

KUTC Newsletter

Winter 2001

A Local Technical Assistance Program (LTAP) of The University of Kansas Transportation Center
In cooperation with Kansas Department of Transportation and Federal Highway Administration

An issue dedicated to paving and road maintenance

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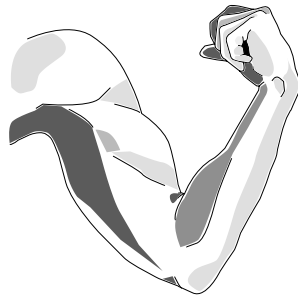
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Add Some Muscle to Your Chip Seals

How to design a chip seal process that can hold up in heavy traffic

... by Lisa Harris

Broken windshields. Noisy roads. Short-lived pavement. These are reasons why road managers shy away from chip-sealing on high-volume roads. But what if these problems could be reduced? Chip-sealing is an economical way to repel water and extend pavement life, and with careful attention to the process, it could be a viable option for high-volume as well as low-volume roads.

The American Society for Testing and Materials (ASTM) published a study in 1998 describing methods of constructing chip seals on high volume pavements (approx. 30,000 ADT) to reduce or avoid these problems. This article will outline the study's recommendations for building stronger and more cost-effective chip seals.

The study outlines these common problems associated with chip seals on high-volume roads:

- *Vehicle and windshield damage, due to:*
 - excess chips
 - inadequate traffic control
 - inadequate sweeping
- *Short life expectancy, due to:*
 - inadequate binder quantity
 - substrate pavement too cold
 - binder too cold

—cool or cold weather immediately after construction

—submergence of chips in substrate pavement

—loss of binder adhesion or cohesion

- *Tire noise and roughness, due to:*

—large one-sized aggregate

The study looked at a wide variety of possible solutions to the above problems at over 20 test sections at four locations in Oklahoma, California, and Virginia. The following methods were tested: single seal, double seal, and “sandwich” seal.

Some strategies worked better than others. Here are the researcher's recommendations based on the results of the tests.

Recommendations for Making Strong Chip Seals

Increase aggregate embedments. As traffic levels increase above 7500 vehicles per day per lane, aggregate embedments should be increased to prevent aggregate chips from becoming dislodged.

Add more binder as ADT increases.

Because existing design procedures appear to be inaccurate predictors of binder content, the study recommends that new design procedure be developed that applies a positive correction for binder rate as traffic increases

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Stronger chip seals, *continued from page 1*

to 7500 vehicles per day and above. Because increasing binder quantity may lead to flushing if conventional binders are used, some form of modification to stiffen the binder was recommended.

Use pilot cars for traffic control.

Traffic control using pilot cars at 25 mph to keep traffic on the new chip seal surface was recommended one hour following final rolling. This trafficking appeared to benefit the early performance of the seal by improving initial embedment.

While slower speeds might be desirable to reduce damage potential to the seal and vehicles, this may be difficult to achieve. At one test site the pilot car traveled at 15mph and some frustrated drivers passed it.

If pilot cars are not feasible, the study highly suggests using polymer modified asphalt binder because of its enhanced adhesive properties.

Control chip application.

Application rates should be controlled to achieve a layer one-stone thick to minimize excess chips and maximize adhesion with the binder. The study describes the appearance before rolling as being somewhat low on aggregate with some holidays on the surface. (Holidays are where some the underlying asphalt shows through.) It is difficult to achieve a one-stone thick application if the aggregate gradation contains may size fractions, so the study suggests using one, or at most, two sizes of aggregate.

Clean the surface after chip application. The use of push or vacuum sweepers was recommended. Light sweeping should be done as soon after rolling as practical such that the fresh seal is not damaged—but so that any loose or excess chip are removed before traffic is allowed on the pavement. A second round of light sweeping approximately 12 hours later was also recommended.

Control chip size. The 4.7mm (No. 4) aggregate fraction should be limited to less than 35 percent passing for 9.5 mm (3/8 inch) and larger maximum size gradations. At one of the test sites, high quantities (61 percent) of material passing the No. 4 sieve became embedded in the emulsion before the 9.5 mm chips, preventing proper embedment of the chips. These 9.5 mm materials became dislodged and contributed to a high incidence of vehicle damage on one particular day at one of the sites.

Avoid steel-wheel rolling. This technique was used at one of the four test sites but observations during construction and performance indicate this practice should be avoided, particularly on high-volume roads, due to lack of compaction and potential for crushing.

Use caution with synthetic aggregates. Lightweight synthetic aggregates were tried at some of the sites in an attempt to reduce vehicular damage. At one test site they disintegrated; at another they held up well.

Use conventional spray nozzles. Variable volume spray nozzles were used at one of the sites and performed well for applying higher binder quantities between wheel-paths. However, the study cautions that the difficulties of machining special nozzles and positioning them in the distributor may outweigh the benefits. Conventional nozzles worked well at the other sites.

Think twice about sandwich seals. This is a double application of chips and a single application of binder. This method was only marginally successful at one of the sites. Although the advantage of using one application of binder for a double seal saves time during construction, the method is very sensitive to application rate and may not be practical for routine use.

Adopt new specifications. The study recommends the development of new specifications when planning construction of chip seals on high traf-

fic facilities. These new specifications should account for: 1) a requirement for a job-mix formula for the chip gradation, much like those used in asphalt concrete construction; 2) positive traffic control requirements; such as pilot vehicles, detours, or closing the road until the next day; 3) positive equipment calibration requirements; and 4) rigorous quality control requirements during construction to assure materials applications rates.

Use double-application seals to reduce noise and increase pavement life.

This method, using two applications of chips and binder (with the second application of chips being smaller than the first) results in a denser surface than a single application. At one of the sites, the double chip seal was noticeably quieter than corresponding single seals using larger aggregate. Minimal vehicle damage on all of the projects and good performance after 5-6 years indicates the feasibility of this type of construction.

Watch the weather. In addition to these specific recommendations, the study noted that the use of heated or precoated chips can help asphalt cement binder adhere to chips in cooler weather. Problems caused by cool weather can be reduced by scheduling chip seal jobs earlier in the fall so that temperatures do not drop sharply at night and affect proper setting of the binder and adhesion to the substrate pavement.

The study summarized in this article is described in greater detail in the source below. The book *Flexible Pavement Rehabilitation and Maintenance* can be purchased from ASTM for \$58, hard copy. It can be ordered online at www.techstreet.com. The book contains eleven comprehensive, peer-reviewed papers examining several topics on pavement evaluation, rehabilitation and preservation.

