Rehab or replace?

Bridge inspection rating tells the tale. Here’s how it works.

...by Courtney Hansen .......

According to Bruce Filippi, bridge design engineer at KDOT, each local government bridge in Kansas over 20 ft. in length must be reviewed by a qualified inspector at least every two years.* This two-year interval is a requirement from the U.S. National Bridge Inspection Standards. The inspection frequency can only be adjusted if the Federal Highway Administration (FHWA) determines that a different interval would be more appropriate.

The purpose of these inspections is to ensure safety and gather information to submit to FHWA for assignment of a sufficiency rating. The federal sufficiency rating system is used not only to evaluate the overall serviceability of the bridge, but also to determine whether federal funding is available for bridge rehabilitation or replacement.

Obtaining federal funding
To be eligible for federal funding, a bridge must be either structurally deficient or functionally obsolete. A bridge is considered structurally deficient if it can no longer carry State legal loads, whether caused by obsolete design standards or structural deterioration. A bridge is considered functionally obsolete if it is unable to adequately handle modern traffic; that is, if the lanes are too few or too narrow, or if the bridge has a low underclearance.

If deficiency is determined, a sufficiency rating is then calculated to determine the type of funding for which the bridge is eligible. If the rating is less than 80, the bridge qualifies for rehabilitation funding; if the rating is less than 50, the bridge qualifies for replacement funding. (In some instances a bridge that qualifies for replacement could be rehabilitated instead.)

Another factor that determines eligibility for replacement or repair funding is the “ten-year rule.” For a period of 10 years after construction or a major improvement, a bridge is ineligible for federal funding for enhancement of the bridge. The rule was designed to prevent bridges from remaining deficient despite repair or replacement.

Factors in determining a rating
To calculate the overall sufficiency rating for a bridge, inspectors score each of three major factors, which are calculated in terms of percentage points and, if perfect, would add up to a total of 100 points. The total of the three scores gives an overall rating that

*bridge inspectors in Kansas must have certain qualifications—see page 9.

continued on page 2 ➤
Bridge sufficiency rating,  
continued from page 1

reflects the sufficiency percentage, or rating, of the bridge.

The first and most weighted factor in determining a bridge sufficiency rating is structural adequacy and safety. This counts for up to 55 percent of the rating, and is determined using primarily two criteria, bridge superstructure and substructure. These are scored on a scale from 0 to 9, and the lowest rating of the two categories determines the base for the structural part of the overall sufficiency rating.

A score of 5, meaning that all primary structural elements are sound, earns a bridge a base rating of 45 percent. This base rating may be lowered in relation to the amount of weight a bridge can hold; for example, if a bridge can only support 20 metric tons, about 15 percentage points would be subtracted from the base rating. The less weight a bridge can hold, the more points are deducted from this category; no points are deducted if the bridge can carry 32 metric tons or more.

The second factor, which counts for up to 30 percent of the rating, is serviceability and functional obsolescence. In this category, each bridge starts out with a 30 percent rating, and deductions are made for characteristics such as poor deck condition, inadequate allowance for drainage, low underclearances and overhead vehicle clearances, and narrow lane width.

The third factor is essentiality for public use, which makes up 15 percent of the rating. This factor is calculated using a ratio that includes the average daily traffic, the total detour length if the bridge is out of service, and the previous two ratings. High daily traffic and detour length will lower the score, while having high ratings in both structural adequacy and service-ability will raise it.

In addition to these three main categories, special deductions can be taken from a bridge's rating if the bridge falls into certain structure-type categories or if the bridge lacks (or has inadequate) safety features such as railings and approach guardrails. However, these deductions cannot total more than 13 percent. These deductions are subtracted from the sum of the three main categories, and the resulting number is the overall sufficiency rating of the bridge.

Inspectors score each of three major factors, which are calculated in terms of percentage points and, if perfect, would add up to a total of 100 points. The total of the three scores is the sufficiency rating of the bridge.

Example of a bridge sufficiency rating calculation

This example is a simplified depiction of a bridge’s sufficiency rating. A full description of every aspect considered in the assignment of this sufficiency rating can be found in FHWA’s Recording and Coding Guide—see page 3.

<table>
<thead>
<tr>
<th>Score received</th>
<th>Why didn’t the bridge get the full score?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Structural adequacy and safety 30.4 out of 55</td>
<td>The bridge structure had some damage, though not enough to cause bridge failure. In addition, the load the bridge was able to carry was less than would be needed for normal traffic.</td>
</tr>
<tr>
<td>Serviceability and functional obsolescence 7 out of 30</td>
<td>The bridge deck was designed poorly and was in poor condition. The bridge also had inadequate underclearances and lane width.</td>
</tr>
<tr>
<td>Essentiality for public use 0 out of 15</td>
<td>The bridge lost all points in this category because it performed weakly in the other categories and had a very high detour length.</td>
</tr>
<tr>
<td>Special deductions N/A</td>
<td>This category is only used when the totals from the previous three categories are greater than or equal to 50.</td>
</tr>
<tr>
<td>Total 37.4 percent</td>
<td></td>
</tr>
</tbody>
</table>

With this total rating, the bridge would be eligible for federal funds for replacement.
sufficiency rating.

