TECHNOLOGY NEWS
Iowa's Local Technical Assistance Program (LTAP): providing transportation technology transfer for Iowa's cities and counties

January–February 2004

Acronyms in this issue

AASHTO	American Association of State Highway and Transportation Officials
APWA	American Public Works Association
CTRE	Center for Transportation Research and Education (at Iowa State University)
FHWA	Federal Highway Administration
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

Where the rubber *really* meets the road

A NEW technique for filling expansion joints with shaved tire particles is catching on after nearly two years of testing.

A stubborn problem

For years the Iowa DOT and its contractors used foam blocks to fill four-inch wide expansion joints where a bridge deck meets the roadway. The blocks were then sealed into the joint.

The problem came when the bridge expanded and contracted with temperature changes; the sealant deteriorated and the blocks were dislodged. Heavy rains could float them out of the joints, leaving gaps of four inches or more between the deck and roadway.

"I had been dealing with the foam plank joint problems for so long, I was getting desperate," says Mark Carter, Iowa DOT District 6 bridge crew leader.

Old foam expansion material deteriorates or washes away, leaving gaps between the pavement and bridge deck. *Photo courtesy of the Iowa DOT.*

Exploring a possible solution

In the mid-1990s Carter encountered a magazine article about rubber tire chunks used on playgrounds. "I started to wonder if that would work better in expansion joints."

Carter made many phone calls inquiring about different types of rubber and their suitability for his idea. In 1996–1997, his crew ran several tests on sample material and tried different topcoats.

In 1998, crew leaders from each district discussed results of test locations in District 6. They also explored possible sources for tire buffings, a byproduct of the tire retreading industry.

Testing

Mike Todsen, Iowa DOT Office of Bridges and Structures, explored the engineering aspects of using tire buffings in expansion joints. He submitted samples from four tire retreading operations to the Office of Materials for testing.

"We tested the material for density, gradation, compression and rebound qualities, foreign material content, and compatibility with several types of sealant," says Bob Steffes, formerly with the Office of Materials and now a research engineer at CTRE.

One combination of buffings and sealant performed better than the rest and was recommended to the bridge crews.

Rubber . . . continued on next page

Preparation of this newsletter was financed through LTAP, a nationwide effort financed jointly in Iowa by the FHWA and the Iowa DOT. Iowa's LTAP is housed and administered at ISU's Center for Transportation Research and Education (CTRE).

The mission of Iowa's LTAP: To foster a safe, efficient, environmentally sound tranportation system by improving skills and knowledge of local transportation providers through training, technical assistance, and technology transfer, thus improving the quality of life for Iowans.

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Benefits

Field testing on repairs of expansion joints demonstrated that rubber works better than foam:

- Tire buffings do not deteriorate over time.
- They are heavier than water so they won't float away in a strong rain.
- If they do become dislodged from a joint, tire buffings are not a significant hazard on the roadway.

In addition, the cost of tire buffings is less than half the cost of foam blocks specified for these joints. Because tire buffings are generally sent to a landfill, tire retread businesses around the state are willing to give the material away or charge only a minimal fee, if the Iowa DOT hauls it away.

New standard

With better performance and lower cost, the next step was to change the standard for new construction.

"The new standards for use of tire buffings in expansion joints are in the Road Design Standard update which took effect in October," says Todsen.

For more information

Standard road plans are available online, www.dot.state.ia.us/design/stdrdpln.htm. Plan RH-52 shows a tire-buffings-filled joint in detail. Note, too, new approach pavement details on RK-20(1).

See the October 2001 Final Report MLR-01-1 "Rubber Buffings for Bridge Approach Expansion Joints." To borrow a copy, contact Jim Hogan, LTAP library coordinator, 515-294-8103, hoganj@iastate.edu. Ask for publication P-1641. •

Editor's note: This article was adapted from one in the Iowa DOT's December 2003 issue of Inside, by Tracey Bramble, editor. Used with permission.