Source: "Design and Construction of Chip Seals for High Traffic Volume," by Scott Shuler, in *Flexible Pavement*

Rehabilitation and Maintenance, edited by Prithvi S. Kandhal and Mary Stroup-Gardiner, ASTM, 1998, pp. 97-118. ■

Lisa Harris is editor of the KUTC Newsletter.

In Memorium

The KUTC would like to acknowledge the loss of a longtime friend to Kansas local road agencies—Vern Everhart. Vern passed away in Topeka on January 20, 2001.

Vern was a civil engineer with the Kansas DOT for 30 years. He was assistant bureau chief/technical management for the Bureau of Local Projects. He was also very active in his community and church.

Vern was a good friend to the KUTC, providing advice and assistance to us on numerous occasions.

We extend heartfelt condolences to Vern's family and colleagues. He will be deeply missed. ■

MUTCD, Free!

Before you rush out and buy a copy of the new Millennium Edition of the *MUTCD*—wait! You may be getting one for free.

KDOT's Bureau of Local Projects will be using federal 402 safety funds to purchase a copy of the revised *MUTCD*, printed copy, for all 105 Kansas counties and for Kansas cities with active local projects. They will be shipped out as soon as they are received by the Bureau. FHWA is estimating delivery in August.

Local Projects will also supply a loose-leaf binder for holding and organizing the different sections.

For more information, call Joel Breakstone at (785) 296-3861. ■

New Guide for Asphalt Mix Selection

What's the best type of hot-mix asphalt for a rural road with a low traffic volume? How about for a high volume highway with heavy truck traffic? Road departments and contractors looking for guidance on selecting the right HMA mix for a variety of traffic and environmental conditions can now turn to a new handbook—*Mix Type Selection Guide*.

The handbook describes several types of mixes including open-graded

friction courses, stone matrix asphalt, and fine-and coarse-graded dense mixtures. The handbook also covers general recommendations for surface preparation, recommended sublayers

for different mix types, types of pavement drainage, and rehabilitation techniques.

It is a joint publication of the Federal Highway Administration and the National Pavement Association.

The handbook is scheduled to be published by mid-February. To obtain a free copy, call Joe Garcia at FHWA at (202) 366-2226 or e-mail him at: jose.garcia@fhwa.dot.gov. ■



59 Kansas Counties to be Affected by GASB 34

In a report from the Kansas Division of Accounts & Reports dated January 24, 2001, the following counties were identified as preparing GAAP financial reports. These counties will need to revise their reporting procedures in accordance with GASB 34. We are printing this list so these counties might network with their peers if they have questions about how to handle infrastructure reporting and other issues of concern.

For more information on GASB 34, refer to Summer and Fall 2000 issues of the *KUTC Newsletter*.

GASB has recently issued an "Exposure Draft" recommending changes to GASB 34. It can be viewed on their website at www.gasb.org. Paragraphs 8 and 32-34 clarify the "Modified Approach for Reporting Infrastructure," i.e., asset management.

Atchison	Douglas	Harper	Marion	Scott
Barber	Edwards	Harvey	McPherson	Sedgwick
Bourbon	Ellis	Haskell	Miami	Seward
Brown	Ellsworth	Jackson	Montgomery	Shawnee
Butler	Finney	Jewell	Morris	Smith
Cherokee	Ford	Johnson	Morton	Sumner
Clark	Geary	Kearny	Ness	Thomas
Clay	Gove	Kingman	Osage	Trego
Cowly	Gray	Lane	Pawnee	Wallace
Crawford	Greeley	Leavenworth	Rawlins	Wichita
Dickinson	Greenwood	Logan	Rice	Wyandotte ■
Doniphan	Hamilton	Lyon	Russell	

Recipe for a Stable Subgrade

... by Robert L. Parsons, P. E.

Use of stabilization agents to improve the performance of subgrade materials has become a widely accepted method for improving the reliability and reducing the cost of pavement sections. Significant and even dramatic improvements in workability, uniformity, strength, and shrink/swell control are achievable with the proper use of these products.

The most commonly used stabilizers are lime, fly ash, and portland cement. Related products, such as cement kiln dust, are available in some areas. A number of liquid stabilization agents are also available, although as a group they have a more limited record of performance. The most appropriate material varies with the project and is a function of the objective of treatment, soil type, cost, and availability.

Soil treatment objectives

Subgrade soils may be treated with one or more different objectives in mind. The most basic is to dry out wet soils. Dry lime, fly ash, and cement will all accomplish this function by consuming the excess moisture in reactions of hydration.

Another objective is soil modification. Modification refers to chemical changes in treated clay soils that can lower the plasticity, improve workability, and greatly reduce shrink/swell problems.

The Kansas Department of Transportation (KDOT) currently requires modification of subgrade soils beneath both bituminous and PCC pavements, with the primary goal of eliminating shrink/swell problems and also to prepare a working table for subsequent construction. Some strength increase will also typically be achieved with modification.

A third potential objective of

treatment is stabilization. Stabilized materials share the characteristics of modified soils and also show a significant strength gain over the unstabilized material. For example, an increase in compressive strength of at least 50 psi is a common mix design criteria (1). Equivalent pavement



designs with reduced pavement thicknesses can be achieved if the subgrades are stabilized. For example, in new subdivisions, Johnson County permits an eight inch asphalt pavement to be replaced with a combination of six inches of fly ash stabilized subgrade and six inches of asphalt.

Stabilization agents

Lime. Lime is probably the most widely used soil improvement agent and is the dominant soil modification agent used by KDOT east of US-81. The term "lime" may be used to refer to several specific materials. These are dry calcium oxide (CaO) or quicklime, dry hydrated lime (CaOH), and lime slurry. Lime slurry is normally prepared by mixing quicklime with water, although hydrated lime may also be used.

Lime improves clay soils in three

ways. At lower concentrations the calcium in the lime modifies the soil by replacing the cations normally present on the surfaces of the clay particles. This exchange of cations improves workability, and greatly reduces the tendency of the soil to draw in water and swell when water is available. Lime is also an effective stabilization agent in many clay soils. Lime will react with the clay particles, forming a gel that acts as a cementing agent—greatly increasing strength. Dry lime also serves as an effective drying agent for wet soils.

