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IOWA STATE UNIVERSITY
Institute for Transportation

De-paving: A potential option for some of Iowa's low-volume roads

With escalating costs and bare-bones budgets, Iowa's local road agencies are looking for alternative solutions for maintaining or reconstructing worn-out paved roadways. Although the problem is most acute in rural areas, some small municipalities are also affected.

One option is to revert failing low-volume paved roadways to aggregate/gravel-surfaced roadways (gravel roads). This article provides an overview of this potential solution.

The need for low-cost alternatives

For several decades beginning in the 1960s, thousands of miles of Iowa's rural gravel roadways—especially farm-to-market roads—were paved. This paving spree was part of a national trend, reflecting the needs of the farm economy, high demand from the rural population, and relatively flush local roads budgets.

Since many of these roads were paved, their traffic volumes and types have changed. Mega-sized agricultural equipment is now common, as is heavy truck traffic for rural

agribusiness and commercial development. Rural subdivisions create pockets of high average daily traffic (ADT) on commuter roads. As a result, many rural pavements are experiencing very different traffic than they were designed for.

Today, many of these pavements are reaching the end of their life spans—some of them literally crumbling apart. For some paved rural roads, damage related to extremely wet springs in recent years has been the final death rattle.

Meanwhile, the cost of maintaining, rehabilitating, and replacing paved roadways has soared. For example, the cost of asphalt cement—a petroleum-based material—has more than doubled in the last 10 years. During the same period or longer, local road agency revenue shortfalls have become the norm, especially during the recent national economic downturn.

Without significant funding increases, it will be impossible to continue maintaining and/

DE-PAVING continued on page 3



Truck loadings on rural roads have significantly increased since many of the roads were first paved (photo courtesy of SD LTAP)

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

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From the director: Opportunities and options



In 2012 Iowa LTAP will continue to look for training opportunities and explore options. The need for technical training for local agencies continues to increase, and we are working to serve that demand as best we can. As I've indicated in several of my columns, Iowa LTAP is always looking for new ideas and/or resources that allow use to serve you better.

New website

We will be updating our website this year. It will have a new look, and we hope it will expand it into a more useful resource of information about locally relevant extension/outreach efforts in Iowa and locally applicable research results. The website will be a work in progress this year.

Connecting you with training you need

Iowa LTAP isn't able to offer training in every subject that is needed every year, but we keep your suggestions in mind. We also keep an eye out for other people and organizations that may offer training on those subjects within Iowa. The route surveying course we co-sponsor with DMACC is one example of this approach.

Our new online registration system, which some of you may have already experienced, will allow us to include in our calendar other organizations' training workshops and webinars that may be

of interest. We need to determine, however, which training opportunities are relevant and useful to local agencies and the most effective manner to share that information.

The amount of training, particularly online, seems to be expanding exponentially. I think I get information about something almost every day. Some workshops—like the soon-to-be-released online Gravel Road Maintenance and Design training being developed by Minnesota LTAP and the Minnesota DOT's Local Road Research Board—will need to be reviewed and shared.

Strategic planning

We are also thinking further down the road. In April we will be holding the first Iowa LTAP strategic planning meeting. The objective is to gather information that will be used to guide decision-making at Iowa LTAP for long-term success.

Highlights of recent and upcoming events

In February we hosted the Federal Highway Administration's Every Day Counts (EDC) Exchange initiative (www.fhwa.dot.gov/everydaycounts/) webinar on geosynthetic reinforced soil (GRS) at three locations in Iowa. Iowa's Brian Keierleber from Buchanan County was one of the speakers for this nationally-broadcast webinar. The webinar was recorded and will be posted online. The next EDC-Exchange webinar is on April 19, and the topic is flexibility in the ROW.

Registration for several workshops in 2012 is currently open and more are being planned. Registrations are being accepted for 10-hour OSHA training from ARTBA, bridge inspection classes, and motor grader operator training. Other subjects being considered for later this year include accessibility, concrete pavements, asset management, and excavation safety.

Have a good 2012.

Keith

DE-PAVING *continued from page 1*

or reconstructing all of Iowa's deteriorated paved roads. One option is simply to reduce or eliminate maintenance of low-volume paved roads.

Local road agencies in several states (California, Indiana, Maine, Michigan, North Dakota, Ohio, South Dakota, and Vermont) have been experimenting with another option: "de-paving" very low-volume roadways, reverting them to gravel roads.

