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Federal Highway Administration

INNOVATOR

Accelerating Innovation for the American Driving Experience

New Highways for LIFE Demonstration Projects Announced

Highways for LIFE incentive funds will help transportation agencies build eight new demonstration projects using innovations that cut construction congestion while enhancing safety, quality and user satisfaction.

Colorado, Florida, Maine, Texas, Utah, Vermont, Washington, D.C., and Wisconsin have been chosen for 2009 grants of up to $1 million each. Jeff Paniati, the Federal Highway Administration's acting deputy administrator, announced that the awards had been made at a Highways for LIFE stakeholders meeting in May.

Since 2006, the agency's Highways for LIFE program has provided incentives for 25 projects in 21 states that use proven but rarely used innovations. For each project, states are encouraged to develop performance goals that define results in key areas—safety, construction time and congestion, quality and user satisfaction.

Faster Construction

The **Colorado Department of Transportation** will use its grant to reconstruct the Interstate 25 Bronco Arch Bridge over the South Platte River in downtown Denver. The state plans to hold constructability reviews and use value engineering and alternative contracting with incentives and disincentives to encourage innovations to minimize construction time, maximize safety and lower construction costs.

The project will include installation of a state-of-the-art automatic deicing system to make the bridge safer for drivers. The agency also plans to use what it learns from tracking performance data on travel time, crashes and traffic delays during the project on future projects.

To enhance safety and customer satisfaction when it rehabilitates a section of U.S. 92 between Daytona Beach and DeLand, the **Florida DOT** will use precast

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Photo credit: Dynatest Consulting Inc.

HIGHWAYS FOR LIFE
Accelerating Innovation for the American Driving Experience.

Innovations Strengthen Highway, Cut Construction Time in California

Innovation by the California Department of Transportation promises to provide a longer-lasting concrete pavement while slashing construction time from five years to two on a Route 15 project near Ontario.

The $81.5 million project to rehabilitate 4.7 miles (7.5 kilometers) of Route 15, projected for completion in November 2010, is being assisted by a Highways for LIFE grant.

One element of Caltrans' innovative approach was use of construction scheduling software, developed by the University of California at Berkeley, to analyze six construction strategies. The resulting strategy called for most of the work to be done during 30 55-hour weekend closures. In the past, eight-hour nighttime closures were used to lessen traf-

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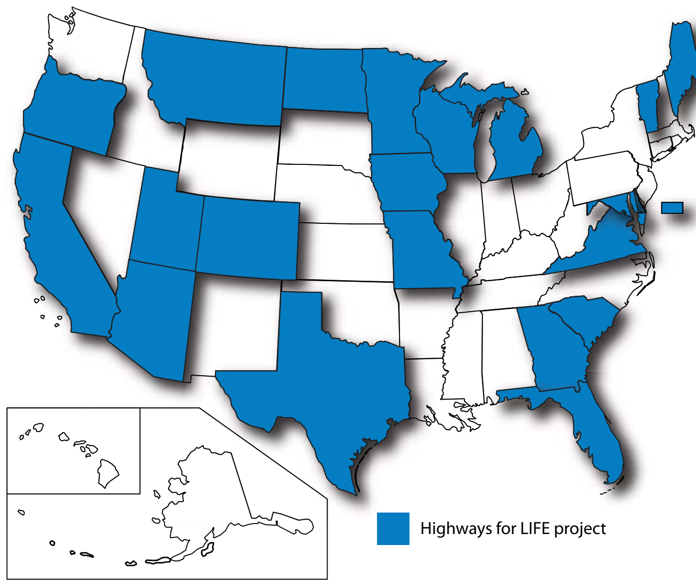
concrete pavement panels at several locations. Installing the panels will require only one overnight road closure per location.

Other safety innovations will include the use of temporary rumble strips to provide an audible warning to motorists who leave the driving lane and an automated flagger to direct traffic. A 10-year pavement performance warranty will improve the quality of the finished project.



A project to replace the Milford Street Bridge over Grand Lake Stream in Washington County will be the **Maine DOT's** first that uses a full system of prefabricated components—a combination of precast, prestressed beams, precast abutments and precast concrete block mats. Using prefabricated components manufactured in a controlled environment is expected to result in a longer-lasting structure with reduced maintenance needs.

