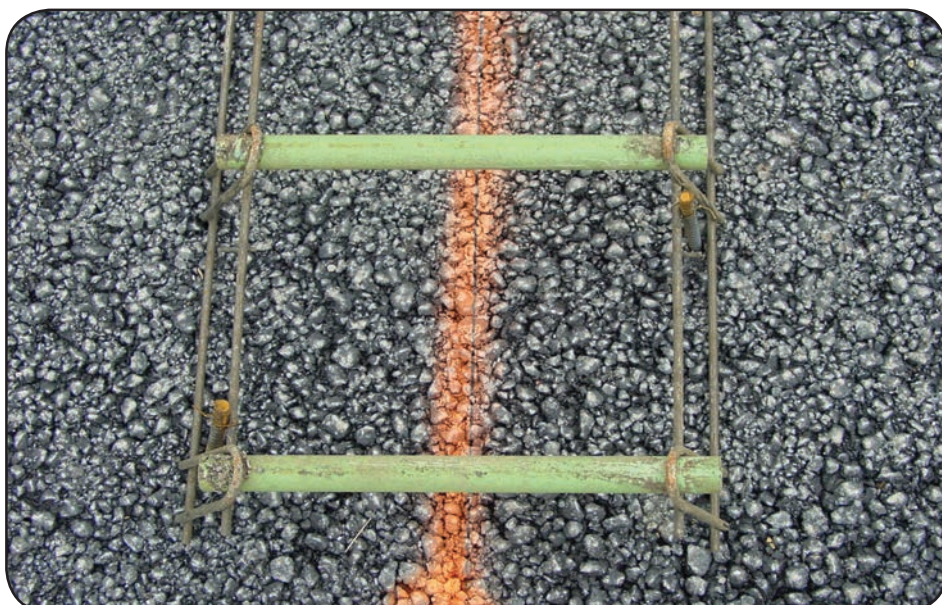
To achieve high quality, Tayabji emphasized, construction requirements must be well-defined and measurable: "No contractor is going to give you more than you specify!" He also quoted from Ray Rollings, a retired engineer with the Army Corps of Engineers: "A poorly designed pavement but well constructed will outlast a well-designed pavement but poorly constructed."

Concrete management—from plant to joint sawing

Tayabji recommended the following specifications for concrete:

- Flexural strength ~750 psi for 10- to 11-inch-thick slabs (using improved base/support)
- Minimum compressive strength ~4,000 psi
- Maximum water/cement ratio <0.50 (<0.45 in freeze areas)
- Well-graded aggregates (3+ bins) and larger maximum aggregate size
- Advanced admixtures
- Smart vibrator systems on the paver and more cores to check for proper consolidation
- Timely curing—especially during hot weather

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Eliminating some dowel bars allows agencies to afford more innovative materials.



Production should be stopped if requirements are not met.

THE SHELF

Links to these publications and many more are on the LTAP website. Questions? Contact Marilee Tuite, Minnesota LTAP librarian, 612-626-8753, ctslib@umn.edu.

Performance Analysis of Centerline and Shoulder Rumble Strips Installed in Combination in Washington State (Washington State DOT, April 2013)

This report examines the combined effects of centerline and shoulder rumble strips and compares installation scenarios with shoulder and centerline rumble strip installation.

Traffic Enforcement Strategies for Work Zones (TRB, 2013)

This report presents guidance for the safe and effective deployment of traffic enforcement strategies in work zones on high-speed highways (those with speed limits of 45 mph or greater). The report discusses the planning, design, and operation of traffic enforcement strategies, as well as administrative issues that should be considered.

Minimizing Traffic-Related Work Zone Crashes in Illinois (Illinois Center of Transportation, April 2013)

This report presents findings that may help to minimize work zone crashes in Illinois, including an analysis of the frequency of work zone crashes and an evaluation of temporary rumble strips in work zones.

