TECHNOLOGY NEWS

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

July–August 2000

New, bigger, better Expo is coming!

Iowa (All Season) Maintenance Training Expo
September 12–13, 2000
Iowa State Center, Iowa State University
Ames, Iowa

Summer: sealing cracks, striping pavements, applying thin maintenance surfaces, managing roadside vegetation, and more. *Winter*: applying brine, plowing snow, fighting fatigue while fighting storms, and more.

This year, join about 1,000 other Iowans in learning about the latest techniques and technologies for summer *and* winter roadway maintenance activities in one information-packed Iowa Maintenance Training Expo.

EXPO . . . continued on page 2

Lasso a prize at Iowa's snow plow and motor grader "roadeos"

Snow Plow Roadeo/Motor Grader Roadeo
September 14, 2000
Iowa State Center, Iowa State University
Ames, Iowa

HONE your snow plow or motor grader operator skills. Learn from other operators. Review operator safety practices. Demonstrate for the public the challenges of plowing paved roadways and grading gravel roads.

With these benefits, everyone's a winner at Iowa's snow plow and motor grader "roadeos." Participants in both events operate a plow or grader over courses that imitate the characteristics of typical streets and gravel roads. Course maps are provided in the

ROADEO . . . continued on page 2

Attendees at Iowa's Maintenance Training Expo always appreciate the opportunity to see new products and equipment at the vendor displays.

Preparation of this newsletter was financed through the Local Technical Assistance Program (LTAP). LTAP is a nationwide effort financed jointly in Iowa by the Federal Highway Administration and the Iowa Department of Transportation. The mission of Iowa's LTAP: To foster a safe, efficient, environmentally sound transportation 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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Expo . . . continued from page 1

The Expo provides a wide selection of educational sessions, a coliseum full of vendor displays, and hands-on equipment demonstrations.

The Expo is for city, county, and state staff responsible for maintaining roads in every season: maintenance supervisors, maintenance equipment operators, public works superintendents, city and county engineers, airport maintenance staff, and technology and equipment providers. Comments from past participants indicate that meeting and sharing information with people who perform many different maintenance-related activities enhances their understanding of their own activities.

Registration brochures are in the mail. For more information, contact Duane Smith, CTRE's director of outreach, 515-294-8103, desmith@iastate.edu. For a brochure, contact Traci Stewart, CTRE's receptionist, 515-294-8103, stewartt@iastate.edu, or download the online copy, www.ctre.iastate.edu/bulletin/expo2000.pdf.

The Expo is sponsored by the Iowa chapter of the American Public Works Association, the Iowa County Engineers Association, Iowa Secondary Road Maintenance Supervisors Association, Iowa Department of Transportation, Federal Highway Administration, and the Center for Transportation Research and Education at Iowa State University. •

The motor grader and snow plow courses challenge contestants to use all their driving skills.

ROADEO . . . continued from page 1

registration brochure so teams can set up their own practice courses in advance of the roadeos.

Contestants in the snow plow roadeo also take a written exam and identify snow plow defects. Competition is fierce but good natured.

The roadeos will follow Iowa's Maintenance Training Expo, to be held September 12–13.

For more information, see the registration brochure. Brochures are in the mail and online at www.ctre.iastate.edu/bulletin/expo2000.pdf. You can also get a brochure by contacting Traci Stewart, CTRE's receptionist, 515-294-8103, stewartt@iastate.edu. •

Expo success stories

Duane Smith, CTRE's Associate Director for Outreach

SOLVING PROBLEMS, evaluating standard practices, learning new techniques, sharing information, comparing new equipment—these are just a few of the benefits cited by the people who attend Iowa's Maintenance Training Expo.

Since 1997, Iowa has offered two Expos each year, one focusing on summer and one on winter roadway maintenance. This year the two events will be combined into one information-packed, two-day Expo for maintenance staff and supervisors.

The Expo includes classroom training sessions, vendor displays, and product demonstrations. In addition, a snowplow roadeo and motor grader competition are held the day after the Expo. This mix of activities has been the key to the Expo's success. At least that's what we are hearing from people who attend.

Ron Johnston, maintenance superintendent from Poweshiek County, tells us that the Expo allows employees to meet their peers and get feedback on how other counties are operating. The motor grader competition is a highlight for Ron. As he puts it, "It allows the operators a chance to show off their skills."

The city engineer from Creston, Tom Meyers, has a slightly different perspective. Tom sends five or six employees to every Expo. Information presented at the Expos has helped him solve problems and reevaluate ways of doing business. For example, sessions he attended at one Expo helped Tom decide to use pre-wetting and anti-icing techniques for winter roadway maintenance. He had known about these techniques, and the Expo provided a format to discuss them with others before he decided to proceed.

The Iowa Department of Transportation (Iowa DOT) has made a strong commitment to the Expo. Jeff Owen, area maintenance manager in district 4, has rotated all district-4 maintenance employees through the summer and winter Expos. He says their attendance at the Expo facilitates employees' acceptance of changes the Iowa DOT is implementing. Sometimes talking with peers can be more influential in changing attitudes than a directive from management. Employees hear about successes and failures from others who have similar jobs, and there are many opportunities for open dialogue along with questions and answers.

Dave Anthony, Boone County engineer, sends about half of his maintenance staff to the Expo every year. Dave believes taking part in the Expo improves employee morale and encourages staff to take pride in their work. Dave has learned about anti-icing techniques and is considering implementing them. He has been observing the Iowa DOT's anti-icing operations in and around his county and comparing his observations to what he is learning at the Expos.

From Bettendorf, we hear from Stan Erickson, manager of the city's streets, sewers, and signs. Bettendorf usually conducts its own snow plow roadeo competition, and the top four competitors come to the Expo and compete against other agencies in the Expo-related roadeo.

According to Stan, there are two benefits to the Expos: well trained employees, and improved practices. The event provides experienced employees with an excellent review of standard maintenance information and techniques, and provides newer

*SUCCESS . . . **continued on page 4***

Expo attendees have hands-on access to vendor displays.

Editor's note: The Center for Transportation Research and Education does not endorse specific brand names mentioned in any of the articles in Technology News.

