RESEARCH SERVICES & LIBRARY

July-September 2017

DEPARTMENT OF TRANSPORTATION

ACCELERATOR

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Putting your ideas in motion

Homegrown Inspection Vehicle Improves Culvert Repair Statewide

Culverts and pipes must be inspected regularly to determine if they need to be repaired or replaced, but culvert accesses are often too small for inspectors to enter. MnDOT District 6 has developed the Hydraulic Inspection Vehicle Explorer (HIVE), a radio-controlled car that takes lights and a camera into the culvert and transmits data wirelessly to a tablet. Each vehicle costs roughly $1,500.

Every MnDOT district now has a HIVE, which has been used to inspect hundreds of pipes.

Read the Guide

The HIVE is just one of the advanced inspection technologies included in MnDOT's new Enhanced Culvert Inspections Best Practices Guidebook.

One visual inspection of a culvert showed damage to the ends of a pipe that typically would result in a full replacement cost of about $45,000. However, HIVE video footage from within the pipe showed that the damage was limited to just 12 feet near the end. Instead of replacing the entire pipe, MnDOT workers fixed the problem for $1,000, resulting in a $44,000 savings.

The HIVE has received the state's 2016 Governor's Better Government Award and was chosen as one of the nation's top research projects in 2017 by the Research Advisory Committee of the American Association of State Highway and Transportation Officials.

MnDOT District 6 developed the ingenious HIVE, which takes lights and a camera into the culvert and transmits data wirelessly to a tablet.

District 6 has shared build instructions with 27 states, counties and cities.

"The HIVE has proven to be an invaluable tool for the inspection of culverts and pipes in southeast Minnesota. The effort has tapped employee expertise across departments and has shown what a fairly simple, but innovative idea can do to improve our efficiency and financial effectiveness," said Jeff Vlaminck, district engineer in District 6.

A July 26 webinar will review the HIVE and other enhanced culvert inspection technologies. Find more information at mndot.gov/research/projects/hive/hive.html.

Transportation Research Synthesis

A Transportation Research Synthesis (TRS) is a short-term research project that summarizes research activity and current state of the practice. To view TRSs or request one to address your research need, visit mndot.gov/research/TRS.html.

Removing Low-Use Local Bridges to Prioritize Bridge Maintenance

BRIDGES & STRUCTURES — Local agencies with limited budgets are often unable to maintain all of their bridges. Removing bridges on low-use roads where alternative access is available for nearby residents could mitigate funding constraints. Officials are often reluctant to take this step, however, because stakeholders often disagree on the criteria for determining which bridges should be removed and how to manage the attendant public relations issues. The Local Road Research Board commissioned a survey of state departments of transportation (DOTs) on this topic, asking about the relationship between the DOT and the local government (for example, whether incentives are offered for bridge removal), whether local agencies maintain an inventory of candidates for removal and how bridges can be removed from the National Bridge Inventory.

Completed in 2008, the I-35W St. Anthony Falls Bridge has a smart bridge monitoring system that includes hundreds of sensors.

Monitoring Bridge Health Using Vibration Data

BRIDGES & STRUCTURES — Since 2008, the I-35W St. Anthony Falls Bridge has operated as a "smart bridge," with over 500 sensors that continuously provide data about the impact of traffic and weather on the concrete structure. To accurately analyze the data generated, researchers must isolate the effects of structural damage from normal cycles of expansion and contraction. Investigators developed a method for creating a "vibration fingerprint"—a baseline of the bridge's natural vibration that makes unexpected deviations more apparent. Data from this fingerprint will help MnDOT detect when a bridge needs repair and ultimately inform design improvements so that bridges better withstand stresses.

TECHNICAL SUMMARY 2017-01

Repairing Bridge Grout Voids in Cost-Effective Ways

BRIDGES & STRUCTURES — Post-tensioned bridges, which are strengthened by running steel strands through the concrete members, are especially durable, but grout around the steel strands is needed to keep them from corroding. Grouting materials used in about 40 older Minnesota bridges often produced air voids that don't completely cover the strands, which could lead to corrosion and may require repair. A two-phase research effort has produced techniques for evaluating these structures and guidelines for managing the process of soliciting and procuring engineering and construction services to repair them.