The project will include a full road closure and traffic detour, but using prefabricated components will enable the agency to replace the bridge and reopen it to traffic in about a month. Total construction time for the project is estimated at 90 days, compared to nine months for conventional construction methods, and it will be done while school is out for the summer.

Higher Quality

The **Texas DOT** will use innovative materials and techniques to build a new roadway section on Farm-to-Market 1938 north of Fort Worth that's designed to reduce congestion on nearby highways. To improve the durability of the concrete pavement, the highway agency will use optimized aggregate gradation and intelligent compaction techniques.

The Texas DOT will install a nonwoven geotextile layer instead of traditional asphalt between the concrete pavement surface and the base. It will also try an innovative curing compound to reduce the potential for cracks in the pavement. Improved texturing and grooving is expected to enhance the pavement's safety and durability and reduce tire-pavement noise.

The **Utah DOT** will use accelerated pavement construction techniques when it rehabilitates a section of concrete pavement on I-215 in Salt Lake County, reducing construction time on the heavily traveled route to 40 days versus six months for traditional construction techniques.

The agency will use precast concrete pavement panels for areas that require full-depth repairs, which will reduce traffic disruption from about 10 days to 10 hours per area. The innovation will allow for nighttime construction with normal traffic operations during the day.

The **Vermont Agency of Transportation** will use a simple design and high-performance materials when it replaces a rural bridge on U.S. Route 2 over the Winooski River in East Montpelier. That will cut construction time by 20 percent and future maintenance requirements, reducing the impact on motorists and the bridge's life-cycle costs.

The new bridge will be a single-span integral abutment bridge. The superstructure will use weathering steel girders with a high-performance concrete deck reinforced with solid stainless steel, topped with a curbless, pedestal-mounted rail—all features designed to minimize the need for future maintenance.

Prefabricated Components

In **Washington, D.C.,** the District DOT will rebuild the Eastern Avenue Bridge over Kenilworth Avenue using prefabricated components for the pier and superstructure to cut construction time from a year to six months. The contractor on the project will have the option to use self-propelled modular transporters, computer-controlled platform vehicles that can rapidly remove the existing superstructure and install the new one.

To reduce backups on Kenilworth Avenue, a major Washington, D.C., artery, the District DOT will detour one lane of traffic onto nearby service roads during construction. In addition to prefabricated components, the agency will use a low-permeability concrete mix to prolong the life of the bridge.

The **Wisconsin DOT** will use temporary bridges to keep traffic flowing freely and improve work zone safety when it replaces four bridges on Wisconsin Highway 25 in Buffalo County. Installing temporary structures is expected to cut construction time from 18 to 10 months. The temporary structures will be designed so they can be used again on future projects.

The highway agency will introduce a variety of innovative techniques and materials to improve the durability and prolong the life of the new bridges. They include using high-performance concrete in the bridge decks, eliminating longitudinal construction joints, relocating expansion joints to the approach slabs, and using high-strength stainless steel bars for the connection between the approach slab and the bridge.

For more information on Highways for LIFE projects, visit www.fhwa.dot.gov/hfl/projects.cfm or contact Mary Huie at (202) 366-3039 or mary.huie@dot.gov.

Credit: Dynatest Consulting Inc.

The Super-Slab® system uses interlocking load-transfer steel dowels cast at one end of each slab matching the locations of slots cast in the bottom of adjacent slabs.

fic impacts, but in this strategy the median, now dirt, will be paved to carry traffic during closure of existing lanes.

"You could say that 55-hour closures might impact traffic more, but that also reduces the number of closures, so the road user costs come out cheaper," said Caltrans Project Engineer Jonathan Den Hartog.

Lower Cost

While road user costs of the traditional approach of eight-hour closures would have been about $130 million, the current strategy should result in road user costs in the $2 million to $3 million range, with slightly lower construction costs as well.

Doing more of the project in 55-hour closures instead of a larger number of eight-hour closures lowers construction costs because it reduces the number of times the contractor has to mobilize and demobilize its operations, Den Hartog said.

Another project innovation is Caltrans' first use of the patented Super-Slab® system of precast concrete pavement slabs in some areas of the project. The approach will replace the traditional methods of using slip-form paving or cast-in-place, fast-setting concrete.