Fly ash. Class C (self-cementing) fly ash is a waste product produced by the burning of sub-bituminous coal. It contains some calcium and pozzolanic materials as a part of the ash and acts as a cementing agent. Fly ash will not generally reduce the plasticity as much as lime, and while it has been shown to reduce swelling in soils with significant swelling potential, there have been conflicting results on its effectiveness when compared with lime. Fly ash is an effective drying agent and can significantly improve soil strength. It is a common method of stabilization used in Johnson County for reconstruction projects.

Portland cement. Portland cement is also used for both modification and stabilization. Well graded sandy and gravelly materials with 10-35 percent fines are considered the most favorable for treatment. These soils may require as little as 3 percent cement by weight for stabilization (2). Soils with little or no fines may be successfully treated, although they may require slightly more cement. Clay soils may be treated with cement but will require a significantly greater proportion of cement to achieve stabilization. Portland cement and fly ash are the primary soil modification

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New Study Establishes Guidelines for When to Install Guardrail on Low Volume Roads

... by Lisa Harris

Roadway managers can readily find guidance for determining where to install guardrail on heavily-traveled roads. But, until now, practical guidelines have not been available for installing guardrail on low volume roads (LVR).

A recent K-TRAN* study addresses that need. Entitled *Use of Guardrail on Low-Volume Roads According to Safety and Cost Effectiveness*, its stated purpose “was to bring together the latest research and models on roadside hazard reduction, site specific Kansas LVR conditions, accident cost, local government finances, and practical common sense.” It provides guidance for installing guardrail adjacent to embankments, utility poles, and three types of culverts on low volume roads.

A technical committee provided expertise for the study. Its members included three Kansas county engineers: Norm Bowers, Dean Chesnut, and Richard Teaford; and four representatives from KDOT: Vern Everhart, Ron Seitz, Jerry Preim, and Gelene Savage. Researchers at Kansas State University conducted the research.

The study resulted in general guidelines for guardrail installation. It includes a group of easy-to-use tables to help LVR personnel identify safe, cost-effective solutions, or a practical balance between least cost and “zero risk.” The tables show different conditions (offset, ADTs, etc.) for each of the types of obstacles. An example of the information contained in one of

*K-TRAN is a cooperative transportation research program between KDOT, Kansas State University and the University of Kansas.

Obstacle Type: CULVERT, Flared wings, ADT 400, OFFSET 1.0 M

TOTAL COST IN ANNUAL WORTH\$
 “shaded” cells indicate guardrail is recommended

Speed (km/h)	Cost of Guardrail	Culvert End Height in Meters			
		1.0	1.2	1.8	2.4
50	\$655	\$112	\$178	\$298	\$443
60	\$681	\$196	\$290	\$456	\$659
70	\$806	\$328	\$445	\$654	\$989
80	\$895	\$579	\$628	\$880	\$1,276
90	\$1,060	\$780	\$838	\$1,241	\$1,696

Note: Guardrail is recommended when its annual worth for collision protection under the conditions shown is greater than the cost of the guardrail itself.

these tables is shown above.

The study’s general findings are listed below, by type of obstacle. Note that the term “justifiable” means *economically* justifiable in this study. The researchers acknowledge that other considerations beyond cost-effectiveness may be important.

- *Reinforced concrete box (RCB) culvert with straight wings*—Based on the total life cycle cost analysis, guardrail was justifiable for speeds of 90 km/h, ADTs of 300 or higher and culvert end height of 2.4 meters. Guardrail was not justifiable if the culvert’s lateral offset from the nearest driving lane was two or more meters.

- *RCB culvert with flared wings*—The study results indicated that, under all conditions, guardrail was not justifiable if the culvert’s lateral offset from the edge of the nearest driving lane was more than three meters. For some other conditions, guardrail was justifiable.

- *Reinforced concrete pipe (RCP) culvert with pipe/headwall*—Guardrail was not justifiable if the ADT was less

than 100. Guardrail was justifiable for some other conditions.

- *Utility poles*—Guardrail was justifiable for speeds of 90 km/h, ADTs of 400 and lateral offset of 0.0 m and 0.3 m.

- *Embankments*—Guardrail was not economically justifiable for either 1:4 or 1:3 (vertical: horizontal) relatively-smooth foreslopes, regardless of the design speed and ADT. For 1:3 rough foreslopes, ADT of 400, speed of 90 km/h and height of fill of four or more meters, installation of the guardrail was justifiable. Guardrail was justifiable on most 1:2 foreslopes with smooth or rough conditions.

Forty percent of accidents on low volume roads, nationwide, are run-off-the-road incidents. The researchers hope that the guidelines in this study will assist LVR managers in preventing some of these kinds of accidents.

This report can be downloaded from the TRIS Online Website at: www.bts.gov/NTL/data/778822.pdf Or call Bill Jacobs at KDOT for a paper copy at (785) 291-3847. ■

Giving New Life to Old Asphalt



Photo by Steve Cross

... by Kathryn Jensen

In this “green” age, there is increased awareness about the importance of conserving resources. During the last two decades, asphalt has become a major player in the recycling realm. This article will outline different methods of asphalt recycling and types of pavement distresses for which they are appropriate.

There are several ways to recycle asphalt into a new pavement surface. The choice of method depends on the condition of the road needing repair and how long the area can be reasonably closed to traffic.

Hot Recycling. This is a good choice for rehabilitating pavement that has been patched or shows cracking (from loads or not), general unevenness, depressions or heaving. In hot recycling RAP is combined with new aggregate and an asphalt cement or recycling agent to produce hot mix asphalt (HMA). Both batch and drum type hot mix plants are used to produce recycled mix. The RAP is generally obtained by pavement milling with a rotary drum cold milling machine or from a ripping/crushing operation. The mix placement and compaction equipment and procedures are the same as for regular HMA.

The ratio or blend of RAP to new aggregate will vary, dependent on the

KDOT—A Leader in Asphalt Recycling

Asphalt recycling is no stranger to the Kansas Department of Transportation. Its first cold recycling project was in 1977; the first hot recycling project a year later. Both projects were done on US-56 between Larned and Kinsley, cities in Pawnee and Edwards Counties. KDOT experimented with different additives and methods in various test sections. The process took about three months. Since then, this stretch of road has succeeded in withstanding traffic and the elements. It has been overlaid twice in the 20+ years since the project was completed.

KDOT now uses asphalt recycling for many of its pavement restoration projects. Between 30 and 40 projects are slated to occur this year. “We’re doing as much or more [asphalt recycling] as any other state, proportional to number of miles,” said Rodney Maag, KDOT field engineer. “We do cold recycling, hot recycling, and hot in-place recycling,” he said. “We basically do every method out there.”