TECHNICAL SUMMARY 2017-04

Following bridge inspections, about one-third of discovered grout voids were filled using vacuum-assisted or pressure grouting repair techniques.

Reductions in speed associated with speed control treatments will decrease the likelihood of crashes as drivers approach and enter roundabouts.

How to Make Drivers Slow Down at Roundabouts

TRAFFIC & SAFETY — Roundabouts are unquestionably safer than intersections with traffic signals or stop signs. But what's the best way to configure signs, pavement markings, illumination and other treatments to get drivers to slow down enough to keep roundabouts safe? Research into existing practices provided information on the effectiveness of various treatments—including high-tech solutions like speed-activated, LED-enhanced warning signs—and a methodology for studying any given intersection to determine what will work best for that location.

TECHNICAL SUMMARY 2017-14

Identifying intersections where drivers are likely to run red lights can help engineers prioritize traffic investments.

Identifying the Most Dangerous Intersections

TRAFFIC & SAFETY — Because crashes at intersections are rare, collisions are not the best indicator of potential safety problems at these locations. Instead, investigators used the SMART-Signal system, which collects data at more than 100 intersections in the Twin Cities, to measure how often drivers run red lights, along with vehicle speeds and traffic volumes. They used this data to develop a formula to estimate with more than 83 percent accuracy how many daily traffic conflicts are likely to occur at each intersection. This kind of data is very useful for directing law enforcement efforts as well as adjustments to signal timing or intersection layout.

TECHNICAL SUMMARY 2017-08

Seven Pilot Projects to Change Minnesota's Transportation Practice

Each spring, the governing board for MnDOT's research program funds initiatives that put new technology or research advances into practice. This year's picks aim to improve the environment, traffic signal data reporting, lane closure notification and pavement quality (full proposals located at mndot.gov/research/implementationawards.html):

- Pilot of a vehicle-mounted mobile imaging device to collect roadway alignment data for intelligent compaction (a pavement roller quality assurance technology that MnDOT will require on all significant asphalt projects beginning in 2018).
- Pilot of arrow board message technology to provide real-time notification of work zone lane closures to 511 and highway message boards.
- Deployment of a quality assurance device, the Rolling Density Meter, on several pavement projects to help contractors obtain the right level of density and eliminate destructive sample coring.
- Upgrade of MnDOT's pavement design software, MnPAVE, to incorporate recycled unbound and conventional base material properties.
- A toolkit for identifying potentially acid-producing rock.
- Analysis of different types of small animal exclusion roadside fencing and the development of a standard set of designs.
- Development of tools to create a regional database of intersection control information that extracts data from MnDOT's recently acquired Central Traffic Signal Control System and soon-to-be adopted Signal Performance Measure application.

MnDOT is a leader in implementing intelligent compaction, a pavement roller technology that offers real-time quality monitoring.

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Calendar

7/18	MnROAD research webinar on Balanced Mix Design
7/18-21	TRB Workshop (Duluth)
7/26	MnDOT Enhanced Culvert Inspections webinar
8/1-9/14	MnDOT/LRRB Research RFP
9/10-13	ASCE Congress (Duluth)
9/27-28	International Intelligent Construction Conference (Minneapolis)
10/16-19	ARRA Semi-Annual Meeting (Minneapolis)
10/24	MnDOT Rolling Density Meter Peer Exchange

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Smart Monitoring on I-35W St. Anthony Falls Bridge

The I-35W St. Anthony Falls Bridge was rebuilt with an innovative monitoring system that assesses bridge health. In the years since the August 2007 bridge collapse, MnDOT has managed more than $5 million in bridge and structures research, contributing to more robust design, construction, inspection and maintenance practices.