In restrictive areas around the busy Route 15/10 interchange, where routing traffic onto a median will not be possible and traffic crossing lanes to reach connectors must be accommodated, Caltrans settled on precast slabs to minimize construction time and provide a long-lasting pavement. Overall, some 600 Super-Slabs will be used to pave nearly 3,000 of the 25,000 lane-meters planned for rehabilitation.

Super-Slab in these areas is expected to reduce construction time from three 55-hour closures estimated for standard fast-setting concrete to one 55-hour closure and one eight-hour closure. Another benefit is that, while fast-setting concrete can bear traffic in as little as four hours, the cure time in an eight-hour window is short enough that it results in a more brittle roadway than the precast system.

Durable Pavement

The durability of the precast system comes not only from the longer cure of its controlled conditions during off-site fabrication, but also from its engineering in the roadway. Each slab is cast and fitted to a specific position in the roadway based on a three-dimensional survey defining coordinates on each corner of the slab it replaces.

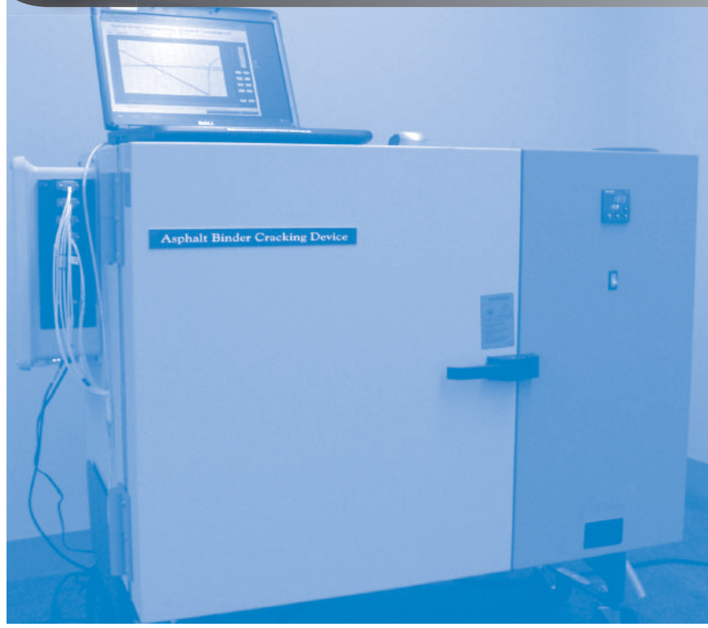
After existing slabs are removed, the cement-treated base beneath them will be left in place because coring has shown that it is still in fairly good condition, said Den Hartog. A bedding of finely crushed stone will be applied to the existing base and graded with a laser-controlled grader to minimize voids beneath the slab.

The precast slabs will then be placed and doweled to adjacent slabs. High-strength, freeze-thaw-resistant grout will be injected into dovetailed dowel slots. A low-viscosity grout, injected through grout ports into channels cast on the underside of each slab, will ensure uniform contact with the bedding and adjacent slabs.

Super-Slab pavement comes at an initial cost of up to twice that of fast-setting concrete pavement, but Caltrans anticipates that it will have a 30- to 40-year life versus about 10 years for fast-setting concrete. That will lengthen the time until repair or replacement is needed, reducing life-cycle costs, construction congestion and exposure of workers and road users to safety hazards.

For more information, contact Jonathan Den Hartog at (909) 383-5998 or jdenhart@dot.ca.gov.

Project Tests Cold-Weather Performance of Asphalt Binders



Credit: EZ Asphalt Technology LLC

The Asphalt Binder Cracking Device uses a simple, reliable method to rate the low-temperature performance of asphalt binders.

Quickly plummeting temperatures can cause asphalt pavement to crack, creating the need for costly repairs and traffic disruption. A device to determine which asphalt binders can withstand cold temperatures is now undergoing tests at laboratories across the country under a Federal Highway Administration program.

Highways for LIFE provided a grant to help EZ Asphalt Technology LLC of Athens, Ohio, develop its Asphalt Binder Cracking Device, or ABCD, which uses a simple, reliable method to determine the cold-weather performance of asphalt binders. The project is funded under the Technology Partnerships program, which helps prototypes in late-stage development with potential to improve the highway system become market-ready products.

