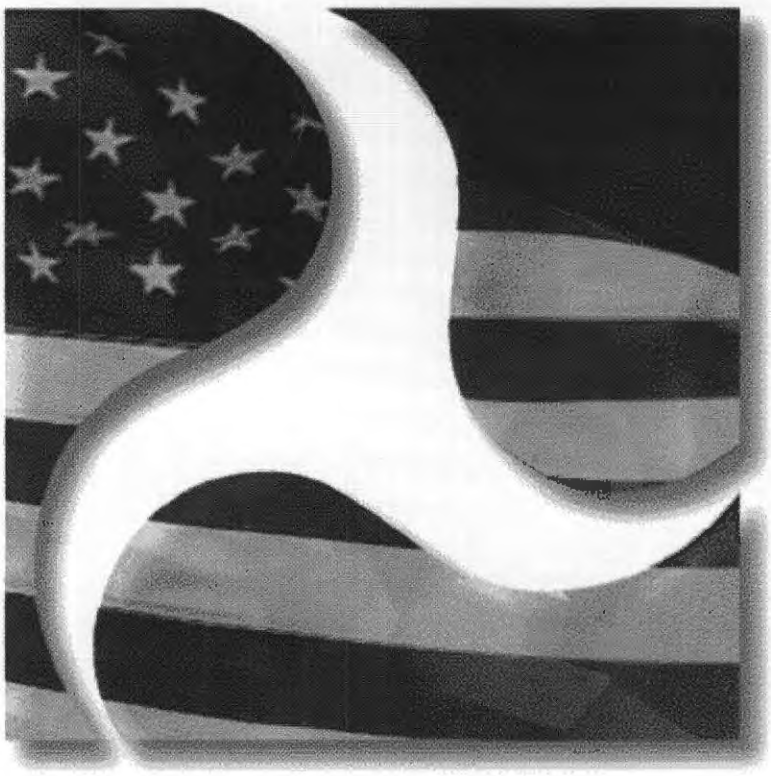
1998

FEDERAL HIGHWAY ADMINISTRATION

research and technology *program highlights*



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This report highlights the activities and accomplishments of the Research and Technology (R&T) Program of the Federal Highway Administration (FHWA) during fiscal year (FY) 1998—October 1, 1997, through September 30, 1998. The first R&T Highlights report was published for FY 1993; this report for FY 1998 is the sixth such report. The information for this report was gathered through interviews with key FHWA officials and staff.

The report describes the major FHWA R&T projects and programs and the progress made in FY 1998 by the following Research & Technology Coordinating Groups: intelligent transportation systems; pavements; structures; highway operations; safety; motor carriers; planning, environment, and real estate services; and policy. Each project is listed according to the FHWA strategic goal that it best advances. The report also briefly describes the management structure of the R&T program.

To access this report on the Internet, please visit the Resource Center of the Turner-Fairbank Highway Research Center Web site at http://www.tfhrc.gov. While supplies last, printed copies of this report are also available, without charge, from: Turner-Fairbank Highway Research Center, Communications Services Group, HRD-10, 6300 Georgetown Pike, McLean, VA 22101-2296, telephone: (703) 285-3103.

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ADMINISTRATOR'S REMARKS

On June 9, 1998, President Clinton signed the Transportation Equity Act for the 21st Century (TEA-21), which contains record levels of investment and several fiscal innovations. The new law upholds the President's commitment to rebuild America and includes a strong emphasis on safety, our top transportation priority.

The Federal Highway Administration (FHWA) is working with the other agencies of the U.S. Department of Transportation on an aggressive effort to implement this law, beginning with extensive outreach to our state and local partners and customers. Secretary Slater's landmark Strategic Plan, which has drawn praise from Congress and elsewhere in the Government, establishes transportation goals for the next 10 years. FHWA, in turn, has developed a Strategic Plan and Performance Plan, which target specific activities to support those goals.

The highway system of the 21st century will be founded on technology. To maintain the transportation systems of tomorrow, we must combine the record level of resources that TEA-21 provides with a strong research, development, and technology program. Research and technological development remain the core functions of the FHWA. They are also absolute necessities for a safe, modern, and efficient transportation system that employs not only the best materials and practices but also takes advantage of the latest communication and computer technology.