A completely perfect bridge would have a rating of 100. A score of zero would not necessarily mean that the bridge was a pile of rubble; it would merely mean that the bridge is completely inadequate for its current use. A bridge is considered adequate if it has a rating of 80 or higher.

**Correction**

In our last issue we reported that Douglas County, Ks., does not have a dust control program. We were wrong. Douglas County in fact has a long-standing and successful dust control program. We meant to say the County does not have a program that allows citizens to pay to have the roads paved in front of their homes to control dust. We regret this error.

We will feature a story on Douglas County's dust control program in an upcoming issue on dust and sediment. Look for it.

**Rehab or replace?**

While the bridge sufficiency rating is the basis for FHWA's decision to designate a bridge for replacement or rehabilitation, the ability of the bridge to carry current traffic loads and accommodate the width of farm equipment could also influence the decision. Even if FHWA determines the bridge only qualifies for rehabilitation funding, replacement is still possible if documents are submitted to FHWA to show replacement is less expensive or is the only viable alternative.

The complete FHWA Recording and Coding Guide for the Structure Inventory and Appraisal of the Nation's Bridges, which includes comprehensive instructions on calculating the sufficiency rating and an example rating calculation, is available in Word and PDF formats at www.fhwa.dot.gov/bridge/mtguide.doc or www.fhwa.dot.gov/bridge/mtguide.pdf.

**Low water stream crossings**

The following information is taken from an Iowa guidebook on low water stream crossing design and construction. While the book covers the use of these crossings specifically in the State of Iowa, most the information is general and is useful for any location.

. . . by Courtney Hansen . . . . .

In a time when funding is drying up, low water stream crossings can be a viable answer to the call for money-saving practices. On very-low-volume roads, these alternatives to standard bridges can be constructed over small streams. Low water crossings often create substantial savings over the cost of maintaining traditional bridges over these streams. These crossings are particularly suited to situations that solicit, but don't require, access across a stream.

Because low water crossings are designed to handle periodic flooding, the road may be closed for a few days in periods of high water. However, in situations where a bridge receives more wear from the weather and the effects of time of less than six inches. Unvented fords are simply stable materials such as crushed rock or concrete placed so that the crossing surface is either at the level of the streambed, or raised above it. The crossing is designed so that the approach grade is less than 10 percent and the depth of the water flowing over the crossing is normally less than six inches. Because this form of crossing can be easily flooded, it is recommended for roads with an average daily traffic of less than five vehicles. Additionally, in cases of extreme flooding, the crossing should be cleared of any sediment that may remain on the crossing surface.

While there are only a few situations where low water crossings are appropriate, these crossings can reduce maintenance and construction costs in the areas to which they are suited.

**Unvented fords**

The first, and least expensive type of low water crossing is an unvented ford. This type of crossing can be used over streams that are dry most of the year, or have a normal stream flow than from vehicle use, a low water crossing can be a practical alternative to a standard bridge.
Which Kansas counties have the most bridges?

Editor’s note: Over lunch at the recent MINK meeting in St. Joseph, MO, I asked a group of county engineers what topics they’d like to see in a *KUTC Newsletter* issue on bridges. One request was a list of counties and how many bridges they have. So here it is! Thanks to Ken Silver of KDOT’s Bureau of Local Projects for providing this information.

The list below shows the name of each county and how many local government bridges are in the county. State-owned bridges are not included. The second number indicates how many bridges are owned by cities within that county. (In some cases the county may maintain those bridges.) Sedgwick County, which is fairly urbanized, tops the list with nearly 900 bridges. But some more rural counties also have a lot of bridges. Have a look. —L.H.

### Local government bridges in Kansas over 20 ft. in length

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Source: Kansas DOT Bureau of Local Projects, 2002 data.
Plastic a low-impact solution for stabilizing older and historic bridges

As steel-supported concrete bridges grow older, the outer layer of concrete begins to deteriorate; eventually it crumbles away, leaving the underlying steel supports vulnerable to rust. For many of these bridges, the addition of more concrete or steel as a reinforcement is an impossibility: it would add too much weight to the bridge, and would in effect damage, rather than repair, the bridge. In more and more of these cases, plastics are being used to provide lightweight support, adding strength to bridges without adding weight. In addition, the plastic reinforcements are thin, and thus cause little change to the appearance of the bridge.