Removable orange rumble strips warn drivers approaching a work zone. *Photos courtesy of Eric Meyer, University of Kansas, and Advance Traffic Markings.*

Direction indicator barricades guide motorists through work zones. *Photo courtesy of WLI Industries, Inc./United Rentals Highway Technologies.*

Work zone safety products

CHECK OUT the following products that may provide your agency with effective, relatively low cost, and convenient means for improving safety in work zones. These products are designed to give workers advance warning of and protection from inattentive drivers or errant vehicles, help motorists navigate confusing work zones, and alert drivers of changing traffic conditions.

Some of these products comply with National Cooperative Highway Research Program (NCHRP) Report 350 guidelines for crashworthiness, although you will need to check specific manufacturers. See "The importance of NCHRP Report 350" (page 6) for a brief reminder about how these guidelines affect you.

The Midwest Smart Work Zone Deployment Initiative (MwSWZDI) is investigating 20 different traffic control and management strategies and devices, some of which are featured here. For more information on MwSWZDI, see "Midwest states study work zone safety products" (page 5).

Temporary rumble strips

Temporary rumble strips, which can be orange in color, alert motorists to changing traffic conditions, such as the need to slow down for an upcoming work zone.

Developed through the Strategic Highway Research Program (SHRP), temporary rumble strips are cut to size and attached to the roadway with adhesive backing about 100 meters before the work zone begins. A limited crew can install and remove the strips quickly, and MwSWZDI testing shows that the rumble strips remain in good condition throughout the work period. Temporary rumble strips may be best suited for low-speed roads that carry few heavy trucks. The strips may also work best in an urban setting.

Plastic signs and sign supports

Cloth roll-up signs are becoming a common sight in work zones because of the need for portability and safety; however, windy conditions can adversely affect their visibility with some designs. Although stability may always be problematic, new plastic signs perform better in the wind while providing safer conditions for workers and motorists.

During crash testing, plastic signs and sign supports caused only minor windshield damage, no occupant compartment intrusion or deformation, and no dangerous debris, making these devices less hazardous in crashes than traditional road signs. In addition, the signs are easily portable.

Lighted raised pavement markers

Lighted raised pavement markers (RPMs) provide greater visibility in work zones than traditional temporary pavement markings such as pavement marking tape. Lighted RPMs are especially helpful in delineating crossovers in work zones, significantly reducing vehicle speeds, and increasing the number of passenger cars that stay in the correct lane.

Ground-mounted and illuminated, RPMs can be operated in flashing, racing, or steady-burn modes.

MwSWZDI research showed that installation and removal of RPMs is hassle free; however, extensive cabling required to power the lights could be problematic in some areas. Solar-powered units are also available and may solve this problem.

Direction indicator barricades

Direction indicator barricades direct traffic more clearly through a crossover. Arrows and lights make these barricades more visible than traditional drums, making needed lane changes more quickly apparent to motorists. The barricades are designed to collapse and lay flat when struck by a vehicle and

WORK ZONE . . . continued on page 5

SUCCESS . . . continued from page 3

employees with some helpful initial training. Upon returning from the Expo, employees share the information with other staff in the shop, For Stan, attending the Expos has resulted in a major change in the city's anti-icing practices. He has changed anti-icing materials because of what he's learned at the Expo and what the Iowa DOT has experienced in the Bettendorf area.

Employees in Stan's shop particularly enjoy seeing new equipment at the vendor displays. Product and process demonstrations are also valuable. Demonstrations like the one of the Missouri Department of Transportation's scrub seal operation give Expo participants an opportunity to see the products and processes that have been developed in other parts of the country. Ron Johnston summed up his feelings about the Expo: "You're on the right track. Keep it up." •

WORK ZONE . . . continued from page 4

will not bounce into traffic or the work zone, making them safer than traditional barricades.

MwSWZDI research showed that plastic direction indicator barricades provided better visibility, more positive guidance, greater portability, and improved recoverability than conventional barricades.

Flashing stop/slow paddles

Flashing slow/stop paddles grab drivers' attention, making them concentrate on the work zone they are entering and increasing the safety of the flagger. The flashing paddle, developed under SHRP, incorporates a high-intensity flashing light on the stop side of the paddle. The flagger activates this light when a driver does not appear to be paying attention to the sign. The light is strong enough to be seen on even the sunniest days.

New designs of the device are more durable and less cumbersome, resolving previous concerns about this product. In addition, the batteries now require less frequent recharging.

Highly visible worker apparel

The Iowa Department of Transportation now issues new style fluorescent yellow-green safety vests to road workers. The bright color increases workers' visibility in all lighting conditions.

Traditional orange construction clothing can blend in with orange machinery and signs in the construction zone. The new yellow-green clothing differentiates workers from the work site. Motorists are more likely to slow down once they recognize an object as a human being, creating a safer environment for road workers.

Portable traffic signals

Flagging is often required to control traffic in work zones, resulting in an increase in staffing and training needs and a decrease in worker safety. One potential alternative to flagging is user-friendly temporary traffic signals.

These units are mobile, wireless, rapidly deployable, and easily programmable. Since the units are solar and battery operated, no auxiliary power source is needed. Setup time from arrival on the job to operation can be as little as a few minutes.

For more information

Contact Tom McDonald, 515-294-6384, tmcdonal@iastate.edu. Additional information on work zone safety research and products is available from the National Work Zone Safety Clearinghouse website, wzsafety.tamu.edu/. •

Midwest states study work zone safety products

ACCORDING TO the Midwest Smart Work Zone Deployment Initiative (MwSWZDI) website (www.matc.unl.edu/project/), the goal of the study is to "develop better ways of controlling traffic through work zones, which improves the safety and efficiency of traffic operations and highway workers." The research determines the safety and operational effects of particular products and develops recommendations for the products' future use.

The MwSWZDI is a pool-funded study between the Iowa, Kansas, and Missouri departments of transportation, the Nebraska Department of Roads, the states' divisions of the Federal Highway Administration, and the Mid-America Transportation Center at the University of Nebraska-Lincoln.

Iowa, Kansas, and Missouri evaluated removable orange rumble strips and found them to be satisfactory because they reduced speed and the number of vehicles remaining in a closed lane. The researchers, however, recommended that the thickness of the strips could be increased to cause a greater effect on large trucks. All three states also determined that installation and removal of the strips were quick and easy.