Worker Safety in Very Short Duration Work Zone Operations: State of Practice and Risk Management Process (Texas Department of Transportation, May 2013)

This report explores highway maintenance operations that occur within 15 minutes or less, and examines risk factors that maintenance workers may face while carrying out these operations.

Evaluation of Dynamic Message Signs and Their Potential Impact on Traffic Flow (Maryland DOT, April 2013)

This report explores the potential impact that dynamic message signs have on traffic flow as well as their accuracy, timeliness, relevance, and usefulness.

Developing Safety Performance Measures for Roundabout Applications in the State of Oregon (Oregon DOT, April 2013)

This report documents efforts to quantify the safety performance functions of roundabouts in order to evaluate the safety performance of single-lane, four-leg roundabouts.

Identification and Laboratory Assessment of Best Practices to Protect DOT

Equipment from the Corrosive Effect of Chemical Deicers (Washington State DOT, March 2013)

This report discusses best practices, such as design improvements and anti-corrosion coatings, for minimizing the corrosive effects of chloride deicers on winter application equipment and vehicles.

Development of an Economical, Thin, Quiet, Long-Lasting, and High Friction Surface Layer: Volume 1—Mix Design and Lab (Illinois Center of Transportation, March 2013)

This report considers four new asphalt concrete mixtures that use locally available aggregates as a way to use a cost-effective mixture that also improves pavement performance.

Slope Failure Investigation Management System (Maryland DOT, March 2013)

This report presents a framework for developing a system that tracks, records, evaluates, analyzes, and reviews soil slope failure and remediation data by using a GIS database and a collective overlay of maps.

Search me

The Minnesota LTAP website features custom search engines to help you find information. You can search:

- LTAP & TTAP Centers
 - State DOTs
 - Transit agencies
 - University transportation centers
- Bookmark www.mnltap.umn.edu/publications/library.

Another great resource is WorldCat. You can use it to locate transportation and related resources.

Bookmark <http://WorldCat.org.LTAP>

Bridge Deck Reinforcement and PCP Cracking: Final Report (Center for Transportation Research, April 2013)

This report discusses optimizing reinforcement in the cast-in-place concrete placed on bridge decks and identifying ways of controlling cracking in precast, prestressed bridge deck panels.

LTAP

Concrete from page 6

Use less paste

He also advocated a reduction in paste content: "When we smooth the surface, we are bringing the paste to the surface—and paste is the weakest part of concrete. Most concrete durability concerns are due to paste issues. Paste is necessary, but we should minimize it—especially at the surface. The surface does not have to be super smooth." He also said designers should:

- Consider end product specifications.
- Use blended cements (ASTM C595).
- Use performance-based cements (ASTM C1157), including portland limestone cement.

Contractor process control

Tayabji said careful process control will limit or eliminate placement of marginal concrete and the use of marginal construction processes: "We accept that problems develop during construction, but it cannot be all day long, every day. The engineer in the field should not let the contractor proceed if material or process specifications are not being met. There should be acceptance testing, and it has to be statistically based because we cannot test every square yard of concrete. Ideally we should be testing behind the paver." He said production should be stopped if aggregate gradation or concrete requirements are not met, and added that "they should also stop the paving process if there are edge slump or consolidation issues."

Tayabji also commented on a variety of construction issues:

- **Jointing**—"Most agencies are moving to single-cut joints. There is no need for double cutting. The question is: If you go to single cut, should you seal the joint or not? There's a lot of discussion on this at the national and DOT levels."
- **Dowel bar alignment testing and specification**—"Better equipment is available for determining dowel bar alignment. Now that we have the equipment to measure dowel bar alignment reliably, we see that projects are not meeting the current specifications. So what do we do? Our specs are not 'performance related' and I don't think we are at the performance-related stage yet."



Courtesy Shiraz Tayabji

A repair in progress along a distressed/deteriorated joint

"The engineer in the field should not let the contractor proceed if material or process specifications are not being met."