The material used is actually not just plastic; it’s a combination of durable resin and high strength fibers such as glass and carbon. While glass and carbon may normally be weak and brittle, they gain significant strength when used in fiber form. When these fibers are covered in a durable plastic such as epoxy, the whole is, indeed, greater than the sum of its parts.

Fiber reinforced plastics, or FRPs, have long been used to create new bridge decks, adding strength and resistance to the bridge elements without adding too much weight. In fact, the first all-composite bridge deck was installed in Russell, Kan., in 1996. Recently, though, interest is increasing in using FRPs in another way—wrapping existing bridge columns to boost strength. To wrap existing columns in FRP, fibers are woven into a kind of fabric, and then covered in a durable resin. They are then applied to the columns using a high-strength adhesive. In addition to reinforcing existing bridge supports, FRPs also guard these supports from the weather, and increase resistance to earthquakes.

This process was used in Pasadena, Calif., on the historic Arroyo Seco Bridge. This concrete bridge spans 1,364 ft and carries six lanes of traffic 120 ft over the Arroyo Seco Canyon. It was the first historic arch bridge in California to be strengthened with FRPs. The material was chosen because steel jackets would be too heavy, and would significantly change the appearance of the bridge. As an alternative to steel, FRP was wrapped around the bottom four feet of each supporting column where it joined the main arch. In addition to providing support, the FRP confined the concrete to the columns, thereby strengthening the bridge with a material that, even at less than three quarters of an inch thick, has a strength comparable with that of steel. The successful use of FRPs on the Arroyo Seco Bridge set a precedent for historic bridge restoration.

All-plastic bridge built in New Jersey

The next time you have coffee in a styrofoam cup, think about this: The cup you are drinking from could end up being part of a bridge. Bridge engineers have succeeded in designing and building an all-plastic bridge made from a composite polymer developed from recycled polystyrene cups and polyethylene milk jugs (no kidding). Neither of the constituent materials would be suitable for structural use alone, of course, but a process developed and patented at Rutgers University that uses melting and extrusion processes gives the resulting composite material unexpected mechanical strength.

The plastic bridge is a single-lane fire-equipment access bridge over a river in Wharton State Park. Its reinforced I-beams and other components are all made of the recycled plastic. The bridge is strong enough to support a fully-loaded fire truck weighing 36,000 lbs.

The Wharton Park project is the first demonstration of this new technology. The bridge was designed by McLaren Engineering in Nyack, NY, and consists of large I-beams supported by posts, with smaller I-beams spanning between the larger structures. The road surface is 3-inch thick tongue and groove decking. All bridge members were manufactured by Polywood Corporation of Edison, NJ.

The new bridge is impervious to water and weathering effects, is virtually indestructible, and never needs painting or other maintenance.


continued on page 9
Dad, how do they know the load limit on a bridge?

I remember a Calvin and Hobbs cartoon where Calvin and his parents were crossing a bridge with a Load Limit 10T sign placed next to it. Calvin asked his father, “How do they know the load limit on a bridge?” His father states in that fatherly voice, “They drive bigger and bigger trucks across the bridge until it breaks, and then they weigh the last truck and rebuild the bridge.” Calvin’s mother quips, “Dear, if you don’t know the answer, just tell him!”

Well, that’s one way to approach the subject. I hope that’s not the way you’re doing it! In this article I’ll describe how load rating is supposed to be done, and why.

As the result of several significant bridge failures in the late 1960s where lives were lost, federal law required all bridges to be inspected every two years. For some bridges, the inspection cycle may be more frequent, but most bridges are on a two-year cycle. As part of that process, each bridge is load rated by a licensed engineer. So, how is that done?

The first step is to conduct a visual inspection of the bridge. Engineers and technicians look for obvious signs of deterioration, such as rusted metal beams or broken concrete, and loss of cross-section of the main load-carrying members. When cross-section loss is found, it is measured and used later in the analysis of the bridge. Bridge inspectors also look for other performance measures of the bridge. They would include the orientation of bridge components such as the main structural members, guardrails, approaches, abutments, and signage. The condition of each bridge element is noted on the inspection form. These notes are valuable for the analysis done by the engineer.

When analyzing a bridge, I like to see how the bridge behaves under traffic and listen to the noises generated by the bridge.

In most states, bridges are load rated for a set of standard truck configurations. The three truck parameters influencing the load ratings for a bridge are: 1) the weight on each axle, 2) the number of axles, and 3) the spacing of the axles. In general, as the number of axles and spacing between the axles increase, the higher total load the bridge can carry.

An engineer has two options for the method of load rating. The traditional method is based on the “working stress” approach. This method takes the stresses caused by the weight of the bridge itself (the dead load) and truck loads and adds them together. The other method, called “load and resistance factor,” takes the bridge’s dead load and truck loads and multiply them by constants, called load factors. These factors are found in AASHTO’s Manual for Condition Evaluation of Bridges. Then the engineer determines the strength of the bridge and calculates the allowable load of the bridge. The load and resistance factor method generally gives more consistent results and is considered the better method.

