Accelerating Infrastructure Innovations

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INSIDE

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U.S. Department of Transportation
Federal Highway Administration

Building Bridges the Geosynthetic Way

A fast and economical solution for achieving the goal of accelerated bridge construction, the Geosynthetic Reinforced Soil Integrated Bridge System (GRS-IBS) was initially developed by the Federal Highway Administration (FHWA) as part of its Bridge of the Future initiative in 2002. Now, following the success of GRS-IBS technology demonstrations in States such as Ohio and New York, one component of the bridge of the future has arrived.

Learn how to put the GRS-IBS system to work for you with FHWA's new *Geosynthetic Reinforced Soil Integrated Bridge System Interim Implementation Guide* (Pub. No. FHWA-HRT-11-026), which takes an engineer through the site selection, design, and construction process. Also available is a companion document, *Geosynthetic Reinforced Soil Integrated Bridge System Synthesis Report* (Pub. No. FHWA-HRT-11-027), which substantiates the design method and presents case histories for GRS-IBS bridges built to date.

"GRS-IBS can be built at a lower cost, with faster construction and improved performance, and can be used to build single span bridges on all types of roads," said Jennifer Nicks of FHWA. "This method of bridge support blends the roadway into the superstructure to create a jointless interface between the bridge and the approach roadways." Compared to standard bridge construction, transportation agencies that use GRS-IBS can cut their costs by 25 to 60 percent.

FHWA selected GRS to be one of the technologies promoted by its new Every Day Counts (EDC) initiative in 2010. The EDC initiative is designed to identify and deploy proven, ready-to-go innovation aimed at shortening project delivery, enhancing roadway safety, and improving environmental sustainability (see June 2010 *Focus*). For more information about EDC, visit www.fhwa.dot.gov/everydaycounts.

Researchers at the U.S. Forest Service and the Colorado Department of Transportation (CDOT) pioneered the early development of the GRS technology. FHWA then worked with CDOT to further refine it. Among the

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The Bowman Road Bridge in Defiance County, OH, was the first bridge in the world to use the Geosynthetic Reinforced Soil Integrated Bridge System (GRS-IBS).

Geosynthetic Bridges,

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GRS-IBS bridges built in Defiance County, OH, include the Vine Street Bridge (top) and the Tiffin River Bridge (bottom).

States that have successfully used the technology to date is Ohio. Defiance County, Ohio, built the Bowman Road Bridge, the first bridge in the world to use GRS-IBS, in 2005. Use of the technology cut costs by at least 25 percent compared to conventional approaches and reduced the construction time by 2 weeks. Since then, Defiance County has built a total of 23 bridges using GRS-IBS. "As we have used the technology more, we have achieved even greater savings. All of the bridges are performing very well to date," said Warren Schlatter, Defiance County Engineer.

GRS-IBS consists of three main components: the reinforced soil foundation (RSF), abutment, and integrated approach. The RSF is composed of granular fill material that is compacted and encapsulated with a geotextile fabric. This method provides embedment and increases the bearing width of the GRS abutment. The abutment, meanwhile, uses alternating layers of compacted fill and closely spaced geosynthetic reinforcement to provide support for the bridge, which can be placed directly on the abutment without the need for a joint or cast-in-place concrete. Construction of the abutment is as easy as 1-2-3: a row of facing blocks, followed by a layer of compacted granular fill, and then a layer of geosynthetic reinforcement. This process is repeated until the required abutment height is reached.

For the third component of the system, GRS is used to construct an integrated approach road to the bridge, alleviating the common "bump" caused by differential settlement between bridge abutments and approach roadways.

The GRS technology is extremely durable and, if properly constructed, can perform well in earthquakes. Other advantages include that the GRS-IBS can be built with readily available materials, using common construction equipment, and without the need for highly skilled labor. GRS-IBS also offers convenience and design flexibility, as the system can be built in variable weather and adapted easily in case of changing or unforeseen conditions. The construction of the abutment can be contained within its own footprint, reducing the project's environmental impact and the size of the needed work zone.