Kansas evaluated the Lightguard System, lighted raised pavement markers (RPMs) used to accentuate crossovers in work zones. By more effectively delineating the crossover, the RPMs in this study resulted in improvements in lane-keeping and substantial speed reduction. The Kansas research recommends continued studies into the effectiveness of various flashing modes and effectiveness of the lighted RPMs in long-term situations.

The Kansas evaluation of the Vertical Safetycade direction indicator barricade showed that the positive guidance of the barricades was superior to traditional drums; however, the researchers observed no statistically significant speed reductions. The study recommends that the barricades be used with weighted boots in all characteristically windy or high-speed locations.

More information on MwSWZDI is available on the Mid-America Transportation Center website, www.matc.unl.edu/research/mwswzdi/. For information on the products listed here and the specific products tested, see the online version of the *MwSWZDI Year One Report*, www.matc.unl.edu/project/. •

Flashing stop/slow paddles grab drivers' attention more effectively than conventional paddles. *Photos courtesy of Peter Hatzi, Federal Highway Administration.*

Sign supports meeting NCHRP-350 crashworthiness guidelines are less dangerous to motorists in crashes. *Photo courtesy of S-Square Tube Products.*

Why the focus on work zone safety?

ACCORDING TO the Iowa Department of Transportation (Iowa DOT), annual traffic on Iowa's roads has increased more than 55 percent since 1980. Increased traffic, especially on aging roads such as many of those in Iowa, leads to increased wear and tear of pavements. Iowa's transportation agencies have shifted their focus from constructing new roads to maintaining and repairing existing ones, resulting in an increased number of highway work zones.

Although the number of work zones is increasing, drivers continue to be unprepared for the dangers in work zones, leading to numerous crashes. In 1997 alone, the Iowa DOT recorded 10 fatalities, 150 personal injury crashes, and 195 property damage crashes in work zones across the state.

Many drivers are not aware that, traveling at 60 miles per hour, a vehicle will travel 1,000 feet (a probable distance between a warning sign and a work zone) in less than 11.5 seconds. Serious consequences may result when drivers fail to reduce speed immediately upon the warning.

Motorists are also unaware of the increased risks once a queue has formed. According to "Capacity of Freeway Work Zone Lane Closures" by Tom Maze, former director of the Center for Transportation Research and Education, backward-moving queues can build at speeds as high as 30 to 40 miles per hour, catching approaching drivers unaware and increasing the risk of crashes. For example, a queue moving at 35 miles per hour toward a vehicle approaching at 65 miles per hour would result in an overall approach speed of 100 miles per hour, a rate that exceeds drivers' expectations.

Transportation agencies can help educate the traveling public about the importance of driving safely through work zones. In addition, they can create work zones that are easy for motorists to understand and navigate, using devices that are effective, easy to install and dismantle, and crashworthy. •

The importance of NCHRP Report 350

THE FEDERAL HIGHWAY ADMINISTRATION (FHWA) requires that the "crashworthiness" of all roadside hardware, which could be anything from breakaway utility poles to work zone devices, be demonstrated before such devices are used on the National Highway System (NHS). Devices are crashworthy if, in a collision, they do not cause undue damage to motorists, road workers, or vehicles.

"Undue damage" is a fairly vague definition. Therefore, to help agencies determine which products are in fact crashworthy, the FHWA has adopted testing guidelines set forth in the National Cooperative Highway Research Program (NCHRP) Report 350. Only products that have been tested and meet NCHRP-350 guidelines can be used on the NHS.

Although devices used on non-NHS roadways (which include most of the roads managed by Iowa's cities and counties) do not have to meet NCHRP-350 standards, voluntary compliance by city and county transportation agencies could benefit motorists in their jurisdictions. This may be particularly true for work zone devices.

The use of NCHRP 350–compliant devices in local work zones should reduce injury and damages when work zone crashes occur. But perhaps even more important, the use of such devices in local work zones may help reduce the number of crashes.

Helping motorists recognize work zones early and navigate them safely is the key to reducing work zone crashes. Using *consistent* devices in *consistent* ways in all work zones on all roadway networks—NHS and otherwise—helps drivers readily identify work zones and quickly understand their particular layouts and requirements.

For more information on NCHRP 350, and to identify products that have met NCHRP-350 standards, see the FHWA's website, safety.fhwa.dot.gov/roadside/.

Additional information on NCHRP Report 350's application to work zone safety products is available from the National Work Zone Safety Clearinghouse, wzsafety.tamu.edu/files/nchrp350.stm. •

Beyond work zones: other new safety products

Tom McDonald, Safety Circuit Rider

MANY NEW PRODUCTS like portable speed humps, recycled rubber matting, and retroreflectometers have recently been introduced to improve safety on the nation's roadways and provide cost-effective means of meeting newly adopted standards, such as minimum retroreflectivity requirements.

Recycled rubber, formed into mats, could result in safer working conditions for many routine maintenance operations. For example, when installed around guardrails, signs, and other locations in high-traffic areas, the rubber mats can reduce the need for erosion control activities and mowing in those areas, thereby decreasing workers' exposure to the hazards of working in close proximity to fast-moving vehicles.

Another innovation is temporary speed humps, which may increase safety where excessive speed is a concern. They can be used both temporarily and permanently at speeds up to 40 mph. They can be installed relatively quickly by a crew of three and leave reasonably little damage to the roadway when removed, making them attractive for trial use before installing permanent humps. (See the article below for information on borrowing these devices from the Iowa Department of Transportation.)

The Federal Highway Administration's impending adoption of minimum retroreflectivity standards for signs and pavement markings on all public roadways has increased local agencies' interest in cost-efficient and effective devices to monitor and document retroreflectivity performance. Several retroreflectometer models that meet these requirements are now available commercially, ranging from large mobile units to small, hand-held models that can take measurements from relatively remote locations.

For more information about any of these products, contact Safety Circuit Rider Tom McDonald, 515-294-6384, tmcdonal@iastate.edu. •

Recycled rubber matting removes workers from high-risk maintenance situations. *Photo courtesy of Welch Products, Inc.*

Retroreflectometers help agencies meet new standards for sign and pavement markings retroreflectivity. *Photo courtesy of Laser Technology, Inc.*

Would you like to try speed humps in your community?