The FHWA's leadership in research and technology is recognized around the world, with internationally renowned experts and many outstanding programs. The agency's reorganization, begun this year, includes designating four Resource Centers to provide a strong career track for many of these experts and to help us forge even stronger ties to our transportation partners, such as universities, state and local transportation agencies, and the private sector.

This report summarizes the highlights of our research and technology program in fiscal year (FY) 1998. The FHWA looks forward to continuing its progress in these areas in FY 1999 and the years ahead as we work together to meet America's transportation needs and to embrace a coming century of challenge and change.

—Kenneth R. Wykle,
Federal Highway Administrator

INTRODUCTION

The Federal Highway Administration (FHWA) is entrusted with the responsibility of providing the leadership, expertise, resources, and information to continually improve the quality of our Nation's highway system and its intermodal connections. Improvements through research and the application of technology are designed to increase the mobility, safety, and productivity of our highway system while also protecting our human and natural environments and ensuring that our roadways are responsive to national security needs.

There is both an art and a science to meeting these responsibilities. When working with a diverse group of stakeholders, customers, and partners, it is an art to provide clear leadership that reflects a common vision of the current transportation needs of the Nation. There is the science of discovering better tools, techniques, and applications of existing or new knowledge to create the improvements needed to keep pace with the increasing demands placed upon our highway system by heavier loads, increased traffic, and economic growth.

To support FHWA in its mission, the Research and Technology (R&T) Program fosters the innovative scientific research needed to create the new methods, materials, and tools to continue to provide Americans with the best transportation system in the world. Building roads and bridges that will last longer and shortening the amount of time it takes to construct new roads or to improve existing structures requires an investment in research. Our Nation's ability to continue to successfully compete in the global marketplace while maintaining safety depends on how well we in the transportation community can pool both our intellectual and financial resources while working together to foster common goals and realize shared accomplishments. Also, to safeguard public health and the environment, we must advance the technology and methods used to detect abuse of regulations and to lessen emissions from surface transportation.

As Francis B. Francois, Executive Director of the American Association of State Highway and Transportation Officials (AASHTO), recently pointed out, "If we could do it now, we wouldn't need research."

MEETING THE CHALLENGE

Fiscal Year (FY) 1998 has seen the R&T administration tap the spirit of innovation that captures the curiosity and creative genius of R&T Program scientists and apply that mindset toward designing new ways of working with customers, stakeholders, and partners. In response to the Transportation Equity Act for the 21st Century (TEA-21), in which decision-making power moves from Washington, DC, to the States and localities, FHWA's leadership role is increasingly more important to:

- Attempt to bring all new funding recipients into a cohesive group with common goals.
- Promote a national transportation agenda.
- Avoid duplication of efforts and misuse of Federal funds.
- Work to ensure that we continue to have the best transportation system in the world.

Although our mission has remained the same, in 1998 we set out to find new ways to perform that mission and fulfill the tasks set before us in the future. For example, we implemented the road-mapping process in which we begin with a specific outcome and determine what is needed to accomplish that outcome. This "reverse engineering" or "backward planning" process enables us to define how funds are used and to develop an understanding of our priorities and responsibilities. These outcome-focused roadmaps provide us with another tool that we use to guide us toward successfully attaining our goals.

We have also come to find strength in our professional diversity—FHWA's innovative products and practices touch every part of the trans-

FHWA participated in the evaluation of the "Channel Bridge" construction method—another innovative way to build bridges more quickly and less expensively.

portation spectrum—and in our record of excellence in delivering the expertise required to produce innovation.

WHO GUIDES THE R&T PROGRAM?

Although the restructuring of FHWA in FY 1999 will result in some changes, the following describes the R&T management structure during the period represented in this report.

The Research and Technology Executive Board (RTEB) provides policy direction for the R&T Program; agrees on R&T Program priorities; and reviews our progress in meeting goals, accomplishments, priorities, and milestones for the R&T Program. The RTEB is chaired by the FHWA's Executive Director, Anthony Kane, and its members include FHWA's six Associate Administrators, three Regional Administrators, and the Director of the Joint Program Office for Intelligent Transportation Systems, as listed on page 20 of this publication. Eight Research and Technology Coordinating Groups (RTCG's) operate under the direction of the RTEB to identify the transportation problems or issues that R&T development can help resolve; determine our role in resolving the problem or issue; formulate their portion of the R&T Program budget, including information on goals, products and milestones, anticipated accomplishments, and major new initiatives; and report to the RTEB on their plans, products, and achievements.

