Technology NEWS

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Iowa LTAP Local Technical Assistance Program

Providing transportation technology transfer for Iowa's cities and counties

Inside this issue

Iowa Local Technical Assistance Program

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IOWA STATE UNIVERSITY
Institute for Transportation

Effective repair of timber bridge pilings and back walls

A large percentage of Iowa's structurally deficient bridges on rural low-volume roads are so classified because of the deteriorated condition of their timber pilings and/or back walls. Recently, funded by the Iowa Highway Research Board (TR-616), a team of ISU researchers studied the effectiveness of several methods used in Iowa to repair/restore the load-bearing capacity of timber substructure components.

The team was led by Brent Phares, director of the Bridge Engineering Center at InTrans. Their key activities, findings, and recommendations are summarized below.

Assessing timber deterioration

Both biological mechanisms (e.g., decay fungi; termites; powder post beetles; carpenter ants) and physical mechanisms (e.g., abrasion from floating debris or ice; overloading; fire; thermal, ultraviolet, and/or chemical degradation; foundation settlement) can contribute to deterioration of timber pilings and back walls. The resulting deterioration can consist of decay, splintering and splitting, holes/tunnels, longitudinal separations between growth rings ("checks"), abrasion damage or "wear," staining, and weathering.

The types and extent of timber deterioration can be assessed through a combination of methods such as visual examination, probing/picking, measuring moisture levels, sounding, stress-wave or drill-resistance devices, core drilling, and analyzing the amount of preservative material retained in the element.

A complete and accurate assessment of deterioration, including its effect on load-carrying capacity, forms the basis for selecting appropriate maintenance, repair, and rehabilitation solutions.

Maintenance treatments

Depending on whether the level of deterioration is none-to-minor, moderate, or severe, the required solution(s) will be preventive, remedial, or major, respectively, to maintain or restore load-carrying capacity.

Preventive maintenance. Preventive maintenance is conducted to protect wood against infiltration and damage by moisture, chemicals, fungi, and insects. It is generally accomplished by applying a water- or oil-borne preservative material to all exposed wood surfaces (including at cuts, drill holes, connections, etc., in the field) and by treating small- to medium-sized cracks or exposed wood with injections of epoxy. In addition, fabric or metal sheeting may be added behind the back wall.

Remedial maintenance. If pile deterioration has resulted in some strength loss, repair and rehabilitation methods can include pile posting/splicing at or above ground level (removing the deteriorated section and replacing it with a new section); jacketing the damaged area with a concrete "cast"; wrapping it with fiber-reinforced polymer (FRP) or polyvinyl chloride (PVC); and/or injecting epoxy.

Remedial maintenance of timber back walls may include adding plank(s) to lower the back wall below the scour line, driving additional sheet piles behind deteriorated walls, and filling deteriorated areas or scour holes with flowable mortar.

Major maintenance. If pile and/or back wall deterioration has progressed to the point of moderate-to-severe strength loss, major corrective measures must be taken. Often the only viable options are to install supplemental steel or concrete piles under the deck or to excavate, remove, and replace the

Pilings continued on page 3

Acronyms and Abbreviations in *Technology News*

AASHTO	American Association of State Highway and Transportation Officials
APWA	American Public Works Association
FHWA	Federal Highway Administration
IHRB	Iowa Highway Research Board
InTrans	Institute for Transportation (at ISU)
Iowa DOT	Iowa Department of Transportation
ISU	Iowa State University
LTAP	Local Technical Assistance Program
MUTCD	Manual on Uniform Traffic Control Devices
NACE	National Association of County Engineers
TRB	Transportation Research Board

U.S. Department of Transportation
Federal Highway Administration

Iowa Department of Transportation

About LTAP

LTAP is a national program of the FHWA. Iowa LTAP, which produces *Technology News*, is financed by the FHWA and the Iowa DOT and administered by the Institute for Transportation at Iowa State University:

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From the director: The New Year – 2013

Iowa LTAP is always looking for input and feedback. During the next year we will be completing a number of activities where we could use your help. We really need feedback on the training that is needed and we expect to distribute an electronic survey and/or hold meetings of discussion groups. What kind of training could you have used as a new employee? Or, what are the subjects where an update is needed? We hope to summarize the needs of different groups of professionals that may already have a meeting scheduled and through 15-30 minute discussions determine what kind of training or outreach would be helpful. We might not be able respond to all the requests, but we can certainly prioritize these needs and introduce them when it is possible.