IF YOUR COMMUNITY would like to try temporary speed humps before installing permanent ones, you may want to participate in the Iowa Department of Transportation's (Iowa DOT) pilot program and concurrent research study.

The Iowa DOT plans to purchase several temporary speed humps and loan them—no charge—to interested communities. Various models will be available for collector and local roadways with vehicle speeds between 25 and 40 miles per hour. (The temporary speed humps will not be authorized for installation on state primary highways and are not recommended for major arterial streets.)

Installing temporary speed humps can be accomplished with only minor, repairable damage to the roadway pavement and may aid your community in deciding whether to invest in permanent speed humps.

The Center for Transportation Research and Education (CTRE) at Iowa State University will concurrently study any traffic volume changes, speed reductions, and safety impacts that may be attributable to the installations, as well as reactions of motorists and adjacent property owners.

If you would like to try temporary speed humps, CTRE's study team will help determine the installation design, assist with the installation, and evaluate/report the impacts of the speed humps before, during, and after installation. The team may also study the application and investigation of multiple speed humps at different spacings along a roadway or within a specific neighborhood.

The Iowa DOT's program to loan temporary speed humps to local agencies, which is funded by the Iowa Traffic Safety Improvement Program, will continue after CTRE has completed its study. If successful, the pilot program may lead to the Iowa DOT's purchase of additional temporary speed humps for use by Iowa communities.

For more information, or to express your interest in participating, please contact Keith Knapp, CTRE, 515-294-7082, kknapp@iastate.edu, or Tom Welch, Iowa DOT, 515-239-1267, twelch@max.state.ia.us. •

Portable speed humps may increase safety where excessive speed is a concern. *Photo courtesy of Recycled Technology, Inc.*

PCC pavement texture that provides traction without noise

"Pavement smoothness is the most significant measure motorists use to judge the quality of our nation's roads." National Quality Initiative highway user survey

"Noise could be reduced using longitudinal or random transverse tining without compromising friction." Chris Brakke, Iowa DOT

FOR YEARS, many people in the portland cement concrete (PCC) pavement industry have accepted that noisy roads are a necessary byproduct of pavement surface traction techniques such as transverse tining. Now, new specifications being used by the Iowa Department of Transportation (Iowa DOT) and others show that PCC pavement can provide both adequate traction and a quiet ride. Such PCC pavement surfaces may be just what motorists want.

Texture for traction

Because pavements can become slick when wet, their surfaces are often textured to provide increased friction for improved traction. On low-speed and/or low-volume roads—for example, municipal roads under 45 miles per hour, low-volume county roads, and state roads under 35 miles per hour—a roughened texture is normally created by dragging burlap or coarse carpet (artificial turf) over the surface before the concrete hardens. A broom finish may be used in lieu of or in addition to this finish.

On roads with higher speeds and/or higher traffic volumes—for example, state primary roads—the texture is made deeper to withstand more wear and tear. Tines are constructed by dragging mechanical or hand rakes over freshly laid concrete. Tining provides a longer lasting texture and reduces the water sheeting effect that causes hydroplaning. As a result, tining can help make roads safer.

Tining can be installed longitudinally or transversely. The texture created by transverse tining, however, often creates a whine when vehicles travel across the tines.

Longitudinal tining machine on PCC surface. *Photos on this page courtesy of Jim Grove, Iowa DOT.*

"Smooth," quiet roads are desired

According to a Federal Highway Administration (FHWA) National Quality Initiative survey, "Pavement smoothness is the most significant measure motorists use to judge the quality of our nation's roads."

In the pavement industry, "smoothness" is related to the condition and quality of roads, not to their surface texture. Motorists, however, judge the "smoothness" of roads not only by their rideability but also by their noise level. Noisy roads—including roads in excellent condition but with textures that cause humming or whining—are perceived negatively.

Several states are researching methods for reducing the noise of textured pavements without reducing traction. A final report on the subject is forthcoming from the Wisconsin Department of Transportation and FHWA.

Efforts in Iowa to decrease road noise

Iowa has demonstrated its commitment to satisfying motorists' desire for quiet roads. Nine test sections of PCC pavement were built in Iowa in 1993 in an attempt to reduce interior and exterior vehicle noise. The sections included uniform transverse, variable transverse, sawed transverse, diamond ground, and longitudinal textures.

"The [Iowa DOT] took a look at what Wisconsin and some other states were doing, evaluated our own test sections, and found that noise could be reduced using longitudinal or random transverse tining while achieving adequate friction," says Chris Brakke, pavement design engineer at the Iowa DOT.

As of last year, the Iowa DOT's new PCC pavements are either tined longitudinally or tined transversely with random spacing. Both methods, with respect to noise, are considered preferable to evenly spaced transverse tining.

Longitudinal tining, as opposed to random transverse tining, "allows you to get the curing compound on quicker—that's an added benefit," says Brakke. "But other than that, the choice between the two preferred methods is primarily a matter of what equipment contractors have."

And because highway users want a quiet ride, they are likely to be much more satisfied as they drive across these new PCC pavement surfaces.

For more information

Contact Chris Brakke, 515-239-1882, cbrakke@max.state.ia.us, or Center for Portland Cement Concrete Pavement Technology Director Dale Harrington, 515-294-8103, pcconc@iastate.edu. •

GASB 34: establishing a value for infrastructure assets

Tom Maze, Vice President, Howard R. Green Company

Editor's note: This is the fourth article in a series about issues raised for local transportation agencies by Governmental Accounting Standards Board Statement No. 34 (GASB 34). The first article was published in the January–February 2000 issue of Technology News. *The entire series, including a longer version of this article, is available on the Center for Transportation Research and Education's GASB 34 website, www.ctre.iastate.edu/gasb34/index.htm.*

ONE OF THE most complex issues for agencies attempting to comply with GASB 34 is developing objective and consistent procedures for estimating monetary values for infrastructure assets (that is, "capitalizing" assets). Whether an agency chooses to report assets by (1) depreciating their value based on historical costs or (2) using the modified approach outlined in GASB 34 (which applies asset management techniques), ultimately the agency must include the value of its infrastructure assets in its comprehensive financial reports.