The ABCD was developed by Dr. Sang-Soo Kim, owner of EZ Asphalt and associate professor of civil engineering at Ohio University. It works by creating thermal cracking conditions similar to those in the field. The unit consists of a metal ring equipped with temperature and strain gauges that fits in a silicone mold. After heated asphalt binder is poured around the ring, the device goes into a cooling chamber.

As the temperature drops, the asphalt binder contracts more than the metal ring, causing the binder to fracture. A computer program records the temperature and stress level at which the fracture occurs. That information helps determine whether the binder is a good fit for a paving project, providing the durability needed for projected temperature conditions at the site.

"The ABCD is the only test method thus far developed that provides a direct measurement of the cracking temperature," said Dr. Ken Edwards, a consultant to EZ Asphalt. "Unlike other methods, the ABCD does not rely on complicated mathematical formulas and assumptions regarding the thermal coefficient of the binder and other variables."

Initial Tests

The first phase of testing the ABCD prototype involved several tasks. First, Kim and researchers improved the ABCD test procedures. They modified the silicone mold, for example, to improve the precision of the test. They added a turntable to make it easier to prepare samples without overfilling the mold or spilling the binder. And they determined the optimum cooling rate for conducting the test.

Next, they conducted a field validation, testing a variety of binders to improve the ABCD process. They also refined the ABCD equipment, adding waterproofing to the ABCD ring to prevent condensation in the cooling chamber that caused the strain gauge to fail. In addition, they upgraded the data analysis software to make it easier to use.

Finally, ruggedness tests were conducted at the North Central Superpave Center in West Lafayette, Ind., the University of Wisconsin–Madison and EZ Asphalt to determine the effects of a variety of factors on the ABCD test method.

