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November-December 2014

RESEARCH SERVICES & LIBRARY

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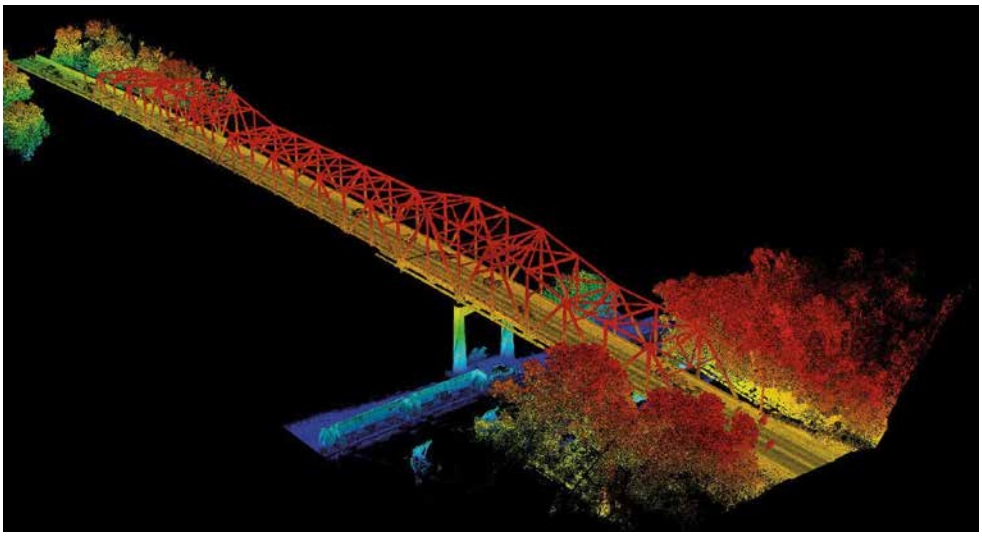
Mobile Imagery and LiDAR for Barrier Inventory: Faster, Cheaper, More Accessible

To properly maintain concrete barriers and plate beam guardrails on its more than 1,100 miles of roadway, MnDOT's Metro District needed an accurate inventory of its assets.



LiDAR imagery such as this image of the Highway 63 bridge in Red Wing provides survey-grade data.

To accomplish this, the district launched a research implementation project using two emerging technologies—mobile imaging and LiDAR—to quickly collect large amounts of highly accurate roadway data.

Mobile imaging uses a camera mounted on a vehicle driving at highway speeds to take high-resolution photos at regular intervals. It's accurate to within 1 foot, which makes it suitable for use in preliminary (30 percent) design plans without additional field surveys. Researchers collected mobile images from all Metro District ramps, overpasses, interchanges, weigh stations, rest areas and historical sites.

Researchers also collected LiDAR data at three sites. LiDAR uses a laser range finder and reflected laser light to measure distances. It provides survey-grade data accurate to within 0.1 foot, but it is significantly more expensive to collect than mobile imaging.

MnDOT's barrier inventory will provide invaluable information for design, planning and maintenance. For example, if a vehicle hits a barrier, maintenance staff will be able to check the database to see details to ensure they bring the right equipment to make repairs. The imagery collected contains data on assets besides barriers, and MnDOT has already extracted noise wall and sign data from it. **Technical Summary 2014-22**

"Mobile imagery and mobile LiDAR are relatively new technologies, but this research shows that they are options that we can use. Collecting this information manually would have taken a lot more time and money."

—Trisha Stefanski
Principal Engineer, MnDOT Metro District

New Videos Demo Timber Bridge Inspection Techniques

Hundreds of Minnesota timber bridges are nearing the end of their life span. To help ensure safety, inspectors are using new, high-tech tools such as stress wave timers and resistance microdrills to detect internal decay.

Access all MnDOT videos at **mndot.gov/research/videos.html**.

Research Highlights

Swales Reduce Water Pollution

Environmental — Stormwater can carry chemicals and sediments into rivers and streams. Roadside drainage ditches, also known as swales, lessen this effect by absorbing the stormwater. In addition, research reported varying data on how effectively swales were infiltrating. This project provided infiltration data on several Minnesota ditches and soil types.

Researchers evaluated five Minnesota swales, measuring how well water flows through soil at up to 20 locations within each swale. They also tested the ability of carbon, iron chips, steel wool and other materials to remove pollutants as ditch check filters—material put into swales to enhance removal of pollutants. A key conclusion from this study: Grassed swales absorb water better than expected, which may reduce the need for other, more expensive stormwater management practices. **Technical Summary 2014-30**

Safeguarding Our Bridges

Continuous Scour Monitoring Improves Bridge Safety

Bridges & Structures — A leading cause of bridge failures is bridge scour, where water erodes riverbed soil around abutments or piers. MnDOT already sends inspectors out to monitor bridges judged at risk for failure because of scour, but having a system in place that would continuously monitor such bridges and alert personnel wirelessly when scour reaches a dangerous level would be much more effective, particularly on bridges that are difficult to access during a flash flood.

