Accelerating Infrastructure Innovations

FOCUS

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INSIDE

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Federal Highway Administration

New FHWA Manual Presents State of the Practice for Accelerated Bridge Construction

From a bridge replaced in less than 3 days in Utah to 14 bridges replaced in 10 weekends in Massachusetts, more State transportation agencies are turning to accelerated bridge construction (ABC) using prefabricated bridge elements and systems (PBES) to shave valuable time off project schedules and greatly reduce the impact and inconvenience experienced by drivers.

While early initiatives focused on using specific prefabricated elements such as bridge decks or pier caps, recent projects have applied PBES and other ABC techniques to all aspects of bridge construction, from superstructures to substructures and foundations. To assist transportation agencies and contractors in implementing ABC, the Federal Highway Administration (FHWA) has released a comprehensive manual, *Accelerated Bridge Construction: Experience in Design, Fabrication, and Erection of Prefabricated Bridge Elements and Systems* (Pub. No. HIF-12-013).

Following previous FHWA publications that looked at various aspects of PBES, such as the 2006 *Decision-Making Framework for Prefabricated Bridge Elements and Systems* (Pub. No. FHWA-HIF-06-030) and the 2009

continued on page 2 ➢

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Accelerated bridge projects in Utah include the Proctor Lane bridge over I-15 in Utah County, which was constructed in 2011.

New ABC Manual,
continued from page 1


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The Utah Department of Transportation installed the prefabricated superstructure of the 4500 South bridge over I-215 in Salt Lake City in 2007.

Connection Details for Prefabricated Bridge Elements and Systems (Pub. No. FHWA-IF-09-010), the new manual presents a global overview on the current state of the practice for many of the major components used in ABC implementation. From project planning to construction to inspection, transportation agencies and contractors can find guidance on every step involved in using ABC and PBES.

"Designers and contractors can work together to optimize the advantages of ABC in meeting project needs," said Myint Lwin, Director of FHWA's Office of Bridge Technology.

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ABC incorporates innovative planning, design, materials, and construction methods to reduce onsite construction time when building, replacing, or rehabilitating bridges. The use of PBES is a key element, as it offers both faster and safer bridge construction and better quality. Compared to conventional bridge construction methods, the use of PBES also improves mobility, reduces costs, and is easily adaptable to many site conditions.

The prefabricated systems can be manufactured offsite at a prefabrication plant or adjacent to the project site, under controlled conditions, and brought to the bridge location ready to install. Building in a controlled environment reduces weather-related delays and enhances constructibility, while also reducing traffic congestion and improving work zone safety. Using PBES can also reduce life-cycle costs and environmental impacts. Because of these advantages, FHWA selected PBES as one of the technologies promoted by its Every Day Counts initiative in 2010 (see June 2010 *Focus*).

In another benefit, States that have implemented extensive ABC programs have seen the public respond favorably to the greatly reduced inconvenience. The Utah Department of Transportation (UDOT) routinely measures public perception of construction projects through the use of post-construction questionnaires. Following one project that used ABC techniques, more than 97 percent of the respondents rated the project as a success.

Users of the new *Accelerated Bridge Construction* manual will find information on ABC techniques, including foundation and wall elements, rapid embankment construction, PBES, structural placement methods, and fast track contracting. Also discussed is the applicability of these techniques to different bridge projects, such as the rehabilitation of existing bridges and the construction of new bridges. The manual then takes transportation agencies and contractors through the decisionmaking process for selecting appropriate ABC methods. This process begins with defining the problem and then considers such issues as site constraints, staging areas, traffic management, right-of-way, utilities, local government constraints, and cost evaluation.

Prefabricated bridge elements are covered in detail, including materials, superstructure elements, substructure elements, and foundations. Also covered are bridge elements such as bridge deck expansion joints, bridge bearings, and barriers and railings. The manual then moves into many aspects of the construction process, ranging from materials testing to fabrication and erection issues to shoring systems and grouting. Guidance is pro-

vided as well on field inspection, including staff training.

Also addressed is the long-term performance of prefabricated elements. Case studies examine the durability of joints in substructure elements and joints in precast concrete deck panels, while guidance is provided on the importance of inspection, preservation, and maintenance.