During 2013 we will also be reviewing and possibly redesigning our Roads Scholar Program. This is a program that encourages professional development and tracks the progress of individual participants. During the last two years we have worked to get the attendance records updated in our system. The online system that allowed individuals to check this information was shut down for a time, but the program continued. The online system is now back in operation and our new registration system, when used, automates the updating process. We believe the system is now up to date, but if you see something that doesn't seem correct please let us know.

In 2013 the curriculum of the Roads Scholar Program will be evaluated. Some of the workshops that are part of our current Roads Scholar Program curriculum have not been offered for some time. There is a range of reasons this has occurred, but it's important that workshops in the program be offered periodically. This will be considered in the evaluation this year. Other issues that will need to be discussed in the evaluation include how people enter into the program, the number of levels in the program, and how people in the program should be recognized for achieving a particular milepost. Of course we will also have to consider how we bring the recognition of those already in the program up-to-date and incorporate them into the new system. In general, the Roads Scholar Program needs to be updated to account for the changes in the working place and at Iowa LTAP. An advisory committee for this process will most likely be created. If you want to be involved let me know.

Have a safe winter and a Happy New Year! Hope to see you at one of our events sometime in 2013. Don't forget, if you need the refresher course in bridge inspection it will be in February and registration needs to occur in the next few weeks. We are also offering an LRFR bridge training course in March.

Keith

Corrections

The names of the 2012 Snow Roadeo loader and grader awardees were reversed in the last issue of *Technology News*. The winners are shown below, this time with the correct names. Our apologies for the error. ■

Grader winners: 1st (left)–Brian Snyder, City of West Des Moines; 2nd (middle)–John Virden, City of Des Moines; 3rd (right)–Jimmy Hutson, Des Moines County

Loader winners: 1st (left)–Patrick Linehan, City of Davenport; 2nd (middle)–John Virden, City of Des Moines; 3rd (right)–Larry Laughridge, City of West Des Moines

Pilings continued from page 1

component(s). These methods are relatively expensive.

Evaluation of four Iowa bridges

The research team conducted live load testing on four Iowa bridges that had previously undergone various repair or strengthening methods.

At the first bridge (126 ft, three equal spans), corrugated metal pipe forms had been constructed around deteriorated portions of two of five timber piles at one pier, then filled with concrete to create casts that provide additional stiffness to the two piles. One pile was completely encased, the other partly. A similar method is shown in Figure 1. All five piles at the pier were instrumented with multiple strain gages to quantify the forces carried by the concrete encasements, the remaining timber sections of the repaired piles, and the three unrepaired timber piles. Based on the results, the near-term performance of this method appears to be satisfactory. Future observations will be required to determine long-term performance.

At the second bridge (16 ft, single span), supplemental, same-size timber piles had been placed adjacent to the middle six of eight existing piles at both abutments, and the bases of all piles were encapsulated with concrete. A similar method is shown in Figure 2. Data from strain gauges on adjacent old-and-new pile pairs were nearly equal, indicating that loads are approximately split between them and that the load on any one pile of each pair has been reduced by half. Although this is a more expensive method than jacketing, when installed correctly it effectively restores the bridge substructure system to its original condition while allowing the original piles to progressively lose bearing capacity as they age without any adverse effects on overall bridge performance.

At the third bridge (53 ft, with 10-ft, 23-ft, and 10-ft spans, respectively), concrete casts with corrugated metal forms had been constructed to stiffen the pier piles, while concrete casts with timber planking forms across the stream-side face piles had been constructed at the abutments/back walls.

Figure 1. One variation of casts created from corrugated metal pipe with concrete infill

Figure 2. A variation of new timber piles (old ones remain) with new concrete sills and pile caps

This second method provides much greater protection from debris damage, plus the piles are reinforced in the transverse direction and thus may have a greater capacity.

At the fourth bridge (58 ft, three equal spans), one timber pile had been repaired with a posting method. This involved removing only the deteriorated section of the pile and replacing it with a steel section extending from the lower sound portion of the pile to the pile cap. Strain data collected by the researchers were unusual and somewhat inconclusive, possibly due to less-than-ideal connections between the steel post and the original pile and the pile cap. Still, when installed correctly, this method appears to be quite adequate. Only select piles at any one pier or abutment should be repaired using this method, as lateral stiffness in the pile (and, therefore, the bridge) is lost at the pile/post connection.