Unfortunately, little research has been conducted to develop standardized methods for capitalizing infrastructure assets. In this article, we provide two possible approaches. The first, relatively simple approach applies the perpetual inventory method (PIM) to depreciate the value of highway infrastructure assets through time. The second example is taken from work done by the California Department of Transportation (CalTrans) to capitalize bridges. The CalTrans method is based on engineering measurements of the condition of bridges and requires a bridge management system; such a method would be useful to agencies using GASB 34's modified approach for reporting capital assets.

Perpetual inventory method

The perpetual inventory method, described by Barbara Fraumeni and exemplified in Table 1, is a depreciation method for valuing capital stock that can be applied to transportation infrastructure assets. PIM accounts for annual capital expenditures and assumes that existing capital assets depreciate in value at a standard rate every year.

The following equation estimates the total value of infrastructure assets on a year-by-year basis:

$$\text{Infrastructure Assets}_{year} = \text{Capital Investment}_{year} + (1-r)\ \text{Infrastructure Assets}_{(year-1),}$$

where $\text{Infrastructure Assets}_{year}$ = the value of infrastructure assets in the current year

$\text{Capital Investment}_{year}$ = the amount of capital investment in infrastructure assets in the current year

r = the annual depreciation rate of infrastructure assets

$\text{Infrastructure Assets}_{(year-1)}$ = the value of infrastructure assets in the year immediately prior to the current year

When using this formula, all capital investments should be expressed in constant dollars so that meaningful comparisons can be made across time. Constant dollars exclude inflation and express dollars in terms of a base year.

GASB 34 . . . continued on page 10

GASB 34 workshop

WANT to learn more about GASB 34? Register for the GASB 34 Educational Conference, August 31, 2000, in Des Moines. This event is cosponsored by the Iowa League of Cities, Iowa State Association of Counties, and CTRE. For more information, see www.ctre.iastate.edu/gasb34/index.htm. •

Table 1 Perpetual Inventory Method Example

Fiscal Year	Capital Investment during Current Year ($)	(1 – 0.0202) x Infrastructure Assets at the End of Prior Year ($)	Estimated Current Infrastructure Assets ($)
1980	1,200,000	100,000,000	101,200,000
1981	2,500,000	99,155,760	101,655,760
1982	3,000,000	99,602,314	102,602,314
1983	1,000,000	100,529,747	101,529,747
1984	500,000	99,478,846	99,978,846
1985	800,000	97,959,273	98,759,273
1986	750,000	96,764,336	97,514,336
1987	850,000	95,544,546	96,394,546
1988	700,000	94,447,377	95,147,377
1989	900,000	93,225,400	94,125,400
1990	2,500,000	92,224,067	94,724,067
1991	2,700,000	92,810,640	95,510,640
1992	2,500,000	93,581,325	96,081,325
1993	2,400,000	94,140,483	96,540,483
1994	2,900,000	94,590,365	97,490,365
1995	2,400,000	95,521,060	97,921,060
1996	2,200,000	95,943,054	98,143,054
1997	2,800,000	96,160,564	98,960,564
1998	2,550,000	96,961,561	99,511,561
	Total 35,150,000		

GASB 34 is only one reason to capitalize your transportation infrastructure

CAPITALIZING infrastructure assets like roads and bridges—that is, assigning a dollar value to them—may be useful beyond complying with GASB 34. For example, in addition to providing information that can be useful to infrastructure asset managers and decision makers, capitalizing transportation infrastructure may be helpful in garnering public and governmental support for transportation infrastructure funding.

Roads and bridges are intended to last for decades; therefore, failure to maintain their value saddles future generations with a deficiency they'll have to pay. The argument that adequate monies must be spent today to maintain the value of infrastructure assets for the next generation has proved to be a powerful and effective one. This stewardship argument has been used with great success by public agencies in other countries (e.g., Australia and New Zealand) to garner increases in funding for their roads and bridges, even when faced with the tough political circumstance of a recession.

Capitalizing roads and bridges allows the public to understand the stewardship issue more clearly. Expressing streets' value in dollar terms is generally more meaningful to people than expressing their value in engineering measures of "condition" or "performance" (e.g., inches of roughness per mile, condition indices, or other measures). This is especially true when year-by-year comparisons are made; the declining dollar value of a city's streets is generally more meaningful to the public than, for example, a reduction in the streets' condition index from 5 to 4. By tracking the dollar value of assets like roads and bridges, an agency may clearly demonstrate whether infrastructure is declining in value faster than new investments or reinvestments are being made. •

GASB 34 . . . continued from page 9

The example in Table 1 uses 1980 as a base year (as does GASB 34) and 100 million dollars as the base value of all transportation infrastructure assets (streets) in a mock Iowa municipality of 50,000 residents (based on Andrew Lemer's study of typical infrastructure investments). Capital investments, expressed in constant dollars, are allocated during each subsequent fiscal year; Barbara Fraumeni's average depreciation rate for transportation infrastructure assets, 0.0202, is used. To simplify our example, we assume no growth in the highway and street network.

Note that in our example the lower annual capital outlays in the mid to late 1980s result in a decline in the value of capital stock that continues through the next decade, although the decline is arrested through a large increase in capital spending.

Note also that a total capital investment of over 35 million dollars over 19 years is required to maintain the value of existing infrastructure assets at a level somewhat close to the value of those assets in 1980.

CalTrans's approach to valuing infrastructure

Although employing systems for managing assets, like bridge management systems, will generally fulfill GASB 34's modified approach requirements for reporting capital assets, such systems do not provide a method for capitalizing infrastructure assets. CalTrans uses information from its bridge management system to derive the bridge infrastructure values required by GASB 34.

CalTrans manages its bridge network using Pontis (a bridge management system distributed by the American Association of State Highway and Transportation Officials). With Pontis, bridge inspectors regularly inspect and rate the condition of the various elements in each bridge in their network. CalTrans has developed a formula for converting the condition ratings for all the elements in a bridge into an overall dollar value for the bridge.

Typically, using Pontis, inspectors rate each element of a bridge according to five conditions: protected, exposed, attacked, damaged, or failed. CalTrans assigns weights, or factors, to these conditions according to their severity, from 1 (protected) to 0 (failed), and determines the cost of failure (replacement cost) for each unit (meter, square meter, etc.) of an element.