Design and analysis is covered in the final section of the manual, including incorporating the Load and Resistance Factor Design method and rating bridges using the Load and Resistance Factor Rating method (see November 2011 *Focus*). The appendices present design examples, information on standard and proprietary products, and sample construction specifications.

The manual also features a case study highlighting UDOT's experience in implementing ABC. UDOT first used ABC to complete several projects during preparations for the 2002 Winter Olympics in Salt Lake City. The success of these projects encouraged Utah to begin moving toward making ABC standard practice for all bridges. In 2010, UDOT met that goal and today, ABC is considered on all bridge projects and used where appropriate. Projects have included the 2007 replacement of the 4500 South bridge over the I-215 East Loop in Salt Lake City, which cut road closures and detours from 6 months to a single weekend and saved $4 million in road user costs. The success of this initiative brought momentum to UDOT's ABC implementation efforts and resulted in public support for innovative strategies such as ABC.

Following installation of the new bridge, I-215 reopened to traffic after a single weekend of work.

Included in the UDOT case study is a sample ABC implementation flow chart for a State agency. As the manual notes, while each agency functions differently and may need to modify the implementation approach to fit its circumstances, the chart presents the major activities that will help to produce a successful ABC program.

The *Accelerated Bridge Construction* manual is available at www.fhwa.dot.gov/bridge/abc/docs/abcmanual.pdf. For more information on ABC, visit www.fhwa.dot.gov/bridge/abc/index.cfm. Information is also available by contacting Ben Beerman at the FHWA Resource Center, 404-562-3930 (email: benjamin.beerman@dot.gov). *

A Helping Hand with PBES

FHWA's PBES deployment team can provide agencies with workshops and additional training focused on advancing PBES and other ABC technologies. "One of the deployment and implementation challenges with ABC and PBES is that there are many viable reasons to accelerate a single bridge project, group of projects, or an entire bridge program, and there are many viable options to consider to meet the objective," said Ben Beerman of the FHWA Resource Center. "For many agencies, it can be difficult to quickly identify which of all of the available options and techniques are better suited to meet their particular needs. The deployment team understands this and is happy to provide training and other assistance."

In addition to the recent release of the *Accelerated Bridge Construction* manual, the team will be facilitating regional Peer to Peer exchanges on PBES implementation in 2012, hosting monthly technical Webinars, and providing focused training workshops. Focused workshops already held covered such topics as prefabricated substructures, ABC/PBES program implementation strategies, and the use of full-width/full-depth precast deck panels.

For more information on PBES/ABC deployment activities, sign up to receive email notices at www.fhwa.dot.gov/bridge/abc. To learn more about the assistance that the deployment team can provide, contact Ben Beerman at the FHWA Resource Center, 404-562-3930 (email: benjamin.beerman@dot.gov).

Redesigning the Bridge: Video Demonstrates a Geosynthetic Approach to Bridge Construction

It's as easy as 1-2-3. A new video released by the Federal Highway Administration (FHWA) demonstrates how to build the Geosynthetic Reinforced Soil Integrated Bridge System (GRS-IBS). Initially developed under FHWA's Bridge of the Future initiative in 2002, GRS-IBS can be used to build single span bridges on all types of roads. The technology offers the advantages of being faster, more economical, and easier to build than standard bridge construction. It is also extremely durable and can be built with readily available materials, using common construction equipment, and without the need for highly skilled labor. "We redesigned the bridge from the bottom up," said Mike Adams of FHWA.

FHWA selected GRS-IBS as one of the technology innovations for accelerated deployment by its Every Day Counts (EDC) initiative in 2010. EDC 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*).

As the video shows, researchers at the U.S. Forest Service and the Colorado Department of Transportation pioneered the early development of the GRS technology. FHWA refined the technology for load-bearing applications. In 2005, Defiance County, Ohio, built the Bowman Road Bridge, the world's first GRS-IBS bridge. Use of the technology cut costs by at least 20 percent compared to the county's previous method for bridge construction. Since then, Defiance County has built a total of 23 bridges using GRS-IBS, realizing savings of 40 percent, and is now able to build a complete bridge in about 2 weeks.