The Research and Technology Coordinating Committee (RTCC) is a special committee convened by the Transportation Research Board (TRB) at our request, which assists us in identifying gaps in research; in considering ways to increase State, local, and private sector participation in highway research; in addressing issues related to the implementation of research results; in identifying areas of duplication; and in providing a mechanism for gathering research needs. We also actively seek input to our program from expert groups such as the Intelligent Transportation Society of America and the National Motor Carrier Advisory Committee. These groups provide information on R&T activities in specific areas, monitor research progress, and recommend applications of research findings.

ORGANIZATION OF THIS REPORT

This publication provides a brief glimpse at some of the year's most exciting advances, discoveries, and initiatives in Federal research and technology. These highlights of our R&T program are the projects that will not only change our Nation's highways, bridges, and structures but will also impact the lives of the traveling public, commercial drivers, and the highway engineering community. To emphasize how our successes correspond to FHWA's mission, we have chosen to display this year's highlights in five sections that align with FHWA's five strategic goals: (1) mobility, (2) safety, (3) productivity, (4) human and natural environment, and (5) national security. Although much of our work corresponds to several goals simultaneously, each project is listed under the goal it advances the most.

Strategic Goal 1:

MOBILITY

We aim to continually improve the public's access to activities, goods, and services through preservation, improvement, and expansion of the highway transportation system and enhancement of its operations, efficiency, and intermodal connections.

With more than 6.4 million kilometers of roadways in the United States, our challenge to improve mobility is often fulfilled in the optimizing of existing routes, intermodal connections, and structures. How well we manage congestion and how quickly we build new facilities are key elements involved in providing Americans with all the opportunities that become available when easy access to affordable mobility is a reality. In FY 1998, we made significant progress toward Transportation Secretary Rodney E. Slater's goal to deploy Intelligent Transportation Systems infrastructure across the United States within a decade.

MANAGING OUR ASSETS

In 1996, FHWA and AASHTO began an initiative to advance "Asset Management" into the 21st century through a public-private dialogue. By 1998, this initiative grew into a national program that included a series of executive seminars and reports and the formation of an AASHTO Task Force on Asset Management. In 1998, the AASHTO Task Force developed a "Strategic Plan" for Asset Management that was unanimously approved by the AASHTO Board of Directors at its 1998 Annual Meeting. The Strategic Plan comprehensively includes all the major elements that are needed to provide assistance, guidance, training, tools, and the research that States can use to advance Asset Management.

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MANAGING THE NATION'S BRIDGES

Bridge management involves bridge inspection, nondestructive evaluation, and the use of bridge management software such as Pontis, Version 3.4, which was released to users in September 1998. Bridge inspection activities are directed toward modernizing the national bridge inventory to make data more easily accessible. A major accomplishment over the last 2 years has been the decrease in the number of deficient bridges reported. Nearly 600 fewer bridges were identified as deficient in FY 1998. Better bridge management makes more effective use of funds in the maintenance, repair, and replacement of a State's bridges.

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For further information, visit: www.fhwa.dot.gov/bridge and www.tfhrc.gov, Pavements section.

REASSESSING THE HIGHWAY PERFORMANCE MONITORING SYSTEM

As the culmination of the past 2 years' work and with input from a wide-ranging outreach program that included a national workshop of customers, partners, and stakeholders, in FY 1998, FHWA moved ahead to develop a prototype replacement to the existing Highway Performance Monitoring System (HPMS), an important data system that provides measures of infrastructure condition and congestion. Migration of the improved HPMS from a mainframe environment to a PC environment continues; submittal software has been fully deployed and used in production this year by the States; and work continues on development and evaluation and on value-added, customer-access software. Many States have credited the new HPMS software with significant time savings.

This project is an ongoing partnership with States, metropolitan planning organizations (MPO's) and the Association of Metropolitan Planning Organizations, AASHTO, and other providers and customers.

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Related documents: Highway Performance Monitoring System Reassessment, Final Report, December 1998; Highway Performance Monitoring System Catalog—New Technology and Techniques, September 1998 (FHWA-PL-98-045); Strategic Assessment of the Highway Performance Monitoring System—Phase I Final Report, September 1997 (FHWA-PL-98-011); HPMS Reassessment Workshop/Steering Committee Meeting—Summary (FHWA-PL-98-012)

For further information, visit: www.fhwa.dot.gov/ohim.