CalTrans then uses the following equation to determine the value of each bridge element. The formula incorporates both the severity factor and the unit failure cost:

Current element value = quantity in condition state x WF x FC,

where WF = severity weighting factor

FC = failure cost of the element (cost to rehabilitate or replace a unit of an element if it fails

Note that a condition factor of 0 (failed) will always result in a 0 value for that element.

In Table 2, the formula is applied to determine the current value of each element of a bridge. The values of all elements are summed to calculate an estimated value for the entire bridge. Note that the steel girder has 61 meters rated 1 (protected), 34 meters rated 0.75 (exposed), and 5 meters rated 0.5 (attacked). At a replacement value of 3,500 dollars per meter, the total current value of the girder is 311,500 dollars. To obtain a current, network-level

GASB 34 . . . continued on page 11

GASB 34 . . . continued from page 10

estimate of the value of its bridges, CalTrans adds together the values of all bridges in its network.

Summary

In this article we have briefly summarized two methods for tracking the value of infrastructure assets. Either method would meet the requirements of GASB 34.

Many engineers and public works directors may view asset management and GASB 34 requirements as merely an academic exercise or as an activity that may be handled by their agency's financial officer. However, we would urge public works professionals and engineers to become engaged in the financial reporting of the value of the infrastructure assets they manage. Valuing assets over time (regardless of the method used) reflects how well infrastructure stewardship responsibilities were performed. The outcome could have significant implications on future resources allocated to the management of infrastructure.

The perpetual inventory method (as well as other depreciation-based methods) is a fairly simple approach to satisfying GASB 34 requirements. This method, however, provides only very aggregate, policy-level information. CalTrans's method, although a more complex process, clearly provides information that is more useful to infrastructure asset managers and decision makers. The CalTrans example demonstrates that the process of capitalizing transportation infrastructure assets can be based on sound engineering practices, using asset-by-asset condition information to build a value estimate for an agency's transportation infrastructure network.

References

Barbara M. Fraumeni, "Strategies for Measuring Productive Highway Capital Stocks," presented to the Transportation Research Board Conference for Information Requirements for Transportation Economic Analysis, Irvine, California, August 1999.

Andrew C. Lemer, "Asset Management: The Newest Thing or Same-old, Same-old?" *APWA Reporter*, June 2000.

Paul D. Thompson and Richard W. Shepard, "AASHTO Commonly Recognized Bridge Elements: Successful Applications and Lessons Learned," presented to the National Workshop on Commonly Recognized Measures for Maintenance, Scottsdale, Arizona, June 2000. •

Table 2 Bridge Valuation Calculation

Element	Calculation	Current Element Value ($)
Concrete deck	300 m^2 x 0.5 x $600	90,000
Steel girder	[(61 m x 1.0) + (34 m x 0.75) + (5 m x 0.5)] x $3,500	311,500
Abutment	24 m x 1.0 x $7,700	184,800
Column	4 x 1.0 x $9,000	36,000
Joint seal	24 m x 0.0 x $556	0.00
	Total Current Value of Bridge	622,300

Salvaging railroad flatcars as low-cost bridges

This article is the first of three exploring bridge replacement alternatives.

DEFICIENT and deteriorating bridges are creating major problems for both state and local highway agencies throughout the nation. Iowa is no exception. Iowa has significantly more bridges per capita than most states, which stresses the available tax dollars for implementing needed bridge replacements and repairs.

According to the 1999 Bridge Inventory in the November 1999 issue of *Better Roads*, 21,057 bridges—nearly 84 percent of Iowa's total—are located on Iowa's secondary road system. Of these secondary road bridges, 31 percent are rated as substandard. Therefore, much of the responsibility for bridge replacement falls to Iowa's county agencies, making it necessary to develop cost-efficient, durable, and easy-to-install options for low-volume roads.

One possible solution

Wayne Klaiber, professor of civil and construction engineering at Iowa State University (ISU), Terry Wipf, professor of civil and construction engineering and bridge engineer at ISU's Center for Transportation Research and Education, Jim Witt, county engineer for Cerro Gordo and Winnebago counties, and Thomas Threadgold, a structural engineering graduate student at ISU, conducted a study sponsored by the Iowa Highway Research Board on a low-cost bridge alternative that uses salvaged railroad flatcars (RRFCs) as bridge superstructure.

The research team determined that salvaged RRFCs are a "safe and feasible bridge alternative" to aid Iowa counties in constructing short-span bridges for low-volume roads.

RRFC BRIDGES . . . continued on page 12

Construction of the Tama County RRFC bridge.
Photo courtesy of the Tama County engineer's office.

RRFC BRIDGES . . . continued from page 11

An overview of salvaged RRFC bridges

Salvaged RRFCs form the superstructure of the bridges. RRFCs are available in various lengths, making it possible to construct bridges of different lengths. The cars can also be joined to create varying bridge widths before being placed on standard abutments. Commonly, the driving surface of the bridge consists of timber planks and metal grating. Salvaged RRFC bridges can be constructed with or without guardrails, depending on location.

After conducting a survey of bridge engineers in the United States and Canada, Klaiber and Wipf determined that states with large rural populations, such as Oklahoma, Texas, Arkansas, Wyoming, and Montana, are most likely to employ salvaged RRFC bridges on county or private roads. Although California uses salvaged RRFCs to create an emergency bridge system, no states report permanent RRFC bridges on state highway systems.

The Iowa research

Wipf and Klaiber worked with former Tama County Engineer Robert Gumbert to test and analyze Iowa's only salvaged RRFC bridge, located on a rural access road in Tama County. The Tama County bridge consists of two salvaged RRFCs placed side-by-side on timber abutments. Metal grating covers the entire bridge surface, and timber planks spanning the center of the bridge create the driving lane.

According to Gumbert, the Tama County bridge was installed in 1986 to replace a deteriorating bridge. "We looked at the options of closing the road, building a new bridge, installing culverts, or using [salvaged] railroad flat cars. We decided that railroad cars were the best option," Gumbert said.

The research team created computer models and field-tested the Tama County bridge to determine strains in the bridge with and without connections between the flatcars. The field tests indicate that connections have minimal influence on the behavior of the bridge.