Rubber particles are spread and then sealed into the expansion joint. ***Photo courtesy of the Iowa DOT.***

High-performing bridge decks

RECONSTRUCTED Interstate-235 through Des Moines (scheduled completion date: 2007) has been designed to perform well for decades. To help accomplish this goal, the Iowa DOT is using high-performance concrete (HPC) in I-235's 71 new bridge decks.

From standard concrete to HPC

In general, HPC begins with a standard concrete mixture that is adjusted to maximize concrete performance under anticipated operational requirements and weather conditions.

The HPC in the I-235 bridge decks, for example, is designed to have very low permeability and cracking and high durability and strength under high traffic counts, heavy loads, and Iowa's extreme seasonal weather conditions.

Adjusting and testing

To achieve these characteristics, staff in Iowa DOT's Office of Materials enhanced standard concrete mix designs. In general, they reduced the water/cement ratio, added supplementary cementitious materials, and improved aggregate gradation.

Although trial tests of a mixture containing silica fume and a high-range water-reducing admixture were favorable, the mix did not perform well in an early bridge deck experiment constructed off the I-235 corridor. So, the silica fume and high-range admixture were eliminated, ground granulated blast-furnace slag or fly ash became the primary supplementary cementing material, and a water-reducing and retarding admixture was added.

Beyond the mix

To help ensure the concrete decks perform as designed, the Iowa DOT is batching, mixing, placing, compacting, and curing the concrete to the highest industry standards.

For example, curing takes place immediately after finishing. (Longitudinal grooving is delayed until the concrete has hardened.) Curing includes placing two layers of pre-wetted burlap less than 10 minutes after final finishing, and continuous wet sprinkling for a full seven days.

These careful construction practices have resulted in almost crack-free decks.

Results

These methods can increase HPC's materials and construction-related costs. The Iowa DOT, however, anticipates that additional up-front investment in I-235 bridge decks will be more than offset by savings related to reduced maintenance and rehabilitation.

HPC . . . continued on next page

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Possible local applications

There's really nothing magical about HPC. Under current specifications, agencies can adjust standard mix designs and construction practices to enhance concrete performance.

For example, where very low permeability is desired and fly ash and slag are available, agencies can incorporate these supplementary cementitious materials into mixtures. To reduce shrinkage cracking, agencies can extend curing time.

For more information

See FHWA's high-performance concrete website, http://knowledge.fhwa.dot.gov/cops/hpcx.nsf/home.

The FHWA's High Performance Concrete Toolkit, which describes demonstrations of HPC on various types of bridges, is available through Iowa's LTAP library. Contact Jim Hogan, library coordinator, 515-294-8103, hoganj@iastate.edu. Ask for publication P1330. •

Editor's note: This article was adapted from "HPC for I-235 Bridge Reconstruction in Iowa," published in the September/October 2003 issue of HPC Bridge Views*, by Kenneth F. Dunker. Used with permission.*

Slag and fly ash in HPC

With a lower heat of hydration than portland cement, slag can help prolong the strength-gaining stage of water-cement hydration, reducing potential thermal contraction–induced tensile stresses. Slag can be an especially useful cementitious material in hot-weather concrete paving projects, but a possible disadvantage in cold-weather projects.

Fly ash can enhance concrete's resistance to attack by sulfates in water, improve mixture workability, decrease the permeability of hardened concrete, and reduce alkali-aggregate reaction in the mixture that weakens aggregate's bond to the cement paste. It, too, reduces heat of hydration.

East 9th Street, Des Moines, bridge deck pour: finishing machine and crew, October 2002.
Photo courtesy of Kenneth Dunker, Iowa DOT.

Iowa Department of Transportation

IOWA LTAP Local Technical Assistance Program

CTRE Center for Transportation Research and Education

Iowa State University

Computer-based anti-icing and RWIS training

INFORMATION IS POWER, especially when winter maintenance staff use it to take preventive, pro-active, anti-icing action during the calm before the winter storm—saving money, time, and even lives.

In Iowa, winter maintenance staff and supervisors have access to real-time data about pavement and atmospheric conditions collected by road weather information system (RWIS) sensors. These data are then sent to computers in maintenance facilities throughout the state.