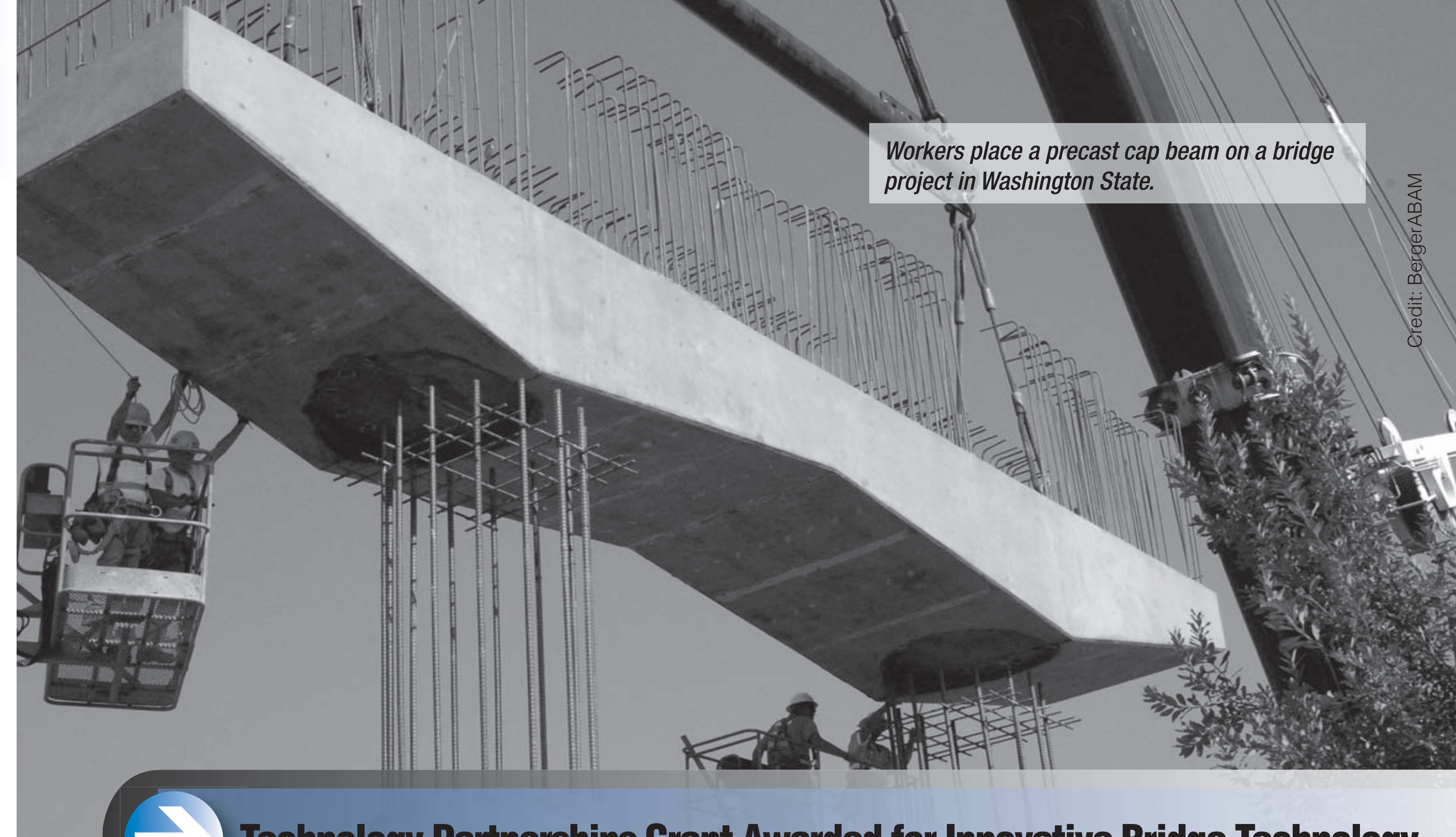
Interlaboratory Study

During the second phase of testing, ABCD's repeatability, accuracy and simplicity are being tested at 29 highway agency, university and industry laboratories. Technicians at each lab set up the ABCD testing system, conduct the tests and answer a questionnaire on their experience. They pack up the system and ship it to another laboratory for more tests.

"We have received positive feedback from the labs so far," said Edwards. "They like the ABCD because the sample preparation is straightforward and cracking temperature determination is direct."

If the ABCD test method is adopted as a standard, the highway industry will have a simple, reliable and repeatable way to rate the low-temperature performance of asphalt binders, said Edwards. That, in turn, will help the industry develop and use better asphalt binders on road projects, extending pavement life, reducing the need for repairs and saving taxpayer dollars.

For more information on Technology Partnerships, visit www.fhwa.dot.gov/hfl/tech.cfm, or contact Julie Zirlin at (202) 366-9105 or julie.zirlin@dot.gov. For details on ABCD, contact Sang-Soo Kim at (740) 597-3230 or skim@ezasphalttechnology.com.



Workers place a precast cap beam on a bridge project in Washington State.

Credit: BergerABAM

Technology Partnerships Grant Awarded for Innovative Bridge Technology

A new Federal Highway Administration grant will help BergerABAM Engineers Inc. develop connections for prefabricated bridge bents used in areas prone to seismic activity.

The $400,397 grant was provided under the Highways for LIFE Technology Partnerships program, which helps the private sector transform late-stage prototypes into market-ready products. Work is already under way on projects announced in 2008 that have the potential to reduce construction congestion and improve highway quality and safety.

The company, based in Federal Way, Wash., will use its grant to develop and test fully precast bridge bents, also known as piers, for use in seismic regions. The bents will provide more ductile, or flexible, connections to the foundation. In the past, states with seismic activity rarely used precast systems for bridge bents because the behavior of the connections was not fully understood and was believed to be nonductile.

Using precast bridge elements in high seismic zones requires connections that allow the structure to deform rather than experience sudden failure. In the proposed system, the connections are made with a small number of large bars grouted into ducts, providing the structural resilience to resist earthquake loads.

The new technology is expected to accelerate construction time and reduce traffic delays, as well as enhance safety for construction workers and motorists. Because the precast elements are constructed off-site, often in a controlled environment, they result in a higher-quality product.

The project will evaluate several different connections to be used on the bents on a Washington State Department of Transportation bridge project. It will also include development of guidelines, examples and specifications for using the technology in bridge design and construction.