Created to educate designers, engineers, contractors, and inspectors on the fundamentals of GRS-IBS, the video takes viewers through the construction process and illustrates best practices to follow. GRS-IBS consists of three main components: the reinforced soil foundation (RSF), GRS abutment, and GRS integrated approach. The RSF is composed of granular fill material that is compacted and encapsulated with a geotextile fabric. The abutment, meanwhile, uses alternating layers of compacted fill and closely spaced geosynthetic reinforcement to provide support for the bridge superstructure, which can be placed directly on the abutment without the need for a traditional bearing 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 finished with a layer of geosynthetic reinforcement. This process is repeated until the required abutment height is reached. GRS is then also used to construct an integrated approach for the road on to the bridge, alleviating the common "bump" caused by differential settlement between the bridge and approach road.

"Once the construction process starts, you can quickly see how easy the concept

Bridges built using the Geosynthetic Reinforced Soil Integrated Bridge System (GRS-IBS) include the Vine Street Bridge in Defiance County, OH.

The Bowman Road Bridge in Defiance County was the first bridge in the world to use GRS-IBS.

is and how flexible you can be," said Jeff Timbrook, Operations Deputy for the Defiance County Engineer.

Following the initial construction experiences of Defiance County, New York's St. Lawrence County is also now using GRS-IBS to replace many of its bridges. "Our biggest benefit is adaptability to different sites," said Toby Bogart, Senior Civil Engineer for St. Lawrence County. "Also, it's cheaper, it's faster." St. Lawrence County has realized savings of 50 to 60 percent on bridges built with GRS-IBS.

To view the GRS-IBS construction video and learn more about the experiences of Defiance County and St. Lawrence County, visit FHWA's YouTube channel at http://youtube.com/user/USDOTFHWA#p/a/u/0/w_5WFoAdoUw. The video can also be viewed on the FHWA EDC Web site at www.fhwa.dot.gov/everydaycounts/technology/grs_ibs/multimedia.cfm.

Best practices in the video follow the guidance outlined in FHWA's *Geosynthetic Reinforced Soil Integrated Bridge System Interim Implementation Guide* (Pub. No. FHWA-HRT-11-026), which is available to download at www.fhwa.dot.gov/publications/research/infrastructure/structures/11026/index.cfm. 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. For additional information about GRS-IBS, contact Daniel Alzamora at FHWA, 720-963-3214 (email: daniel.alzamora@dot.gov), or Mike Adams at FHWA, 202-493-3025 (email: mike.adams@dot.gov). For details on upcoming GRS-IBS Webinars, see page 8.

Online Training Offers Introduction to Warm Mix Asphalt

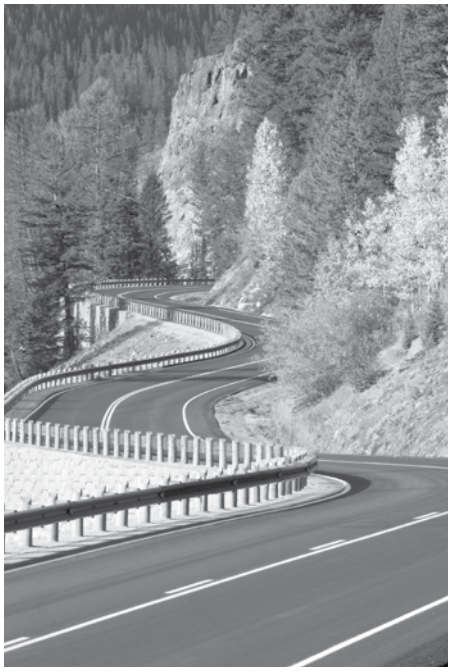
As more transportation agencies explore the use of warm mix asphalt (WMA) for pavement projects, a new Web-based training course available from the Federal Highway Administration's (FHWA) National Highway Institute (NHI) offers an introduction to "Special Mixture Design Considerations and Methods for Warm Mix Asphalt" (Course No. FHWA-NHI-131137).

FHWA selected WMA as one of the technologies promoted by its Every Day Counts (EDC) initiative in 2010. EDC 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*).

WMA encompasses a variety of technologies that allow asphalt to be produced and then placed on the road at lower temperatures than the conventional hot mix asphalt (HMA) method. The lower temperatures may result in cost savings and reduced greenhouse gas emissions because less fuel is required. The use of WMA also improves compaction, which then improves pavement performance, reduces fuel and energy usage, and increases worker comfort by reducing exposure to high temperatures, fuel emissions, and odors. Since the asphalt mix can maintain workability at lower temperatures, the use of WMA can also extend the construction season, allowing projects to be completed in a timelier manner.