But making sound winter road maintenance decisions based on current environmental data requires training and practice. That's why the Iowa DOT is one of 31 state DOTs using a new computer-based training (CBT) program to learn the art of RWIS data interpretation and operational application.

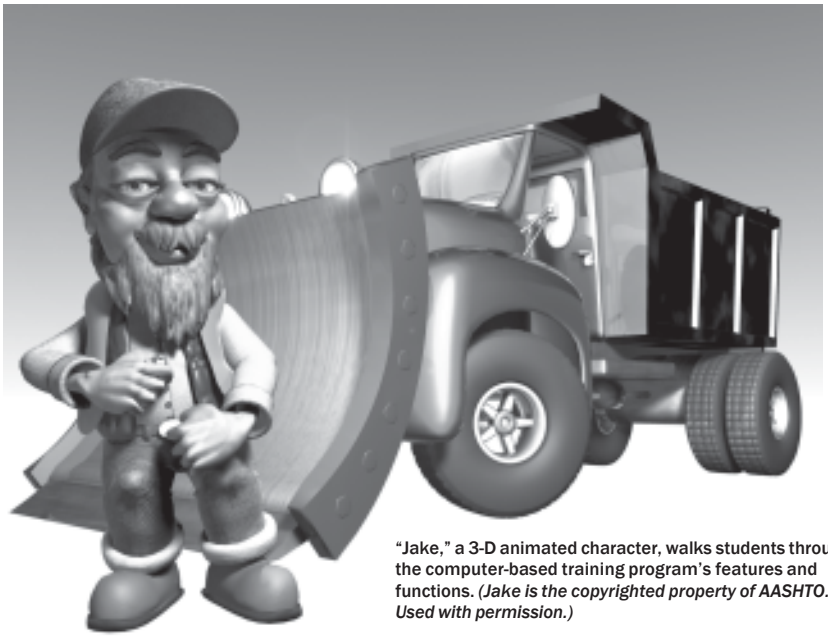
CBT includes modules specific to staff responsibilities and is accessible through an interactive CD-ROM, allowing users to learn at individual paces, as follows:

- Maintenance supervisors learn how to decide when and where to deploy anti-icing equipment and how much chemical to use.
- Operators learn how to override a snowplow's automated system when necessary to fine-tune chemical placement.
- Decision-makers learn how to analyze the effectiveness of anti-icing strategies under various weather conditions.

Generic versions of the CBT will be available to road agencies in spring 2004 from the APWA and NACE. The Iowa DOT has placed a generic version of the training in each maintenance garage around the state and encouraged operators and supervisors to test the system. In fall 2004, they will release an adapted version of the CBT that includes Iowa DOT policies and procedures with pictures of Iowa roads and road conditions, so users will feel right at home.

For more information

Contact Leland Smithson, AASHTO Snow and Ice Cooperative Program coordinator, 515-239-1519, leland.smithson@dot.state.ia.us. •



"Jake," a 3-D animated character, walks students through the computer-based training program's features and functions. *(Jake is the copyrighted property of AASHTO. Used with permission.)*

Winter maintenance decision support system

WE ALL have trouble making decisions sometimes. When those decisions involve how to care for often-unpredictable winter roads, winter road maintenance managers have an especially tough job.

Help may be on the way. For the second winter, the Iowa DOT is testing a prototype of the Maintenance Decision Support System (MDSS) being developed by five national research centers for the FHWA. Based on data the system collects, the MDSS makes road maintenance recommendations about how much chemical to apply and when and where it's needed.

The data are collected from several sources, including the road weather information system (RWIS) sensors, numerical weather prediction models, and surface observations. The system monitors road and weather conditions throughout the state, alerting road maintenance managers to critical changes.

Even though the MDSS makes specific recommendations, managers must still be able to evaluate those suggestions based on their job experiences and interpretations of weather information. Therefore, computer-based RWIS training is still crucial (see related article).