One advantage to cold methods for deep restoration is that the projects are completed on-site and are drive-able within a few hours of doing the work. Hot projects take longer to cure and often require the milled RAP to be transported to a hot-mix plant and back, as part of the process.

Hot in-place recycling is completed on the roadway. (In this process, the top inch of the road is heated and scarified. An additive is mixed with the RAP and the mixture is relaid and compacted.) To make these projects more efficient, contractors have been using three or four heaters to heat the pavement. The last heater scarifies the existing roadway.

“That way they can go longer distances in a given amount of time than if they used fewer machines,” said Maag. “This cuts down on the amount of time flaggers are needed.” Maag said that increasing the number of machines is not required by KDOT, but the contractors who work this way say that it saves their companies money.

Recycling processes have remained essentially the same over the years, with one exception: fly ash is now added to make the asphalt stronger rather than using straight emulsion. KDOT is currently testing another additive: a emulsion and lime slurry combination.

Maag said that KDOT considers asphalt recycling for most projects because it may be more cost effective than laying all new material. “You’re using the same material you already paid for,” he said. On several Superpave projects each year the contractor is given the choice of using RAP.

For more information on KDOT’s asphalt recycling projects, call Rodney Maag at (785) 296-3711.

recycled mix properties desired and the type of hot mix plant. New technology using microwave heating may allow the use of up to 100 percent RAP without the occurrence of blue

smoke problems.

Hot In-Place Recycling. This is useful for surface defects and deformation (raveling, washboarding, shallow rutting), some types of cracking, and

general unevenness. Hot in-place recycling is performed on-site, in place, with the existing pavement typically processed to a depth of 3/4 to 1-1/2 inches. The deteriorated asphalt pavement is heated and softened to allow it to be scarified or hot rotary mixed to a specific depth. As required, new hot mix material and/or rejuvenating agent or other liquid additive is added to the reclaimed material.

Hot in-place recycling is performed as a single or two pass operation. With a single pass the restored existing pavement material is combined with new/virgin material. For two passes, the restored material is recompacted and the application of a new wearing course then follows after a prescribed interval or delay.

Cold In-Place Recycling. This method is appropriate for deep rutting, all kinds of cracking, and to rehabilitate maintenance patching. It reuses existing pavement materials, and all work is completed while on the pavement being recycled. Additional transportation of materials is normally not required except for the additive being used. The depth of treatment is typically around four inches. In some cases virgin aggregate may be added to the recycled material to change/improve the RAP characteristics. Asphalt emulsion, emulsion with lime, fly ash or asphalt rejuvenating agents may also be used.

Cold in-place recycling involves pulverizing the existing pavement, sizing the RAP, incorporating an additive and placing and compacting the recycled mix. A recycling train may be used that includes a large cold milling machine pulling a screening and crushing unit followed by a mixing device. The mix is deposited in a windrow for placement and compaction.

Full Depth Reclamation. This method is useful on roads with deep rutting, all types of cracking, patches, general unevenness, depressions or high spots. With this method all of the asphalt pavement section and a prede-

termined amount of underlying materials are treated to produce a stabilized base course. Additives are used for an improved base that include imported materials, asphalt emulsions and chemical agents such as calcium chloride, portland cement, fly ash and lime.

The full depth process includes five basic steps: pulverizing, introducing an additive, shaping, compacting and applying a surface or wearing course. For some projects, new materials are added to the mix for increasing the road thickness and mix properties.

Whichever method is used, asphalt recycling cuts costs by reusing material and decreasing the amount of

materials to be transported to the job site. It has proven to be an excellent method of road restoration for state and local road departments.

Sources:

Missouri-Kansas Introduction to Asphalt Recycling and Reclaiming (Conference Guide), by the KS and MO LTAPs and the ARRA, 1994.

An Overview of Recycling and Reclamation Methods for Asphalt Paving Rehabilitation, Asphalt Recycling & Reclaiming Association (ARRA).

Kathryn Jensen is a senior in journalism at the University of Kansas.



Using RAP on Low-Volume Roads— One County's Experience

With a sizeable stockpile of recycled asphalt on hand, Goshen County (WV.) decided to test their RAP as a surface material for roads. In Fall 1998 they mixed some RAP and asphalt emulsion with a motorgrader and applied it to over a mile of county roads. The following year the section was still holding up, but there were a few problems and room for improvement.

The material was produced and laid in cold temperatures, making it difficult to work and compact. The crews also encountered problems with blading a non-uniform material and either the wrong type or amounts of emulsion. Not having a uniform mix made it difficult to work—with the larger chunks dragging under the blade for several feet. Many of the surface problems were worked out in the next season, however, with warmer temperatures and the action of vehicle tires under traffic.

Gary Craig, the Goshen County's road and bridge superintendent, determined that using a more uniform size of RAP would improve processing,

compaction and smoothness. More ambient heat would soften the RAP and make it easier to mix and place. Craig also sent a sample of RAP to Koch Materials to determine the amount and type of emulsion that would work best with that particular kind of RAP.

The next project was undertaken in August, in warmer weather. To begin the project, crews checked the base material, and additional base material was brought in, watered and compacted when needed. Using their own equipment and crews, the County crushed the asphalt just prior to hauling it to the project to avoid any reconsolidation of the RAP stockpile. Crews crushed the material early in the morning when temperatures were cool. The pile retained residual moisture throughout the process which made placing and mixing easier while serving to hold down dust. The crushed material was hauled to the job site and deposited in a windrow to one side of the roadway.

A CSS-1H tack coat was shipped

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New Federal Focus on Asset Management Emphasizes Preventative Pavement Maintenance

“Pavement preservation is at the core of all future highway programs...”
—Madeline Bloom, director, Office of Asset Management, FHWA.

This article is reprinted with permission from *Pavement Preservation*, a newsletter of the Foundation for Pavement Preservation.

Agrowing federal focus on preserving the existing system of state, local and national pavements is underscoring today’s new emphasis on preventive pavement maintenance.

In the 1980s—as the nation entered the post-Interstate era—emphasis began shifting from construction of new pavements to maintenance of existing pavements. Much of this was fueled by the Intermodal Surface Transportation Efficiency Act of 1991, which explicitly provided maintenance funds via its Interstate Maintenance Program, and Surface Transportation Program (STP) funds which generally

could be used as a state saw fit.