The free 2-hour NHI course highlights modifications that need to be made to the current Superpave volumetric design procedure to complete a WMA mixture design, as proposed in American Association of State Highway and Transportation Officials' R35, Standard Practice for Superpave Volumetric Mix Design for Hot-Mix Asphalt. The training highlights key differences in WMA and HMA design procedures. Participants also have the opportunity to convert HMA mixtures to WMA mixtures.

Available to schedule at any time, the course is intended for experienced HMA mixture design technicians and engineers. For more details or to schedule the training, visit www.nhi.fhwa.dot.gov. For more information about WMA, including a list of frequently asked questions, case studies, and useful publications, visit www.fhwa.dot.gov/everydaycounts. Information is also available by contacting Matthew Corrigan at FHWA, 202-366-1549 (email: matthew.corrigan@dot.gov).



A section of the East Entrance Road to Yellowstone National Park in Wyoming was paved in 2007 using warm mix asphalt.

Highway Technology Calendar

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

US-92 Precast Concrete Pavement Systems Showcase
January 10, 2012, DeLand, FL

As highlighted in this showcase, precast concrete pavement systems are revolutionizing highway renewal and repair. The Florida Department of Transportation (FDOT) will be the first to use precast concrete pavement as an "unbonded overlay," which allows the existing pavement to remain in place, with no need for demolition and disposal and little or no need for repair or surface preparation. Sponsored by the Federal Highway Administration's (FHWA) Highways for LIFE program, in conjunction with FDOT, the showcase will include a half-day technical workshop, followed by a visit to the project site.

Contact: To register, visit www.t2events.ce.ufl.edu/assnfe/Ev.asp?ID=1606. For more information, visit www.fhwa.dot.gov/hfl/showcases/fl, or contact Mary Huie at FHWA, 202-366-3039 (email: mary.huie@dot.gov).

West Mesquite I-15 Interchange Project Showcase
January 10–11, 2012, Mesquite, NV

Sponsored by FHWA's Highways for LIFE program and hosted by the Nevada Department of Transportation, this showcase event will highlight innovative approaches for minimizing mobility impact on I-15 traffic during replacement of the West Mesquite Interchange. Slide-in construction techniques will be used to place the new structure in less than 56 hours. The showcase is scheduled to include a site visit during the slide-in operation.

Contact: Timothy Cupples at FHWA, 202-366-1342 (email: timothy.cupples@dot.gov).

Transportation Research Board (TRB) 91st Annual Meeting
January 22–26, 2012, Washington, DC

More than 10,000 transportation professionals from around the world will gather to share perspectives on current developments in transportation research, policy, and practice.

Contact: For information, visit the TRB Web site at www.trb.org (click on "Annual Meeting"). Questions about the meeting can be emailed to trbmeetings@nas.edu.

Ninth National Conference on Transportation Asset Management: Making Asset Management Work in Your Organization
April 16–18, 2012, San Diego, CA

Sponsored by TRB, the American Association of State Highway and Transportation Officials (AASHTO), and FHWA, conference topics include asset management implementation; pavements and bridges; beyond pavements and bridges (featuring assets such as intelligent transportation systems and signs); and transit state of good repair.

Contact: Francine Shaw-Whitson at FHWA, 202-366-8028 (email: francine.shaw-whitson@dot.gov), or visit www.trb.org/conferences/assetmanagement2012.

2012 Design-Build in Transportation Conference
April 25–27, 2012, Phoenix, AZ

Join transportation leaders in discussing lessons learned in the use of the design-build project delivery method for transportation projects. Discussions will cover choosing the right delivery method, contracting approaches, risk allocation, and performance contracting. The conference is cosponsored by FHWA, AASHTO, and industry groups.

Contact: Jerry Yakowenko at FHWA, 202-366-1562 (email: gerald.yakowenko@dot.gov), or visit www.dbtranspo.com/index.cfm.

Seventh RILEM International Conference on Cracking in Pavements
June 20–22, 2012, Delft, 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: Katherine Petros at FHWA, 202-493-3154 (email: katherine.petros @dot.gov), or visit www.rilem2012.org.

