

# FOCUS

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## Scour Evaluations a Key Element in Improving Bridge Foundation Design

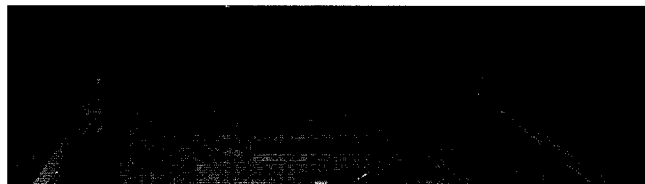
With construction nearly ready to begin on the new 12-lane Woodrow Wilson Bridge just outside of Washington, DC, last year, engineers found themselves concerned about the depth of the scour that might form around the bridge piers. Scour, which is the erosion of stream bed material around bridge foundations, is the leading cause of bridge failures in the United States. In designing the bridge over the Potomac River, engineers realized that the combination of large river piers, high river velocities, and a complex soil structure under the river presented particular challenges. The pipe piles supporting the river piers had to be founded deep enough to make the bridge stable against the worst case scour expected to occur.

The Maryland State Highway Administration, Federal Highway Administration (FHWA), and several consultants involved in designing

the bridge turned to FHWA's Hydraulics Laboratory at the Turner-Fairbank Highway Research Center in McLean, Virginia, for assistance in predicting the scour at the new bridge and also at selected piers on the existing bridge, which will remain in service for several years while work proceeds on the new structure.

Researchers at the lab used a combination of advanced numerical and physical scale modeling to simulate the flow and sediment transport conditions at the bridge and the resulting scour at the piers. Traditional research on pier scour has concentrated on sand channels, whereas the Potomac River bed is comprised in part of cohesive soils such as silt and clay. Taking into account these cohesive soils, a special design technique known as the Erodability Index Method was also used in the scour evaluation. This method checks the erosion resistance of different types of soil bed materials. "That isn't something we can very

readily model in a hydraulic lab," says Sterling Jones of FHWA and manager of the Hydraulics Laboratory. "The index method provides a way to analyze the erosion resistance of various soil strata up to the maximum ex-



## Scour Evaluations

continued from page 1

using the standard pier scour equations in the current FHWA guidelines.

During the design process, a number of alternative pier designs were studied. The Hydraulics Lab evaluated these alternative designs and provided immediate feedback on the scour depths to the bridge engineers. The accuracy of the FHWA lab studies was validated by selected larger-scale tests at the U.S. Geological Survey Biological Research Division lab in Turners Falls, Massachusetts.

The scour evaluations were part of a process that led to substructure design changes that are expected to make the bridge more cost-effective. Savings will result from reducing the predicted scour depths by an average of 4.5 to 6 m (15 to 20 ft), using fewer but larger piles, and incorporating vertical piles instead of battered piles, which are more difficult and expensive to install. Another major benefit is that engineers gained a greater understanding of how vessel impact structures, which are placed around the bridge's foundations to prevent collisions, affect the scouring process. Lab tests revealed that the concrete structures, known as dolphins, proposed for protecting the main river piers from ship collisions would dramatically increase scour at the piers. This finding led to changing the design to use a fender ring protection system that extends all the way around the piers. Using the protective ring instead of the dolphins is expected to reduce the maximum scour by nearly half and provide better protection from vessels at no additional cost.

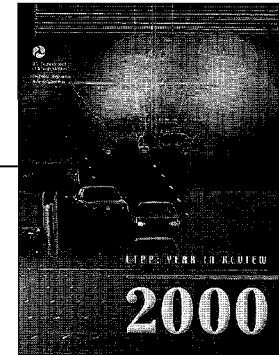
The scour studies served to validate a more accurate method for estimating scour

## In Brief...

The Federal Highway Administration (FHWA) has embarked on an update of its Bridge Maintenance Training Course. The course, which is presented through the National Highway Institute, is designed to train State and local bridge maintenance personnel in planning, scheduling, and performing effective bridge maintenance and repairs. Course topics include the mechanics of structures, materials used in bridge repair, equipment available for structural maintenance, work methods and prioritization, and evaluation of maintenance alternatives. The updated course, which will debut in the fall of 2001, includes information on new technologies, such as improved materials for patching, and will incorporate modern, hands-on training methods. For more information, contact George Romack at FHWA, 202-366-4606 (email: [george.romack@fhwa.dot.gov](mailto:george.romack@fhwa.dot.gov)).