—Shiraz Tayabji

- **Proactive contractor process control**—"If we see problems occurring, we need to respond right away during construction."
- **Stringless paving**—"Stringless paving is the way of the future and is available now. It should result in a faster and well-controlled paving process."
- **Performance-related specifications**—"We are not yet at the point where we can use performance-rated specifications, but at least we know how to specify the end results and can let the contractor do his job without telling him how to do it."
- **Proactive contractor process control**—"We're seeing more and more of this. If we see marginal construction, we stop and correct it."

Repair and rehabilitation

To improve rehabilitation of concrete pavements, Tayabji recommended:

- Timely maintenance and repair/restoration activities to extend the service life of existing pavements.
- Accelerated rehabilitation projects using full closures rather than night and/or weekend closures to ensure a quality end product.
- Thinner (5- to 7-inch-thick) concrete overlays with a 6-foot by 6-foot joint spacing over deteriorated concrete pavements that can still provide good support.
- Precast pavements for accelerated repair and rehabilitation; he noted that MnDOT has constructed a precast pavement test section.

Joint rot issue

On some projects, joints are deteriorating sooner than they should be. Tayabji suggested that paste saturation during freeze/thaw cycles may be the main culprit, as has been shown in recent studies. He said recommendations being proposed to overcome this problem include:

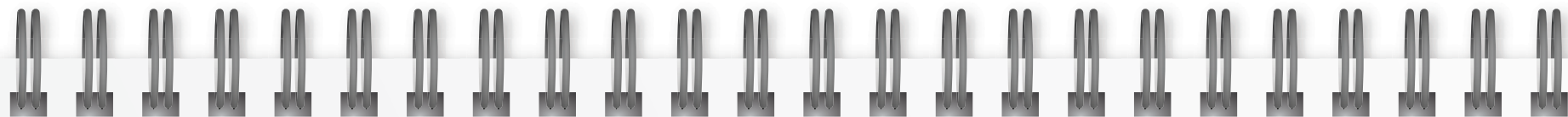
- Better quality concrete with water-to-cement ratios below 0.40
- Good in-situ air system
- Dense concrete
- Well-drained pavements, especially at the joint

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Conference materials online

Presentation slides and selected videos are available from the Transportation Engineering and Road Research Alliance (TERRA) Pavement Conference at terreroadalliance.org. TERRA sponsored the conference in cooperation with CTS, the U of M Department of Civil Engineering, the Minnesota Local Road Research Board, the City Engineers Association of Minnesota, the Minnesota County Engineers Association, MnDOT, Minnesota LTAP, the Minnesota chapter of the American Public Works Association, and the Minnesota Street Superintendents Association. **LTAP**

WORKSHOPS AND TRAINING



Calendar

If your professional organization meets on a regular basis, let us include the information here. Contact us at mnltp@umn.edu. For details and an up-to-date list of events in Minnesota, please see mnltp.umn.edu/training.

National Rural ITS Conference

Aug. 25–28, St. Cloud

AirTAP Fall Forum

Sept. 26–27, Minneapolis

Toward Zero Deaths Annual Conference

Nov. 14–15, St. Cloud

APWA-MN Fall Workshop: Winter Maintenance Supervisory Training (1 cr) LTAP

Nov. 20, Brooklyn Center

Truck-Weight Compliance Training (1 cr) LTAP

Sept. 4, Montevideo

Sept. 26, St. Cloud

Oct. 2, Bemidji

Minnesota Fall Maintenance Expo (1 cr) LTAP

Oct. 2–3, St. Cloud

From Line to Leadership (Hennepin Technical College)

TBD

Snowplow Simulator Training (0.5 cr) LTAP

Fall TBD

Road Dust Institute's 3rd Road Dust Best Management Practices Conference

Feb. 4, Minneapolis

TERRA Pavement Conference (1 cr) LTAP

Feb. 5, Minneapolis

Minnesota's Transportation Conference

March 4–6, Bloomington

LTAP workshops

LTAP workshops, along with events cosponsored by Minnesota LTAP, are marked with an LTAP. Check the web for details and to register online: mnltp.umn.edu/training. To be added to our print or electronic mailing lists, contact Minnesota LTAP at mnltp@umn.edu or call 612-625-1813.