For more information on Technology Partnerships, contact Julie Zirlin at (202) 366-9105 or julie.zirlin@dot.gov. For e-mail notification of the next grant solicitation, sign up at www.fhwa.dot.gov/hfl/partnerships/notify.cfm. For details on precast bridge bents for use in seismic zones, contact Lee Marsh at (206) 431-2300 or lee.marsh@abam.com.

Michigan Mainstreams Use of Temporary Traffic-Actuated Signals

After trying them on its Highways for LIFE demonstration project, the Michigan Department of Transportation has made use of temporary traffic-actuated signals a standard practice for future construction projects.

The highway agency's leadership made the decision after reviewing innovations used on the project, according to Michigan DOT Region Engineer Tony Kratofil. "Based on the benefits demonstrated in reduced delay and the positive feedback from motorists, they were impressed by the outcome and directed us to make the temporary signal actuation a standard option to be considered for all projects," he said.

The 2008 project to rehabilitate a section of M-115, a two-lane rural road, used performance-based contracting, an approach in which the highway agency defines goals for the project and the contractor has the flexibility to determine how to achieve those goals.

Part of the project involved replacing the superstructures of two small bridges on the route, which required narrowing the road to one lane during that phase of construction. To minimize motorist delay, the contractor suggested using automatically actuated temporary traffic signals. The portable systems detect the number of waiting vehicles and adjust the lights for efficient traffic control.

"The signal system would adapt to the traffic, which is very important on a route with peak flows that are not symmetrical," said Terry Palmer, manager of the Michigan DOT's Mt. Pleasant Transportation Service Center. "It would continue to let traffic flow or, conversely, if there was no traffic it would switch to the other direction."

Use of the signal system helped the contractor to meet the Highways for LIFE project performance goals of keeping vehicle queue lengths under half a mile and travel time delay less than 10 minutes at all times during the project.

The Michigan DOT identified 11 projects it plans to use temporary traffic-actuated signals on in 2009 as a result of the lessons learned on the M-115 project, Kratofil said.

To see the Michigan DOT's Construction Advisory on Traffic Actuation of Temporary Traffic Signals, go to www.michigan.gov/documents/mdot/MDOT_CA_2009-02_267190_7.pdf. For more information on the Michigan Highways for LIFE project, see "Michigan Project Features Performance Contracting" at www.fhwa.dot.gov/hfl/innovator/issue09.cfm#a1.

FHWA Offers Work Zone Planning Guide

The Federal Highway Administration has published a new guide on analytical tools for work zone planning to meet goals such as reducing the impact of construction congestion on drivers and cutting traffic management costs.

Work Zone Modeling and Simulation: A Guide for Decision-Makers (FHWA-HOP-08-029) provides decision-makers with guidance on the applicability and use of a broad range of analytical tools for work zone planning and management.

To access the guide, volume VIII in FHWA's Traffic Analysis Toolbox, go to www.ops.fhwa.dot.gov/wz/traffic_analysis/tatv8_wz/index.htm. For links to all of FHWA's traffic analysis tools and training, visit ops.fhwa.dot.gov/trafficanalysistools/index.htm.

Work zone management is a key element of "making work zones work better," one of the Vanguard Technologies that Highways for LIFE promotes through a rapid, focused approach to technology deployment. The deployment effort is designed to help highway agencies improve their work zone management programs and use innovations to lessen the negative effects of work zones on construction workers and the public.

For more information on making work zones work better, visit ops.fhwa.dot.gov/wz/about/wz_story.htm.

Web Seminar Highlights Self-Consolidating Concrete

Self-consolidating concrete—a promising technology with application in the construction of bridges, tunnels and precast elements—doesn't require the mechanical vibration needed by traditional concrete, enables faster construction with less noise, and results in better quality and durability.

A Web conference, part of the monthly "Innovations" series sponsored by Highways for LIFE and the National Highway Institute, explained self-consolidating concrete and highlighted successful applications. "SCC has significantly improved both how concrete is placed and the quality and performance of concrete products," said Byron Lord, Highways for LIFE team leader, who moderated the seminar.

Myint Lwin, director of the Federal Highway Administration's Office of Bridge Technology, explained that SCC's advantages over traditional concrete derive from three key properties of the material:

- Its ability to flow into and completely fill complex forms under its own weight
- Its ability to pass through and bond to congested reinforcement under its own weight
- Its high resistance to aggregate segregation

European Use

The properties of SCC also make it less skill dependent and labor intensive than traditional concrete, according to Lwin. He provided examples of applications in Europe where SCC reduced cast time by 35 to 40 percent and reduced labor by 50 percent, with no repair for defects needed.