John Klemunes has departed from his position as FHWA's Western long-term pavement performance (LTPP) program coordinator. The interim contact for information on LTPP product development and implementation is Monte Symons at FHWA's Midwestern Resource Center. He can be reached at 708-283-3549 (fax: 708-283-3501; email: [monte.symons@fhwa.dot.gov](mailto:monte.symons@fhwa.dot.gov)).

Highlights of the LTPP program's accomplishments last year can be found



brochure.htm or can be obtained by calling Mary Taylor-Mattox at FHWA, 202-493-3155 (email: [mary.taylor-mattox@fhwa.dot.gov](mailto:mary.taylor-mattox@fhwa.dot.gov)).

Details on high-performance concrete (HPC) bridge projects in nine States are available in a new collection of fact sheets from FHWA. The fact sheets provide a general description of each project, including location, concrete type, bridge dimensions, and project partners. Each fact sheet also contains an "Outline of HPC Features" section that describes such factors as concrete strength and mix composition and a benefits section that lists information on cost savings and reductions in materials used. Projects described include two parallel bridges under construction on U.S. 401 over the Neuse River in Raleigh, North Carolina, and a two-lane, four-span structure on Route 40 in Lynchburg, Virginia. The fact sheets can be downloaded from the Web at [www.tfhrcc.gov/structur/hpc/flyers.htm](http://www.tfhrcc.gov/structur/hpc/flyers.htm). For more information on HPC, contact Terry Halkyard at FHWA, 202-366-6765 (fax: 202-366-3077; email: [terry.halkyard@fhwa.dot.gov](mailto:terry.halkyard@fhwa.dot.gov)). \*

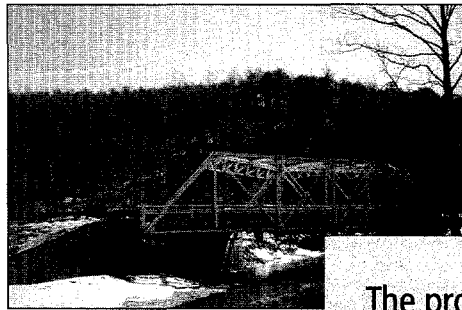
# Innovative Bridge Research Program: Building for the Future

**B**uilding bridges that last longer and require less maintenance, thus reducing the traffic congestion and disruption resulting from bridge construction and rehabilitation projects, are the primary goals behind the Federal Highway Administration's (FHWA) Innovative Bridge Research and Construction Program (IBRC). Established in 1998 by the Transportation Equity Act for the 21st Century (TEA-21), the 6-year program provides funding to help State and local transportation agencies use innovative materials for bridge repair, rehabilitation, replacement, and construction.

As stated in TEA-21, the program's objectives include developing:

- New, cost-effective ways to use innovative materials in highway bridge applications;
- Construction techniques to increase safety and reduce construction time and traffic congestion;
- Engineering design criteria for using innovative products and materials in highway bridges and structures;
- New nondestructive bridge evaluation technologies and techniques; and
- Highway bridges and structures that will withstand natural disasters, including alternative processes for the seismic retrofit of bridges.

The program also has the goal of reducing the maintenance and life-cycle



The deck of this bridge on Maryland State Highway 24 is being replaced with an FRP composite deck.

bridge in Alabama with fiber-reinforced polymer (FRP) composite girders, the use of high-performance concrete (HPC) for the deck slab and high-performance steel (HPS) for the bridge plate girders of a new bridge in Connecticut, and the incorporation of HPS plate girders into a Georgia bridge. FRP composites are more corrosion-resistant than conventional materials, as well as being more lightweight and easier to handle and install. HPC is engineered to produce mixes that better meet the requirements of specific bridge projects, while HPS is stronger, easier to weld, and more resistant to corrosion than conventional steel.

Projects selected for FY 2001 funding include the use of HPS for the girders and

gies (note: some projects used more than one material).

TEA-21 authorized \$108 million for the program, with \$6 million of that targeted for research and technology deployment activities. It is expected that \$17 million will be available each year for construction projects until the program concludes in 2003.

Candidate projects for FY 2002 funding will be solicited beginning in March of this year. The project solicitation will be sent to all State departments of transportation and FHWA division offices and will also be published on the IBRC Web site at [ibrc.fhwa.dot.gov](http://ibrc.fhwa.dot.gov). While bridges on all public roads are eligible for IBRC funding, applications must be submitted through a State department of transportation.

