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Looking to the Future of Pavement Technology

by Tommy Beatty

To achieve smoother, durable, and more cost-effective asphalt and concrete pavements is a foremost goal of the Federal Highway Administration's (FHWA) Office of Pavement Technology as it works nationwide with State, local, and industry partners.

As part of our ongoing initiative to improve pavement smoothness across the country, for example, we are working with 11 States this year to hold workshops tailored to each State. These individual State workshops will address such areas as pavement smoothness specifications, design/construction techniques, and the use of road profilers to measure smoothness when paving. We also sponsored a road profiler comparison and verification study this year to improve analysis methods and testing procedures used for profiler verification (see article, page 3). More information on our projects and activities related to pavement smoothness can be found at www.fhwa.dot.gov/pavement/pshome.htm.

Another ongoing initiative focuses on the new dimension that the forthcoming *Mechanistic-Empirical Design Guide for New and Rehabilitated Pavement Structures* will bring to pavement design. Developed under National Cooperative Highway

Research Program Project 1-37A, the Guide will provide a uniform basis for the analysis of flexible, rigid, and composite pavements using mechanistic-empirical approaches that more realistically characterize inservice pavement performance. This year, FHWA's newly formed Design Guide Implementation Team will be introducing engineers from State highway agencies and FHWA to the Guide through a series of workshops presented around the country. These workshops will detail how participants can get ready to use the Guide. More information on the workshops and a schedule is available at www.fhwa.dot.gov/pavement/dgitfly2.htm.

Also changing the way highway agencies do business today is the increasing use of

longer-term pavement performance warranties. With the goal of improving pavement performance and reducing life-cycle costs, such warranties guarantee the integrity of the product and the contractor's responsibility to repair or replace defects for a defined period.

Today's pavement technology reflects an emphasis on environmental stewardship as well. FHWA's Pavement Recycling Team, which includes several members

from the Office of Pavement Technology, works to increase the highway industry's overall use of recycled materials. The team

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has also partnered with the University of New Hampshire's Recycled Materials Resource Center (RMRC) on numerous efforts. In September, the RMRC, in conjunction with the FHWA Recycling Team and the American Association of State Highway and Transportation Officials' Recycling Task Force, will present a workshop on the beneficial use of recycled materials in transportation applications in Manchester, New Hampshire. The workshop will bring together State highway agency materials engineers and environmental specialists, State environmental protection agency staff, and FHWA Division Office personnel from 11 northeastern States to discuss the use of recycled materials in highways. It is planned that the workshop will serve as a model for other similar regional events.

The Office of Pavement Technology also works with FHWA's Long-Term Pavement Performance (LTPP) program to promote the implementation of the many LTPP products. Since 1987, the LTPP program has partnered with highway agencies on a series of long-term field experiments monitoring more than 2,400 asphalt and Portland cement concrete pavement test sections across the United States and Canada. Products resulting from this research include the online DataPave program (www.datapave.com), which contains all of the pavement data released by the LTPP program, and the LTPPBind software program. LTPPBind provides users with the ability to apply regional temperature and traffic conditions to select Superpave performance-grade asphalt binders. Additional information on LTPP products is available at www.fhwa.dot.gov/pavement/ltpphome.htm.

To advance the country's concrete pavement technology, FHWA launched the Concrete Pavement Technology Program (CPTP) in partnership with States, industry, and academia. The program features a Concrete Technology Transfer Team that includes some of the Nation's leading experts on pavement technology. More than 30 CPTP projects are now underway in 6 focus areas: advanced pavement design, improved concrete materials, improved construction processes, repair and rehabilitation, workforce training, and enhanced user satisfaction. The projects include everything from high-performance pavements to performance-related specifications to the use of precast concrete panels for rapid repair and rehabilitation. To learn more about CPTP, visit www.fhwa.dot.gov/pavement/concost.htm.

Key to successfully implementing today's new pavement technology is a well-trained workforce. To train FHWA and State highway agency staff, we sponsor a 6-week pavement materials course every year in Reno, Nevada. And to keep FHWA's engineers up-to-date on advances and issues in pavement technology, a pavements workshop is held every December in Washington, DC. Past workshop topics have included pavement design; surface characteristics (smooth-

ness, noise, and friction); and quality control/quality assurance procedures. This year the workshop will focus on the use of pavement warranties and other innovative contracting technologies.