Both the theoretical and experimental data collected by the research team suggest that RRFCs are structurally adequate as a bridge superstructure, and that the Tama County bridge is capable of carrying legal Iowa highway loads.

"[During the research team's load testing,] the [Tama County] bridge turned out much stronger than anyone thought it would," Gumbert explains.

Salvaged RRFC bridge safety

Klaiber foresees no difficulty with the use of salvaged RRFC bridges and emphasizes the safety of these structures. "Properly engineered, railroad flatcar bridges are fine structures, and there is no danger to the public," he explains.

Salvaged RRFC bridges employ only railroad cars that have sustained no damage during railroad use and have not reached the age for mandatory retirement. The cars used in bridge construction have been retired for economic reasons. That is, their repair costs have become exorbitant, or they have been replaced by cars with more cost-effective designs.

Gumbert also expresses the safety of RRFCs. "Railroad flatcars are designed to carry tremendous loads, and that makes them very strong as bridges," he says. Salvaged RRFCs experience significantly reduced loads as bridges than the 50 to 100 tons they were designed for.

Benefits of salvaged RRFC bridges

Salvaged RRFC bridges are low maintenance and can span various lengths. Their primary benefits, however, are low cost and quick installation.

Skipp Gibbs Company, a California company specializing in ready-to-install bridge superstructures, estimates savings between 30 and 70 percent of the cost of conventional bridges. The low cost results from installation speed, ease of design, long life, low maintenance, and length of span.

"Railroad flatcar bridges are cheap, quick, and very strong," Gumbert says of his experience with the Tama County bridge. He estimates the time to install the salvaged RRFC at about a day. The abutments were installed beforehand.

Reactions

Gumbert and the Tama County engineer's office would not hesitate to use RRFC bridges in the future. "Since [the installation of the Tama County RRFC bridge], we have always thought it was an attractive option, but we have not run across another good location," Gumbert says.

According to Gumbert, the public has also reacted favorably to the salvaged RRFC bridge. "The people that use the bridge are happy to have a bridge that is wider and stronger than the previous bridge," he explains.

For more information

For information about Iowa's research, contact Terry Wipf, 515-294-6979, wipf@iastate.edu, or Wayne Klaiber, 515-294-8763, klaiber@iastate.edu. For information on the Tama County bridge, contact the Tama County engineer's office, 515-484-3341.

To obtain a copy of the research team's final report to the Iowa DOT, *Use of Railroad Flatcars for Low-Volume Road Bridges*, funded by the Iowa Highway Research Board, TR-421, or the December 1991 report, *Bridges Constructed from Railroad Cars*, conducted for the Arkansas State Highway and Transportation Department by Thomas J. Parsons of Arkansas State University, contact Stan Ring, CTRE's library coordinator, 515-294-9481, sring@iastate.edu. •

East and west: Iowa is bordered by new National Scenic Byways

On June 15, 2000, the Great River Road and the Loess Hills Scenic Byway officially became Iowa's first National Scenic Byways.

The National Scenic Byways Program was created to preserve and protect the nation's scenic byways while promoting tourism and economic development.

Through a "grass roots" application process, byways receive designation following review by a panel of experts. Byways are selected based on their important scenic, natural, historical, cultural, archaeological , or recreational qualities. Corridor management plans incorporate how the byway organization will preserve and protect the intrinsic qualities of the byway.

About 25 million dollars is available for the byways annually. However, no specific funding amount is given to any state; instead, funding is distributed in response to applications with priority given to projects consistent with the byway's corridor management plan.

The Great River Road tracks the Mississippi River for 326 miles from Iowa's northern to southern borders. The Loess Hills Scenic Byway winds 220 miles in seven counties through the unique landscape along the eastern edge of the Missouri River Valley.

For more information on Iowa's National Scenic Byways or the National Scenic Byways Program, contact Jan Thompson, Iowa Division, Federal Highway Administration, 515-233-7324, or Margaret Roetman, Iowa Department of Transportation's Scenic Byway Coordinator, 515-239-1792, or visit National Scenic Byways Online, www.byways.org. •

CTRE welcomes new writer/editor

Mark Anderson-Wilk joins the publications team at the Center for Transportation Research and Education. Mark comes from the University of Chicago Press, where he was an editor at the *Astronomical Journal*. His specialization has been in editing technical and scientific manuscripts. He earned his MA degree in English at the University of Minnesota.

Mark will be writing articles for various publications, including *Technology News*, and editing reports and software manuals. •

Staff snafu

In April we introduced CTRE's newest transportation engineer, Gary Thomas. The article incorrectly stated that Gary was originally from Minnesota. Actually, he hails from Wisconsin.

Sorry for the slip, Gary. •

library resources

Library news

THE LOCAL TECHNICAL ASSISTANCE PROGRAM (LTAP) library at the Center for Transportation Research and Education has some great new videos, a few of which are described below. You can borrow these or other library materials any of three ways:

- Order online at www.ctre.iastate.edu/Outreach/ltap/library/search.cfm.
- Use the order form of the back of this newsletter.
- Contact Stan Ring, library coordinator, 515-294-9481, sring@iastate.edu. •

Stan Ring, LTAP library coordinator

V 628 Mini-Roundabouts: Getting Them Right—Parts I and II. This video was taped at a seminar by Clive Sawers, a British designer and expert on roundabouts. He explains the history and development of traffic circles and their evolution to roundabouts, with considerable details about the fundamentals of roundabouts operations.

V 629 I-70/Vail Road. This video is about North America's first roundabout interchange. It shows the interchange operating with little delay during peak Christmas vacation tourist traffic. It also shows how ramp and frontage road interchanges were converted, increasing capacity by over 50 percent.

V 630 Non-Conforming Traffic Circle Becomes Modern Roundabout. This video, produced for the California Department of Transportation, explains the conversion of an old 470-foot–diameter nonconforming traffic circle into a modern roundabout. It carries 5,000 vehicles per hour, has reduced accidents, and has improved operations to level of service A, making it one of the most efficient high-capacity intersections in the United States.

V 631 Snow at Roundabouts. This video shows footage in Norway before the 1994 winter Olympics with modern roundabout interchanges under deep snow.