Is de-paving cost effective?

For several years ending in 2010, Ken Skorseth, field services manager for the South Dakota LTAP at South Dakota State University, working with the SD DOT, collected data from 26 counties (120 roadway sections) and analyzed 20-year life-cycle costs for three road surface types:

- Gravel.
- Blotter (asphalt surface treatments such as prime/chip seal on aggregate base).
- Hot-mixed asphalt pavements.

The results of the study were fairly straightforward: In general, gravel surfacing is cost effective for roadways experiencing up to 170 ADT (150 ADT if user costs are considered).

According to the South Dakota study, gravel roads with traffic volumes higher than 170 ADT have extensive aggregate loss, require frequent blade maintenance, and will have extensive loss of fine material due to road dust, which can also be an environmental as well as a safety problem. All of this results in high life-cycle costs and reduced performance. Above 300 ADT, it is almost

impossible to maintain even marginal quality gravel surfaces.

These findings are similar to those of a 2005 InTrans study for the University of Minnesota's Center for Transportation Studies. The Iowa researchers found that gravel surfacing is cost effective when daily traffic averages less than 200 vehicles.

Keys to success

In recent years, several counties in South Dakota have successfully experimented with reverting low-volume roadways from asphalt to gravel surfacing. Based on their experiences and his earlier research, Skorseth has become the national go-to person for information and advice about de-paving projects and has developed several basic tips to help ensure success:

Effective public communication

Reverting a paved roadway to a gravel one can involve a political battle. It is common for the affected residents to resist this change. Good communication is your best option for gaining public support:

- Prepare simple documentation that clearly presents the following information:
 - Total road funds available and the current or projected shortfall to maintain the road network.
 - Cost comparisons of paved and unpaved alternatives.
 - Planned construction, summer maintenance, and winter maintenance activities.
 - Success stories from other jurisdictions.

In recent years, several counties in South Dakota have successfully experimented with reverting low-volume roadways from asphalt to gravel surfacing.

- Communicate with affected residents, personally whenever possible but also via brief, informative mailings.
- Communicate with the general public via public meetings, your website, and news media.

In spite of initial negative reactions, most jurisdictions have experienced public acceptance after a smooth gravel road has been constructed.

Data-based roadway selection

Skorseth suggests that failing paved roadways may be good candidates for reverting to gravel under the following conditions:

- Very low traffic volume (he suggests approximately ≤ 100 ADT).
- Low percentage of truck traffic.
- Nearby source of aggregate/gravel/ recycled aggregate.

David Creamer, a field operations specialist at the Center for Dirt and Gravel Road Studies at Pennsylvania State University, suggests that some hard-surfaced roadways may be candidates for surface recycling. According to Creamer, new technology allows asphalt to be recycled into a durable gravel-like surface that is cheaper to maintain and adequately prevents potholes and mud.



(L) A badly deteriorated low-volume paved roadway in SD that might be a candidate for de-paving
(R) Deuel Co. (SD) road turned back to gravel in mid-1980s; photo taken August 2010
(photos courtesy of SD LTAP)

Iowa LTAP Mission

To foster a safe, efficient, and 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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Dealing with frost boils and heaves

The unseasonably mild winter of 2011–2012 may mean that Iowa's road maintenance crews will have a below-average "crop" of spring frost boils and frost heaves to deal with. But some roadway upheavals are inevitable, especially in counties that have received more snow and/or experienced colder temperatures. Such damage can occur in paved roadways, but the following overview focuses on gravel- or aggregate-surfaced roads.

What causes frost boils and heaves?

Although they are not the same, the terms frost boils and frost heaves are often used interchangeably. Both forms of damage involve the breaking up of a section of roadway surface where moisture from spring thaws and/or precipitation cannot drain adequately. The damage from both frost boils and frost heaves is often large and deep enough to make a roadway impassable. The potential for damage is increased after a severe winter, which deepens the frost layer, and/or where significant late-winter or early-spring precipitation further saturates the soil.

As temperatures begin to rise in the spring, frozen moisture in roadway surfaces and supporting layers starts thawing from the top down. Depending on the amount of frozen moisture in the ground, melting winter snow, and spring rain, and the extent to which drainage is inhibited, the result is a saturated, muddy roadway surface, which is a problem in itself.