The Office of Pavement Technology also operates two fully equipped pavement materials mobile testing laboratories. These labs, one for asphalt and one for

Portland cement concrete, visit 8 to 10 States and actual project sites each year, participating in materials design, construction testing, training, and equipment demonstrations.

As a member of FHWA's Pavement and Materials Forum, the Office of Pavement Technology provides overall pavement technology direction and guidance for the agency. The Forum also includes representatives from the Office of Asset Management, Office of Infrastructure Research and Development, National Highway Institute, Federal Lands Highway Division Office, and FHWA's Resource Center and Division Offices, as well as the Pavement and Materials Technical Service Team. Forum members meet twice a year to define technology focus areas and goals and assess progress.

As pavement technology continues to change and advance, a major emphasis of the Office of Pavement Technology this year and in 2005 will be determining the status of the Nation's pavements. We will be working with the LTPP program and FHWA's Offices of Asset Management and Policy to perform a comprehensive study and evaluation. *Focus* will provide updates on this study as it progresses. Better determining the current condition of the country's pavements will serve as a roadmap for where we go next in continuing to advance and implement today's array of pavement technology, and in achieving our ultimate goal of better and longer-lasting pavements.

Tommy Beatty is the Director of FHWA's Office of Pavement Technology. *

To learn more about the work of the Office of Pavement Technology, visit www.fhwa.dot.gov/pavement.

The Great Pavement Profiler Round-Up

Sixty-eight road profilers. Two test tracks. Five days. The largest road profiler comparison and verification study to date was held April 4–8, 2004, at the Virginia Department of Transportation's Smart Road Facility in Blacksburg, Virginia, and the Pennsylvania Department of Transportation's road profiler testing facility in Newville, Pennsylvania. Sponsored by the Federal Highway Administration (FHWA), the profiler "round-up" study was performed by the University of Michigan Transportation Research Institute (UMTRI).

"An experiment of this size and variety was needed to improve the way people verify profilers. We also wanted to compare different types of profilers and see how reproducible profiler results are," says study director Steve Karamihas of UMTRI. "The project was also designed to increase the comfort level of States in using profiler devices," adds Mark Swanlund of FHWA. "We want to increase awareness so that using profilers becomes the standard." About 48 States are using profilers to evaluate the pavement quality of their road networks, with approximately 10 using them for construction quality control for individual projects. An additional 25 States are considering the use of profilers for construction quality control.

Road profilers use lasers and other technology to measure pavement smoothness, as calculated using indexes such as the International Roughness Index (IRI). With more highway agencies emphasizing the importance of enhancing pavement smoothness, "the payoff in using profilers is that the quality of the data is much better," says Karamihas. "You can measure what you've produced quickly on a job site, and if you see a problem with the pavement you can correct the problem before additional paving is done." Profilers provide a clearer picture of the shape of the road, while older devices, such as the California profilograph, would result

in a more distorted profile that didn't exactly match the pavement. Profilers also provide a more accurate rating of how the road's smoothness would be perceived by the average driver.

In addition to comparing different types of profilers and improving methods for verifying their results, goals of the study include:

- Establishing criteria for selecting profiler verification sites;
- Studying the interaction of various profiler types with pavement surface texture; and
- Setting performance requirements for reference profilers.

The round-up featured a range of profilers, with high-speed, lightweight, low-speed, walking-speed, and reference devices tested. The measurements taken by the various profilers will be compared to reference profiles of the test roads, to check profiler accuracy, and to the results obtained by the other participating devices. Participants represented State highway agencies, FHWA, universities, manufacturers, and industry. Auburn University, for example, brought its high-speed profiler, which it has been using

since 2001 for research studies. High-speed profilers mounted on trucks or vans can travel at highway speeds, with no need for traffic control. "The profiler is infinitely faster than previous methods and gives you more consistent data," says Mary Stroup-Gardiner of Auburn University.

In Virginia, profilers were tested on the Smart Road's 2.57-km (1.6-mi) track. The track features five different 161-m long (528-ft) test sections: two with smooth

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FHWA's ultra-light profiler was built using the Segway™ Human Transporter.