This new implementation effort led to the installation of fixed remote monitoring stations on four bridges. The stations on the first two bridges have run successfully for three years. **Technical Summary 2014-37**

Preventive Maintenance for Bridge Deck Cracking

Bridges & Structures — When concrete bridge decks crack, moisture and deicing chemicals can seep in and corrode reinforcing steel, deteriorating the deck and necessitating early replacement. To prevent cracking, MnDOT regularly inspects bridge decks and seals cracks using approved sealing products.

In this study, researchers performed field evaluations over a three-year period using sealing products from a list of MnDOT approved products as well as products that had not been approved. They found some of the approved products did not perform well while some unapproved ones did. MnDOT is evaluating these results to update the qualification process for the list. Recommended procedures for sealant application identified in this project will be incorporated into the MnDOT Bridge Maintenance Manual. **Technical Summary 2014-34**

TRS on Creating Strategic Plans for Transportation Research

Policy & Planning — As part of a departmentwide effort to apply strategic planning principles to research activities, MnDOT surveyed other state departments of transportation about their research program strategic plans and examined plans from national transportation organizations. The Transportation Research Synthesis identified several alternative approaches to structuring a plan, factors critical to plan development and a range of methods to measure a research program's performance. **Transportation Research Synthesis 1412**

"The information provided by this TRS will help us ensure that our research programs are increasing MnDOT's financial effectiveness."

—Jean Wallace, Assistant Director, MnDOT Modal Planning and Program Management Division

To request a TRS on YOUR topic, visit mndot.gov/research/transportation-research-syntheses.html.

Maintaining and Optimizing Our Pavements

Less Pavement Rolling Resistance Means Better Fuel Efficiency

Researchers at the Technical University of Gdańsk, Poland, developed a trailer that measures rolling resistance using sensors to account for confounding variables like ride quality and slope.

Materials & Construction—Rolling resistance is the force resisting a vehicle's tires as they roll across a pavement surface. This has to do primarily with the way the shape of a rubber tire changes as it rolls against a pavement surface. If pavement surfaces can be designed with less rolling resistance, then vehicles will use less fuel and have lower emissions.

Researchers at the MnROAD pavement testing facility recently finished a second round of tests using various pavement surface types (on 52 test cells) and three types of passenger vehicle tires. The information collected will help MnDOT consider friction, ride quality as well as rolling resistance when designing pavements and choosing surface textures. **Technical Summary 2014-29**

Colored Concrete Pavement Deterioration

Materials & Construction—Pavements sometimes incorporate colored concrete as a safety feature—to delineate some aspect of the roadway. Other times, it's used simply to improve the pavement's appearance. But in Minnesota, many of these pavements have cracked—in some cases, within five years of construction. To understand why some pavements deteriorated so quickly, researchers collected and analyzed core samples.

Although a conclusive cause for the cracking wasn't identified, one likely candidate was deicers seeping into concrete pores. The report includes recommendations for improving mix design and construction techniques to help mitigate the problem; the ready-mix colored concrete industry is also addressing this issue. Still, agencies may want to consider alternatives like concrete stains or other surface treatments. **Technical Summary 2014-26**

How Much Damage Can Heavy Vehicles Do to Roads?

Materials & Construction—When new facilities or freight hauling routes open, unanticipated strains are placed on roadways. Local engineers needed a way to calculate this damage, so a new implementation project adapted a tool that had been developed to estimate the comparable effects of heavy wind turbine components.

The resulting "impact calculator" allows users to analyze a single street segment or an entire road network by entering data about vehicle types, whether the vehicles were fully loaded and other parameters to determine the portion of a pavement's design life consumed by the load. The tool also calculates the extra bituminous material (and associated costs) that would have been required to construct the pavement if it had been designed to support the additional traffic. **Technical Summary 2014-32**

A New Guide to Pavement Preservation Techniques

Maintenance Operations & Security—Effective pavement maintenance can save money while improving the overall condition of Minnesota's road network. Local engineers now have **interactive guidelines** for activities like crack sealing, chip sealing, microsurfacing, joint sealing and diamond grinding, which describe what treatment to apply where and how often, what data to collect about road segments and how to best contract for the work needed. **Technical Summary 2014-33**

Watch MnDOT's recent video "Why Aren't They Working on My Road?" (mndot.gov/research/videos.html) to learn why it's often more important to the overall road network to proactively apply preservation techniques to roads that appear to be in good condition than to focus on roads that are already too damaged for preservation.

MnDOT Research Services & Library
395 John Ireland Blvd., MS 330
St. Paul, MN USA 55155-1800

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Calendar

11/13–14	Minnesota Toward Zero Deaths Conference
11/21–24	AASHTO 2014 Annual Meeting
12/3–4	Local Road Research Board Meeting
12/5	Freight and Logistics Symposium
12/8–9	TRIG Meeting

Contact

Research 651-366-3780
research.dot@state.mn.us
Library 651-366-3791
library.dot@state.mn.us

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