Test planned for new bridge-building technology

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INNOVATIVE NEW METHODS for designing and building small bridges could give local governments and state agencies cost-effective options for keeping those bridges open and safe. The Federal Highway Administration (FHWA) is promoting one of these new technologies through its Every Day Counts (EDC) initiative and will work with the Wisconsin Department of Transportation this year on a pilot project to test it out.

The Geosynthetic Reinforced Soil-Integrated Bridge System, or GRS-IBS, is a bridge construction method that alternates layers of compacted granular fill material with geotextile fabric to build an abutment. The FHWA says the technique reduces project time and costs, and produces a smooth transition from roadway to bridge.

The pilot project, slated to begin in early summer on State Highway 40 in Chippewa County, will give state and local road officials the chance to see a GRS-IBS installation for themselves.

Vertical strength

Wisconsin is among the first states in the country to explore the benefits of this alternative to conventional poured concrete abutments, says Structural Engineer Joe Balice, who is with the FHWA Division office in Madison. "What we know about GRS-IBS suggests it could be a good choice for replacing local bridges, especially single spans over low-velocity waterways that drain small watersheds."

Construction requires readily available materials and basic equipment, a fact that Balice says helps speed the work and reduces construction costs—in some cases, up to 60 percent over conventional methods.

Other suitable GRS-IBS projects include roads crossing streams that have banks with good base soils. Balice says the vertical structures are made strong internally by the interweaving of fabric and aggregate but need a foundation of competent, or well-compacted soils to ensure stability and minimize future settlement and scour concerns.

Once that foundation is ready, the GRS-IBS abutment construction begins with a row of facing block that establishes the outer perimeter of the structure. Next comes a layer of compacted fill placed to the height of the block followed by a layer of geosynthetic fabric positioned over the fill and block. Crews repeat this three-step process to reach the abutment height specified in the design. Then they place the bridge beams on the GRS mass and build the geotextile-reinforced approach to join the bridge and roadway, a detail that eliminates the bump drivers often experience entering or leaving a conventionally constructed bridge. The technology actually eliminates the use of typical abutments.

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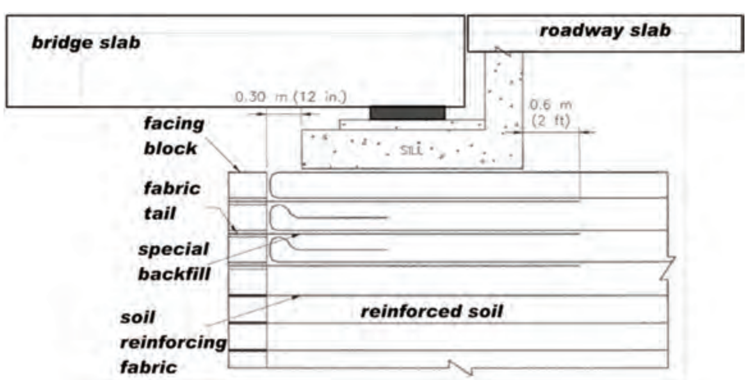

Cut-away schematic illustrates the wall of facing block, and the fabric and soil layers in a GRS abutment, and shows how the structure meets the bridge deck and roadway.

Explore the benefits

WisDOT's William Oliva, Chief of the Bureau of Structures Bridge Development Section, says the idea of doing the GRS-IBS pilot came from faculty members in the University of Wisconsin Department of Engineering who contacted WisDOT almost two years ago about developing a proposal to do field research on the characteristics of the technology with funding from FHWA's Innovative Bridge Research and Deployment program (IBRD). The state agency saw it as an opportunity to learn if the method was a good fit for constructing and replacing bridges. It also aligned with WisDOT/FHWA collaborations on other new EDC road improvement technologies.

Scheduled for replacement in 2012, the 60-year-old Hwy 40 Bridge was a good candidate for the demonstration project. WisDOT altered the original plan to construct it instead as a GRS-IBS project and received help on the redesign from the FHWA Resource Center. "Here was our chance to see where GRS-IBS is appropriate and how we can take advantage of the benefits," Oliva says.

Among the benefits are lower costs and a smaller construction footprint. These are important but Oliva says saving time is the biggest advantage of the technology. "GRS-IBS could give state highway officials and local governments a worthwhile option for replacing many of the smaller bridges that need replacement across Wisconsin on a much quicker schedule," Oliva suggests.

He says another plus is that the simpler GRS-IBS construction process should expand the field of contractors qualified to bid on local projects. Since the method does not require heavy equipment, like a pile driver, and many items on the short list of common materials can come from local sources, it opens the door to more vendors.

Monitoring project

The suggestion to secure IBRD funding to research GRS-IBS in action came from Engineering Professor Mike Oliva and Associate Professor Dante Fratta at the UW-Madison and Sam Helwany, Professor of Geotechnical Engineering at UW-Milwaukee. They will lead a group that includes engineering students who will monitor the construction process and, once the new bridge is in service, measure the performance of the GRS-IBS structures.

"We'll examine building techniques during construction to record any difficulties and identify changes to improve the process on future projects," Professor Oliva says. "At the same time, the students will install devices that will record the impact of traffic on the new structures over time."

The group will measure internal pressures in the GRS foundation over a two-year period and deformations in the foundation and roadway.

Worth considering

Monitoring of the Hwy 40 project over the long-term will help transportation engineers in Wisconsin and nationally better understand the structural interaction in a GRS-IBS abutment and approach, according to WisDOT's Oliva. Balice adds that the research team's results will contribute to standardizing the GRS-IBS bridge replacement process and expand the use of the technology to other structures.

WisDOT and FHWA plan to host a showcase during the GRS-IBS installation on Hwy 40. Watch for more information about this opportunity to see first-hand the application of a method local governments might want to use on future bridge projects. ■

A method that takes only days to construct versus a month could make a real difference in project turnaround and the duration of bridge closures that disrupt the flow of traffic.

Photos taken by the FHWA's Joe Balice at a GRS-IBS project in Ohio show the process of preparing a foundation of compacted soil TOP LEFT, followed by placing layers of aggregate and geosynthetic fabric to the specified height of the structure, LEFT CENTER & BELOW. A wall of facing block, ABOVE, establishes the outer perimeter of the abutment.

Resources

GRS-IBS page on FHWA Every Day Counts website with descriptions of the technology and links to case studies and helpful resources.

www.fhwa.dot.gov/everydaycounts/technology/grs_ibs/

Transportation Research Board publication reports on research behind development of a GRS design method and bridge construction guidelines. Available for purchase or as PDF download.

www.trb.org/main/blurbs/157301.aspx

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