Sixty-eight road profilers were tested at the Smart Road in Blacksburg, VA, (shown here) and the Pennsylvania Department of Transportation's road profiler testing facility in Newville, PA.

Pavement Profiler Round-Up,

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Eighteen States and FHWA are participating in a \$1.5-million pooled-fund study, "Improving the Quality of Pavement Profiler Measurement," which kicked off in May 2003. The 4-year study's top priority is to build a transportable reference device that States and their contractors can test profilers against. "We need a tool that States can use to calibrate their devices, as there's no broad agreement currently as to what the reference is," says Brian Schleppi of the Ohio Department of Transportation and chair of the pooled-fund study. The study will also:

- Deliver sample profiler procurement specifications and maintenance guidelines.
- Establish criteria for verification centers and assist with their development.
- Provide software that can locate surface imperfections that require repair during pavement construction.

For more information on the pavement profiler pooled-fund study or to join the study, contact Bob Orthmeyer at FHWA, 708-283-3533 (email: robert.orthmeyer@fhwa.dot.gov), or visit pooledfund.org and search for Study No. TPF-5(063).

asphalt and one each with rough asphalt, continuously reinforced concrete, and jointed plain concrete. The sections had downward slopes ranging from 3 percent to 6 percent. The Pennsylvania test track featured four 161-m long (528-ft) test sections: smooth concrete, rough concrete, smooth asphalt, and rough asphalt. High-speed profilers also had the option in Pennsylvania of taking measurements on three nearby road sections with live traffic.

Laurin Lineman of FHWA's Federal Lands Highway Office tested the high-speed MGPS surface profiler. The MGPS surface profiler was developed from the FHWA Turner-Fairbank Highway Research Center's ROSAN texture measurement system and is now commercially available. The Federal Lands Highway Office has owned three of the profilers for

it than we did previously using the California profilograph," says Lineman. "Another advantage is that we can obtain the data a lot faster." At a cost of approximately \$80,000, the profiler is more expensive than older devices such as the California profilograph, but the additional cost is offset by savings realized from not having to close traffic lanes to collect data.

Mike Upp, an engineer for the Harley-Davidson Motor Co., brought a high-speed laser profiler to the testing. The profiler is mounted on a trailer system and can be towed behind a truck or van. "We just started using the profiler this year," says Upp. "Road roughness correlates to damage, which affects our riders. We use the profiler at our own testing facilities in Alabama, Arizona, and Florida, to see what various road surfaces are like. Then we figure out how they will affect our cus-

tomers. We like the trailer system because it's flexible and it's easy to ship around the country."

The Maryland State Highway Administration has two high-speed profilers that it has used for the past 4 years for quality assurance testing on new projects and for some network-wide assessments. Maryland combines the IRI data collected from the network-wide assessments with rutting and cracking data to create a Pavement Condition Index. This Index helps Maryland decide which road projects to work on. For new projects, contractors are required to report on the road's pavement smoothness. Sample quality assurance testing is then done by Maryland to check on the accuracy of the contractor's data. Contract incentives are awarded for meeting smoothness targets.

The Virginia Department of Transportation (VDOT), meanwhile, has three high-speed profilers. It uses them to measure the ride quality of new overlays and set targets for contract incentives and disincentives for pavement smoothness. VDOT also uses the profilers to collect data required for the Federal Highway Performance Monitoring System. "Virginia is also starting to use them to collect



The GSI® profiler uses sonic technology to measure the pavement.

In Brief...

data on bridges and is looking at the profiler's ability to measure pavement texture," says Kevin McGhee of the Virginia Transportation Research Council.

FHWA tested its ultra-light, slow-speed profiler, which was built using the Segway™ Human Transporter. The device operates at about 16 km/h (10 mi/h) and performs laser measurements of the pavement. An attached computer collects the data. Another slow-speed device tested was GOMACO's new GSI® profiler, which uses sonic technology to measure the pavement. The device, which provides real-time measurements, can straddle a pavement slab to profile it and does not have to be driven on the pavement. The GSI provides smoothness readings for both wet or cured concrete and asphalt slabs. Any irregularities in the slab are identified, and their locations are recorded through the use of a distance tracking encoder. Contractors can then repair the concrete surface while it's still in the plastic state. Smoothness readings can also be seen before saw cuts are made for joints and tining or the texturing of the slab.