Laboratory experiments

The research team also developed and tested details for two new timber pile strengthening solutions, with the goal of improving constructibility and economy.

The first solution involved modifying the existing steel posting method (used on the fourth bridge described above). A steel post was fabricated that could be vertically adjusted with leveling nuts at the connection between the existing timber pile and new steel post. Although under simulated load the deflection values were higher than desired, this problem can likely be remedied with a thicker base plate or other minor design changes.

The second solution entailed installing steel "sisters" on a section of a timber pile with localized deterioration. Each sister was bolted to the pile opposite the other at, and extending beyond, the simulated area of deterioration/strength loss. Under load and with a simulated section loss of 50 percent, the pile performed well, even though the sisters were not engaged until pile failure was imminent. It is possible that modifications to the connection details could engage the sisters earlier.

Key findings and recommendations

More than one condition assessment method, and preferably several, should be used to gain a complete and accurate understanding of timber component conditions.

The commonly used preservative copper naphthenate is recommended by the American Wood Protection Association (AWPA) for applying to exposed timber in the field. To gain the most benefit from preservatives while minimizing their potential environmental impacts, AWPA recommendations and standards should be followed.

When decay or damage is present, maintenance activities should be conducted as soon as possible to avoid increased costs associated with major repair methods later.

The addition of steel reinforcement in the form of angles, channels, W shapes, or similar items can provide increased load capacity to mildly or moderately deteriorated piles.

Most techniques evaluated in this research project effectively restored desired stiffness.

Field adjustability of the posting repair method can be achieved with few minor and relatively inexpensive parts.

For more information

The report and summary are online, www.intrans.iastate.edu/research/projects/detail/?projectID=-436345656. For questions about specific bridges, contact Brent Phares, 515-294-5879, bphares@iastate.edu. ■

Be smart about soil compaction

When a pavement begins to crack and crumble long before it has served its design life, one of the first suspects is the foundation. A poorly compacted and/or nonuniform foundation will almost surely result in premature pavement distress and/or failure.

Proper compaction of the subgrade and base materials is therefore one of the most important processes in roadway construction. "Intelligent compaction" (IC) roller systems help optimize pavement performance by improving the quality and uniformity of pavement foundation layers.

The development of IC is among the major innovations related to compaction and roller equipment since the development of double-drum vibrator rollers nearly 50 years ago. With their smart technologies, IC systems are transforming the earthworks construction industry.

What's "intelligent" about IC?

In general, IC systems consist of four technologies that help remove guesswork and error from compaction operations:

An advanced dynamic evaluation device (accelerometer) positioned on or in the roller drum(s) measures the response of the underlying materials to the compaction forces of the drum.

A global positioning system (GPS) determines and records the roller drum location throughout operations.

An onboard computer collects data from the accelerometer and GPS. It analyzes location-specific compaction levels and materials uniformity and compares the results with those of previous passes to determine whether adjustments are needed.

The onboard display presents measurements and roller operations in real time. A continuous record of color-coded plots displays number of roller passes, compaction measurement values, and the precise location of the roller, providing the operator with easy-to-understand information about areas that need additional coverage to achieve 100 percent compaction.

Caterpillar (CS-563) vibratory smooth drum roller with IC technology used in widening/reconstruction of a section of roadway near Akeley, MN; inset is onboard display (Photos courtesy of David White, ISU)

Some systems also provide wireless capabilities to remotely monitor roller operations.

IC systems are available for rollers that compact soil and aggregate base materials, and for rollers that compact asphalt pavement materials.

Benefits of IC

The benefits of using IC technology for pavement foundation preparation include the following:

Improved quality of compaction operations. IC capabilities allow operators to identify and resolve nonuniform or weak areas before they become a problem. This is a significant improvement over limited conventional spot testing, which may not be representative of the total operation.

Cost savings. By reducing over- or under-rolling, IC systems maximize productivity, ensuring operations are done right the first time and minimizing contractor pay reductions for not meeting agency requirements. Cost-benefit analyses indicate that investment in IC can break even within one to two years.