HIGH-PERFORMANCE MATERIALS

The condition of the Nation's highway bridges can be improved and upgraded through innovative materials research and development. New materials for 21st century applications are being identified, and FHWA, with the support of the States, industry, and academia, has undertaken the work of increasing the understanding and performance characteristics of high-performance materials. These materials, including high-performance steel, high-performance concrete, fiber-reinforced polymer composites, and aluminum, each have outstanding individual properties and surpass traditional materials. In partnership with State departments of transportation, FHWA is currently monitoring 3 high-performance steel projects, 19 high-performance concrete projects, 35 varied fiber-reinforced polymer bridge projects, and 2 aluminum bridge superstructures.

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SHARING DATA

Intelligent Transportation Systems (ITS) are providing a wealth of data, and some ITS can augment or even replace other older data-gathering systems. The National ITS Architecture is being revised to incorporate the Archived Data User Service (ADUS), and projects are underway to determine the technical and institutional issues involved. By archiving ITS data through ADUS, data already being collected for ITS are made available and are proving useful for various transportation-related applications, including policy, safety, planning, operations, and research. Using ITS-generated data for different purposes is not only more efficient and economical, but it often includes data that would be difficult to gather by other means. ADUS has the potential to provide data needed for performance monitoring, progress assessment, policy evaluation, and other transportation activities, including multimodal and intermodal applications. The steering group for this ongoing project consists of FHWA, the Federal Transit Administration, the National Highway Traffic Safety Administration (NHTSA), the Bureau of Transportation Statistics, and the Intelligent Transportation Society of America (ITS America).

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Related documents: ITS as a Data Resource: Preliminary Requirements for a User Service

For further information, visit: www.fhwa.dot.gov/ohim/its/itspage.htm. Updates: Go to www.itsa.org and search for ADUS.

ADVANCING THE DEPLOYMENT OF INTEGRATED ITS TECHNOLOGIES

Seattle, San Antonio, and Phoenix showcased the successful deployment of multimodal trans-

Researchers at FHWA's Turner-Fairbank Highway Research Center test a beam of high-performance concrete.

Building a Bridge to Tomorrow

TO BUILD OUR NEXT GENERATION OF BRIDGES, FHWA HAS LOOKED TO THE ADVANCED COMPOSITE MATERIALS KNOWLEDGE THAT EXISTS IN THE AEROSPACE INDUSTRY. DR. JOHN B. SCALZI, CURRENTLY ON SABBATICAL FROM THE NATIONAL SCIENCE FOUNDATION, IS LEADING AN FHWA EFFORT TO ANALYZE EXISTING OR PLANNED BRIDGES THAT HAVE EITHER BEEN BUILT OR REHABILITATED USING THESE NEW COMPOSITES IN THE UNITED STATES, AS WELL AS IN CANADA, ITALY, JAPAN, AND SWITZERLAND. RESEARCH RESULTS AND FIELD EXPERIENCES WILL BE SHARED WITH BRIDGE ENGINEERS, DESIGNERS, AND MEMBERS OF ACADEMIA WHO ALL SHARE THE COMMON GOAL OF BUILDING BETTER BRIDGES.

portation and traveler information systems in FY 1998, and the fourth deployment was launched in the New York City metropolitan area on October 5, 1998. These four metropolitan areas were selected to participate in the ITS Model Deployment Initiative to deploy an intelligent transportation infrastructure with nine ITS components. Partnerships of public agencies and private companies deployed integrated, regional transportation management systems that provide improved operations, faster emergency response, better incident management, and up-to-the-minute traffic information for travelers. A rigorous evaluation is underway to document benefits, costs, and lessons.

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STABILIZING EARTH WALLS AND SLOPES

Our Engineering Applications area aims to bring about innovations in bridge design and construction by applying R&T advances in design, seismology, corrosion, hydraulics, and geotechnology. A major accomplishment in 1998 was the AASHTO endorsement of the strategic roadmaps for hydraulics and geotechnology. One of the highlights of the geotechnology roadmap is the promotion of two demonstration projects that further ground-reinforcement technology through the use of mechanically stabilized earth and soil nails. Mechanically stabilized earth walls and slopes, which are extremely cost-effective and aesthetically pleasing, combine soil-reinforcing materials made of steel or polymers and an appropriate facing to produce a composite material with improved engineering properties. Soil nailing is a construction technique that strengthens the existing ground (in place) by driving or drilling steel reinforcements for earth-cut applications. Both of these methods are substantially faster and less expensive than other conventional types of earth-retaining systems for both temporary and permanent applications.

