Quality Matters
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from the Quality Assurance Branch (QAB) of Highway Design

An Innovative and Cost-Effective Solution

KYTC designs, builds quicker using new bridge technology

In July 2014, District 4 staff constructed the first bridge in Kentucky using a new construction technology (*see video*) -- Geosynthetic Reinforced Soil - Integrated Bridge System (GRS-IBS). It utilizes fabric and compacted rock, contained by a split-faced masonry block to build the superstructure. It saves the expense of concrete, steel and formwork associated with concrete substructures.

Frequent flooding at a low water stream crossing on Palestine Road just north of Campbellsville required maintenance crews to close the road several times a year to clear debris from the five 18-inch pipes. This recurring maintenance issue prompted District 4 to seek a solution to its water woes. Palestine Road is a Rural Secondary road with limited funding, so the solution had to be cost-effective.

To address this problem, District 4 design staff surveyed the roadway and stream, estimated the drainage opening size, located utilities and developed a plan sheet and centerline profile. The District had box beams on a facility lot that were salvaged from another bridge replacement project.

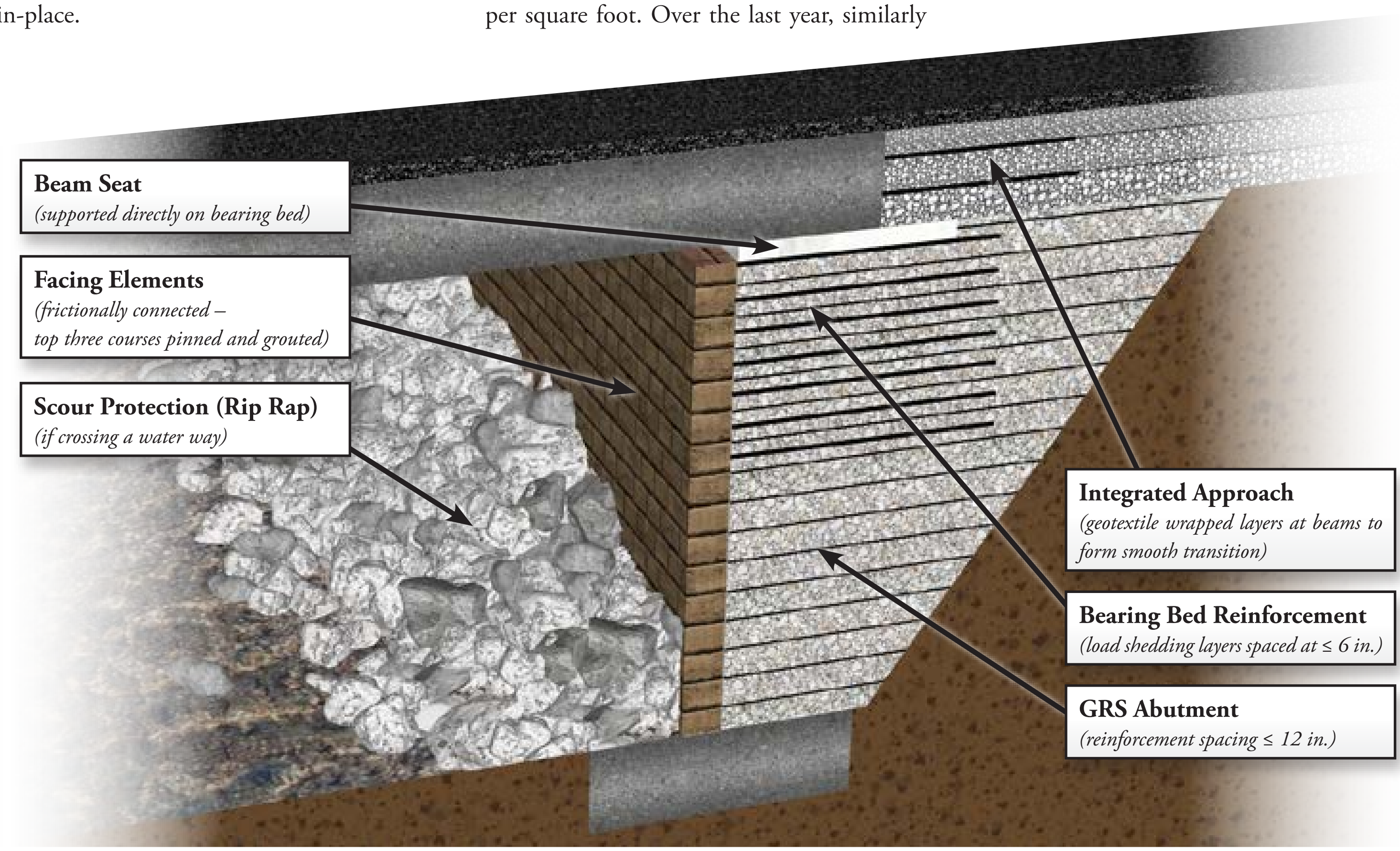
The plans were then handed to a special maintenance crew tasked to construct a bridge using the GRS-IBS technology. Aside from abutment locations, plans did not include a lot of details about constructing the substructure. District construction staff used the FHWA GRS-IBS *Implementation Guide* to properly build the abutment and wing walls. They excavated from where the face of the wall would be and built a shallow concrete footer on solid rock of the creek bed to create a level surface for placing the first layer of eight-inch blocks. Crushed aggregate was placed and compacted behind the block with a layer of geosynthetic fabric on top. This basic pattern was continued to the top.