The data collected at the round-up will be used to test the American Association of State Highway and Transportation Officials' provisional standards, which were adopted in 2002 and published the following year. These provisional standards cover profiler use, including how to certify a profiler and how to use it on a job site. The standards also address how to incorporate pavement smoothness requirements into a paving contract. Improving the quality of pavement profile data is the goal of a new State pooled-fund study as well (see sidebar). "We want to generate a golden profiler standard against which other profilers can be measured," says Bob Orthmeyer of FHWA.

Karamihas is now evaluating the data collected at the two test tracks in April to see how repeatable the data collected from each profiler device was and how repro-

Numerous **technical advisories on various pavement topics** are now available on the Federal Highway Administration's (FHWA) Office of Pavement Technology Web site at www.fhwa.dot.gov/pavement/ta.htm. The advisories provide technical guidance and information on recommended practices. Advisories currently listed are:

- Asphalt Concrete Mix Design and Field Control
- Paved Shoulders
- Concrete Pavement Joints
- Open Graded Friction Courses
- Use of Coal Ash in Embankments and Bases
- Continuously Reinforced Concrete Pavement
- Development and Review of Specifications
- Texturing and Skid Resistance of Concrete Pavements and Bridge Decks.

Encouraging students, professors, and highway engineers from around the world to get involved in using the Long-Term Pavement Performance (LTPP) program database is the goal of the **Fifth International Contest on LTPP Data Analysis**. Contest participants can work individually or in teams to develop papers that will benefit the transportation community. The event is cosponsored by FHWA and the Transportation and Development

Institute of the American Society of Civil Engineers.

The contest has four categories:

1. Undergraduate students (individual or team entry)
2. Graduate students (individual or team entry)
3. Partnership (Students can partner with a highway agency or consultants)
4. Curriculum (Professors can submit course curricula developed using the LTPP data).

Entries are judged on:

- Usefulness and potential benefit to end users
- Originality of concept and demonstrated use of the LTPP database
- Organization and presentation of the paper.

In the undergraduate, graduate, and partnership categories, winners will receive a first place prize of \$1,500; a second place prize of \$1,000; and a third place prize of \$500. The curriculum category winner will receive \$1,000.

The contest deadline is August 16, 2004. Visit www.tfhrc.gov/pavement/ltpptest2004.htm for more information, including a contest guide and winning entries from previous contests. Information is also available from Antonio Nieves at FHWA, 202-493-3074 (fax: 202-493-3161; email: antonio.nieves@fhwa.dot.gov). *

ducible, in terms of two different devices obtaining the same result. This data evaluation will aid in determining a reference standard for profilers. All participants will receive a report about their profiler results. An overall report on the study results will also be issued later this year.

To learn more about the profiler round-up study, contact Mark Swanlund at FHWA, 202-366-1323 (email: mark.swanlund@fhwa.dot.gov), or Steve Karamihas at UMTRI, 734-936-1057 (email: stevemk@umich.edu). *

Your Pavement and Materials Connection

They're all about pavements. The Federal Highway Administration's (FHWA) Pavement and Materials Technical Service Team (TST) offers information and technology to help State and local agencies and others design and build better pavements. Headquartered in FHWA's Resource Center office in Atlanta, Georgia, the team also has members located across the country. The team is one of 10 new specialized TSTs created by FHWA in 2003.

"Our biggest initiative this year is the introduction of the forthcoming *Mechanistic-Empirical Design Guide for New and Rehabilitated Pavement Structures*. We will be working with FHWA's Design Guide Implementation Team to host workshops nationwide," says team leader Monte Symons of FHWA. The workshops will help State highway agency and FHWA staff get ready to use the new Guide.

Working in partnership with FHWA's Office of Asset Management and Division Offices, new pavement technologies that the team is promoting include the high-speed Rolling Wheel Deflectometer (RWD), which measures pavement deflections under a moving truck wheel load. The RWD consists of a single axle, dual-wheeled semi trailer equipped with four spot lasers mounted on a beam beneath the trailer. Measurements can be collected while traveling at 64 to 80 km/h (40 to 50 mi/h). "A prototype of the device is available and we are encouraging States to take a look at it and try it out," says Symons. Because it allows faster data collection, the device can be used on a network basis, not just for collecting data on individual road projects.