FHWA's Implementation Guide details how to design and construct GRS-IBS, covering such topics as:

- Materials.
- Design methodology.
- Construction.
- In-service performance.
- Special requirements for hydraulic and seismic conditions.
- Inspection, maintenance, and repair.
- Procedures for quality control and quality assurance.

The section on construction walks users through each step of the process, including labor and equipment requirements, site preparation, compaction, reinforcement, placement of the superstructure, approach integration, and site drainage.

Also featured in the guide is a design example for the Bowman Road Bridge in Defiance County, Ohio. The design example outlines the project process, including establishing the project requirements, performing a site evaluation, determining the layout of GRS-IBS, calculating loads, conducting both internal and external stability analyses, and implementing design details.

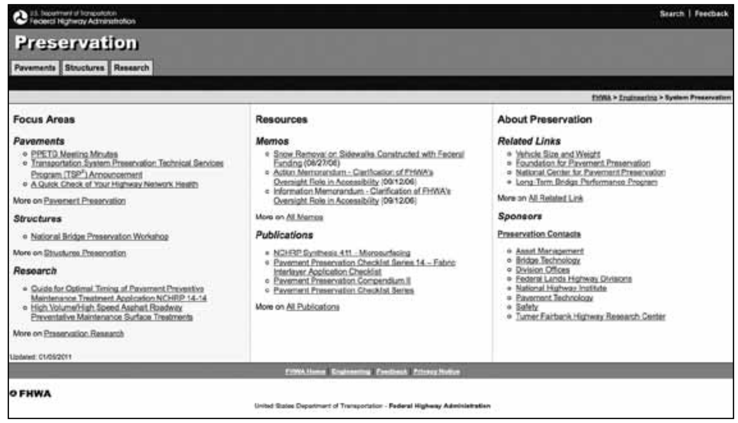
The Geosynthetic Reinforced Soil Integrated Bridge System Interim Implementation Guide and its companion synthesis report are available at www.fhwa.dot.gov/publications/research/infrastructure/structures/11026/index.cfm. For more information about GRS-IBS, contact Jennifer Nicks at FHWA, 202-493-3075 (email: jennifer.nicks@fhwa.dot.gov). To learn more about FHWA's GRS-IBS Every Day Counts initiative, contact Daniel Alzamora at the FHWA Resource Center, 720-963-3214 (email: daniel.alzamora@fhwa.dot.gov). For additional information on Defiance County's GRS bridges, contact Warren Schlatter, Defiance County Engineer, at 419-782-4751 (email: dce@defiance-county.com). ✻

Guidelines for the Preservation of High-Traffic Volume Roadways

In recent years, transportation agencies have turned to pavement preservation as a key strategy to extend the life and improve the condition of their roadway networks. With many agencies now facing decreased capital budgets, it will become critical to keep good roads in good condition. Preservation treatments and approaches will be even more important in the future, therefore, as relatively small investments in preservation activities can significantly increase infrastructure life. However, the use of many available strategies has been restricted to roadways experiencing lower traffic volume, with little use on high-volume roads.

A new report issued by the Second Strategic Highway Research Program (SHRP 2), *Guidelines for the Preservation of High-Traffic-Volume Roadways*, provides information to help expand agencies' ability to use varied treatments to best meet the preservation needs on higher-volume roadways. The report is the result of research performed under SHRP 2 Renewal Project R26: Preservation Approaches for High-Traffic-Volume Roadways.

Pavement preservation is a network level, long-term strategy that enhances performance and extends pavement life by using a variety of cost-effective surface treatments. As the guidelines note, "most preservation treatments will have the same beneficial effects on a pavement regardless of traffic volumes." Barriers historically inhibiting the greater use of preservation treatments on high-traffic-volume roadways have included increased performance expectations, increased risk of failure associated with the durability of treatments under higher traffic volumes, and lack of agency experience with certain treatments. The guidelines are intended to address some of these concerns by sharing the successful experiences and practices of transportation agencies nationwide and by providing direction to agencies on the selection and use of preservation treatments.