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MEASURING THE BENEFITS OF ITS STRATEGIES

FHWA has developed modeling software to simulate individual vehicles within a real-world roadway environment that consists of freeways and arterial streets. Our CORSIM model provides detailed information that can assist transportation operators, designers, and planners in their evaluation of traffic operational performance measures along roadways. Measuring the benefits of ITS strategies such as ramp metering, high-occupancy-vehicle (HOV) lanes, and advanced controller logic is an important product of the CORSIM simulation.

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Strategic Goal 2:

SAFETY

Protecting the health and safety of the traveling public and commercial drivers is imperative. While we have gained important ground in reducing highway fatalities over the past decade, there remains room for safety improvements. Highway crashes are disruptive and can often be costly—not only in human lives but also in lost productivity and related economic costs. At FHWA, we strive to improve the safety of our highways. In FY 1998, we implemented simple, but ingenious, solutions to old problems like using continuous shoulder rumble strips to warn drivers who stray off the roadway, applied new knowledge about driver fatigue, promoted public awareness of many safety issues, and deployed ITS programs that hold the promise of dramatically in creasing the safety of our transportation systems.

MAKING ROADS USER-FRIENDLY

Even a road built entirely to code can introduce unsafe conditions that were overlooked in the design phase. Missing signs, confusing pavement markings, poor sight distance, and similar missed details can contribute to making a road difficult—or even unsafe—to drive. In FY 1998, FHWA introduced the road safety audit process in which a team of independent experts attempts to identify unsafe roadway conditions during project design or on existing roads. With 14 States piloting this new program, we are improving roadway safety by looking from the user's perspective to find those elements that do not match safety criteria. By implementing this road safety audit in the design phase of roadway construction, we also minimize potential crashes due to unsafe conditions, cut costs by doing it right from the start, and foster a spirit of checking it all twice to make sure our roadways are user-friendly, as well as safe, for the motoring public.

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STAYING SAFE IN THE ZONE

Hazardous conditions are a given in work zones, which can present dangerous conditions for road crews as well as for motorists. In February 1998, FHWA, in partnership with Texas Transportation Institute and the American Road & Transportation Builders Association, opened the National Work Zone Safety Information Clearinghouse. The mission of the Clearinghouse is to provide an information resource aimed at enhancing work zone safety. In a related project, FHWA has worked in partnership with 21 States to increase public awareness of work zone safety issues through an outreach campaign entitled, Get the Picture, Listen to the Signs. This multimedia campaign makes television and radio ads, as well as written materials, available to States and localities. Kansas has even used a flagger from the campaign to make live appearances in their public school systems' driver education program through which young drivers are learning all about work zone safety right from the start.

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HEARING THE APPROACH OF DANGER

Commercial motor vehicle operators must meet driver hearing requirements, but is truck driving a hearing-critical job? According to a recent FHWA study, the ability to hear is a critical requirement for safe driving that aids in crash avoidance when car horns, train whistles, or sirens are heard. Hearing also enables the driver to detect in-cab auditory warning signals and allows both face-to-face and CB communication. While reaffirming FHWA's position that current driver hearing requirements are necessary, this study also answered many questions concerning truck driver hearing, noise exposure, and hearing-critical tasks. Researchers recommended consideration of pure-tone audiometric testing as an objective basis for driver testing and requested that truck manufacturers attempt to decrease the noise levels in

The mission of the National Work-Zone Safety Information Clearinghouse is to provide information that enhances work-zone safety.

the cabins of future truck models. This project is completed.

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Related documents: Role of Driver Hearing in Commercial Motor Vehicle Operation: An Evaluation of the FHWA Hearing Requirement, September 1997 (NTIS PB98-114606);Role of Driver Hearing in Commercial Motor Vehicle Operation: An Evaluation of the FHWA Hearing Requirement, November 1998 (FHWA-MCRT-99-001)

STAYING AWAKE MEANS STAYING ALIVE

One-third of all vehicle crashes involve motorists running off the road. A simple, but effective, solution is found in the use of continuous shoulder rumble strips. These regularly spaced alterations to the road surface can be raised, milled, or rolled. Different types of rumble strips produce different sounds and vibration patterns, but all are effective warnings to drivers who may be more fatigued than they realize while driving. To promote the use of continuous shoulder rumble strips, FHWA has produced several educational CD-ROM's for States to use before determining the type of rumble strips they will place into use. These CD's even present the different sounds produced by each type of rumble strip.