Accelerated operations. IC rollers are able to compact greater areas with fewer passes than traditional rollers, and often in a much shorter time. In projects nationwide, the use of IC is proving to be a cost-effective method for accelerating highway pavement construction.

Environmental sustainability. Improved rolling operations result in reduced fuel use and carbon dioxide emissions.

IC continued on next page

IC continued from previous page

Safer operations. IC reduces the number of personnel needed to evaluate operations, minimizing exposure to work zone traffic.

IC training for roller operators is straightforward. IC rollers are not significantly different from conventional rollers. Training generally lasts a couple of hours, and practice will further improve operations.

The continued use and improvement of IC systems will produce better quality roadways that help keep motorists safe and allow street and roadway agencies to operate more efficiently.

For more information

For additional information, including generic IC specifications, two technical briefs released by FHWA, and other data, visit www.intelligentcompaction.com. Or contact Joe Jurasic, transportation engineer at the FHWA, Iowa Division, 515-233-7304, joe.jurasic@dot.gov.

David White, ISU professor of construction engineering and director of the Center for Earthworks Engineering Research at InTrans, leads the multi-state Technology Transfer Intelligent Compaction Consortium (TTICC). See the TTICC website for consortium events and products, including reports of the first and second annual consortium workshops, www.ceer.iastate.edu/research/project/project.cfm?projectID=-598919230.

Editor's notes: "Intelligent compaction" is one of several high-priority technology innovations being promoted through the FHWA's Every Day Counts (EDC) initiative. Deployment of these technologies can help agencies cost effectively accelerate project delivery, enhance roadway safety, and protect the environment while maximizing roadway performance. See the EDC website, www.fhwa.dot.gov/everydaycounts/.

This article was adapted from information on the EDC website and a story in the July 2012 issue of FHWA's *Focus* magazine, "Intelligent Compaction: The Road from Evaluation to Implementation," www.fhwa.dot.gov/publications/focus/12jul/12jul03.cfm. ■

Funds available to replace overhead flashing beacons at intersections

All public agencies in Iowa are eligible to request funding to replace flashing red and yellow overhead beacons at intersections on public roads with two-way stops. Limited funds are available through the Iowa DOT's Office of Traffic and Safety, Transportation Safety Improvement Program.

Problem and solution

This type of intersection traffic control can be a safety hazard. Traffic on the side roads (with a stop sign and a flashing red beacon) may assume that traffic on the main road also has a flashing red beacon and is supposed to stop. However, traffic on the main road has a flashing yellow beacon and does not have to stop. Crashes occur when vehicles on the side road pull out into the path of traffic on the main road.

To improve safety at these intersections, red beacons on side roads are replaced with stop sign–mounted flashing red lights, and yellow beacons on the main road are replaced with advance warning sign–mounted flashing yellow lights.

Applying for funding

Additional details about the program, plus links to the application form and to the Iowa DOT Funding Guide, are online, www.iowadot.gov/traffic/flashingbeacon.html.

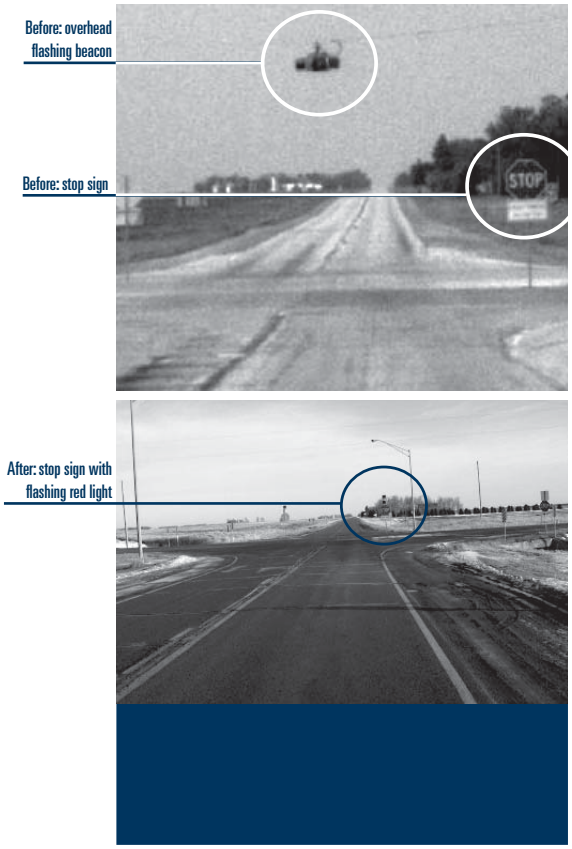
Completed applications should be submitted electronically to the program administrator, Steven Schroder, Iowa DOT Office of Traffic and Safety, steven.schroder@dot.iowa.gov.