Now, an advancing philosophy of “asset management”—adapted from the corporate world—is providing new momentum and excitement for pavement preservation, and it’s being spearheaded at the federal level by the Office of Asset Management, created in February 1999.

“Pavement preservation is at the core of all future highway programs,” said Madeleine S. Bloom, director, Office of Asset Management, Federal Highway Administration. “Much, if not most, of tomorrow’s infrastructure is already built. Now our challenge is to preserve and manage what we already have. Our focus is on the preservation of our highway assets, and the great importance of this preservation on the performance of our national highway system.”

Bloom spoke at Inroads 2000, a conference conducted by Foundation for Pavement Preservation (FP 2) charter association members—the International Slurry Surfacing Association and the Asphalt Emulsion Manufacturers Association.

The concept of asset management makes sense when you consider the change in focus of the highway program from building new highways on new thoroughfares, to maintenance of the existing infrastructure, Bloom said. While railroads were the dominant transportation mode up to World War II, cars and trucks came to the forefront soon after.

“We responded by building the magnificent Eisenhower System of Interstate Highways, which knit our

Will this new federal focus affect local agencies?

We at the KUTC have heard some concern expressed about the new federal focus on asset management. There’s a fear that local agencies may eventually need to adopt asset management (and use GAAP financial reports) in order to receive federal funds for local projects. Is this fear warranted? We asked Jim Sorenson of FHWA and Larry Emig, bureau chief, KDOT Local Projects (BLP), for their input on this.

Sorenson is senior construction & system preservation engineer with FHWA’s Office of Asset Management in Washington, D.C. He pointed out that a decade ago (through ISTEA), federal-aid funds were made eligible for preventive maintenance on the Interstate system if an activity was cost-effective and extended the highway’s service life. Preventive maintenance eligibility was extended to all Federal-aid highways by the 1995 NHS Act.

The FHWA has given the states considerable flexibility in spending funds for preventative maintenance. This same flexibility is also given to Kansas local agencies by the KDOT’s BLP that administers federal funds for local road and bridge projects. Emig said: “Our policy is to allow the local agencies to select the scope of their requested projects.” He noted that many agencies select bridges, because they are expensive projects.

FHWA does not require local agencies to prepare GAAP financial reports or implement asset management, although these practices are encouraged. “Applying the right fix to the right road at the right time will make our roads perform longer and prove to be much more cost-effective,” Sorenson said.

Emig has not heard of any change in policy from FHWA. He said, “I am not aware of a change... We will see what the FHWA has to offer in terms of project types to consider and if we need to revise our process.”

nation together,” she said. “Today, the interstate system basically is complete, with very small linkages remaining,” Bloom said. “We want to continue to maintain that marvelous system and improve it, and perhaps add a few miles. But what we are not doing is adding thousands of new miles.”

Throughout the world there has been a shift from constructing new highway systems to preserving, maximizing and effectively operating what we have. “We will manage our investment in the system to optimize its performance, and deliver integrated services to our customers, be they freight shippers, commuters or tourists,” Bloom said.

A new look at management

There is a perceived need by many transportation professionals for a comprehensive management approach to road systems, given their common background in aging infrastructure, always less-than-adequate budgets despite the magnitude of resources, and constrained staff resources. All the while the public has increased its expectations of what the transportation system can develop, she told the delegates, implying asset management makes that easier.

“There also is a great need for transportation officials to communicate in financial and economic terms, as well as to explain our engineering conditions,” Bloom said. “By using recognized accounting, financial and economic principles, we hope that asset management will enable highway managers to discuss infrastructure requirements with budget and policy people in a common language.”

Bloom defined “asset management” as a systematic process to maintain, upgrade and operate physical assets on a cost-effective basis. “We like to say it combines engineering principles with sound business practice, and gives us the tools to facilitate an organized approach to decision-making,” she said. What

makes asset management unique these days is its goal to merge different themes in road management to a unified, centrally managed approach, Bloom said.

“Asset management, different from, say, bridge management, for example, emphasizes the entire system and incorporates a multi-year perspective,” Bloom said. “When you evaluate a broad range of resources and assets over a fairly long period of time, asset management can result in somewhat different decisions than if each asset were evaluated in the very short term on its own.”

For a more in-depth look at asset management, download the *Asset Management Primer* (PDF file) off the FHWA Office of Asset Management web site at www.fhwa.dot.gov/infrastructure/asstmgt/amprimer.pdf. (Or obtain a hard copy from FHWA’s Topeka office, (785) 267-7281.) There are many other documents on the office’s web site that will be of interest to readers. See them at www.fhwa.dot.gov/infrastructure/asstmgt/.

Bloom listed a variety of benefits to asset management applied to highway systems:

- determination of the remaining service life of assets;
- optimization of system level improvements; and
- analysis of investment strategies, rather than just one project at a time.

“It allows us a common yard stick for rating a whole range of investment decisions,” Bloom said. “From a state transportation agency perspective, asset management should result in improved management of the program, and better use of available funding. From a user perspective, the customer should benefit by receiving better-managed facilities and more efficient operation of the system.”

Pavement preservation is key

The 1995 nationwide survey of highway users determined that pavement condition—particularly pavement smoothness—was the most important criterion by which user satisfaction was ranked. “Pavement condition has

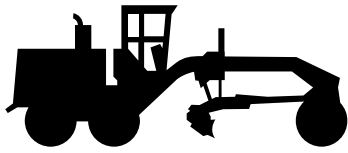
been a No.1 concern,” Bloom said. “Also, there was great concern about work zones.”

The politically appealing, but wasteful “worst first” approach to road maintenance comes into Bloom’s cross hairs. “To ensure cost-effectiveness and high quality pavements requires a clear identification of our goals,” she said. “This may mean a redefinition [of goals], to develop a more strategic, customer-driven approach to maintain and preserve existing highways, rather than simply follow the traditional approach of fixing the worst first.”

The industry must focus on time-efficient and cost-effective preventive maintenance techniques, she said. “There’s a great demand for preventive maintenance techniques that can cut the need for time-consuming — and traffic disrupting — rehabilitation, with all its associated user costs,” Bloom said.

And that falls squarely into the laps of contractors and material and equipment suppliers, in partnership with government agencies. “By applying a range of low-cost preventive maintenance treatments highway agencies can start to develop the means to extend pavement service life,” she added. “We’re partnering [with industry] to get the word out on a variety of innovations that can help preserve pavements, thereby maintaining our enormous investment in the highway infrastructure.”