CTRE researchers are collecting data from the test this winter, and the system is constantly being tweaked to improve forecast performance. In fall 2004, the finished product will be available to road agencies and state DOTs throughout the country.

For more information

Contact Dennis Kroeger, CTRE transportation research specialist, 515-296-0910, kroeger@iastate.edu. •

Anti-icing/ deicing video

WHEN should deicing chemicals be used instead of abrasives? Where would a snow fence help?

The answers to these questions and more can be found in the Iowa DOT's *Winter Operations Training Program: Anti-icing/Deicing* video. This 30-minute video is the fifth in the *Winter Operations Training* series from the Iowa DOT.

To borrow the video, contact Jim Hogan, LTAP library coordinator, 515-294-9481, hoganj@iastate.edu. Ask for video V-567. •

focus on
rural highway safety

Reducing crashes at rural intersections

CAN intelligent transportation systems (ITS)—which are already transforming metropolitan highway safety programs—enhance safety on Iowa's rural roads?

The University of Minnesota is studying the effectiveness of a rural ITS application that could be useful in Iowa.

Driver error at rural intersections

Iowa's network of two-lane rural highways and collector roads connecting small cities and towns accounts for the majority of the state's road miles. Nationally, the highest crash fatality rates occur on just such roads.

Many rural crashes occur where highways and collector roads intersect. The most common driver error involved in rural intersection crashes is the failure to correctly gauge how much of a gap in traffic is needed to safely cross or merge from a side road onto a highway.

The traditional "fix" for high-crash rural intersections, according to Max Donath, director of the University of Minnesota's Intelligent Transportation Systems Institute, has been to install a standard traffic signal. But, says Donath, conventional signals do not necessarily reduce fatalities in these situations.

In fact, traditional signals often increase the number of rear-end collisions at rural intersections.

Signals also disrupt traffic on the main highway, a significant issue in rural areas where highways are heavily used by large commercial vehicles that take a long time to reach highway speed after stopping.

Helping drivers decide

The ITS Institute is developing an Intersection Decision Support (IDS) system that could enhance drivers' ability to safely negotiate unsignalized rural intersections where low-volume roads cross highways carrying high-speed traffic.

The IDS system consists of four components:

- **Surveillance**. A network of radar sensors adjacent to the roadway monitor the position and speed of vehicles on the highway approaching the intersection.
- **Communications**. Each radar sensor station sends vehicle speed and position data to a central processing unit.
- **Processing**. Based on the data collected, the CPU tracks gaps between vehicles on the main highway and predicts if gaps are sufficient to allow vehicles stopped on a secondary road to cross the highway or merge into traffic safely.
- **Driver interface**. A graphic display alerts drivers on the crossing road when it is not safe to cross or merge. (Drivers on the main highway see no display or signal.)

What's next?

The IDS system researchers, led by Donath at the ITS Institute, have carried out several demonstrations of the system, including one of a working installation on a closed traffic course.

The next step is to implement and study a working system at selected intersections. Stay tuned.

For more information

Contact Craig Shankwitz, director of the Intelligent Vehicles Laboratory at the ITS Institute, 612-625-0323, shank004@umn.edu. •

Editor's note: Information in this article is from "Intersection Decision Support: reducing crashes at rural intersections," by Peter Nelson, associate editor at the ITS Institute, published in the fall 2003 issue of The Sensor. *Used with permission.*

The University of Minnesota is studying the effectiveness of a rural ITS application that could be useful in Iowa.

focus on
rural highway safety

Examining traffic safety on rural expressways

Expressways provide most of the mobility of interstates at significantly less up-front cost. But other factors need to be considered when determining overall corridor costs.

LIKE MANY STATES, Iowa is constructing rural expressways at a relatively fast clip. But few studies have been conducted about their safety performance.

Now recent research indicates that, although expressways are very safe at low traffic volumes, their crash rates and crash severity increase as traffic volumes increase. This finding begs some additional research.

The appeal of expressways

Expressways are multi-lane, divided, arterial highways. Like interstate highways, expressways can support high traffic volumes and speeds.