The beams sit on a bearing pad supported by the backfill. There are no piles needed when using GRS-IBS due to its high compressive strength. One of the benefits of this technology is, if any settlement takes place, the roadway approach and the bridge superstructure settle the same amount, eliminating the common problem of a bump at the end of the bridge. Staff is monitoring settlement on this project and so far it has been negligible. A *study* of GRS-IBS structures installed more than 20 years ago also indicates minor settlement since construction.

GRS-IBS is cheaper and faster than conventional bridge building techniques. With no pile foundations and no concrete abutments or wing walls, construction can be completed in days, reducing impacts to road users. This project (*see pictures*) took less than three weeks. In fact, one of those weeks was due to delay in material delivery so it could be completed in about two weeks. No special equipment was needed to construct the superstructure. However, special trucks were rented to haul the beams to the project and a crane was needed to move the beams in-place.

Costs of materials, equipment rental and labor to build the bridge totaled $114,000, which included approaches, guardrail and asphalt pavement. Adding in an estimated cost to purchase new beams, the total cost would have been less than $190,000, or $136 per square foot. Over the last year, similarly sized bridges contracted out in the district ranged between $170 and $310 per square foot. Use of GRS-IBS helped achieve more than a 20 percent savings.

by: Brent Sweger, PE, AVS



Project Update — 3D Modeling Helping Shape Elliott County Project

In the Summer 2013 newsletter, an article featured 3D modeling. An upcoming project was also mentioned, the reconstruction of KY 7 in Elliott County, in which electronic plans would be part of the contract plan set. Below is an update of the experience on that project so far.

The contract was awarded to Elmo Greer & Sons in August 2013. The company has excavated nearly one million of the nearly three million total cubic yards. The contractor is using conventional methods to get the subgrade to within 0.2 feet and then use GPS-based Automated Machine Guidance (AMG), programmed with the 3D model data, to complete the finish grading. Many contractors that develop their own 3D models based on the 2D plans use AMG for all of the earthwork.

KYTC staff continues to monitor the project and the quality of the data in the model. The model has helped everyone better visualize the final product and the work needed. Inspectors have benefited by being able to use GPS rovers to take subgrade measurements and then compare them to the model. This allows any mistakes to be caught and addressed earlier. The model also helped in the bidding process by improving accuracy of quantities and allowing the contractor to develop the bid faster.

Another related lesson learned by the contractor is that he was able to tie the company's GPS equipment into the KYCORS network, freeing the contractor from setting up multiple base stations along the five-mile route.

KYTC and the contracting industry met in October to discuss the challenges and the future direction of 3D models. There are still many questions regarding the KYTC role versus contractor role in development of 3D plan sets.

In the meantime, KYTC Highway Design Developmental Branch is developing another 3D model project in Jessamine County that will begin construction in 2015. Any project manager interested in using this approach should first contact Kevin Martin.

By Kevin Martin, PE

Bicycle Safety: Navigating Sawed Rumble Strips

Sawed rumble strips offer tremendous safety benefits to automobile users. However, they can be hazardous to a cyclist. Sawed rumble strips that alert motorists to lane departures can cause a cyclist to crash or create bike damage. Proper consideration during design and construction can greatly mitigate these impacts and accommodate more users on the highway.

Rumble strips that are poorly positioned laterally can make a shoulder difficult for cyclists to use by reducing the clear path or forcing to them to ride where debris collects. The best way to achieve a debris-free surface is to locate the sawed rumble strip as close to the edge line as possible or utilize rumble stripes.

When rumble strips take up too much of the shoulder, riders are unable to avoid them, often making the shoulder unusable. *FHWA design guidance for bicycle accommodation* suggests a minimum shoulder width required to operate a bicycle safely is four feet of clear path.

The guidance does not recommend installing a rumble strip unless that minimum can be met.