CTAP workshops

Circuit Training and Assistance Program (CTAP) workshops bring LTAP services to your neck of the woods. CTAP uses a fully equipped van to provide on-site technical assistance and training. Current CTAP training courses and special presentations are:

- Asphalt Pavement Maintenance and Preservation (0.5 cr)
- Culvert Installation and Maintenance (0.5 cr)
- Gravel Road Maintenance / Dust Control (0.5 cr)
- Roadside Vegetation Management and Erosion Control (0.5 cr)
- Snow and Ice Control Material Application (0.5 cr)
- Snowplow Controller Hands-on Workshop (0.5 cr)
- Work-Zone Traffic Control and Flagger Training (0.5 cr)

For more information or to schedule classes, call the CTAP instructor, Kathy Schaefer, at 651-366-3575, or e-mail Kathleen.Schaefer@state.mn.us.

Roads Scholar credit

You can earn credits in Minnesota LTAP's Roads Scholar program by attending LTAP and CTAP workshops and other cosponsored events. To learn more or enroll in the program, visit mnltp.umn.edu/roadscholar. LTAP

ONLINE TRAINING

Gravel Road Maintenance and Design—Online (1 cr) LTAP

Anytime, anywhere!

Work-Zone Safety Tutorial—Online LTAP

Anytime, anywhere!



Gravel road know-how online: webinar and course

Minnesota LTAP offered a webinar on May 29 about gravel road drainage, maintenance, and design. Three gravel road experts shared their knowledge of and experience with properly designing and maintaining a gravel road for effective drainage. The webinar, cosponsored by the LRRB, is archived online for viewing.

In addition, Minnesota LTAP continues to offer an online course—Gravel Road Maintenance and Design. It provides a high-quality training option at a low cost, and it counts as one required credit in the Roads Scholar Program. Minnesota LTAP developed the course in partnership with the LRRB.

One satisfied customer of the online course is Mary J. Andrist, New Haven township supervisor (Olmsted County). "Gravel Road Maintenance and Design is a very interesting and informative course," she said. "I enjoyed taking it online."

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STUDENTS HAVE COMPLETED THE ONLINE GRAVEL ROAD MAINTENANCE AND DESIGN COURSE.



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He also advocated for timely and proper joint sawing: "This is not an issue for transverse sawing, but delay in longitudinal sawing can result in premature cracking. We continue to see problems with this because some contractors don't understand that you need to do longitudinal joint sawing as soon as you do transverse joint sawing. This means they need to have enough sawing equipment available. If they wait to do longitudinal sawing after transverse sawing because of limited equipment, it can be too late, and premature longitudinal cracking can result."

Well-developed specs with end-product emphasis

Tayabji concluded by reemphasizing the importance of specifications: "Good specs lead to good construction!" He said the purpose of the specification is to:

- Identify and minimize variability in the concrete pavement construction process.
- Deliver an end product that is durable.
- Minimize risk of premature failures.
- Minimize owner's risk of accepting a marginal product.
- Minimize contractor's risk of rejecting an acceptable product.

The industry, Tayabji said, needs to move away from prescriptive specifications: "The future is end-product specifications. Whether for profile, thickness, or strength, end-product specifications enable clear definition of critical paving processes. We don't tell the contractor how to do those things. By giving the contractor a freer hand, we should obtain greater innovation in the process. Results must be objectively definable and measurable—not arbitrary!"

As a resource for specifiers, he recommended the *Guide Specification for Highway Concrete Pavements*, published in 2012 by Iowa State University's National Concrete Pavement Technology Center. LTAP

—Richard Kronick, LTAP freelancer

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