V 632 Modern Roundabouts. This video explains the difference between modern roundabouts and nonconforming traffic circles and gives advantages of disadvantages of modern roundabouts compared to signalized cross intersections. It includes high-capacity roundabouts, mini-roundabouts, and modern roundabout interchanges.

V 633 Designing Neighborhood Streets. This video includes presentations at the International Conference on Transportation and Sustainable Communities held March 23–26, 1997.

V 625 Danger Signs. This video contains footage of the trial of sign vandals who removed a stop sign as a prank. As a result of the vandals' prank, three 18-year-old boys drove through an intersection and were struck and killed by an eight-ton truck.

tip from the field

Eliminating leaning sign posts

IN HIS NEW POSITION as traffic control technician with the Clinton County Highway Department, Raymond Myers uses a large truck with a hydraulic boom and auger to install signposts. Using the auger to dig a straight hole and then installing a post is easy, but compacting the soil enough to keep the post straight has been a challenge. With all the precipitation in Clinton County earlier this year, more rain and wind easily make a newly installed post lean inside its eight-inch hole where the soil has been disturbed, even with the addition of gravel or lime.

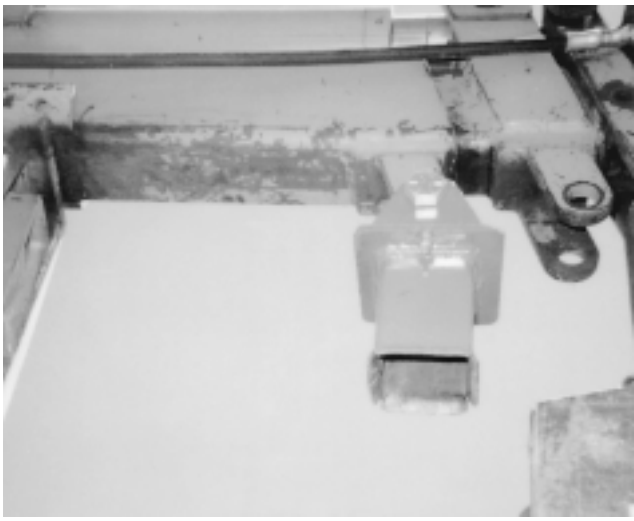
To alleviate this problem, Myers invented a receiver for the post. Mounted to the underside of the hydraulic boom, the receiver allows him to push posts into the ground. With the soil undisturbed, posts stay straight.

TIP . . . continued on page 15

conference calendar

July 2000			
25	Motor Grader Operator Workshop	Cherokee	Sharon Prochnow 515-294-3781, prochnow@iastate.edu
August 2000			
8	Motor Grader Operator Workshop	Mason City	Sharon Prochnow 515-294-3781, prochnow@iastate.edu
8–11	Work Zone Safety Workshops for Utilities	Sioux City	Tom McDonald 515-294-6384, tmcdonal@iastate.edu
16	DOT Flagger Training	Red Oak	Tom McDonald 515-294-6384, tmcdonal@iastate.edu
17	DOT Flagger Training	Council Bluffs	Tom McDonald 515-294-6384, tmcdonal@iastate.edu
31	GASB 34 Educational Conference	Des Moines	David Plazak 515-294-8103, dplazak@iastate.edu
September 2000			
6	DOT Flagger Training	Cedar Rapids	Tom McDonald 515-294-6384, tmcdonal@iastate.edu
7	DOT Flagger Training	Cedar Rapids	Tom McDonald 515-294-6384, tmcdonal@iastate.edu
12–13	Iowa Maintenance Training Expo	Ames	Duane Smith 515-294-8103, desmith@iastate.edu
14	Snow Plow Roadeo and Motor Grader Roadeo	Ames	Duane Smith 515-294-8103, desmith@iastate.edu
October 2000			
11	DOT Flagger Training	Davenport	Tom McDonald 515-294-6384, tmcdonal@iastate.edu
12	DOT Flagger Training	Peosta	Tom McDonald 515-294-6384, tmcdonal@iastate.edu
19	Iowa Secondary Road Maintenance Supervisors Association	Ames	Sharon Prochnow 515-294-3781, prochnow@iastate.edu
26–27	Iowa Traffic Control and Safety Association Annual Conference/25th Anniversary Celebration	Ames	Tom McDonald 515-294-6384, tmcdonal@iastate.edu
31–Nov 1	Iowa DOT Highway Safety Networking Conference	Council Bluffs	Tom Welch 515-239-1267

Ray Myers's hydraulic boom–mounted receiver for installing sign posts (perspective is from below the receiver).



TIP . . . continued from page 14

The receiver is constructed of a piece of four-inch square tubing, six inches long, cut at the corners and flared slightly. The attaching piece is triangular and welded to a cover plate with a 1.25-inch hole to accept a bolt and nut. After installing the post into the receiver, a small hole accepts a light nail for holding the post; this allows the unit to be swung into position. The unit can swing in and out and hangs straight, making it easier to insert the post into the ground straight. If corrections need to be made in the other direction, the swing feature of the boom can do that. The knuckle boom allows positioning of the post.

For more information about the post receiver, contact Raymond Myers, 319-659-8230. •

WWI trucks and Iowa's highway commission

Stan Ring, CTRE's Library Coordinator

FOLLOWING the armistice of World War I, the US Army made surplus vehicles available to the Iowa State Highway Commission (ISHC). According to the February-March 1920 *ISHC Service Bulletin*, Iowa received 578 War Department trucks, ambulances, and motor cars; 572 of the vehicles were new. The value was estimated at 2.5 million dollars.

More than half the vehicles were distributed to the counties. The ISHC kept 272 of them. These trucks were modified to serve as snow plows and graders and to perform other maintenance services.

To store the vehicles, ISHC leased a tract of land on the south side of Lincoln Highway and west of Grand Avenue in Ames. Four buildings were erected at a cost of 43,000 dollars to serve as storage buildings and repair shops. The 1920 ISHC annual report noted that at least four more buildings were needed.

Later, through donations, the people of Ames were able to purchase the land and give it to ISHC with the contingency that its headquarters remain there. Some of the original buildings are still in use as offices at today's Iowa Department of Transportation. •

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