To learn more about preservation strategies for both pavements and structures, visit www.fhwa.dot.gov/preservation.

"These guidelines can be used to help expand an agency's toolbox and encourage them to use all available options to safely preserve high-volume roadways and see the greatest network improvement with their available budget," said Christopher Newman of the Federal Highway Administration (FHWA).

The guidelines include details on factors affecting project and treatment selections for pavement preservation, including traffic level, pavement condition, climate and environment, work zone duration restrictions, expected treatment performance, and relative costs. "Selecting an appropriate preservation treatment for a given pavement at a given time is not a simple process. It involves balancing performance considerations with condition, traffic, materials, funding, and other factors, as well as the applicability and constraints of the treatments being considered," said Newman. A sequential approach for evaluating possible preservation treatments for an existing pavement and identifying the preferred one is presented in the guidelines, diagramming how data sources and project constraints are considered.

Also presented is information on pavement distresses and how the various preservation treatments can address them. The treatments are described in initial feasibility matrices that outline possible applications for specific distresses and the treatments' ability to prevent or slow pavement deterioration or to restore functionality or surface characteristics.

Appendix A of the Guidelines, Preservation Treatment Summaries, contains technical summaries for each of the preservation treatments described in the report, including a listing of reference materials that users can consult for further guidance. Appendix B, Examples of Identifying Feasible Preservation Treatments, provides two sample exercises illustrating how feasibility matrices can be used to make an initial assessment of potential treatments and their effectiveness.

Guidelines for the Preservation of High-Traffic-Volume Roadways is available to download at http://onlinepubs.trb.org/onlinepubs/shrp2/SHRP2-S2-R26-RR-2.pdf. Printed copies are available from the Transportation Research Board for $43. To order a copy, visit http://books.trbbookstore.org/s2r26.aspx. For more information on the guidelines, contact Christopher Newman in FHWA's Office of Asset Management, 202-366-2023 (email: christopher.newman@fhwa.dot.gov). To learn more about SHRP 2 Renewal Project R26, visit www.trb.org/SHRP2 (click on "Projects" and then select "Renewal Projects"). *

For Soil Nail Walls, It's a SNAP

For designing soil nail walls, it's a SNAP. The Federal Highway Administration's (FHWA) new Soil Nail Analysis Program (SNAP) is a complete, easy-to-use software program for designing soil nail earth retaining structures, including both the nail and wall-facing elements of the structure. The soil nailing technique can be used for both temporary cut excavations or permanent applications.

When using soil nailing, the existing ground is reinforced and strengthened by installing closely-spaced, epoxy-coated steel bars, known as "nails," into a slope or excavation as construction of a retaining wall proceeds from the top down. This creates a reinforced section that is stable and able to retain the ground behind it. "In certain soil conditions, soil nail walls can be a more feasible and cost-effective alternative to conventional retaining structures," said Khamis Haramy of FHWA's Central Federal Lands Highway Division office.

Although the use of soil nailing for highway applications has become a standard in the United States, computer programs for designing soil nail walls had not kept up to date. The programs available had limited use and were not capable of designing temporary or permanent wall-facing elements or checking the stability of the overall soil nail wall system. Realizing the need, FHWA's Central Federal Lands Highway Division office, through its Technology Deployment Program, contracted with Yeh and Associates in Denver, Colorado, to develop SNAP.