The team offers courses and workshops on such topics as:

- Construction of Pavement Subsurface Drainage Systems
- HIPERPAV
- Life-Cycle Cost Analysis in Pavement Design

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San Francisco, CA

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- Advanced Life-Cycle Cost Analysis in Pavement Design.

Also offered is a seminar on preventive maintenance/pavement preservation designed for mid- to upper-level managers in transportation agencies. The team's Web site (www.fhwa.dot.gov/resourcecenter/teampave.cfm) features details on each course, as well as information on pavement and materials best practices, upcoming events, and useful publications. Team members are also working with FHWA's Long-Term Pavement Performance program and Accelerated Construction Technology Transfer initiative to advance the implementation of their pavement prod-

ucts and construction strategies. The team collaborates with FHWA's Office of Pavement Technology as well.

Three additional members will be joining the team over the next several months. Steve Mueller will be located in Denver, Colorado; Chris Wagner in Atlanta, Georgia; and Dennis Dvorak in Olympia Fields, Illinois.

For information or assistance, contact one of the team members listed in the sidebar or Monte Symons at 404-562-4782 (fax: 404-562-3700; email: monte.symons@fhwa.dot.gov).



Highway Technology Calendar

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

Second National HERS-ST Conference

August 19–20, 2004, Chicago, IL

The conference will provide practical assistance to highway agencies using the Highway Economic Requirements System–State Version (HERS-ST) software, as well as other agencies considering its use. HERS-ST is an engineering/economic analysis tool designed to evaluate the implications of alternative programs and policies on the conditions, performance, and user cost levels of highway systems.

Contact: David Winter at the Federal Highway Administration (FHWA), 202-366-4631 (email: david.winter@fhwa.dot.gov). More information and online registration is available at www.fhwa.dot.gov/infrastructure/asstmgmt/hersconf.htm.

Seminar on Design and Construction of Segmental Concrete Bridges

August 30–31, 2004, Orlando, FL

The seminar focuses on the design and construction of precast and cast-in-place segmental bridges constructed using the cantilever and span-by-span methods. Also addressed are cable-stayed bridges.

Contact: Cliff Freyermuth at the American Segmental Bridge Institute, 602-997-9964 (email: asbi@earthlink.net). Visit www.asbi-assoc.org for more information (select “Menu” and then “ASBI Events”).

2004 National Hydraulic Engineering Conference

August 31–September 3, 2004, Asheville, NC

Conference topics will include hydrology, modeling, environmental issues, coastal engineering, stream stability, and scour. The event is sponsored by FHWA and the North Carolina Department of Transportation.

Contact: Cynthia Nurmi at FHWA, 404-562-3908 (email: cynthia.nurmi@fhwa.dot.gov).

Ninth Annual Eastern Winter Road Maintenance Symposium and Equipment Expo

September 8–9, 2004, Knoxville, TN

The symposium will feature best practices and new products and equipment for winter maintenance. Sponsoring the event are FHWA, the Tennessee Department of Transportation, and the Tennessee Transportation Assistance Program.

Contact: Mark Sandifer at FHWA, 708-283-3528 (email: mark.sandifer@fhwa.dot.gov). Information is available online at www.easternsnowexpo.org.

Second National Prefabricated Bridge Elements and Systems Workshop

September 8–10, 2004, New Brunswick, NJ

The workshop will look at how the use of prefabricated bridge elements and systems enables bridge owners, designers, and construction contractors to “Get in, Get out, and Stay out.” The event is sponsored by FHWA, the American Association of State Highway and Transportation Officials (AASHTO), New Jersey Department of Transportation, and Rutgers University, in cooperation with the Midwest Transportation Consortium.

Contact: For information on registration or abstract submission, contact Hani H. Nassif at Rutgers University, 732-445-4414 (fax: 732-445-8268; email: nassif@rci.rutgers.edu). For information on scholarships available for State highway agencies, contact Harry A. Capers, Jr., at the New Jersey Department of Transportation, 609-530-2557 (fax: 609-530-5777; email: Harry.Capers@dot.state.nj.us). For general information on the workshop, contact Helene Cook at FHWA,

609-637-4230 (fax: 609-538-4913; email: helene.cook@fhwa.dot.gov). Information can be found online at www.fhwa.dot.gov/bridge/accelerated.