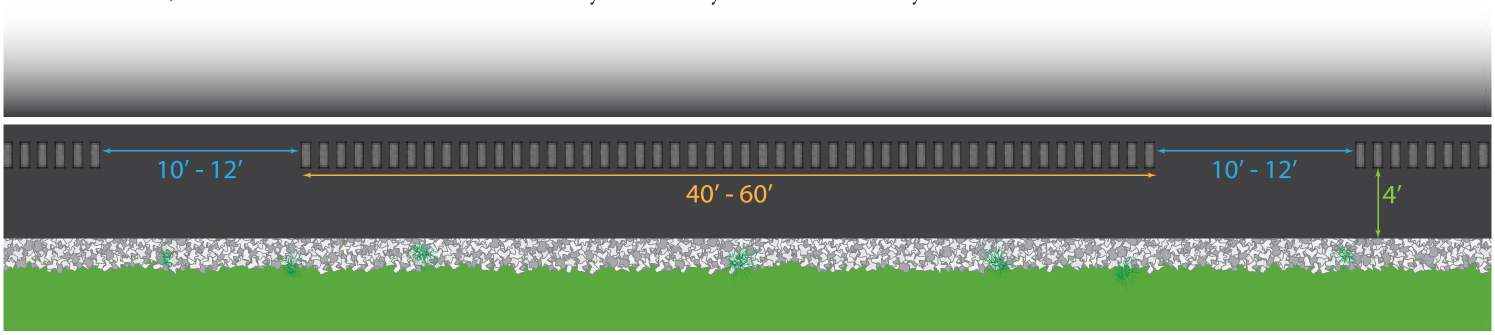
A continuous line of rumble strips also poses difficulties for cyclists. Periodic gaps in a line of sawed rumble strips allow bicyclists to move safely between shoulder and travel lane to make turns or avoid large objects on the shoulder. Providing gaps also reduces the cost of sawed rumble strips.

Recently, representatives of five KYTC divisions met and reviewed a proposal for rumble strips/stripes on state-maintained roadways to safely accommodate cyclists. Based on national research examining vehicular and bicycle safety, one of the proposed recommendations addresses the design of a gap:

Where a paved shoulder space exists beyond the rumble strip and where bicyclists have four feet or more of usable space; recurring short gaps should be designed in the continuous rumble strip pattern to allow for ease of movement of bicyclists from one side of the rumble to the other. A typical pattern is gaps of 10 to 12 feet between groups of the 40 to 60 foot long milled-in rumble elements.

Consideration of seemingly inconsequential details can often make all the difference for safe bicycling accommodations. For additional information, contact Troy Hearn, KYTC Pedestrian and Bicycle Coordinator.

By: Troy Hearn and Brent Sweger, PE, AVS



Communicating All Promises (CAP)

As a project progresses toward a construction letting, many commitments are made. They may include one to an environmental resource agency, a property owner, a utility company, an elected official or the general public. A promise may be a feature related to the design or an action to take during construction. For example, there may be a promise to keep the road open when school is in session to minimize traffic impacts. Another may be to avoid excavating the root system of a favorite big oak tree in a specific property owner's yard.

It is the goal of KYTC to keep these promises in order to maintain trust and credibility. Sometimes, it can be overwhelming to keep track or remember promises that were made over the life of the project and sometimes they can be lost because of turnover in staff. To be sure all commitments are followed through, the district Project Development Manager should ensure CAPs meeting their approval are entered into the Precon database. This is a centralized place that anyone can quickly see the CAPs and their time frames.

It's simple and quick to do.

Simply find your project and click on the CAP tab. Then enter the requestor, location on the project, request date and a very specific CAP description. For a project without a CAP, then enter "No CAPS." A report can be generated easily by selecting the Open CAP Report button.

The project manager should be sure this information gets passed along to the resident engineer, inspectors and contractor, by including the CAP report in the bid package and the contract document. Entering this data is a great way to share these promises with those that need to follow them through.

By Brent Sweger, PE, AVS

Check out Florida DOT's updated *Median Handbook*. It's not KYTC policy, but this document is an excellent, comprehensive resource containing information about median design.

Upcoming Training:

Kentucky Engineering Center:

- **KRS 322 MTS Code of Conduct & Expert Witness**
  Date: 12/10/2014
  Location: Lexington
  Time: 8 a.m.–5 p.m.
- **Lexington One Day Fall Seminar**
  Date: 12/10/2014
  Location: Lexington
  Time: 8 a.m.–5 p.m.
- **MicroStation I for Civil Professionals**
  Date: 2/3/2015 through 2/6/2015
  Location: Frankfort
  Time: 8 a.m.–4:30 p.m.