Bloom can be reached at the Office of Asset Management at (202) 366-0392 or by e-mail at madeleine.bloom@fhwa.dot.gov ■



How 'bout Them Gravel Roads?

Are yours meeting the standards you set?

... by Rose Lichtenberg

Quality gravel roads are the product of well-trained and capable grader operators who have access to good equipment. Your operators will have an opportunity to further develop their skills by attending a one-day classroom session during late March and early April. Ten sessions have been scheduled:

- March 27 in El Dorado
- March 28 in Emporia
- March 29 in Chanute
- April 3 in Garden City
- April 4 in Colby
- April 5 in Hays
- April 6 in Hutchinson
- April 10 in Salina
- April 11 in Washington
- April 12 in Topeka

An old saying goes: "The three most important elements in maintaining a good road are drainage, drainage, drainage." This course will add another saying: "The three most important ways to get good drainage are with a proper profile, proper profile, proper profile."

For more information, or to register, call Rose Lichtenberg at 785/864-2594, or visit our web site at www.kutc.ku.edu. You can click on our training calendar and register for this training on-line. ■

Rose Lichtenberg is training coordinator for the Kansas LTAP.

What do Deicing and Cheese Have in Common?

Researchers may be on the way to making calcium magnesium acetate (CMA) from cheap feedstocks such as cheese whey.

According to a December 7, 1999 news release from the U.S. Department of Transportation, the Federal Highway Administration, in partnership with the New York State Energy Research and Development Authority and several state highway agencies, funded the research that involved fermenting cheese whey to produce acetic acid. When acetic acid reacts with lime it produces CMA.

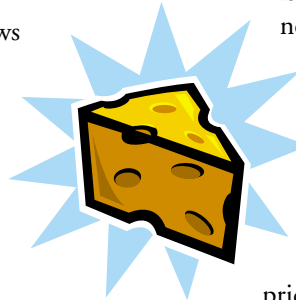
Researchers from Ohio State University's Department of Chemical Engineering conducted the research

on behalf of the agencies.

CMA has a deicing ability comparable to salt but has no significant health or environmental concerns. It is not corrosive to vehicles and not harmful to concrete, structural steel, vegetation, fish or other aquatic life.

Cost analysis shows that CMA made from cheese whey can be produced at a cost of less than 30 percent of the current market price for commercial CMA, helping to make environmentally-friendly winter highway operations more cost effective. ■

Reprinted with permission from the Fall 2000 issue of *T2 Interchange*, a newsletter of the Nebraska Technology Transfer Center.



Using RAP on low volume roads *continued from page 7*

to the County and applied to the existing roadway before the surface material was placed. The same tack material was applied to the windrow and two motor graders began the process of mixing and grading. The distributor made subsequent passes to bring the amount of oil up to five percent.

The RAP was compacted to an average thickness of three and a half inches over a 24 foot wide road. A water spray system was added to keep the material from sticking and a fog seal was applied to the finished road, using the same emulsion.

Volumes of traffic for these roads last summer ranged from 200 to over 500 vehicles per day. Most of the roads were left open to traffic during construction. Over 4.5 miles of roads

were surfaced at a total cost of \$1.62 per square yard. This amount includes all costs such as use and rental of equipment, operator wages, hauling, fuel, emulsion, and other materials. This cost would have been less if crews could have crushed nearer the RAP pile. The county intends to chip seal these roads this year to extend the expected life.

Gary Craig is convinced that using recycled asphalt is good for his County. If you would like more information about this project, call Gary at (307) 532-3716.

This article was adapted with permission from "Recycled Asphalt in Goshen County, by Gary Craig and Sue McFarland, from the Fall 2000 issue of the *Wyoming T² Newsletter*. ■

KDOT Korner



New Video Gives Concrete Advice on Pavement Smoothness

... by Stan Whitley.

Achieving success often comes from emulating a leader. That's why KDOT is being used as a model for developing ultra-smooth highway pavements.

KDOT implemented smoothness specifications for concrete pavement 15 years ago. Now a new video, *Smoother Roads Playbook*, is providing insight into the successful strategies the agency used to achieve smoother concrete pavements. The smoothness

Engineer. Lackey was interviewed extensively for the video. "The bottom line is we get our money's worth because we have pavements that last longer and require less maintenance."

Smoothness has been promoted in Kansas not only by the specifications but also through an incentive/disincentive program. The program and smoothness specifications have generally been well received by contractors because it allows them compensation for their extra efforts.

"We don't think our quality costs

- striving for mix consistency
- minimal hand finishing
- using good equipment
- motivating the work force

The stringline is the primary guidance system for most paving concrete equipment. It must be set precisely and protected from damage before paving. It should also be checked for proper grade and elevation before each paving operation.

The video noted that "the stringline has the greatest potential to affect smoothness." Maintaining a consistent paving speed and avoiding stopping or slowing the paver was also cited as being very important.

To accomplish this objective, contractors must have an adequate supply of concrete delivered to the paving sites and have delivery vehicles that can move quickly and easily through a site and then back to the concrete plant.

The impetus for producing the video was the results of a 1995 survey conducted by the FHWA. The survey found that smoothness of ride was one of the most important factors in increasing public satisfaction with the highway system.

This article was reprinted with permission from *Translines*, October 2000 issue, a KDOT publication. ■

Stan Whitley is an Informational Specialist at the Kansas Department of Transportation.

Smoothness has been promoted in Kansas not only through specifications but also through an incentive/disincentive program. This has generally been well received by contractors because it allows compensation for their extra efforts.

specifications have resulted in Kansas gaining national recognition for its innovative techniques.

The video, produced by FHWA and KDOT, features Kansas pavements and construction procedures. John Madden, former NFL coach and well-known football commentator, provided introductory and closing remarks for the video.

The introduction of pavement smoothness specifications was "the single most important impact on concrete paving that I have seen in my career," said Mike Lackey, former KDOT State Transportation

a lot of money," David Wittwer, president of Wittwer Paving commented on the video. "In fact, I've told our people that quality doesn't cost—it pays."

Eight practices and techniques used in Kansas to achieve smoothness with Portland cement concrete pavement are highlighted on the video. The list includes:

- precise stringline
- watching pavement speed and delivery rate
- building from the ground up
- controlling the concrete head

A Leg Up

Maintenance Ideas for Safer Driving & Bicycling

From *Implementing Bicycle Improvements at the Local Level*, FHWA.



Surface irregularities that run parallel to travel are particularly hazardous to bicyclists.

