Kansas
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GRS-IBS: A Strong and Economical Design Option for Bridges

By Chris Wichman and Lisa Harris

A new innovation in bridge construction is gaining traction around the nation and may soon be coming to Kansas. The Geosynthetic Reinforced Soil Integrated Bridge System, or GRS-IBS for short, is a simple bridge construction method that uses readily available, inexpensive materials and basic earthwork techniques to build bridges better, faster and cheaper. The technique is being promoted by the Federal Highway Administration's (FHWA) "Every Day Counts Initiative" that aims to identify innovations for shortening project delivery while enhancing roadway safety and protecting the environment. This article will give an overview of the GRS-IBS method and summarize thoughts about the technology from local agencies that have either implemented or are considering the technique.


Federal Highway Administration

Bowman Bridge in Defiance, County, Ohio, is a GRS-IBS structure. It was built in six weeks by one crew.

How it works

The GRS-IBS technique creates a substructure of closely-spaced alternating layers of compacted granular fill material and geosynthetic fabric reinforcement. Rather than drilling deep piles, the reinforced soil method builds up the substructure in a faster, simpler, and less expensive way. The FHWA compares the technique to building a layer cake, with the fabric being the "filling" or frosting between the thicker cake layers.

The abutment construction process is as follows:

Step 1. Lay a row of facing blocks along the stream channel to contain fill.

Step 2. Place a layer of compacted fill (soil, etc.) behind the facing blocks.

Step 3. Top with a sheet of geosynthetic fabric.

Repeat from Step 1 until the desired height is achieved.

This low-tech approach continues until the abutment reaches the desired height, and the bridge beams are placed directly on top of the GRS abutment mass. An approach-way is then built behind the bridge abutment to transition the bridge deck to the roadway. No joint or cast-in-place concrete is needed. Since the bridge extends naturally out of the roadway, there is no "bump at the end of the bridge" caused by differential settlement between the bridge abutment and the approaching roadway.

Want to see one being built? The FHWA has produced a very informative 19-minute minute video showing the construction of a GRS-IBS bridge from start to finish, found at http://www.youtube.com/watch?v=w_5WFoAdoUw.

Benefits

The FHWA lists a number of advantages of GRS-IBS technology compared with conventional concrete abutments.

- ***Shorter construction time.*** A GRS-IBS abutment can be built in a shorter period of time compared with many other bridge designs; generally a few days rather than weeks or months. GRS-IBS technology is also appealing to the public because travel lanes are closed for a shorter amount of time.
- ***Lower costs.*** Construction costs are generally lower due to reduced construction time (labor hours), the use of inexpensive and common equipment and materials, and no need for highly skilled labor. The FHWA cities a 25 to 60

percent decrease in costs for a GRS-IBS bridge compared with traditional methods.

- ***Smoother transition.*** The faulting between the bridge deck and approach slab is eliminated.
- ***Less susceptible to movement.*** The flexible design makes GRS-IBS able to withstand both large lateral deformations and vertical settlement, adding to the long-term strength and durability of the bridge.

GRS-IBS spells success in Ohio

Defiance County in Ohio was an early adopter of the technology. In 2005, FHWA began working with the County's engineering department to provide guidance on GRS abutment design. "After seeing a presentation on the technology and meeting with FHWA representatives to learn more, we modified our plans from using traditional abutments to building ones with GRS," said Warren Schlatter, Defiance County engineer. The county's first bridge using GRS-IBS technology was completed that same year. Since then, Defiance County has built a total of 27 bridges using GRS-IBS, and the 28th is under way.

Schlatter is drawn to the simplicity of the GRS building process. "Now that our crews are comfortable with the process, we can build an abutment in three days. It is convenient for us to build them ourselves with materials that are easy to manage, do not take up much room, and do not expire. We order the geo-synthetic fabric in bulk and are able to store it easily. We use our local quarry for the fill material and a local manufacturer for facing blocks so we are never caught waiting around for materials to be delivered," Schlatter said. This allows the department a lot of flexibility in scheduling bridge-project construction.

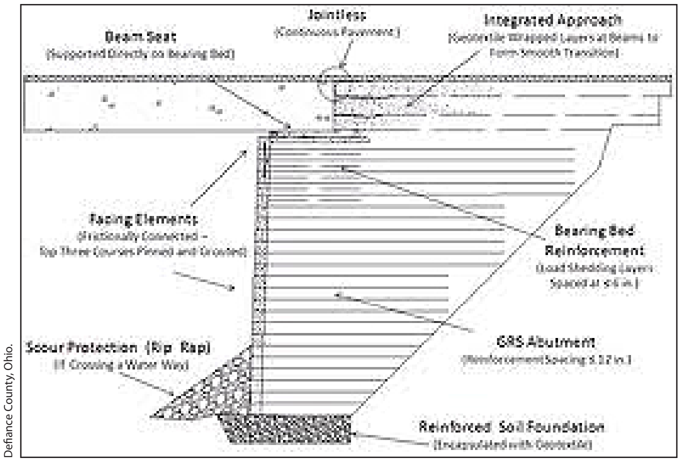
Defiance County has also used contractors for a few GRS-IBS projects that were funded by FHWA grants. Schlatter said contractors had no trouble picking up the GRS building method. "One of our contractors budgeted 10 days for each abutment since they had never done it before. It ended up taking them five days for each abutment," he said.

Schlatter said the GRS construction method takes a little getting used to, "but it is pretty hard to mess up."