The selected projects will be announced in December 2001. The selection criteria includes looking at whether the project meets one or more of the program goals, incorporates materials or products that are readily available, and is ready or nearly ready to proceed to the construction phase.

For more information on IBRC, contact John Hooks at 202-366-6712 (fax: 202-366-3077; email: [john.hooks@fhwa](mailto:john.hooks@fhwa)).

**The program also has the goal of reducing the maintenance and life-cycle costs of bridges, including the costs of new construction and the replacement or rehabilitation of deficient bridges.**

# Mobile Concrete Lab Brings Technology Strai

**I**t can perform a wide range of both conventional and innovative nondestructive concrete tests. It can provide highway agency staff with hands-on experience in new technologies and test equipment. And it can come straight to your door. The Federal Highway Administration's (FHWA) Mobile Concrete Laboratory (MCL) is designed to introduce Federal, State, and local transportation personnel to state-of-the-art concrete technology for materials selection and mixture design, as well as field and laboratory testing. The current emphases for lab visits include assisting in implementing the use of high-performance concrete (HPC) for pavements and bridges, nondestructive testing, and performance-related specifications (PRS).

The fully equipped laboratory can be used to perform an extensive list of concrete tests, including such quality control tests as temperature, slump, air content,

and unit weight measurements; elastic modulus; and strength testing. Nondestructive tests that can be carried out include maturity testing, tensile bond strength, impact echo, pulse velocity, and match curing. And available durability-related tests include rapid chloride permeability, surface airflow permeability, microwave water content, and alkali-silica reactivity detection.

The Nebraska recently used the plain concrete pavement lab's 2-week stay, to evaluate the pavement form pavement using the impact content ratios with content test, and ing. According to



## 2001 Mobile Concrete Lab Schedule

*Note: This schedule is tentative and is subject to change.*

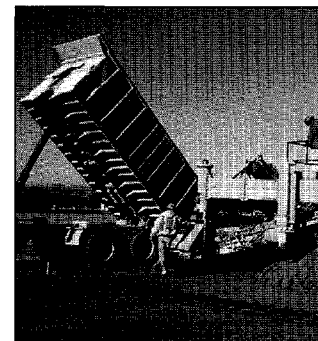
March 6-7—On display at Missouri/Kansas American Concrete Pavement Association Conference in Kansas City, Missouri

March 12-16—National Highway Institute Materials course training in Reno, Nevada

April—Field testing for mixture evaluations for HPC bridges on I-99 in Pennsylvania

May—Field testing for Wacker Drive project in Chicago, Illinois

June—Field testing for project on I-65 near Nashville, Tennessee



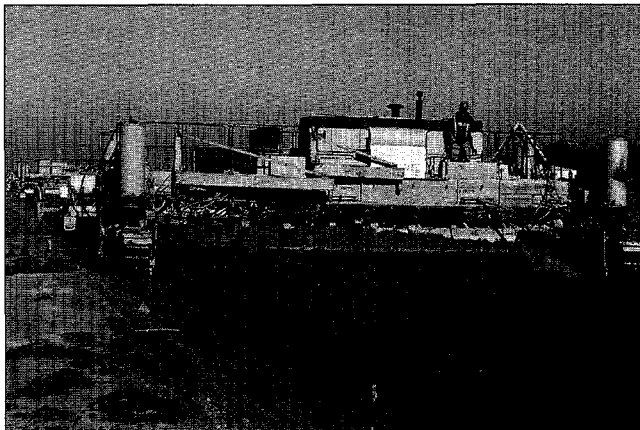
the Department of Roads, the knowledge gained from the lab testing resulted in better design calculations and an improved final product. "The most important benefit, however, was the hands-on experience with staff who have tested similar projects in other States," he says.

The Indiana Department of Transportation (DOT) also received assistance from the MCL recently at a PRS project on a section of Interstate 465. The DOT used the lab for both comparative and verification testing, including performing impact echo tests for pavement thickness measurements and maturity testing for later age strength predictions. "The lab's visit was extremely beneficial," says Rick Smutzer of the Indiana DOT. "The lab introduced us to new technologies for non-destructive evaluation that we didn't have in-house. We're now going to use this technology in the future for PRS projects." While the lab was in Indiana, FHWA per-

sonnel also hosted an open house for Indiana DOT staff and contractors. "Everyone benefited from the lab's visit," says Smutzer.