There is no deadline to apply for funding; applications will be approved on a first-come, first-served basis, as funding allows.

Applicants should not purchase equipment until they have received approval from the Iowa DOT.

For more information

Contact Steven Schroder, 515-239-1623, steven.schroder@dot.iowa.gov. ■



Stanley L. Ring Memorial Library: New materials

Publications

P-1766 New MUTCD Sign Retroreflectivity Requirements

This *free*, four-page brochure describes basic new MUTCD retroreflectivity requirements. (US DOT-FHWA)

P-1778 Highway Safety Manual: Implementation Guide for Managers

This guide is intended for DOT managers charged with leading and managing agency programs that impact project development and safety programs. It is based on lessons learned from early adopters of the Highway Safety Manual (HSM). It outlines what the HSM is (and is not), how it relates to other core technical documents and policies, and the potential benefits of its use.

P-1779 Stabilization and Rehabilitation Measures for Low-Volume Forest Roads

This guide presents a wide range of available rehabilitation practices. Problems and solutions discussed generally deal with erosion control, slope stabilization, roadway surface and subgrade stabilization, road surface and subsurface drainage, and stream and wet area crossings.

P-1780 Synthesis of the Median U-Turn Intersection Treatment, Safety, and Operational Benefits

This synthesis summarizes the advantages and disadvantages of the Median U-Turn Intersection Treatment (MUTIT). It presents design guidelines and information on capacity and crash experience.

P-1781 Traffic Signal Timing Manual

This manual is intended as a comprehensive guide for traffic signal timing engineers and technicians on traffic signal control logic principles, practices, and procedures. It represents a synthesis of traffic signal timing concepts, analytical procedures, and applications based on North American practice.

DVDs

DVD-375 Best Practices: Crack Filling/Sealing

This video presents best practices for crack filling and sealing and was developed by the Ohio LTAP.

DVD-376 Hand and Power Tool Update (2005)

This video shows how accidents can be significantly reduced by applying good safety rules and reviews hazards associated with specific types of tools. It covers choosing appropriate tools for the job, avoiding tool-related hazards, personal protective equipment, special hazards associated with electric power tools, and tool care and maintenance.

DVD-377 Cranes, Chains, Slings, & Hoists

This video is designed for anyone operating jib hoists or cranes. It explains sling angles, safety techniques, inspection procedures, and more. This program meets OSHA training requirements (1910.180). It covers practices for inspection, maintenance, and safe use of lifting devices; daily pre-use inspection and proper use of equipment; physics of sling angles and safe load capacities; and more.

DVD-378 General Safety Videos

This DVD combines safety videos for construction and forestry equipment users. The tapes include Looking Back (18:00), Split Seconds Split Lives (22:50), It Happens to the Other Guy (22:40), and Round Trip Danger (24:00).

DVD-379 Hand Signals for Excavators and Backhoes

Correct use of hand signals on a job site can prevent accidents or even save a life. This video describes how hand signals can protect workers in potentially dangerous situations.

DVD-380 Lockout/Tagout of Construction Equipment

Accidental startup of construction equipment during repair is an ever-present danger. This video puts implementation of a lockout and tagout procedure in perspective with an easy-to-follow process. Everyone will work more safely by following a few simple procedures to isolate equipment from accidental start-up or movement during repairs or service.

DVD-381 Transporting Construction Equipment

The important points of transporting types of construction equipment are covered in this video. These points include trailers, safe loading and unloading techniques; correct tie-down techniques: tips for safe transport in varying traffic, road, and weather conditions; safely handling and securing unusual equipment; and interviews with professional equipment haulers sharing experiences.

Three ways to order LTAP library materials

- Use the online catalog, www.intrans.iastate.edu/ltap/library/search.cfm.
- Contact Jim Hogan, library coordinator, 515-294-9481, hoganj@iastate.edu, fax 515-294-0467.
- Mail or fax the order form on the back cover of this *Technology News*.