GRS-IBS in Kansas

Currently there are no GRS-IBS bridges in Kansas, but some local agencies are interesting in building them. FHWA and KS LTAP held Webinars on the topic in Wichita and Topeka last February, and there was a presentation about GRS IBS at the KCHA/APWA joint meeting in Newton this past May. We spoke with a few local agencies that are becoming familiar with the technology.

Sedgwick County bridge engineer, Penny Evans, said that while her relatively urban county probably will not install a GRS-IBS bridge, she sees the value of the technology for counties that are seeking economical ways to build bridges on low volume roads in areas without significant scour problems. Sedgwick County has higher than average traffic volumes and relatively sandy, scourable soil. Evans



Defiance County, Ohio.

Typical cross section of a GRS-IBS abutment face wall.

said "I have seen scour up to 4 ft deep all over the place" in the Arkansas River basin. The Arkansas River flooded countywide a few years ago. In her county, to prevent scour, Evans said a concrete pad would have to be poured, and "the way I see it, if you're pouring the pad you might as well go ahead and pour a concrete box," she said.

Evans said she was impressed with the aesthetic quality of the GRS-IBS product as shown in the FHWA video. "When I heard about how it was constructed, I was not expecting to see something that nice," she said.

Justin Mader, ***McPherson County*** project engineer, is very interested in the technology and hopes to build a GRS-IBS bridge using in-house staff within the next few years. He sees the technology as a good solution for replacement of bridges that span 40-60 ft on very low volume roads. This span range is "too big for a KDOT standard-size box and too small for the expense of putting in a haunched slab," he said.

Mader is considering their first location for a GRS-IBS project on a stream with relatively low velocity and on a road with very low traffic volume—just a few vehicles a week, he said. He explained that they have some areas that are dependent on a bridge for access, and closing the bridge is not an option they want to consider.

Mader said putting in a low water crossing is another alternative at those kinds of locations, but "in many cases you really want a span bridge—to hold down the maintenance required after a rain event." A GRS-IBS bridge is an economical solution for a span bridge because, for other types of span bridges, a crane would be required to drive deep foundation piles. "That gets pretty darned expensive," Mader said.

Mader sees very few disadvantages to the GRS-IBS technology at the proper locations, but downsides include the initial learning process when building the first bridge, and the time taken away from other county activities while the county crew is constructing it. If his commissioners

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Bowman Bridge abutments under construction.

approve using the technology, his first project will be relatively short and low until the crew becomes more comfortable with the construction process.

Clark Rusco, ***Barton County*** engineer, said his county is considering using the GRS-IBS technology in the future. He said his county has many aging bridges built between 1930 and 1960 that are going to need replacement and that have a replacement-span size that meets GRS-IBS criteria. For these particular bridges, Rusco said there is little worry of saturation or scour. There is currently no time-line for constructing their first GRS-IBS bridge, but the county has applied for a grant from KDOT for off-system bridges to build a GRS-IBS demonstration project. If awarded, KDOT would bid the project and a contractor would be responsible for building the project, while the county road-bridge crew would be on-hand to view the process and be trained in the GRS-IBS method. The crew would then build smaller bridges until comfortable with the construction methods and eventually move on to bigger projects.

Rusco sees the benefits to his county of GRS-IBS technology as:

—Extends the construction season; abutments can be built in winter and early spring;

—Can use in-house labor, rather than contracting construction crews;

—Can use in-house equipment, aside from crane rental to set beams for longer span bridges.

KDOT has been considering GRS-IBS projects at a few locations, and may build one on I-70 in western Kansas.

FHWA has an aggressive goal of having one GRS-IBS project built in 50 percent of the states by December of this year. While Kansas will not have a project on the ground by that time, Norbert Muñoz, FHWA's Kansas Division assistant division administrator, is pleased with the interest he's hearing in Kansas about the technology.

"I was very happy with the participation in the webinars. It was more than we expected," he said. "There was good give and take and participants had a lot of good ideas to share." Muñoz said that once a project is in place in Kansas and people see it, he expects the technology to really take off.

Conclusion

Although the GRS-IBS technology is not right for every situation, the FHWA says it can be a good solution for low-volume, single span bridges of less than 120 feet. Kansas local agencies that are becoming educated on the technology recommend careful attention to the potential for scour and to consider scour prevention measures in determining the cost effectiveness of the technology at your particular locations. Defiance County's Schlatter advises that a deep enough foundation be put in place to reduce the risk of water getting underneath the abutment. Proper drainage is essential to avoid the problem of creep, which can happen if the soil-fabric and fill material become saturated with water. The potential for scour can be addressed by various design solutions outlined by FHWA. With appropriate countermeasures, the potential for creep and scour can be mitigated, and the benefits of cost- and time-savings of using GRS-IBS technology can be achieved.

For more information

For a good range of resources on GRS-IBS bridges, visit Defiance County's GRS site at http://www.defiance-county.com/engineer/GRS.htm and FHWA's GRS-IBS web site—see the first listing in the sources for this article, below. ■

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Sources:

- Federal Highway Administration GRS-IBS Resources. http://www.fhwa.dot.gov/everydaycounts/technology/grs_ibs/.
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- Geosynthetic Reinforced Soil Integrated Bridge System. CA-LTAP Tech Transfer Newsletter. Fall 2010. http://www.techtransfer.berkeley.edu/newsletter/10-4/edc-grs-ibs.php.
- Phone interview: Warren Schlatter, Defiance County engineer, June 21, 2012.
- Phone Interview: Clark Rusco, Barton County engineer, June 20, 2012.
- Phone interview: Penny Evans, Sedgwick County bridge engineer, June 25, 2012.
- Phone interview: Justin Mader, McPherson County project engineer, June 25, 2012.