... by Lisa Harris

Potholes, accumulated sand, debris, and other roadway hazards are dangerous for both motorists and bicyclists. Some of these hazards can cause particular problems for bicycle riders, especially near the right margin of the road where bicyclists tend to ride. These areas are generally less well maintained than the main lanes.

This article will identify common roadway maintenance issues and ways to make roads safer for bicyclists. It will also discuss how to be proactive about roadway maintenance, so that future problems can be anticipated before they happen. The recommendations are from *Implementing Bicycle Improvements at the Local Level*, produced by the Bicycle Federation of America and published by the FHWA in 1998.*

Bicyclists' concerns can usually be addressed by slightly modifying current maintenance procedures, often resulting in safer roads for all modes.

Here are some ideas for solutions for common maintenance problems:

Typical maintenance concerns and solutions

Potholes and other surface irregularities: Take extra care to make smooth repairs, giving special attention to areas of the roadway used more frequently by bicycles. Also, require contractors and utility companies to patch to a similarly high standard. Require further maintenance if the repairs fail within a year.

Debris (sand, gravel, glass, auto parts, etc.) near the right edge of the road: Sweep close to the right edge, using vacuum trucks if debris accumulates adjacent to curbs. Pay particular attention to locations like underpasses where changes in lighting conditions can blind bicyclists to roadway hazards. Areas where debris washes across a paved surface should also receive special attention. Eliminating the source of the problem is ultimately a more cost-effective solution than increased sweeping.

Debris or surface irregularities at curves and intersections: Curves and intersections are often filled with debris, especially after the winter season or after flooding or high winds. Be sure to carefully sweep these high-risk areas.

Chip seal gravel: Remove excess gravel as soon as possible and suggest alternate routes as detours.

Ridges or cracks: These should be filled or ground down to reduce the chance of a bicyclist catching a front

wheel and crashing. Pay special attention to ridges or cracks that run parallel to the direction of travel. Check any areas where a merging lane is provided just beyond an intersection. Because traffic must merge left to continue traveling straight, bicyclists will be crossing the joint between the merge lane and through lanes at a very shallow angle.

Encroaching vegetation: Keep grasses adjacent to roadways mowed so bicyclists can spot potential hazards ahead. Trim vegetation back to allow at least two feet of clearance between the edge of the pavement and the vegetation, paying special attention to inside curves.

Poorly maintained signs and pavement markings: Special bicycle signs may be subject to frequent theft or vandalism. Be alert to missing or damaged signs and replace/repair them promptly. Pay particular attention to bike route signs at decision points, warning signs at hazard locations, and regulatory signs on popular streets for bicycling. Some pavement markings suffer more wear and tear than others and may need special attention, such as "hot spot" areas for traffic signal loop detectors.

The bigger picture—"Think Maintenance"

Improving bicycle-related maintenance in the long term requires action on several fronts. First, maintenance policies used by all relevant agencies should be reviewed and changed if necessary. Second, designers should be encouraged to "think maintenance" when they design—low maintenance should be the rule rather than the exception. Third, an outreach effort

should be implemented to encourage bicyclists to report maintenance problems and to communicate existing maintenance problems to bicyclists, especially on bike paths or on popular bicycling routes.

Let's take a closer look at these ideas:

Identify key players. Work closely with agencies and personnel responsible for maintaining and designing the infrastructure. These may include state and local highway departments, contractors and utility companies.

Review existing policies and practices. Obtain copies of existing schedules and policies and determine if any changes need to be made. Consider adding new standard procedures or training to create consistency and awareness among personnel in providing maintenance services to increase safety for bicyclists.

Review results in the field and solicit comments from bicyclists. Hop on a bicycle and ride the streets. This can help uncover previously unknown problems. For instance, an agency may have a policy to sweep arterial streets every two weeks. But field experience may show that certain arterials accumulate debris faster due to adjacent land uses. If bicyclists commonly use these roads, increasing the sweeping frequency may be justified.

Solicit comments from area bicyclists as well. They can often pinpoint specific locations and needs. To obtain such information, send news releases to bicycle groups and ask the media for assistance.

One way to increase useful dialogue with bicyclists on maintenance issues is to create an ongoing spot improvement program. This can help identify problems before someone gets hurt. Create mail-back postcards for distribution to local bicycle shops and user groups. As cards come in, check the locations identified and take action as necessary. Set aside a modest budgetary allowance to repair maintenance problems identified in this program.



Sample objectives— and steps to achieve them—for making roads safer for bicycles

Maintain roadways to a relatively "hazard free" standard:

- by sweeping pavement edges and paved shoulders with sufficient care.
- by patching surfaces as smoothly as possible and by requiring contractors and utilities to do likewise whenever they dig up and patch a road or trail.
- by making sure pavement overlay projects feather the new surface into the existing one or otherwise do not create new linear joints.
- by replacing hazards such as dangerous grates or utility covers as the opportunity arises.
- by patching potholes in an expeditious manner.
- by routinely cutting back all encroaching vegetation, especially on trails or popular bike routes.

Encourage bicyclists to report maintenance problems/hazards:

- by developing a "bicycle spot improvement" form and distributing copies throughout the bicycling community.
- by ensuring that returned forms are acted upon in a timely fashion.

Design and build new roadways to reduce the potential for maintenance problems in the long term:

- by using edge treatments, shoulder surfaces, and access controls that reduce the potential accumulation of debris.
- by using materials and construction techniques that increase the longevity of new surfaces.

Include maintenance costs and clearly spelled-out maintenance procedures in all bicycle facility projects:

- by including reasonable estimates of the maintenance costs in the project's budget
- by establishing clear maintenance responsibilities in advance of construction

Source: *Implementing Bicycle Improvements at the Local Level*, FHWA publication FHWA-RD-98-105, September 1998.

Recommend appropriate changes and evaluate progress. Identify solutions to maintenance problems based on reviews and comments, implement them, and make sure they work effectively. A good way to get feedback on improvements is to ask the bicycling community for comments on maintenance issues on an annual basis.

*FHWA's *Implementing Bicycle Improvements at the Local Level* is out

of print, but it has been re-issued by the Institute of Traffic Engineers. It is available for \$25 for ITE members and \$35 for nonmembers. Call (202) 554-8050 for more information. ■

Correction: Our last issue's article on audible pedestrian signals had an error in the amount Topeka pays per intersection for installation of those signals. The correct amount is \$2,800.