There are advantages and disadvantages using either method, and they can give very different answers. I remember a consulting job where using these two methods for a small bridge with a very heavy dead load produced very different results. With the working stress method, the allowable load was quite small and the analysis showed that the bridge should be closed. With the load and resistant factor method, the analysis indicated that bridge could remain open and carry moderate traffic. You see, load rating a bridge is more than just plugging into formulas. There is a certain art to it.

In this case, the engineer could recommend that the bridge be kept open but severely restrict the weight of traffic using the bridge. Or he or she could recommend that the bridge be closed. Ultimately, the governing body that owns the bridge will receive the engineers’ recommendation and make the final decision about the load rating.

Why do you see the different truck signs on load-restricted bridges? Bridge engineers know that if you spread out the load, bridges can carry heavier loads. Thus, when the truck is configured with more axles and longer lengths, it can carry a heavier load and still be safe. Engineers try to take advantage of this principle by posting bridges for multiple truck configurations.

Another concept that seems to confuse people is the two different load levels that engineers use to load
rate a bridge. The operating rating is the truck weight that a bridge can carry safely. However, it is recognized that if it were to carry that load on a regular basis, the life of the bridge would be reduced due to fatigue of the bridge material. A lower rating, called inventory rating, is the load that the bridge could carry throughout its useful life. Bridges are posted somewhere between the inventory rating and operating rating depending upon the policies of the owner.

Does the engineer decide on the load ratings put on the signs? The answer to that question is no. In most situations, the engineer recommends to a governing body the suggested load limits for the bridge. The governing body is responsible for passing the ordinance that authorizes the load limit sign to be posted.

Writing this article reminded me of a conversation I had at a load rating school years ago. An attendee was telling of a friend who had a posted bridge near his farm. The load limit sign didn’t stop him from using the bridge with a significantly higher load on his truck. And, (back to the cartoon at the beginning of this article), according to Calvin’s dad, the bridge was safe. If the bridge was posted correctly, it could actually carry and support heavier loads. However, two important issues must be considered.

First, by subjecting the bridge to these heavier loads, the bridge will wear out faster due to fatigue of the bridge structure. Eventually, bridge inspectors will observe fatigue cracks in the bridge members. Second, the factor of safety for the bridge under that heavy load is reduced. Thus, there is a higher risk of the bridge failing while his friend is on the bridge.

So, my message to Calvin’s dad is this: Yes, your way would be one way to load rate a bridge. However, engineers have much better methods to ensure safety of the traveling public and to protect the public’s investment their bridges.

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Under construction: Kansas Road Scholar Program for cities

Board members of the Kansas Chapter of the American Public Works Association (APWA) have given their support to developing a Kansas Road Scholar Program for cities. A committee, comprising the individuals pictured above, met in Salina on January 22, 2004. The first effort of the group will be to identify training needs—met and unmet—that exist in each of their own cities. Jeff Hancock has agreed to chair the group and Chuck Soules will co-chair. For more information, contact any of the committee members.

Back Row: Larry Emig (KDOT); Kyle Sulzman (Hays); Lee Holmes (KDOT); Jeff Hancock (Manhattan); Robert Mendoza (Derby); and Chuck Soules (Lawrence). Front Row: Mike Fraser (Salina); Wendell Bates (Hutchinson); Patrick Pruitt (Wichita); and Andy Haney (Ottawa). Committee members not pictured: Joe Finley (Dodge City), Pat Weaver and Rose Lichtenberg (KS LTAP).
State and County combine funds to save stone arch bridge

Unless you’re a student of obscure Kansas history, you’ve probably never heard of Fort Fletcher. After all, it only existed for a little more than a year.

But in 1936 the Ellis County Commissioners dedicated a stone arch bridge over Big Creek that bears the name of the fort. The bridge was constructed at a cost of $14,213 by local laborers using limestone quarried nearby. It was a project of the Works Progress Administration (WPA), a federal program that employed about one-third of the nation’s 10 million unemployed workers during the “dirty Thirties.” Many buildings and other structures across the state are results of this economy-stimulating program.

The Fort Fletcher Stone Arch Bridge was scheduled for replacement until local citizens learned they would lose their distinctive span. It is now listed on the National Register of Historic Places and its renovation has recently been completed. The project included excavation, temporary shoring, stone repair, repointing of masonry, backfill and concrete pavement repair.

Financing for the nearly $1 million renovation was an 80/20 split between KDOT (using Transportation Enhancement Funds) and Ellis County. The county also received a $90,000 grant from the Kansas Heritage Trust Fund, a competitive grant administered by the State Historical Society.