The bigger problems occur in the support layers, as far down as the frost line. During the cold winter months, moisture in these layers freezes and expands. As spring temperatures warm the support layers, the melting frost may produce a fluid subgrade condition that provides little or no support. Under traffic, the pressure is relieved through the point of least resistance—up through the roadway surface—producing a mound of mud, or boil. The boil is a visual indication that the roadway is not stable.

During the spring, the ground is subjected to repeated freeze-thaw cycles. When drainage is inadequate and soils are frost-

susceptible, ice lenses form that destabilize and heave the soil, causing an upheaval of the roadway surface. Frost heaves are most prevalent where there are silt and clay subgrades.

How can damage be repaired?

The only sure cure for frost boils and heaves is a sustained period of wind, sun, and dry weather to dry the roadway and allow for thorough road repairs and enhancement of drainage.

In the meantime, check for blockages in the ditch that can be removed to improve drainage immediately, which may prevent further damage.

Stopgap-only measures to allow traffic on the affected roadway generally involve temporarily reinforcing heaved or soft spots. This is generally accomplished by spreading rock on the affected areas.

Focus first on soft spots in the worst places, and on priority trouble spots like bridge approaches and intersections with paved roads.

Timing is critical: Don't start randomly hauling rock, but plan to work when the frozen roadway will support the load, such as early in the day while the road is still stiff from low nighttime temperatures.

If possible, remove water-soaked material and/or pull in the roadway edges and build up the crown to help moisture drain off the road. Then spread and compact the rock.

When laying rock as a stopgap measure, Warren County uses a pull-behind roller to compact the surface. Although this requires using two motor graders and trucks to pull the roller and haul rock, rolling makes the temporary repair last longer, according to Eric Thompson, road superintendent.

Back-dumping is a strategy for spreading rock with a minimum of damage to the road. Back-dumping puts a layer of rock down ahead of the truck so the truck doesn't travel directly on saturated ground. It can be especially useful in special situations like cemetery access roads.

Pavement marking options for Iowa's low-volume rural roads

by Tom McDonald, safety circuit rider, and Bob Sperry, local agency safety liaison

With today's budgetary constraints, some local agencies are questioning the cost effectiveness of installing and maintaining pavement markings on low-volume rural roads. This article provides a brief overview of this topic.

Iowa's paved rural road system

As a result of a major program initiated in the 1960s, thousands of miles of Iowa's farm-to-market and other important local roads were paved. Today Iowa has an extensive system of paved rural (secondary) roadways—about 18,000 miles—of which approximately 8,500 miles carry only 400 vehicles per day (vpd) or less. In addition, many more miles of low-volume rural roads have been improved with surface treatments such as seal-coating to provide a dust-free driving surface.

It has been common practice for counties to enhance such roadways with pavement markings, including white edge lines and yellow centerline and no-passing markings. (In addition to the yellow pavement markings, in Iowa no-passing zones are indicated with a No Passing Zone pennant warning sign (W14-3).) These markings provide improved guidance for drivers, particularly at night, and can help in reducing run-off-road crashes.

MUTCD requirements

Based on the *Manual on Uniform Traffic Control Devices* (MUTCD), however, these pavement markings are not required on most paved secondary roads in Iowa. The two primary factors are roadway classification and traffic volume, or vpd.

The pertinent MUTCD requirements, recommendations, and guidelines regarding markings for paved roadways are outlined below.

Centerline markings (for urban arterials and collectors)

Section 3B.01 of the MUTCD requires that centerline markings be placed on all urban arterials and collectors with traffic volumes of 6,000 vpd or more. This section recommends centerline markings on paved urban



Deteriorating low-volume county roadway in Iowa (photo courtesy of Tom McDonald)

arterials and collectors with traffic volumes of 4,000 vpd or greater.

Centerline markings (for rural arterials and collectors)

Section 3B.01 of the MUTCD recommends centerline markings on rural arterials and collectors with traffic volumes of 3,000 vpd or greater.

Centerline markings can be placed on other paved two-way roads as an option; an engineering study can be used to justify this option.

No-passing zone markings

Section 3B.02 of the MUTCD requires no-passing zone pavement markings on roads where centerline markings have been placed; this section provides guidance for establishing those zones.

Edge line markings

Section 3B.07 of the MUTCD requires edge line markings in several situations, including freeways, expressways, and rural arterials with traffic volumes of 6,000 vpd or greater.