Stable subgrade, *continued from page 4*

agents used west of US-81 by KDOT.

Constructing with additives

The additives discussed above differ in construction procedures. The National Lime Association recommends that soils mixed with lime have a moisture content five percent above optimum during mixing to promote the reaction of the lime with soil particles (3). It is normally recommended that soils be allowed to "mellow" for 24 to 48 hours between initial and final mixing to permit the lime and water to break down the clay clods. Fly ash should be mixed dry of optimum and compacted as quickly as possible (within two hours) after mixing. Cement treated soil should also be compacted as quickly as possible and have a moisture content near optimum or slightly above to account for moisture loss from evaporation and hydration (4). Thorough mixing is encouraged for all stabilization agents to promote a uniform product

and maximize strength gains. Detailed construction specifications for each product are available from industry organizations.

Selecting a stabilizer

The most appropriate stabilizer is a function of soil type and objective. Lime is normally the most cost effective stabilizer for highly plastic clays while cement is more appropriate for use with coarse grained materials. Fly ash is more of an intermediate material. As the optimum application rate can vary for all stabilizers, it is recommended that a mix design be performed prior to construction to select the stabilizer and determine the appropriate application rate.

More information

More information on these products, including mix design information and recommended construction procedures, is available from the following organizations. For lime, contact the National Lime Association at (703) 243-5463 or www.lime.org. For information on fly ash, contact the

American Coal Ash Association at (703) 317-2400 or www.acaa-usa.org. For information on cement, contact the Portland Cement Association at (847) 966-6200 or www.cement.org.

References

1. *Lime Stabilization: Reactions, Properties, Design, and Construction*. Transportation Research Board, National Research Council. State of the Art Report #5. 1987.
2. *Soil Cement Construction Handbook*. Portland Cement Association. Skokie, Illinois. 1995.
3. *Lime Stabilization Construction Manual*. National Lime Association, Bulletin 326. Arlington, Virginia, 1991.
4. *State-of-the-Art Report on Soil Cement*. American Concrete Institute Committee 230. ACI230.1R-90. 1990.

Dr. Robert L. Parsons is an assistant professor of Civil Engineering at the University of Kansas.

Calendar

... 2001

March 20
*Millennium MUTCD
ATSSA/APWA Satellite
Discussion
in Colby, Salina, Hays,
Garden City, Pittsburg,
Wichita and Lawrence

March 20-21
Bridge Load Testing
and Rating Workshop
in Kansas City, Mo.
Contact MU
Conference Center at
573/882-4349

March 29
APWA Roundtable
Discussion
in Wichita
call Mike Fraser,
785/826-7380

Spring
*LTAP Successful
Supervision Workshop
sessions to be held by
request of local agency

*LTAP Motor Grader
Operator Training
March 27, El Dorado
March 28, Emporia
March 29, Chanute
April 3, Garden City
April 4, Colby
April 5, Hays
April 6, Hutchinson
April 10, Salina
April 11, Washington
April 12, Topeka

April 8-11
APWA North American
Snow Conference
in Indianapolis, In.
Call 816/472-6100

April 10-11
Kansas Transportation
Engineering
Conference
in Manhattan, Ks.
Contact Ellen Stauffer
at Kansas State Univ.
Continuing Education
at 785/532-5569.

April 12
APWA Roundtable
Discussion
in Topeka
call Mike Fraser,
785/826-7380

April 18-20
APWA Mid America
Conference,
in Columbia, Mo.
Contact Tammy
Bennett at 785/832-
3133

April 21-25
National Association of
County Engineers
(NACE) Annual
Meeting and
Management and
Technical Conference,
in Bloomington, Mn.
Contact NACE at
202/393-5041 or visit
www.naco.org/affils/nace

April 25-26, tentative
*NHI Course: AASHTO
Roadside Design
Guide
Topeka, Ks.

May 1-3, tentative
*NHI Course:
Highways in the River
Environment,
in Topeka, Ks.

May 8, tentative
*NHI Course: Work
Zone Traffic Control
for Maintenance
Operations on Rural
Roads
in Hutchinson, Ks.

May 8-9
Kansas Transportation
Safety Conference,

in Hutchinson, Ks.
Call University of
Kansas Continuing
Education, toll free at
877/ 404-5823

May 14-16
KCHA Spring Meeting
in Hays, Ks.
Call Ron Karn at
785/863-2211

For information on calendar items indicated with a * or to suggest a topic for a future LTAP workshop, contact:

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KUTC
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Videotapes

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Smoother Roads Playbook

24 minutes, by the Kansas DOT and FHWA, 2000. Shows eight practices used in Kansas to achieve smoothness with Portland cement concrete pavement. Includes remarks with former NFL football coach John Maddon. For more information, see article on page 11.

Traffic Barriers

46:27 minutes, by FHWA. This tape includes three short programs on traffic barriers: 1) an overview; 2) W-beam guardrails; and 3) end treatments. Shows proper installation and safety guidelines. This is not a new production, but has been added to our lending library.

Publications

You are free to keep these unless otherwise noted.

Pavement Preservation: A Road Map for the Future

(16 pages) Presents information discussed at a national forum in Kansas City, Mo., in October 1998, about pavement preservation. Keys areas for action are identified. FHWA, 1999.

Kansas Motor Grader Information

A one-stop course for information on using a motorgrader. Includes two Kansas LTAP publications—*Motor Grader Operator Handbook* and *Motor Grader Tips and Techniques*—plus several short articles. Kansas LTAP, 2000.

Improving Highway Safety at Bridges on Local Roads and Streets

(35 pages) Provides an excellent general guide to effective, low-cost methods for improving and enhancing bridges and bridge approach safety. LTAP/FHWA, 1998.

Equipment

Available free—for loan to local highway agencies. Call us at (785) 864-5658 to arrange time period needed for loan. There could be a waiting list for these items.

Jamar Technologies, Inc. (DB-400) Turning Movement Counter Board

A basic model for recording turning movements at intersections. The board is is lightweight and comes with its own case.

Jamar Technologies, Inc. (TDC-8) Turning Movement Counter Board

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The *KUTC Newsletter* is one of the KUTC's educational activities. Published quarterly, the newsletter is free to counties, cities, towns, tribal governments, road districts and others with transportation responsibilities. Editorial decisions are made by the KUTC. Engineering practices and procedures set forth in this newsletter shall be implemented by or under the supervision of a licensed professional engineer in accordance with Kansas state statutes dealing with the technical professions.

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. Robert L. Parsons



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