SCC was used, for example, in reinforced concrete sections of a tunnel project in Sweden to strengthen the tunnel's rock lining. SCC worked well with the heavy reinforcement and uneven rock surfaces in the project. It also had the advantage of not requiring the vibration needed with conventional concrete in an application where "manual vibration is almost impossible," said Lwin. "So SCC can be effectively used in concrete rock lining, underground structures, tunnel entrances, retaining walls and so on."

SCC was developed in Japan in the mid 1980s to eliminate vibration in the placement of concrete, said Lwin. By the early 1990s, Japanese contractors had taken hold of the concept and further developed the material and its application. European countries formed a consortium in 1996 to develop SCC for practical applications and are now using it in bridges, tunnels and walls. In the United States, FHWA has been promoting SCC since 2000.

"In the U.S., the precast industry was the first to adopt SCC," said Lwin. "Many precast plants have now been retooled and have invested in new equipment for producing SCC. Complex precast elements can be cast more cost effectively using SCC. You can be more creative and innovative in SCC, and you can help solve difficult and costly field problems."

Technical Topics

Other conference presenters targeted topic areas in greater technical detail. Lou Triandafilou, senior structural engineer at the FWHA Resource Center, described general principles of concrete mix design, limitations being overcome and performance concerns, and standard tests and specifications.

Celik Ozyildirim, principal research scientist with the Virginia Transportation Research Council, highlighted the benefits of using SCC for 25 arches for a bridge the Virginia Department of Transportation built. He also described the state's experience using 40 SCC beams in the Route 33 Bridge over the Pamunkey River.

Auburn University Civil Engineering Professor Anton Schindler described the problems inherent in drilled-shaft concrete and the benefits of using SCC for this application. He presented a success story on the use of SCC in drilled shafts by the South Carolina DOT.

For more information on SCC, contact Myint Lwin at (202) 366-4589 or myint.lwin@dot.gov.

To register for future "Innovations" Web conferences and view recordings of past sessions, including the SCC seminar, visit www.nhi.fhwa.dot.gov/about/innovationseries.aspx.

CALENDAR

Precast Concrete Pavement Systems, Highways for LIFE/National Highway Institute Innovations Web Conference, July 1, 2009, 2:30 to 4 p.m. EDT. Register at www.nhi.fhwa.dot.gov/about/innovationseries.aspx.

Petersen Asphalt Research Conference and Pavement Performance Prediction Symposium, July 13–17, 2009, Laramie, Wyo. Information at www.petersenasphaltconference.org.

National Local Technical Assistance Program/Tribal Technical Assistance Program Conference, July 27–30, 2009, Pittsburgh, Pa., Details at www.ltap.state.pa.us.

Institute of Transportation Engineers Annual Meeting, Aug. 9–12, 2009, San Antonio, Texas. Register at www.ite.org/annualmeeting.

U.S. Domestic Scan Report: Accelerated Construction Technology Transfer/Best Practices in Project Delivery Management, Highways for LIFE/National Highway Institute Innovations Web Conference**,** Aug. 19, 2009, 2:30 to 4 p.m. EDT. Visit www.nhi.fhwa.dot.gov/about/innovationseries.aspx.

Precast/Prestressed Concrete Institute National Bridge Conference, Sept. 12–15, 2009, San Antonio, Texas. Details at www.pci.org.

Speed Management in Work Zones, Highways for LIFE/National Highway Institute Innovations Web Conference, Sept. 16, 2009, 2:30 to 4 p.m. EDT. Visit www.nhi.fhwa.dot.gov/about/innovationseries.aspx.

Eighth National Conference on Transportation Asset Management, Oct. 19–21, 2009, Portland, Ore. Visit www.trb.org/conferences/2009/asset.

INNOVATOR

Innovator, published by the FHWA Highways for LIFE program, advances implementation of innovative technologies and processes in the highway industry. Its audience is transportation professionals in highway agencies, trade and research groups, academia and the private sector, and the driving public.

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