But what about the fort? Here’s the story:

In 1865, Fort Fletcher was established along the Smoky Hill Trail, a stagecoach road to Denver. It was named after Missouri Governor Thomas C, Fletcher who signed an executive proclamation that made slavery illegal in that pro-slavery state—and this during the Civil War!

Just a year later the fort was renamed to honor Major General Alexander Hays who was killed in 1864 during the Battle of the Wilderness, Grant’s first step in the Overland Campaign against Lee. Three years later a flash flood destroyed the fort and it was relocated 14 miles to the northwest near the present site of the City of Hays.

Remains of the old Fort Fletcher (aka Fort Hays) rest in a pasture northwest of the bridge. Because it’s on private property, access is restricted. Visiting the Fort Fletcher bridge, however, is well worth the side trip from I-70. Go four miles south from the Walker exit (Exit 172) and take a journey back in time.

Tom Hein is a public involvement liaison for KDOT’s District Three.

Reprinted with permission from Translines, May 2003, a publication for KDOT employees.
Low water stream crossings, continued from page 3

Vented fords
A more reliable and slightly more expensive type of low water crossing is a vented ford. Vented fords can be used over streams with a normal flow that is greater than six inches. Vented fords improve on the unvented ford design by adding pipes at least one foot in diameter through the crossing to accommodate the normal flow of water. At least one foot of crossing material is then placed over the pipes. This allows for a mostly dry crossing, which tends to flood less than its unvented sibling.

Low water bridges
On roads that carry more traffic, a low water bridge, the third type of low water crossing, should be a consideration. Low water bridges are also useful for crossing streams with a flow that exceeds the capacity of a vented ford, or over streams that carry debris that may clog a vented ford. This crossing consists of a concrete slab bridge at about the level of the stream banks with a profile that allows high water to pass over it without causing significant damage. The deck is designed to be heavy enough to resist drag and uplift in flood conditions, and has rounded edges to lessen the resistance created by the bridge. This crossing is suited for low-volume roads that have an average daily traffic between five and 400 vehicles, or for crossing streams that exceed the capacity of a vented ford. Low water bridges are the most expensive of all the low water crossings, but still may be more economically feasible than a typical bridge because it is designed to sustain little damage during floods.

Safety considerations
With all low water crossings, there are some factors that may make them an illogical choice for the situation. Low water crossings should not be used on roads that are the only route to inhabited dwellings, because the crossings may flood periodically, closing the road for up to several days. Likewise, they should not be used on roads where no alternative emergency access is available. Just a little over six inches of water can carry a car off of a road, and accidents can occur if a driver attempts to cross the stream while the road is flooded. For this reason, low water crossings should not be used where visibility is low, and signs should be posted, warning drivers of the potential for danger.

While there are few situations where low water crossings are appropriate, these crossings can reduce maintenance and construction costs in the areas to which they are suited.

A complete report from the Iowa Department of Transportation and Iowa State University, called Low Water Stream Crossings: Design and Construction Recommendations, is available in a 55 page, 1.04 MB PFD for download at http://www.ctre.iastate.edu/reports/LWSC.pdf. If you do not have internet access and would like a printed copy of this report, call us at (785) 864-5658.

What qualifications do bridge inspectors need in Kansas?

According to John Gough, bridge inspection engineer for KDOT’s Bureau of Local Projects, there are three different ways to be qualified to inspect local government bridges in Kansas:

1) be a licensed P.E.; or 2) have a minimum of 10 years of experience of bridge inspection assignments and completion of the federal bridge inspection course; or 3) be a NICET-certified bridge safety inspector.

NICET is an acronym for National Institute for Certification in Engineering Technologies.

Federal bridge inspection courses are offered by the National Highway Institute across the United States. The course is held approximately every two years in Kansas, and is usually coordinated by KDOT. This two-week long course costs approximately $1200 per person, but KDOT has been able to subsidize some Kansas attendees. The course “keeps you moving,” said Gough, and includes hands-on field work as well as classroom work. Participants must pass a final exam to pass the course.

I asked Gough if he had any recommendations for local governments when looking for a bridge inspector. “Look for ample prior experience inspecting bridges, especially local bridges in Kansas,” he said. “Just like anything else, the more you do something, the more you know the ins and outs. “The whole point of bridge inspection is safety,” Gough added. The more experience an inspector has had in the field, the better able he or she will be to identify safety problems on your bridges.”
Students have a “whale”
of a time collecting data
in Barton County

. . . by Adam Krug, Barton County summer intern . . . . . . . . . . . . . . . . . . . . . .

Barton County, located right in the middle of Kansas, has adopted a very efficient system for inspection, inventory, determining locations of structures and surveying around its many miles of paved and sand roads. The data for these projects is collected using a global positioning system (GPS) for use with ESRI software.