In addition to onsite visits, the MCL has an equipment loan program where State highway personnel can borrow testing equipment for varying lengths of time after having been trained in its use by lab staff. Lab personnel can also put on specialized workshops for States, provide speakers at workshops and conferences, and provide assistance over the phone or by email.

For more information on scheduling a visit by the lab or using the other services available, contact Gary Crawford at FHWA, 202-366-1286 (fax: 202-493-2070; email: [gary.crawford@fhwa.dot.gov](mailto:gary.crawford@fhwa.dot.gov)) or Leif Wathne at FHWA, 202-366-1335 (fax: 202-493-2070; email: [leif.wathne@fhwa.dot.gov](mailto:leif.wathne@fhwa.dot.gov)). For a schedule of locations the lab is already slated to visit in 2001, see sidebar on page 4. \*



During the Mobile Concrete Laboratory's 2-week stay in Nebraska, it was used to perform pavement thickness measurements, among other tests.

## Technology Champions for a New Century

What are the high payoff, innovative technologies that State and local transportation agencies and industry can start using now to improve our Nation's roads and bridges? And how can those technologies best be transferred into the hands of State, local, and industry users? Answering these questions is the charge of the new American Association of State Highway and Transportation Officials (AASHTO) Steering Group for Technology Deployment, which kicked off its first meeting in Indianapolis in December.

At the meeting, the group defined its mission as "championing the implementation of technology among AASHTO member agencies, local agencies, and their industry partners to improve the Nation's transportation system." Reflecting this mission, the steering body will now be known as the Technology Implementation Group (TIG). Over the next 3 months, TIG will be identifying three to four technologies to champion and finalizing its business plan for delivering the technologies to users, as well as creating partnerships to facilitate that technology delivery.

For more information on TIG, contact Haleem Tahir at AASHTO, 301-975-5275 (fax: 301-330-1956; email: [haleem.tahir@nist.gov](mailto:haleem.tahir@nist.gov)). \*

# Highway Technology Calendar

*The following events provide opportunities to learn more about products and technologies for building and maintaining better, safer roads.*

## **Superpave Binder Course**

March 26–28, 2001, Indianapolis, IN

The course will provide detailed instruction on the Superpave binder specifications and testing procedures. An overview of the binder aging methods and direct tension tests will also be provided. The course includes both classroom instruction and hands-on laboratory work.

*Contact:* For information about course content, contact Rebecca McDaniel at the North Central Superpave Center, 765-463-2317, ext. 226 (fax: 765-497-2402; email: rsmcdani@purdue.edu; Web: bridge.ecn.purdue.edu/~spave/). For registration information, contact Nona Schaler at Purdue University, 765-494-2756 or 800-359-2968, ext. 92N (fax: 765-494-0567; email: njschaler@conf.purdue.edu).

## **National Work Zone Awareness Week**

April 9–12, 2001

This nationwide event is dedicated to promoting safety and mobility in work zones. The event is being cosponsored by the American Association of State Highway and Transportation Officials, American Traffic Safety Services Association, and the Federal Highway Administration (FHWA).

Symposium topics will include alkali-silica reaction in concrete testing, frictional properties of aggregates in pavement surfaces, and aggregate classification and handling. The event is being cosponsored by the Aggregates Foundation for Technology, Research, and Education; the National Aggregates Association; and the National Stone Association.

*Contact:* ICAR at 512-471-4498 (email: icar@mail.ce.utexas.edu; Web: www.ce.utexas.edu/org/icar/index.html).

## **2001 AASHTO Value Engineering Conference**

July 10–13, 2001, San Diego, CA

The conference will feature main tracks on starting and maintaining a value engineering program and advanced tools and techniques for value engineering, as well as a number of case studies.

*Contact:* Earl Burgess at the California Department of Transportation, 916-653-4436 (fax: 916-653-1527; email: earl.burgess@dot.ca.gov; Web: www.dot.ca.gov/hq/oppd/value).

## **International Symposium on Transportation Technology Transfer**

July 29–August 2, 2001, St. Petersburg, FL

and programs, and partnering with technology transfer centers. The event is being sponsored by FHWA, the Local Technical Assistance Program, World Road Association, Organisation for Economic Co-operation and Development, Transportation Research Board, and the Pan American Institute of Highways.

*Contact:* The Office of International Programs at FHWA, 202-366-9636 (fax: 202-366-9626; email: 2001symposium@fhwa.dot.gov; Web: www.international.fhwa.dot.gov).