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PARTNERS IN SAFETY

We are forging a new relationship with the automobile industry in the interest of bringing technologies such as crash warning systems, fatigue alert systems, route guidance systems, in-vehicle automation systems, and night vision enhancements into the vehicle. As envisioned by the Intelligent Vehicle Initiative (IVI), smart vehicles will be able to give route directions, sense objects, warn drivers of impending collisions, automatically signal for help in emergencies, keep drivers alert, and may ultimately be able to take over driving. In an intelligent vehicle, drivers will have access to more information than they are traditionally accustomed. This includes information on road and weather conditions, route directions, vehicle diagnostics, anti-collision warnings, the driver's physiological status, etc. Over time, IVI expects that intelligent vehicles will advance in three primary ways: in the capabilities of in-vehicle systems, in the sophistication of the driver-vehicle interface, and in the ability of vehicles to communicate with each other and a smart infrastructure. IVI is focused on stopping crashes before they occur through the use of advanced technology.

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For further information, visit: www.tfhrc.gov, Human Factors section.

EVALUATING BRAKE TESTING

FHWA recently completed field testing of several performance-based brake testers and devel-

oped criteria that help provide an objective, consistent, and standard measure of the "as is" braking performance of a commercial motor vehicle. Inspectors performed a visual inspection and a performance-based assessment on 2,865 vehicles in 10 different States. While keeping in mind that performance-based assessment is quantitative and objective, and visual inspection is qualitative and subjective, the results of these two methods were compared to determine the differences in brake defect rates when measured using different inspection methods. Simultaneous use of both techniques will foster safer vehicle maintenance and operation. This project is completed.

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Related documents: Development, Evaluation, and Application of Performance-Based Brake Testing Technologies, Draft Final Report, July 1998; Development, Evaluation, and Application of Performance-Based Brake Testing Technologies, Technical Brief, July 1998 (FHWA-MCRT-98-001)

PREVENTING ACCIDENTS BEFORE THEY HAPPEN

When driving at night, it's not a bad idea to have a talkative passenger along who makes sure the driver stays awake or realizes when it's time to pull over and rest. For commercial truckers who drive alone, the electronic equivalent of the chatty passenger may be found in a joint FHWA and National Highway Traffic Safety Administration program on alertness monitoring systems. FHWA-funded laboratory research has recently verified that an eyelid closure measure called "PERCLOS" is a highly valid and reliable measure of driver alertness. Related technology development has produced a prototype camera and software that can monitor driver eye activity to determine the onset of drowsiness. This technology was field tested with encouraging preliminary results. This project is completed.

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Related documents: Evaluation of Techniques for Ocular Measurement as an Index of Fatigue and as the Basis for Alertness Management, April 1998 (DOT-HS-808-762); PERCLOS: A Valid Psychophysiological Measure of Alertness as Assessed by Psychomotor Vigilance, October 1998 (FHWA-MCRT-98-006)

For further information, visit: www.hf.faa.gov/dot/fatigue/ and www.mcregis.fhwa.dot.gov/study/htm.

SAVING LIVES AND MAKING PROGRESS

Many of the R&T projects start off with an objective to improve the effectiveness or accuracy of a product, process, or technique, and they wind up producing significant safety enhancements as well as improving quality. An example is the soil stiffness gauge for which our Geotechnical Laboratory was nominated in 1998 for the Construction Innovation Forum's NOVA award. The guage allows engineers to better evaluate the acceptability of a constructed fill or earthworks by directly measuring the soil modulus or stiffness rather than the density, which has been the customary method for many decades because density is much easier to measure. Also, the guage is quicker, easier, and less expensive than previous methods, and it will save lives and reduce exposure to injuries by enabling the technician to conduct each test rapidly. Previously, many technicians were injured and at least one was killed when they were preoccupied while conducting a density test and were run over by heavy construction vehicles.