This section recommends edge line markings on rural arterials and collectors with traffic volumes of 3,000 vpd or greater and other locations where an engineering study or judgment indicates a need. Edge lines can be used with or without centerline markings.

Clearly, the MUTCD does not require centerline, no-passing zone, and edge line markings on low-volume paved rural roadways. Reducing or eliminating maintenance of these enhancements on such roads, therefore, could potentially be a legitimate cost-saving endeavor for Iowa counties.

Procedural considerations

Such pavement markings, however, do perform safety functions. Any discontinuation of their installation and/or maintenance should be undertaken only after appropriate study and public discussion.

A formalized procedure could be adopted for discontinuing pavement markings on selected paved roads. Following are several items to consider for such a procedure:

Criteria for selecting roadway segments for discontinuation of markings

- Data such as traffic volumes, annualized cost of maintenance.
- Common practices by other agencies, etc.
- Performance of a detailed engineering feasibility study.

Communicating with the public:

- The proposed procedure and rationale should be given to county supervisors.
- A public information effort should be undertaken.

DE-PAVING *continued from page 3***Good design with adequate support**

Inadequate base strength under an existing paved surface can make reconstruction to a gravel-surfaced road more difficult and expensive.

If the roadway carries any heavy loads, a deeper layer of surface gravel will be required. Depending on the condition of the subgrade and the estimated number of heavy loads daily, the depth of the surface layer should range from 6.5-in. deep for up to 5 heavy trucks daily on a roadway with low subgrade support, to 14.5-in. deep for up to 50 heavy trucks daily on a roadway with low subgrade support. (Low subgrade support is defined as average California Bearing Ratio ≤ 3 percent.)

Stabilizing the top few inches of gravel may be appropriate on some roads with heavy loads. Skorseth has documented success with liquid magnesium chloride, Bentonite™, and pelleted calcium chloride but

does not have good life-cycle data on these surfaces.

Skilled, knowledgeable motor grader operators

Skorseth emphasizes that construction and maintenance costs will rise if a jurisdiction doesn't have well trained, skilled motor grader operators.

Effective dust control

Using appropriate materials and processes for stabilizing or reducing dust on gravel roads is important not only to help maintain not only good surface conditions but also the goodwill of residents.

For more information

Contact Ken Skorseth, 605-688-4138, ken.skorseth@sdstate.edu.

Following are several online resources:

- Taylor, Charles. "Counties turn some paved roads back to gravel." *NACO County News* (online), Vol.

42, No. 23, Dec. 13, 2010. www.naco.org/newsroom/countynews/Current%20Issue/12-13-10/Pages/Countiesturnsomepavedroadsbacktogravel.aspx (accessed Oct. 2011)

- *Economics of Upgrading an Aggregate Road*, Local Roads Research Board, Minnesota DOT, Jan. 2005. www.lrrb.org/pdf/200509.pdf (accessed Dec. 2011)
- Etter, Lauren. "Roads to Ruin: Towns Rip Up the Pavement." *Wall Street Journal* (online), July 17, 2010. <http://online.wsj.com/article/SB10001424052748704913304575370950363737746.html> (accessed Oct. 2011)
- SD DOT study: www.state.sd.us/Applications/HR19ResearchProjects/oneproject_search.asp?projectnbr=SD2002-10 (temporarily unavailable as *Technology News* goes to print)

Editor's note: Many thanks to Ken Skorseth for providing resources and reviewing this article.

FROST BOILS *continued from page 4***What are some preventive measures?**

The common denominator for preventive measures is improving drainage. In the spring, notice new or severe problem areas and put them at the top of your list for good-weather repairs and drainage improvements. Options include the following:

- Lowering or otherwise improving the side ditches. This lowers the water table beneath the roadway. It also helps keep the grade from becoming saturated by promoting drainage.
- Tiling.
- Bridging over the problem area. Remove the roadway surface to a depth of two

feet, then place stone and engineering fabric below a final top layer of aggregate or gravel.

- Coring down below the frost line in the center of the road and filling the bore hole with calcium chloride. The chloride helps to melt the ice lens, and the bore hole allows moisture to drain.
- Maximizing spring drainage by following good maintenance practices during the summer season. Clean ditches. Correct secondary ditches created by vegetation or windrows that obstruct water drainage from the roadway. Grade the crown for a four to six percent slope. Ensure a

uniform layer of well graded granular material for a dense crust.