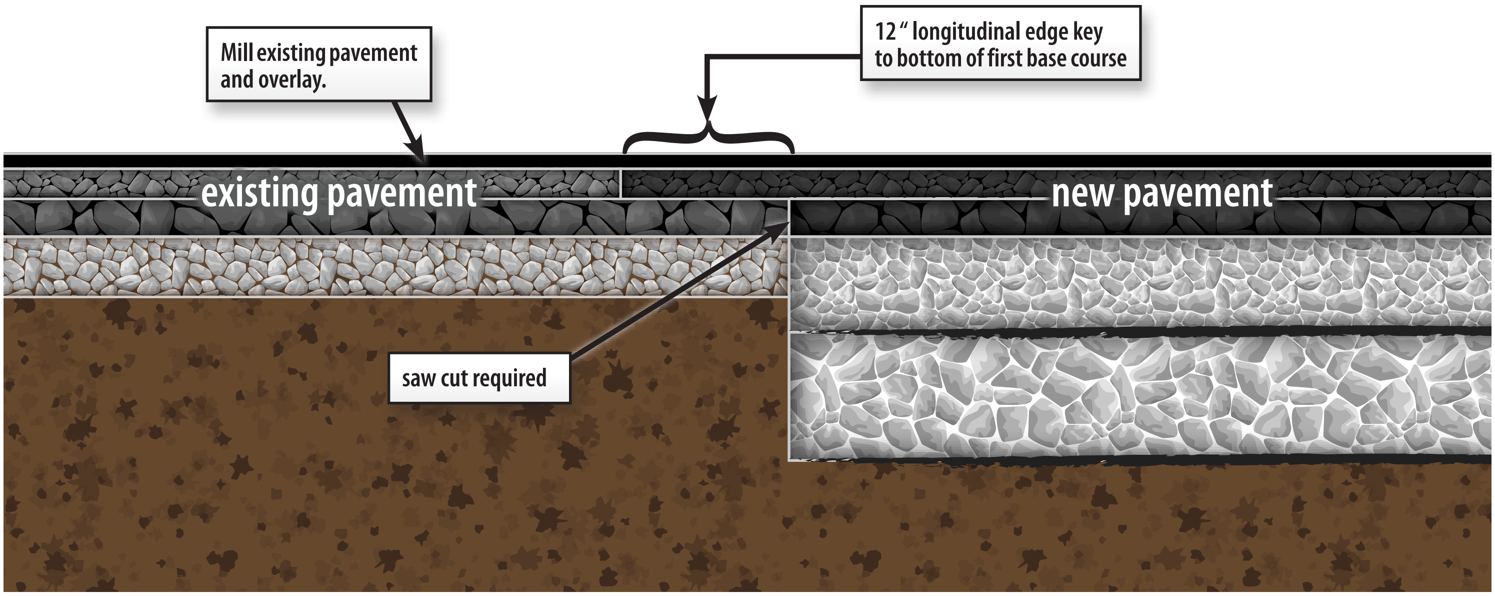
KYTC employees should contact ***Kevin Martin*** *to schedule training.*

Edge Key to Success

Widening projects have become common place in the transportation industry. Many construction projects are limited to work within the confines of existing right of way. With that comes many challenges to quality construction practices. On recent post-construction reviews a common concern is long-term durability of the full depth joint created by the widening process and prevention of reflective cracking at the full depth joint.

A couple of simple and cost effective options are saw-cutting and longitudinal edge keys. As the Quality Assurance Branch discussed this topic with the construction industry across various regions of the state it became evident that saw-cutting and longitudinal edge keys are necessary to combat potential differential settlement of the adjacent pavement structures. This may seem obvious, but in many cases projects are only using one or none at all. The cross-section below shows proper way to form the longitudinal edge key to maximize success.

By: Travis Carrico, PE, AVS



Remember! **When a project uses Type A or A-1 bridge end guardrail connectors, there should be island curb on all four corners, even when a curb box inlet is not included. This is to ensure water is drained away from the bridge abutment to prevent erosion. For details, see Active Sepia drawing numbers 026 and 027.**

Lessons Learned Database Available Online

Intelligent Compaction

GPS-equipped vibratory compaction rollers take the guess work out of compacting bituminous pavements. GPS data is collected and shown on a display near the operator offering real time information display to help the operator track uniform passes. The ability of the operator to see those passes helps maintain consistent compaction across a lift of asphalt and ensures in-place densities are representative of that lift. In July, the technology was demonstrated on Interstate 65 near Horse Cave. Expect a special note to be added soon to the Standard Specifications for Road and Bridge Construction. Learn more about *intelligent compaction*.

By: Shawn Russell, PE, AVS

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