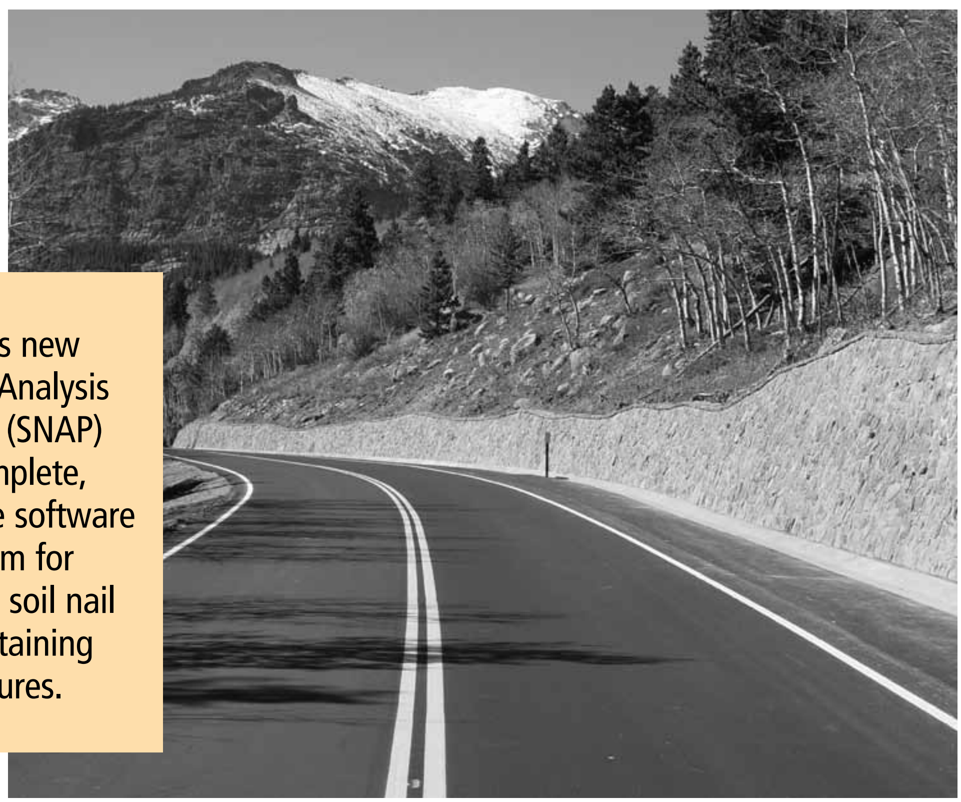
FHWA's new Soil Nail Analysis Program (SNAP) is a complete, easy-to-use software program for designing soil nail earth retaining structures.

To run the program, users enter information about:

1. Wall, back-slope, and fore-slope geometries.
2. Retained slope material properties, such as friction angle, unit weight, and cohesion.
3. Ground water elevation.
4. Seismic loading.
5. Uniform or varying nail size, length, and inclination.
6. Temporary and permanent facing support elements.

For wall-facing design and analysis, SNAP can perform evaluations for both temporary, shotcrete-only and permanent, cast-in-place concrete facing.

Program features include the ability to conduct both internal (wall facing and nail) and external failure mode analysis for static and seismic loading conditions. This analysis is based on the guidelines described in FHWA's *Manual for Design and Construction of Soil Nail Walls* (Pub. No. FHWA-SA-96-069R). Internal failure mode analyses include nail pullout and tensile strength, nail head strength, and facing element strength for both temporary and permanent conditions. SNAP can also evaluate the maximum nail loading along the entire length of each nail.



A soil nail earth retaining structure built by FHWA's Central Federal Lands Highway Division in Rocky Mountain National Park near Estes Park, CO.

Soil nails are installed as part of an FHWA Central Federal Lands Highway Division project in Guanella Pass near Georgetown, CO.

External failure mode analyses include global stability, sliding, overturning, and bearing capacity. Users can also choose to include the effects of seismic forces in the program's external stability calculations.

After performing the various analyses, SNAP can generate a complete report on the structure's soil nail design.