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Strategic Goal 3:

PRODUCTIVITY

America's highways provide an economic life line for many businesses across the Nation. Road closures and congestion can mean delayed shipments and lost productivity. To eliminate lane closures for routine maintenance and testing, FHWA has fostered the development of a host of diagnostic equipment that can be used at highway speeds while vehicle mounted. These technological breakthroughs not only keep traffic moving, but they employ non-invasive techniques to determine the condition of pavements and highway structures such as bridges and overpasses. As important to transportation as the discovery of the x-ray was to medicine, these nondestructive, non-invasive technologies are truly revolutionary. They are safer, faster, and easier to use, and they provide more accurate and complete information.

DETECTING BRIDGE FLAWS AT 90 KM/H

HERMES (High-speed Electromagnetic Roadway Mapping and Evaluation System) produces images of the internal structure of reinforced concrete bridge decks and can be towed over a bridge deck at speeds of up to 90 km/h. For the development of this new ground-penetrating radar technology for bridge deck inspection, FHWA won the coveted "R&D 100 Award," presented annually since 1963 by *Research and Development* magazine to recognize the 100 most technologically significant inventions worldwide. An earlier prototype, named PERES (Precision Electromagnetic Roadway Evaluation System), produced images at a rate of only 2 meters per hour; therefore, a second system with practical inspection speed was developed.

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For further information, visit: www.tfhrc.gov, Materials Technology section.

MEASURING THE LOAD-CARRYING CAPACITY OF A PAVEMENT AT 90 KM/H

FHWA has designed and built a rolling-wheel deflectometer that is capable of deflecting, or bending, a pavement in order to measure the amount of deflection that occurs when the pavement is strained by a heavy load. If there is too much strain, a pavement will crack or show other signs of abuse. Deflection serves as the primary measure of the pavement's structural capacity by helping to determine how much weight a particular pavement can handle at a specific point in its life span. In the past, measurements of this sort necessitated lane closures and meant risking the safety of highway workers performing pavement measurements on one lane of an operating highway carrying traffic. Today's rolling-wheel deflectometer is mounted to a vehicle and travels a roadway at the speed of traffic. There is no risk to workers and no decrease in the traffic-carrying capacity of the highway while the measurements are taken. The rolling-wheel deflectometer is the first of its kind in the world and will soon be brought to a test track to validate its accuracy and precision.

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MEASURING ROAD ROUGHNESS AT 120 KM/H

In October 1997, a Cooperative Research And Development Agreement (CRADA) was signed to support the conversion of the research prototype version of the Road Surface Analyzer (ROSAN) into a product available to the highway industry, including the State agencies, contractors, and researchers. ROSAN can measure macrotexture, faulting, grooving, rutting, slope, and road profile at speeds of up to 120 km/h and distances up to about 160 kilometers. After a year of effort, the first phase of product development has been completed, and a sales strategy has been developed. ROSAN is investigating pavement/tire noise associated with pavement

This van is equipped with ROSANvm, a laser sensor that is moved along the bar by a computer-controlled motorized trolley.

texture. In addition, ROSAN has applications in other transportation modes, such as monitoring the surface condition of runways and surveying the track-pentograph-catenary system along the Northeast rail corridor.

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For further information, visit: www.tfhrc.gov, Materials Technology section.

EVALUATING PAVEMENT PERFORMANCE

In FY 1998, FHWA's Long Term Pavement Performance (LTPP) program kicked off its second decade with the introduction of DataPave. DataPave is a new software package that presents on an easy-to-use CD-ROM most of the data that LTPP, the largest and most comprehensive pavement study in the world, has collected on pavement performance over the past 11 years. Other LTPP accomplishments in 1998 include: (1) launching a Data Resolution initiative through which the States and Provinces reaffirmed their commitment to LTPP throughout its next decade and pledged to resolve a variety of issues related to missing or questionable data; (2) introducing LTPPBind, a Windows-based software program that provides State and Provincial highway engineers with the ability to apply regional temperature and traffic conditions to select more cost-effective and less restrictive Superpave asphalt binders; (3) developing software that automates AASHTO-approved design procedures for jointed concrete pavements to achieve the best balance between initial construction costs and long-term performance; and (4) disseminating findings to add to the body of knowledge on pavement design, construction, and rehabilitation.

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SIMULATING THE MECHANICS OF ASPHALT PAVEMENT

In the year since the inception of the Simulation Imaging and Mechanics of Asphalt Pavement (SIMAP) program, we have demonstrated that it is possible to get high-resolution, three-dimensional images of asphalt pavements. This makes it possible to qualitatively distinguish between pavements with good and bad resistance to rutting. We are developing mechanistic and computer simulation models, and collaborating with researchers in other

countries. These efforts will allow us to engineer and construct more durable asphalt pavements.