International Conference on Long-Life Concrete Pavements
September 18–21, 2012, Seattle, WA

Organized by FHWA, in partnership with the National Concrete Pavement Technology Center, the conference will address aspects of concrete pavement design, construction, and materials technologies that result in long-life, sustainable concrete pavements. A mini-symposium on concrete paving durability will be held on the final day of the conference. The event is targeted at pavement, materials, and geotechnical engineering professionals, including Federal, State, and municipal engineers; consulting engineers; contractors; materials suppliers; and members of academia.

Contact: Shiraz Tayabji at Fugro Consultants, Inc., 410-302-0831 (email: stayabji@aol.com), or Sam Tyson at FHWA, 202-366-1326 (email: sam.tyson@dot.gov). Conference information is also available at www.fhwa.dot.gov/pavement/concrete/2012conf.cfm. *

FHWA Releases New Guidance on Patented and Proprietary Products

New guidance released by the Federal Highway Administration (FHWA) clarifies existing regulations on the use of patented and proprietary products for Federal-aid highway projects. The regulations are contained in 23 Code of Federal Regulations (CFR) 635.411. The revised guidance ensures that implementation of the regulations does not conflict with FHWA's goal of promoting innovation in highway projects.

The guidance emphasizes that a State transportation agency may specify proprietary products when the agency certifies that no suitable alternative product exists, such as in the case of an innovative product that offers better performance, or that the product is needed for synchronization with existing highway facilities. The updated guidance encourages State transportation agencies to post their proprietary product certifications on the American Association of State Highway and Transportation Officials' Product Evaluation List (APEL) Web site (http://apel.transportation.org). The APEL site will be fully functional by January 2012.

Other circumstances under which Federal-aid highway funds may be applied to the cost of a patented or proprietary product on a Federal-aid highway construction project include competitive bidding; for research or experimental purposes; or, if other equally suitable products exist, if FHWA approves a public-interest finding (PIF). The approved PIF will be posted on the FHWA Web site at www.fhwa.dot.gov/construction/contracts/pnpapprovals/index.cfm.

The guidance also clarifies that additional FHWA approvals are not required when proprietary products are being evaluated in an FHWA-sponsored program, such as the Highways for LIFE program, Innovative Bridge Research and Deployment Program, and Innovative Pavement Research and Deployment Program. Once the work of the program is complete, the existing regulations as contained in 23 CFR 635.411 would apply to further use of the proprietary product.

To view FHWA's updated guidance, visit www.fhwa.dot.gov/programadmin/contracts/011106qa.cfm. For more information on the guidance, contact John Huyer at FHWA, 202-366-1937 (email: john.huyer@dot.gov). *

The revised guidance ensures that implementation of the regulations does not conflict with FHWA's goal of promoting innovation in highway projects.

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FOCUS on Training

Infrastructure Innovation Webinars

These free Webinars provide a quick introduction to the latest infrastructure innovations and technologies.

Geosynthetic Reinforced Soil Integrated Bridge System (GRS-IBS) Design
January 5, 2012, 1–3 p.m.
(eastern standard time)

GRS-IBS Case Histories
February 2, 2012, 1–3 p.m.
(eastern standard time)

Sponsored by the Federal Highway Administration's (FHWA) National Highway Institute, the Webinars provide practical information on the implementation of GRS-IBS. This technology is accelerating bridge building by alternating layers of compacted local soil and sheets of geotextile fabric reinforcement to build abutments and provide support for the structure. The result is bridges that are both extremely durable and cost effective, with costs potentially reduced by 20 to 60 percent.

To register for the January Webinar, visit https://www.nhi.fhwa.dot.gov/resources/webconference/web_conf_learner_reg.aspx?webconfid=23931. Registration for the February Webinar is available at https://www.nhi.fhwa.dot.gov/resources/webconference/web_conf_learner_reg.aspx?webconfid=23932.

LRFR Load Rating of Segmental Concrete Bridges
January 19, 2012, 1–4 p.m.
(eastern standard time)

Sponsored by FHWA, the Webinar will provide the latest information about rating segmental concrete bridges using the Load and Resistance Factor Rating (LRFR) method. To register, visit http://fhwa.adobeconnect.com/segmentalbridges/event/registration.html. *