Since 1996 the Iowa DOT has improved more than 275 miles of two-lane highway on Iowa's 2,275-mile Commercial Industrial Network (CIN) to four-lane, rural expressway; additional miles are scheduled for conversion in the next decade.

The idea is that by providing high-speed, high-capacity corridors between major business and industrial centers, expressways support Iowa's goal of fostering economic development and diversification.

Reasonable initial investment

Because expressways provide only partial access control, they require significantly less investment to design and build than do roadways designed to interstate standards.

Consider the savings: Most expressway intersections are at-grade. A few have traffic signals, but the majority rely on stop signs on the crossing roadways only. Unlike interstate highways, which require full access control, expressways require

- few, if any, interchanges and related overhead bridges
- fewer access rights to purchase from adjacent landowners
- less expensive cross-sections, depending on design standards

Expressways provide most of the mobility of interstates at significantly less up-front cost. But other factors, like roadway safety, need to be considered when determining overall costs of a corridor.

Safety-related implications

Researchers at CTRE and at CH2M HILL in Minnesota analyzed three years of crash data for expressway segments in Iowa and Minnesota. They focused on crash history as a function of the mainline level of traffic.

Crash rates. Researchers found a non-linear relationship between crash frequency (the number of crashes per unit of time per unit of roadway) and traffic volume.

That is, they found that crash rates consistently increase with traffic volumes. See figures at right.

Intersection crashes. They also found that the percentage of crashes at expressway intersections increases as traffic volume increases.

In Minnesota the percentage of crashes at intersections more than doubles (27 percent to 59 percent) from the lowest traffic volume intervals to the highest. In general, Iowa expressways carry lower volumes than those in Minnesota, but the trend regarding intersection crashes is the same.

Crash severity. Finally, by applying Minnesota's crash severity weight index to the datasets, researchers concluded that, in both Minnesota and Iowa, crashes become more severe as traffic volumes increase.

Researchers speculate that at some level of traffic, safety may be compromised to such a degree that the expressway is no longer the most cost-effective option.

What's next?

The next goals for expressway safety research may be twofold:

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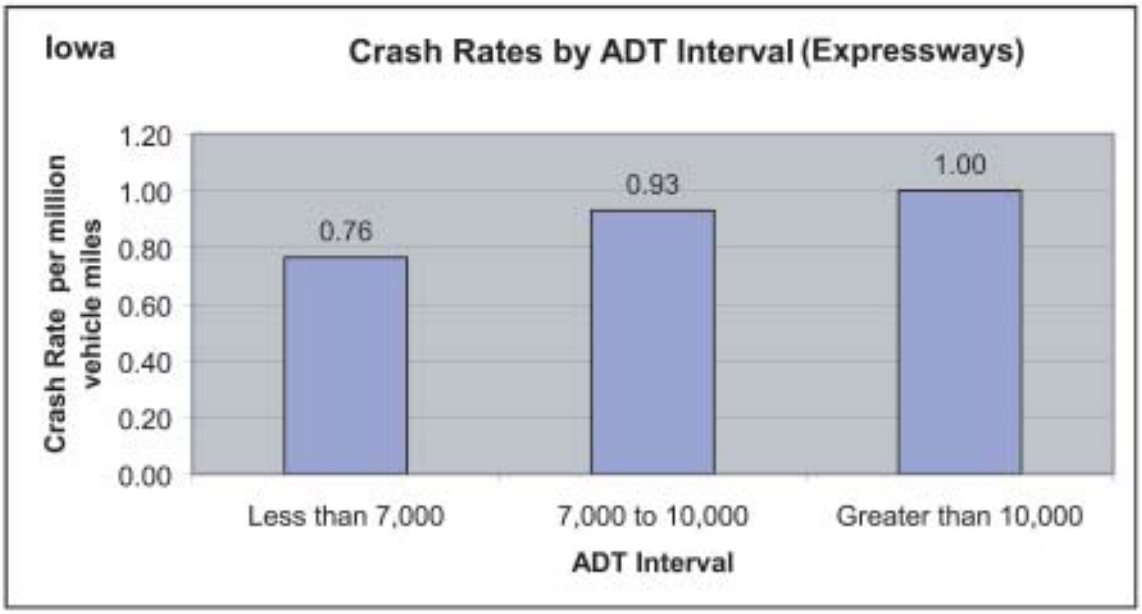
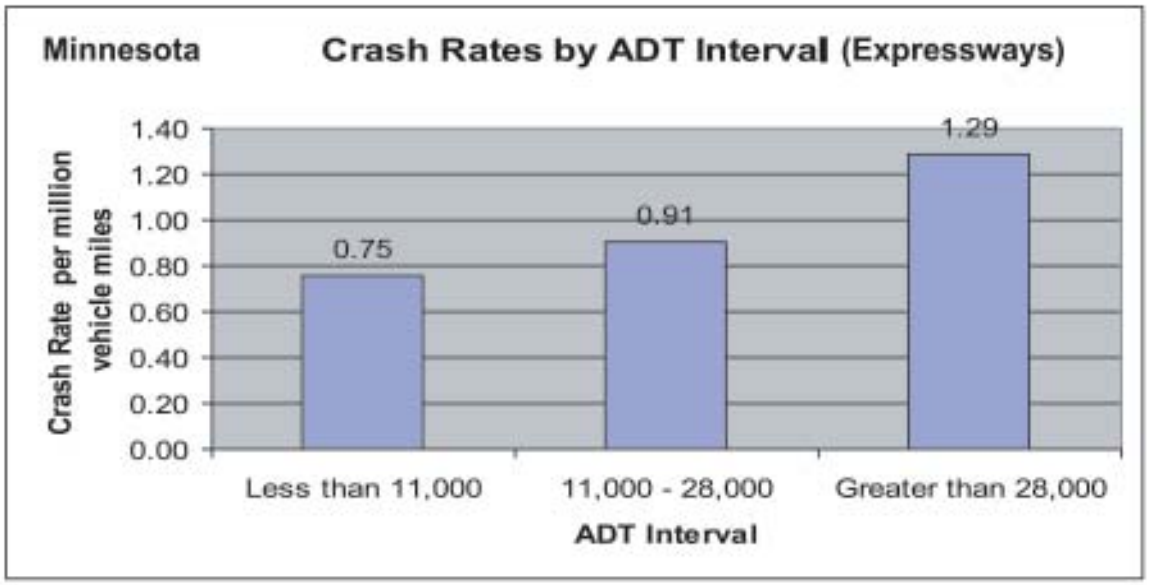
(1) to better understand expressway crashes so that countermeasures, other than reduced access control, may be designed, and eventually

(2) to develop guidelines that would allow highway agencies to proactively identify when conversion from expressway to interstate design standards is warranted.

For more information

Contact Tom Maze, professor of civil engineering, Iowa State University, 515-294-9459, tmaze@iastate.edu, or Howard Preston, project manager, CH2M HILL, 651-688-8772, hpreston@ch2m.com. •





Researchers speculate that at some level of traffic, safety may be compromised to such a degree that the expressway is no longer the most cost-effective option.

In and out of the driver's seat — safely

Most accidents that occur during mounting or dismounting equipment involve experienced operators.

OPERATING heavy equipment can be a dangerous occupation. Just getting on and off loaders and motor graders and other motorized monsters can be hazardous to your health!

In just 18 minutes, a unique new training video—On Again Off Again: A Guide to Mounting and Dismounting Heavy Equipment—effectively teaches operators how to avoid injuries when getting on and off heavy equipment.

This video isn't just for novices. Most accidents that occur during mounting or dismounting equipment involve experienced operators. In Oklahoma, where the video was produced, between 25 and 30 falls from equipment occur every year, at an estimated annual cost of $800,000.

Previewed at National Association of County Engineers (NACE) meetings, the video has been applauded as an entertaining and informative training tool that equipment operators relate to.