Structural Materials Technology: NDE/NDT for Highways and Bridges 2004

September 14–17, 2004, Buffalo, NY

Participants will learn about the state-of-the-art in nondestructive evaluation (NDE) and nondestructive testing (NDT) technologies. The event is sponsored by The American Society for Nondestructive Testing, Inc., New York State Department of Transportation (NYSDOT), Transportation Research Board (TRB), FHWA, and the Structural Engineering Institute.

Contact: Glenn Washer at FHWA, 202-493-3082 (fax: 202-493-3442; email: glenn.washer@fhwa.dot.gov), or Sreenivas Alampalli at the NYSDOT, 518-457-6827 (email: salampalli@dot.state.ny.us; Web: www.fhwa.dot.gov/bridge/smt.htm).

Second International Conference on Accelerated Pavement Testing

September 26–29, 2004, Minneapolis, MN

The conference will present research findings on accelerated pavement testing topics, including bridge decks, fatigue, instrumentation, performance, stabilization material, and permanent deformation. Conference sponsors include AASHTO, FHWA, the Minnesota Department of Transportation (Mn/DOT), TRB, and the University of Minnesota’s Center for Transportation Studies.

Contact: Ben Worel at Mn/DOT, 651-779-5522 (fax: 651-779-5616; email: ben.worel@dot.state.mn.us) or Kenneth Fults at the University of Texas, 512-232-3081 or 512-310-2933 (email: kenfults@yahoo.com). Information is available online at www.cce.umn.edu/engineering/accelerated_pavement.



FOCUS

Focus (ISSN 1060-6637), which is published monthly by the U.S. Department of Transportation's Federal Highway Administration (FHWA), covers the implementation of innovative technologies in all areas of infrastructure.

Its primary mission is twofold: (1) to serve the providers of highway infrastructure with innovations and support to improve the quality, safety, and service of our roads and bridges; and (2) to help promote and market programs and projects of the various offices of FHWA's Office of Infrastructure.

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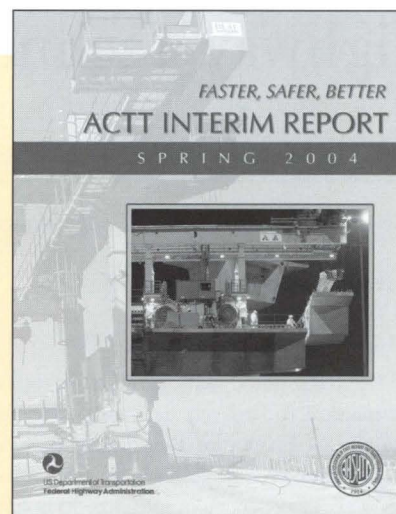
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Faster. Safer. Better. The Accelerated Construction Technology Transfer (ACTT) initiative is dedicated to better serving the highway community's customers through rapid adoption of new technologies and innovative practices. Initiated by the Transportation Research Board and now sponsored by the American Association of State Highway and Transportation Officials (AASHTO) and the Federal Highway Administration (FHWA), ACTT's goals include minimizing the impact of highway construction on motorists and surrounding communities by streamlining project schedules and containing costs, all while enhancing safety and improving quality. ACTT's activities and accomplishments to date are highlighted in a new *ACTT Interim Report* (Publication No. FHWA-IF-04-007) now available from FHWA and AASHTO.

The report features details on two pilot ACTT workshops and six additional workshops that have been held since 2002 to apply the ACTT process to a specific corridor or project. At each workshop, a multidisciplinary team of national transportation experts collaborates with local agency professionals to evaluate all aspects of the project and deliver feasible recommendations for reducing roadway construction time. These recommendations are helping transportation agencies save time while reducing construction-related congestion and improving work zone safety.

The *ACTT Interim Report* is available online at the Accelerated Construction Technology Transfer Web site (www.fhwa.dot.gov/construction/accelerated/index.htm). Also available is a final report on a September 2003 ACTT workshop held in Dallas, Texas, as well as general information on ACTT, articles and newsletters, and case studies. For more information about ACTT, contact Dan Sanayi at FHWA, 202-493-0551 (email: dan.sanayi@fhwa.dot.gov). *



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