Note about delivery of materials: The library sends orders through the U.S. Postal Service. If you have an urgent need for library materials, let us know when you place your order and we will arrange faster delivery.

DVD-382 Safety Training for Repair Technicians

Three common types of injuries occur in a shop environment: eye, hand, and back injuries. This video builds awareness about shop safety and how to avoid these costly injuries.

DVD-383 Compressed Gas: Safety Awareness

Pressurized gases are used in so many ways that people take them for granted – to their detriment. Useful though they may be, pressurized gases are dangerous if handled improperly. This video covers classifications and labeling; flammable, non-flammable and toxic gases; handling cylinders; and valves.

DVD-384 Roadway Worker Safety: In the Zone

Roadway work is full of potential hazards, from passing traffic and trenches to electrical wires and hearing loss. This video covers roadwork hazards, flagging, night-work operations, personal protective equipment (PPE), special training, materials safety data sheets (MSDS), and traffic control pattern awareness.

DVD-385 Trenching and Shoring Safety

OSHA estimates approximately 90 deaths and thousands of injuries occur each year because employees don't know basic trenching and shoring safety guidelines. This video covers the practical safeguards that can prevent these needless casualties. It includes evaluating an excavation site, effective worker protection systems, and emergency response. ■

Conference calendar

December 2012			
4–6	Iowa County Engineers Annual Conference	Ames	Keith Knapp
19	PCC Overlays Under Through Traffic	Cedar Rapids	Melisse Leopold
January 2013			
4	District 6 Lunch and Learn: Rapid Partial-Depth Repair and New Diamond Grinding for City Streets	Dubuque	Anne Leopold
8	PCC Overlays Under Through Traffic	Sioux City	Melisse Leopold
18	PCC Overlays Under Through Traffic	Ottumwa	Melisse Leopold
29	Work Zone Safety	Ames	Tom McDonald
30	Work Zone Safety	Cedar Rapids	Tom McDonald
31	Work Zone Safety	Cedar Rapids	Tom McDonald
February 2013			
1	Work Zone Safety	Ottumwa	Tom McDonald
19-21	NHI Bridge Inspection Refresher Training	Ames	Sharon Prochnow
March 2013			
4	Work Zone Safety	Mason City	Tom McDonald
5	Work Zone Safety	Mason City	Tom McDonald
6–8	Greater Iowa Asphalt Conference and Preconference Workshop	Des Moines	Minnie Coree
11	Work Zone Safety	Storm Lake	Tom McDonald
12	Work Zone Safety	Sioux City	Tom McDonald
13	Work Zone Safety	Council Bluffs	Tom McDonald
25–28	NHI Bridge Training: Fundamentals of LRFP and Applications for Bridge Superstructures	Ames	Sharon Prochnow
28	Work Zone Safety	Ames	Tom McDonald
28–29	Iowa Chapter, American Public Works Association (APWA)/ISOSWO Spring Conference	West Des Moines	Peggy Englehart
April 2013			
21–25	National Association of County Engineers NACE 2013: Annual Conference	Des Moines	Rebecca Page
August 2013			
15–16	2013 Mid-Continent Transportation Research Symposium	Ames	Judy Thomas

Conference contact information

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Judy Thomas, 515-294-1866, jathomas@iastate.edu

Event details and online registration

Watch for details and online registration information, by specific dates/events, on the online calendar, www.intrans.iastate.edu/mors/calendar/.. ■

Take advantage of winter training opportunities

Those brief down times between weather–related road maintenance activities provide opportunities to take online courses offered by the Public Employees leadership Institute. The institute is certified by the American Public Works Association.

Fourteen online courses are available. Each is rich in content for employees of city and county agencies as well as private businesses. Courses can be taken in any order and are self-paced. Users can stop and re-start at any point, at any computer.

Course topics include government fundamentals, legal issues, communications, customer services, team development, supervisory and management skills, finances, emergency management, and winter operations.

Since the institute opened in fall 2010, nearly 600 courses have been completed, the vast majority of them by employees of Iowa cities and counties.

Learn more and register for courses online, www.instrans.iastate.edu/ltap/leadershipinstitute/.

The institute is administered by Bob Sperry, LTAP safety liaison, 515-294-7311, rsperry@iastate.edu. ■

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