The video was produced by the Association of County Commissioners of Oklahoma (ACCO) and is being distributed free to LTAP centers, courtesy of ACCO, the Public Entity Risk Institute, and NACE.

To borrow a copy, contact Jim Hogan, LTAP library coordinator, 515-294-8103, hoganj@iastate.edu. Ask for video V-726. •

Operating heavy equipment is a regular part of the job for city and county road crews.

A network of information resources at your fingertips

BEGINNING March 1, 2004, TransCat, a new online catalog of transportation-related resources, will provide Iowa's transportation community access to a gold mine of training and information materials.

Here's what will be available with only a few clicks of a computer mouse:

- TransCat catalogs the holdings of 11 state DOT libraries, including Iowa's, plus those of the
  - – Transportation Research Board library,
  - – University of Minnesota Center for Transportation Studies library,
  - – University of California–Berkeley Harmer E. Davis Transportation Center Library,
  - – Northwestern University Transportation Library,
  - – University of Michigan Transportation Research Institute Library,
  - – Virginia Transportation Research Council, and the
  - – Los Angeles County Transit Authority.
- TransCat is searchable by anyone with internet access.
- A free public view, Guest Access, allows users to view and search TransCat holdings.
- Most resources listed in TransCat are available for loan to any transportation official or practitioner.
- A growing number of items in TransCat are linked to online, full-text publications that can be downloaded and/or printed.

The TransCat service was initiated by a consortium of state agency and university transportation libraries—the Midwest Transportation Knowledge Network (MTKN).

TransCat is supported with funds from the National Transportation Library.

TransCat . . . continued on next page

Replacing a salt shed door

THE HEAVY WOODEN DOOR would barely open on the Iowa DOT's salt shed in Cedar Rapids. Even with two men pulling it, the door wouldn't slide open easily, if at all. Meanwhile, the garage's salt dome had no door at all.

First, the Iowa DOT folks in Cedar Rapids bought a canvas door for the dome that could be raised and lowered, folding up like a roman blind. Steel rollers on the side of the canvas moved on metal tracks along the door frame.

(top) Winch to wind door up.
(left) Salt shed door built entirely in-house.

But, the new door wasn't quite right. It wouldn't fold all the way to the top, so trucks couldn't fit through the opening.

By then Greg Callanan and Dale Sexton, equipment operators with the Iowa DOT in Cedar Rapids, had had enough. They replaced the dome door's metal tracks with wooden ones and the steel rollers with pipes running horizontally through the canvas and sliding up and down inside the wooden tracks. Now the door rises easily all the way above the door frame, well out of trucks' way.

After taking care of the dome door, Callanan and Sexton decided to replace the original salt shed's door, too. They designed a door with a similar roman blind design and wooden tracks. They used truck tarps, fence top rail, cable, hardware, and a winch—all materials they had in the shop. The second door cost about one-quarter of the cost of the original canvas door purchased for the dome.

Now opening and closing both doors is a snap. They glide smoothly all the way to the top and are much lighter than before.

For more information about replacing your salt shed door, contact Dale Sexton, 319-364-8189. •

Editor's Note: The "Replacing a Salt Shed Door" is the third in a series of several winning innovations from the 2003 "Better Mousetrap" competition at the Iowa Maintenance Training Expo. In each issue of Technology News *we are highlighting one of the winners. For information about other winning "mousetraps," see CTRE's website: www.ctre.iastate.edu/ (under the "Services" category).*

TransCat . . . continued from previous page

For more information

Read a brochure about MTKN, www.dot.state.mn.us/library/MTKN.pdf.

Bookmark MTKN's website, www.mtkn.org, so you'll be ready to go when access to TransCat becomes available in March.

For additional information, contact Hank Zaletel, Iowa DOT librarian and Iowa's representative in the MTKN, 515-239-1200, hank.zaletel@dot.state.ia.us.

Of course, you can continue to access training materials and other resources through Iowa's LTAP library. Contact Jim Hogan, 515-294-9481, hoganj@iastate.edu. The catalog is online, www.ctre.iastate.edu/library/search.cfm. •