## **Context Sensitive Highway Design: Transferring Lessons from Our Collective Experiences**

September 5–7, 2001, Missoula, MT

The goals of the workshop include sharing information on and advancing the practice of context-sensitive design for highway and other transportation projects. The workshop is sponsored by the Montana Department of Transportation, Western Transportation Institute, and FHWA.

*Contact:* Meetings Northwest at 406-273-7224 (email: traci@meetingsnorthwest.com).

## **Seventh International Conference on Concrete Pavements**

# The LTPP Forecast

bilitation of various types of concrete pavements. Another highlight will be a day of workshops and technical sessions on "Formulating the Long Range Research Needs for PCC Pavements." In addition, an exhibit hall will showcase new products and services.

*Contact:* Shiraz Tayabji at Construction Technology Laboratories, Inc., 410-997-0400 (fax: 410-997-8480; email: stayabji@ctlgroup.com; Web: iscp.tamu.edu).

## **Beneficial Use of Recycled Materials in Transportation Applications Conference** November 13-15, 2001, Washington, DC

The conference will bring together experts from North America, South America, Europe, and Asia to address the use of recycled materials generated from transportation, industrial, municipal, and mining processes in transportation applications. The conference is intended for researchers, equipment suppliers, material generators, processors, regulatory officials, engineers, and others involved in the management of recycled materials. Event sponsors include the University of New Hampshire's Recycled Materials Resource Center, FHWA, National Asphalt Pavement Association, and the

**R**olling out a new version of the DataPave software, introducing improved testing procedures and guidelines, and studying the benefits of the long-term pavement performance (LTPP) research are just a few of the activities the LTPP program has planned for 2001.

DataPave 3.0 will contain even more data on traffic, materials, performance, environment, and other variables at the more than 2,400 LTPP test sections across the United States and Canada. The software is scheduled for release midyear and will be available on both CD-ROM and the LTPP program's Web site ([www.tfhr.gov/pavement/ltp](http://www.tfhr.gov/pavement/ltp)). Other products in the pipeline for release this year include an improved start-up procedure for resilient modulus testing, guidelines for temperature adjustment of falling-weight deflectometer test results, and a software program containing climatic data for use in pavement design, research, forensics, and construction scheduling. "Putting products such as these out there is the reason we're doing the LTPP program," says Charlie Churilla of FHWA.

The program's data collection activities will focus on evaluating in-place pavement drainage systems and using ground-penetrating radar to assess section layer

Nineteen States have committed to participating in this pooled fund study, which is designed to increase and improve the collection of monitored traffic data for five of the SPS projects.

With more than 10 years of data collection and product releases behind it, the LTPP program has also launched a study of the benefits resulting from its work. These benefits range from such tangible items as the establishment of the LTPP database and advances in materials testing and pavement evaluation to such in-

tangibles as increased awareness of the importance of effective traffic monitoring and greater sharing of information by States. In many cases, the benefits translate into cost savings. For example, it is estimated that \$68 million a year could be saved if the LTPP program's LTPPBind software, which provides improved low- and high-temperature models for selecting performance-graded binders for a specific location, was used in

only a quarter of hot-mix asphalt projects in the United States. Details of these and other benefits will be covered in the study's summary report, which is due out this summer.

For more information on the LTPP program's products and activities, contact Charlie Churilla at FHWA, 202-493-3142

**The program's data collection activities will focus on evaluating in-place pavement drainage systems and using ground-penetrating radar to assess section layer thickness.**

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Check out *FOCUS* online at  
[www.tfhr.gov/focus/focus.htm](http://www.tfhr.gov/focus/focus.htm)

The National Partnership for Highway Quality (formerly National Quality Initiative) is now accepting Application Achievement Awards. The awards recognize those who are improving quality in the planning, design, construction, and maintenance of Nation's highways. The four award categories are Partnering, Risk Taking, and State Quality Initiative. The deadline for submission is May 31, 2001. The submissions will be reviewed by a panel composed of officials from the Federal Highway Administration, State Departments of transportation, and industry. Award winners will be invited to a banquet to be held in November 2001 during the National Partnership for Highway Quality Seminar in Fort Worth, Texas.

Organizations interested in submitting an application should contact the State Quality Initiative steering committee. For more information, contact Betsy Templeton at the National Partnership for Highway Quality, 500 E. Templeton (toll free: 877-526-9899; fax: 512-301-9897; email: btempleton@harrington-hughes.com).

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