Summer 2002 was the big test, because all of the equipment was new and nobody in Barton County had ever used anything like this. A sign inventory was the big undertaking that year. Through trial and error most of the kinks were worked out of the system, so that by the following summer it was just a matter of learning a few simple settings on the GPS unit to get the next projects going—plus a lot of time driving around the county collecting data. In Summer 2003 we tackled bridge and drainage structure inventories, among other projects.

Getting the “whale” rolling
The whole purpose for having the GPS receiver unit is that it takes the coordinates within 3-4 feet of the location of the antenna, which was positioned on top of the county car. The car that was issued to us for this project was a ’91 Caprice, which was definitely the largest car in the fleet. The car was so large, in fact, that everyone in the courthouse who had the privilege to drive this car called it “the whale.” The car’s size was very functional, because it had plenty of room for all of the equipment including the GPS backpack, laptop computer, digital camera, lots of maps and other papers, a 400w inverter, and two large people with lunches packed.

Bridge inventory
This mobile office worked very well on the first project of the summer, which was recording the coordinates of all the bridges in the county that were over 20 ft. in length. There are nearly 400 of these bridges in the county and over 1000 miles were logged on “the whale” to get all of the data back into the office.

It’s all in the system
The bridge inventory project was just a warm-up for our next project that summer: recording driveway or field entrances off paved county roads. The less than 400 bridges were nothing compared to the more than 4,100 entrances and pipes for which we recorded the location, size, material and condition.

The key to being efficient is to find a system that works for you. For the first week it was just a one-man operation and all of the data was taken down on paper. That method did not seem too terribly slow at the time, but after we added another person and got the laptop going, productivity tripled. The entrance project took close to a month to complete just the data-gathering portion.

Drainage structure inventory and inspection
The next task in the “Summer of Projects” was to GPS-locate and inspect all the drainage structures under 20 feet and crossroad pipes on paved county roads. This project was the most involved and required the most equipment. All of the stops and starts, plus running the air conditioner pretty hard, caused the “whale” to overheat on a regular basis, plus we needed a 4-wheel drive vehicle to get in and out of ditches and off the roads while inspecting.

We developed a simple system for this project as well. The driver would record the location and then get out of the car with a hammer and a digital camera. The hammer was for checking the condition of the concrete and the camera was used to take a picture of the structure and any defects. In places where tall grass grew around some of the bridges the driver also carried a machete and a golf club to cut a path through the brush and hit snakes if they looked like they might want to bite. While all of this was going on, the passenger was recording the dimensions of the structure and the structural characteristics. The driver would come back and report on the structure’s condition.
Making the data useful

When it was time to come into the office at the end of each day, it was also time to download all of the data collected that day. This was quick and easy. Spreadsheets were used to add data to the ESRI mapping software. The data can also be shown on fancy-looking maps which are useful for seeing the big picture. Usually within a few minutes the raw data from the spreadsheets could be seen as color-coded symbols on an aerial photograph.

The spreadsheet format was also useful because the digital pictures could be linked directly to the picture number column on the spreadsheet, making viewing the pictures of the bridge or the defects as easy as clicking on the picture number on a computer screen.

All of the data was easy to collect and even easier to access and use for future county projects.

Practice makes perfect

This method of gathering and using data can seem complicated at first. Setting up the whole system and getting the data organized is a time-consuming process, but once a person has done it, it is much easier the second time—and it keeps getting easier as the projects add up over time.

The overall cost of these projects is very low. The equipment and software can all be purchased for a few thousand dollars, plus gas to keep the vehicles going, and a little bit of money to pay the people to run all of the equipment. The projects this past summer were done by a couple of college students: myself and Jamie Rusco, a senior at the University of North Carolina-Charlotte.

There are endless possibilities to what can be done with GPS as the technology continues to advance. Barton County has gotten a lot done in only two summers. By using our simple methods, other counties should be able to have the same success.

Adam Krug is a junior at Betheny College in Lindsborg, Ks.
Bridging the access gap

... by Ira Allen .........

County bridges are historically not the safest locations for bicyclists and pedestrians. A build-up of grit and grime in close proximity to motorized traffic creates situations that are dangerous not only for bicyclists and pedestrians, but for motor vehicle drivers as well. If an issue occurs on the shoulder of a bridge, bicyclists and pedestrians have nowhere to go but over the edge or into traffic. The problem is one of escape.

We recognize this danger when we talk about safety issues for roadside construction workers, but the idea comes up less frequently with respect to bicyclist and pedestrian access to bridges. Pedestrians and bicyclists on county bridges, many of which have no sidewalks and some of which have no shoulder to speak of, often face threats to their safety equal to those faced by roadside workers, and they do it without warning signs, flares, or speed reduction measures.