The SNAP program and an accompanying *SNAP User's Manual* (Pub. No. FHWA-CFL/TD-10-004) are available for download at no cost at www.cflhd.gov/programs/techDevelopment/geotech/SNAP. A recently released commercial upgrade to the free FHWA version of SNAP is also available from Lodex Engineering Corporation in Highlands Ranch, Colorado. A demo version of the commercial product can be found at www.Lodexengineering.com. For more information on SNAP, contact Khamis Haramy at FHWA, 720-963-3521 (email: khamis.haramy@fhwa.dot.gov). ✻

Enter the World of LTPP Data

Tap into the world's largest and most comprehensive pavement performance database with the new Standard Data Release (SDR) 25 from the Federal Highway Administration's (FHWA) Long-Term Pavement Performance (LTPP) program. The SDR is in Microsoft Access© format and is available at no charge on DVD.

The release contains the complete LTPP pavement performance database. Since the LTPP program began in 1987, data have been collected on the performance of nearly 2,500 in-service pavement test sections throughout the United States and Canada. The test sections represent a range of climatic and soil conditions. Users of SDR 25 will find a tutorial on "Accessing LTPP Data," which provides step-by-step examples of working with the SDR and building queries for data extraction. An accompanying Reference Library DVD provides information on software utilities, resource documents, and research reports that support the database.

LTPP data have been translated into an array of products and tools for pavement engineers, including ones supporting data collection and equipment calibration. LTPP data have also played a critical role in helping State highway agencies validate and calibrate the *Mechanistic-Empirical Pavement Design Guide*.

To obtain a copy of SDR 25, contact LTPP Customer Support Services at 202-493-3035 (email: ltppinfo@dot.gov). For more information about the LTPP program, visit www.fhwa.dot.gov/research/tfhrc/programs/infrastructure/pavements/ltpp. Information about LTPP products and online access to the LTPP database are available at www.ltpp-products.com. ✻

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Highway Technology Calendar

The following events provide opportunities to learn more about products and technologies for accelerating infrastructure innovations.

Forty-Eighth Annual Petersen Asphalt Research Conference
July 11–13, 2011, Laramie, WY

Organized by the Western Research Institute (WRI), the conference will present current research aimed at understanding and improving asphalt performance. Topics covered range from fundamental compositional research to applied field engineering. Attendees are also invited to participate in an open mic discussion.

Contact: Steve Salmans at WRI, 307-721-2306 (email: ssalmans@uwyo.edu), or Jack Youtcheff at the Federal Highway Administration (FHWA), 202-493-3090 (email: jack.youtcheff@fhwa.dot.gov). Information is also available at www.petersenasphaltconference.org.

2011 Pavement Performance Prediction Symposium
July 14, 2011, Laramie, WY

Presented by WRI in cooperation with FHWA's Turner-Fairbank Highway Research Center, the symposium will take an indepth look at the effects of asphalt binder, mix design, and construction on the durability of pavement.

Contact: Steve Salmans at WRI, 307-721-2306 (email: ssalmans@uwyo.edu), or Jack Youtcheff at FHWA, 202-493-3090 (email: jack.youtcheff@fhwa.dot.gov). Information is also available at www.petersenasphaltconference.org.

Tenth International Conference on Low-Volume Roads
July 24–27, 2011, Orlando, FL

Sponsored by the Transportation Research Board, the conference will feature the latest information about low-volume road management, design, construction, safety, maintenance, and other topics. Attendees will also have the opportunity to participate in a half-day field trip to observe and study low-volume road issues.

Contact: For more information, send an email to TRBMeetings@NAS.edu, or visit www.trb.org/LowVolumeRoadsconference/LVR10.aspx.

Second International Conference on Warm Mix Asphalt
October 11–13, 2011, St. Louis, MO

Sponsored by the National Asphalt Pavement Association and FHWA, the conference will provide a progress report on the implementation of warm-mix asphalt. Featured topics will include mix design, long-term performance, accelerated performance testing, effects on binder properties, and innovative temperature reduction processes. The conference will be of interest to engineers, researchers, contractors, and transportation agency personnel.

Contact: Matthew Corrigan at FHWA, 202-366-1549 (email: matthew.corrigan@fhwa.dot.gov), or visit www.warmmixasphalt.com.