- As budgets allow, improving spring drainage during the winter by removing snow and ice from the roadway and pushing snow banks away from the roadway.

For more information

The Iowa LTAP's Stanley L. Ring Memorial Library has a video about the causes and effects of frost action in soils with excellent explanations and discussions of problem solutions. Contact Jim Hogan, library coordinator, 515-294-9481, hoganj@iastate.edu. Ask for DVD 266, *Frost Action in Soils*.

PAVEMENT MARKINGS *continued from page 5***Implementation process**

- Phased implementation, beginning with the lowest vpd paved and/or seal-coated roads.
- Installation of advisory signing at each end of selected segments, and at any paved intersections within those limits, describing the absence of maintenance of pavement markings.

- Possible exception(s) to discontinuation of markings, such as edge line markings through high-degree horizontal curves.
- Retention of No Passing Zone pennants until the pavement markings have entirely deteriorated.
- Thorough record-keeping of any crashes and subsequent public reactions.

- Potential expansion of the program to higher-volume paved roads.

For more information

Contact Tom McDonald, 515-294-6384, tmcdonal@iastate.edu.

Conference calendar

March 2012

19	Work Zone Safety Workshop: County, City, Utility	Mason City	Tom McDonald 515-294-6384 tmcdonal@iastate.edu www.cpm.iastate.edu/workzone
20	Work Zone Safety Workshop: Construction, Maintenance	Mason City	Tom McDonald 515-294-6384 tmcdonal@iastate.edu www.cpm.iastate.edu/workzone
21	Work Zone Safety Workshop: County, City, Utility, Construction, Maintenance	Ames	Tom McDonald 515-294-6384 tmcdonal@iastate.edu www.cpm.iastate.edu/workzone

April 2012

19	FHWA Every Day Counts-Exchange: “Flexibility in ROW”	Ames (webinar)	Keith Knapp 515-294-8817 kknapp@iastate.edu
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June 2012

21	FHWA Every Day Counts-Exchange: “In-Lieu Fees/Mitigation Banking”	Ames (webinar)	Keith Knapp 515-294-8817 kknapp@iastate.edu
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August 2012

16	FHWA Every Day Counts-Exchange: “Adaptive Signal Control Technology”	Ames (webinar)	Keith Knapp 515-294-8817 kknapp@iastate.edu
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September 2012

11–12	Snow Plow Operators Training (SPOT)	Des Moines	Karen Koppenhaver 515-294-4152 kkoppenh@iastate.edu
13	Equipment Rodeo	Des Moines	Karen Koppenhaver 515-294-4152 kkoppenh@iastate.edu
25–27	Iowa Streets and Roads Workshop and Annual Conference	Ames	Beth Richards 515-294-2869 brich@iastate.edu

*Making Every Day Count (EDC)

On February 16, 2012, Iowans at three Ames locations participated in the EDC-Exchange webinar on geosynthetic reinforced soils.

Iowa LTAP is working with the Iowa Division of FHWA to host a series of these new, FHWA-sponsored, dynamic webinars. The goal is to help street, road, and highway agencies accelerate the implementation of “market-ready” transportation technologies.

The *free*, three-hour webinars are broadcast to specific locations around the country,

including sites in Ames. Each event consists of presentations by content experts, facilitated discussions at the local sites, and a Q/A period between the content experts and participants across the country.

For more information about EDC, and detailed information about the five focus areas of innovation, visit www.fhwa.dot.gov/everydaycounts/index.cfm.

Iowa LTAP welcomes Karen Koppenhaver

In December 2011, Karen Koppenhaver joined the Iowa LTAP team as program coordinator. She also spends part of her day as secretary to InTrans.

With more than 20 years of experience at Iowa State University, Karen has jumped into her new LTAP role with enthusiasm. Already she has participated in planning committee meetings for the September 2012 rodeo and snow plow operator training—two of the biggest Iowa LTAP–hosted events of the year.

She is enjoying the challenge of organizing events all around the state and looks forward to getting to know LTAP partners and clients.

Welcome, Karen!



Online registration

Information and registration details about transportation-related training events sponsored by LTAP, InTrans, or other organizations are available via the online calendar, www.intrans.iastate.edu/mors/calendar/.

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