So what does the transportation industry do for the bicyclists and pedestrians trapped on bridges with dangerously fast, heavy motorized traffic? In this article, we look at some of the approaches taken, and consider a couple of the solutions offered by the experts. To get a full spectrum of responses, we spoke with Keith Browning, county engineer for Douglas County, Kansas, Andrew Sanford, senior bridge engineer for California-based design firm Simon Wong Engineering, and Tom Mulinazzi, chair of Civil, Environmental & Architectural Engineering at the University of Kansas.

Bikers and walkers and cars, oh my!

Mulinazzi outlined the two basic dangers bicyclists and pedestrians face, even on bridges with “adequate” shoulders: debris and mirrors. For pedestrians, truck mirrors can be fatal, as in the case of a pedestrian hit from behind by a truck mirror and knocked off a bridge near the University of Maryland. He said this was not the only instance of a pedestrian being hit from behind by a high, wide truck mirror, although most cases do not result in falls from the bridge.

Fortunately, this is a problem that is relatively easily solved. Wide sidewalks or shoulders are a good start. Mulinazzi notes, “In rural areas, the shoulder should be carried across the bridge and possibly widened, to account for the difficulty of escape for pedestrians.”

Concrete “New Jersey”-type barriers, such as those Keith Browning says will be installed along the Kasold Street Bridge over Interstate-70 in Lawrence, can help ensure that vehicles maintain safe distances from the sidewalk, and also keep pedestrians from straying out onto the roadway. Jersey barriers also keep debris buildup, a major problem for bicyclists, on the road and off the shoulder or sidewalk. Of course, this only helps bicyclists if they are allowed to ride on the sidewalk; in most localities, bicyclists are encouraged or legally obligated to ride with the direction of traffic on the road itself.

For bicyclists, the build-up of debris that naturally occurs to the sides of roads can be deadly, particularly on bridges. Both Browning and Mulinazzi cited instances of bicyclists riding on the road amid fast-paced traffic, even on bridges with shoulders, because the shoulder is where debris collects and “it’s very easy to lose control in those sandy, grimy areas.” Bicyclists will venture onto busy roadways, including those on bridges, when they deem the shoulder to be simply too cluttered for safe riding, despite the proximity of motorized vehicles.

Browning explained the difficulty of alleviating this problem, saying, “We don’t have the personnel and equipment to dedicate to clearing debris from what few paved shoulders we do have.

One possible solution would be for counties to concentrate only on sweeping and clearing shoulders on bridges, since the relatively small space available for maneuvering makes these areas most dangerous.

Mulinazzi said, “You’ve got to get out there as soon as you can with a sweeper, and sweep off all the grime and grit.” This is good for both bicyclists and motorists, giving bicyclists the safe access granted them by law in such a way that they do not interrupt motorist’s speedy pursuit of the American dream.

Another maintenance and cleaning option involves cooperation with local bicycling groups. Browning explained, “We would be interested in working with bike clubs to see if they would be willing to provide some of that help by cleaning shoulders on some of their busier rides.”

Pedestrians and bicyclists also may have trouble on bridges that simply do not have a shoulder. Unfortunately, this is not an issue likely to be resolved soon. The Transportation Equity Act for the 21st Century (TEA-21) mandates, “in any case where a highway bridge deck being replaced or rehabilitated with federal financial participa-
tion is located on a highway on which bicycles are permitted to operate at each end... and the Secretary determines that the safe accommodation of bicycles can be achieved at reasonable cost, the such bridge shall be so replaced.” Since most bridge replacements or rehabilitations are expensive enough affairs that federal funds are required, this requirement has significant long-range impacts, but bridges are not something we replace or reconstruct all that frequently. So, as Browning put it, “We’re not going to be able to provide shoulders for bicyclists overnight, so it’s real important that bicyclists and motorists alike respect each other and realize that both types of transportation are going to be using these roads.

Accommodating everybody
Because the needs of bicyclists, motorists and pedestrians are so diverse, it is difficult to accommodate them all. If you build a Jersey barrier to help protect pedestrians, bicyclists are trapped outside the walkway, on the debris-strewn, now-narrower shoulder. If you maintain shoulders meticulously, that won’t stop anyone from getting clipped on the back of the head by a truck mirror, nor will it help prevent small children from running out into traffic, in pursuit of some shiny, small treasure. The ideal bridge, perhaps, would have a raised sidewalk with Jersey barriers, with a well-maintained, wide shoulder between the barriers and the roadway. The shoulder would be impeccably maintained and regularly swept clean of dirt, sand and debris. And the bridge would be that much more of an imposition on the landscape, with the extra width making it that much more expensive to build.