Fifth Asphalt Shingle Recycling Forum
October 27–28, 2011, Dallas, TX

Organized by the Construction Materials Recycling Association, the forum will cover all aspects of the opportunities offered by shingle recycling. Using recycled asphalt shingles in hot-mix asphalt and other construction applications can save money and conserve natural resources, while maintaining quality.

Contact: Audrey Copeland at FHWA, 202-493-3097 (email: audrey.copeland@fhwa.dot.gov), or visit www.shinglerecycling.org.

National Bridge Management, Inspection, and Preservation Conference
October 31–November 4, 2011, St. Louis, MO

Building upon FHWA's successful 2007 National Bridge Preservation Workshop, the conference will feature separate tracks for bridge management, inspection, and preservation topics. "Making the Case for Bridge Preservation" and "Next Generation Bridge Inspection" will also be featured themes. The conference is sponsored by FHWA and the American Association of State Highway and Transportation Officials (AASHTO).

Contact: For more information, visit www.TSP2.org/bridge.

Industrial Byproducts Conference
November 1–2, 2011, Austin, TX

Sponsored by FHWA, the Industrial Resources Council, and the Rubber Manufacturers Association, the conference will highlight the use of industrial byproducts in road construction.

Contact: Jason Harrington at FHWA, 202-366-1576 (email: jason.harrington@fhwa.dot.gov), or visit www.RMA.org.

Seventh RILEM International Conference on Cracking in Pavements
June 20–22, 2012, Delft, The Netherlands

Conference topics will include the detection, prediction, and mitigation of cracking in pavements; laboratory and field model validation; and accelerated pavement testing. Organized by RILEM (the International Union of Laboratories and Experts in Construction Materials, Systems, and Structures), conference partners include FHWA and AASHTO.

Contact: For more information, visit www.rilem2012.org.

An Interactive Overview of Right-of-Way Requirements for Local Agencies

With millions of dollars in funding for local infrastructure distributed as part of the Nation's economic recovery program over the past 2 years, a new training course from the Federal Highway Administration's (FHWA) National Highway Institute (NHI) has been designed to provide a basic overview of the requirements of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970 (Uniform Act). Any State or local government receiving Federal funding for local transportation projects must comply with the provisions of the Uniform Act.

Introduction to Federal-Aid Right-of-Way Requirements for Local Public Agencies (Course No. FHWA-NHI-141050) highlights Federal requirements and procedures for acquiring property for Federally-assisted transportation projects. The 2-day course has been designed as a hands-on, highly interactive learning experience to guide participants through a series of right-of-way (ROW) problem solving exercises. For those with limited ROW knowledge, a free Web-based course, Real Estate Acquisition Under the Uniform Act: An Overview (Course No. FHWA-NHI-141045), can be taken in advance.

The main instructor-led course will cover the legal basis for land acquisition by a governmental entity, enable participants to assess the impact of a roadway improvement as it relates to the Uniform Act, and demonstrate how to sequence the ROW process within the overall project development process. On completion of the course, participants will also be equipped to determine the appropriate valuation process for ROW acquisition, apply the Uniform Act requirements to ROW acquisition and relocation assistance, and determine their agency's responsibilities for managing real property.

Designed for a minimum of 20 participants and a maximum of 35, the course costs $400 per person and is aimed at local public agency (LPA) personnel responsible for acquiring ROW for Federally-funded projects and those responsible for oversight of LPAs. FHWA personnel, consultants, State agency staff, and other interested parties are also invited to participate.

For additional information on Introduction to Federal-Aid Right-of-Way Requirements for Local Public Agencies or the Web-based Real Estate Acquisition Under the Uniform Act: An Overview, contact Carolyn James at FHWA, 202-493-0353 (email: carolyn.james@fhwa.dot.gov). To schedule the courses or to learn more about NHI training opportunities, visit www.nhi.fhwa.dot.gov.

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