As hinted at above, the needs of the traveling public are not the only ones to consider. Andrew Sanford underscored the importance of making the structure as visually appealing as possible. He said, “You need to take into account how it’s going to impact the community, so people don’t think, ‘Wow, that’s a big, ugly bridge,’ or ‘That’s a nice bridge that doesn’t really fit our community.’ That’s something that we do that doesn’t cost a lot extra, but makes a big difference in the end.”

Obviously, this is less of an issue for a rural county bridge than for a bridge spanning a river downtown, but some of the lessons of downtown bridges can and should apply to more rural bridges. Small things, like painting the bridge to blend with the surrounding landscape or integrating stone into the concrete pillars for a more natural look, can make the difference between a bridge that fits the community and one that is functional but unattractive. Among other things, attractive bridges give local lawmakers a better impression of the departments that build or refurbish them, which may translate into much-needed public works funds.

A final need to consider relates to safety of a different sort than that previously discussed. Sanford said bridge designers need to be aware of the view of the pedestrian. “For instance,” he explained, “if you have a bridge with high exterior girders, obstructing the view of people on the bridge from people off the bridge, you create an opportunity for crime, such as mugging or rape. While muggings are pretty rare in rural Kansas, the principle is still valid, if for no other reason than to minimize graffiti. Any time you create a situation where people on the bridge are not in sight of anyone, you create the potential for crime.

Forging ahead
County engineers in Douglas and other counties recognize that accommodation is an issue that is not likely to go away, especially accommodation for bicyclists. Browning said, “There is more bicycle traffic than there used to be, and bicycles must be taken into account when you’re doing road and bridge projects.” Browning said that, to provide safe access for bicyclists, “When we do a bridge replacement project, we assure there are shoulders on the new bridges even if there are none on the road.” Douglas County engineers also try to accommodate bicyclists by providing shoulders that at least match the shoulder width of the road.” Like many other counties in Kansas, Douglas County is off to a good start, and more growth is both necessary and expected.

The accommodation of diverse bridge users is a broad and thorny issue. This article could hardly hope to have explored all avenues for providing safe access to bridges for pedestrians and bicyclists, and we would be interested to hear (and write about) any experiences you have had in this area, as well as any solutions you have found. Contact Lisa Harris at (785) 864-2590 to share your story about this or any other road-related news topic.
Reviews

... by Lisa Harris ............

**Thunderstorms, Tornadoes, Lightning...Nature’s Most Violent Storms**
15 pages, produced by US Department of Commerce and the American Red Cross. Contains an overview about how violent storms form and precautions to take if one comes your way. Provides general tips useful for employee safety information.

**Floods: The Awesome Power**
13 pages, produced by the US Department of Commerce and the American Red Cross, August 2002. Contains numerous facts about floods and flash floods, including an illustration of the various forces that act upon a vehicle when driving over a water-covered section of a road. Well illustrated and a good safety publication for employees.

**Winter Storms: The Deceptive Killers**
11 pages, produced by the US Department of Commerce and the American Red Cross, December 2001. A basic-level, well-illustrated guide about the health and safety risks of winter storms and how storms are formed. Includes advice for safety items to have in your vehicle in the event of a storm, and how to avoid hypothermia.

**Installation Manual for Corrugated Steel Pipe, Pipe Arches and Structural Plate**
48 pages, produced by National Corrugated Steel Pipe Association. This booklet provides practical information for the installation of corrugated steel pipe as storm sewers and culverts. Targeted for engineers and contractors, it is liberally illustrated and well written.

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### 2004

**March 23-25** Synchro and SimTraffic Workshop Lawrence, KS

**March 24** MUTCD Workshop Topeka, KS

**March 10—Garden City**

**March 11—Hutchinson**

**March 12—Topeka**

**March 13—Sedgwick**

**March 14—Wichita**

**March 15—Manhattan**

**March 16—Great Bend**

**March 17—Kinsley**

**March 18—Chanute**

**March 19—Olathe**

**March 20—Lawrence**

**March 21—Hays**

**March 22—Hays**

**March 23—Great Bend**

**March 24—Manhattan**

**March 25—Olathe**

**March 26—Topeka**

**March 27—Salina**

**March 28—Lewiston**

**March 29—Emporia**

**March 30—Wichita**

**March 31—Abilene**

**April 1—Hays**

**April 2—Wichita**

**April 3—Lawrence**

**April 4—Abilene**

**April 5—Chanute**

**April 6—Olathe**

**April 7—Great Bend**

**April 8—Lawrence**

**April 9—Emporia**

**April 10—Lewiston**

**April 11—Salina**

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- **Floods: The Awesome Power**
  Free. 13 pages, produced by the US Department of Commerce and the American Red Cross, August 2002.

- **Winter Storms: The Deceptive Killers**
  Free. 11 pages, produced by the US Department of Commerce and the American Red Cross, December 2001.

- **Installation Manual for Corrugated Steel Pipe, Pipe Arches and Structural Plate**
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