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USING COMPUTERS TO BUILD BETTER PAVEMENTS

HIPERPAV, a user-friendly computer program, was developed to determine the best combination of pavement design, mix design, construction, and environmental considerations for preventing uncontrolled cracking in new concrete pavements for a given project. The final benefit is greater assurance that the pavement will be constructed without early-age uncontrolled cracking, thus ensuring longer pavement life.

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HELPING LAWMAKERS ASSESS EXISTING TRUCK SIZE AND WEIGHT LAWS

In FY 1998, FHWA provided staff support for the Department of Transportation's Comprehensive Truck Size and Weight Study, which will provide a fact-based framework for assessing the Nation's current body of truck size and weight laws. Our efforts included the development of state-of-the-art analytical tools—models and databases—that can be used to evaluate alternative truck size and weight policy proposals. We have applied these tools to five illustrative policy scenarios that were selected by an intermodal departmental oversight group. These scenarios—pavement preservation; bridge protection; geometric requirements; external factors, including safety of the system, environmental quality, energy consumption, and traffic flow; and economic considerations, such as rail competitiveness and shipper costs—were evaluated with respect to their impact on highway agency costs. This project is ongoing and has benefited from an unprecedented level of outreach involving private citizens, public interest groups, and State partners.

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COLLECTING TRAFFIC DATA USING NEW TECHNOLOGIES

The goal of this technology transfer project is to evaluate the capabilities of a variety of automated non-intrusive vehicle detection technologies in real-world conditions. Non-intrusive data collection devices are defined as those that cause minimal disruption to normal traffic operations. In addition, non-intrusive devices must be able to be deployed more safely than conventional devices. Devices tested in this research fall into several broadly defined categories: passive and active infrared, passive and active magnetic, microwave, sonic and ultrasonic, and assorted approaches using video-capture technology. Phase one of the research emphasized the historical data collection needs of vehicle counts and speed. Based on feedback from the project outreach program, phase two

Keeping Pace With the Future—ITS Moves to Deployment

The ITS program continues to move along a path that is leading from a research and development focus, through operational testing, and toward deployment as an integral part of the delivery of transportation services. This path is taking us toward the vision of seamless transportation with intelligent vehicles and an intelligent infrastructure working together to create an intelligent transportation system.

During the Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA) era (FY 1991 through FY 1997), the ITS program was largely devoted to building the foundation on which deployment of ITS could take place. These efforts included an aggressive research and technology program aimed at addressing concerns about the technological limitations of ITS, an extensive operational test program to demonstrate the viability of first-generation ITS technologies and services, and an architecture and standards program to create the framework needed for the deployment of integrated ITS systems. Much has been accomplished, including:

- An industry with technical expertise and commercially viable products exists.
- Research and development has proven ITS to be technically feasible.
- Operational tests have shown the benefits of first-generation ITS services.
- A National ITS Architecture exists, and ITS standards are under development.

TEA-21 continues to maintain a strong research program while seeking to advance the deployment of integrated ITS technologies in metropolitan and rural areas and through the Commercial Vehicle Information Systems and Networks (CVISN). Building upon the ITS foundation of technical knowledge, institutional partnerships, national architecture, and standards, TEA-21 establishes a program that fosters integrated deployment in a manner that will improve the mobility, productivity, and safety of our transportation system.

In FY 1998, work also continued on the second part of the Intelligent Transportation System—the vehicle. The Intelligent Vehicle Initiative (IVI), established in 1997 to consolidate all of the ITS vehicle-based research into a single, focused effort, has begun to take shape and move forward. An IVI Business Plan that articulated the vision, mission, and scope of the program was developed. This business plan was published in the December 1997 *Federal Register* as part of a request for public comment on IVI. More than 150 responses, totaling more than 700 pages, were received from a broad range of interested parties, including domestic and foreign car manufacturers, truck manufacturers, transit agencies, and local transportation agencies. Through ITS America, the responses were analyzed, and a letter of advice was sent from the ITS America Board of Directors to the Secretary of Transportation in August. This letter expressed support for the program content and direction, and it recommended joint government/industry governance of the program. ■

New technologies, such as electronic toll collection, keep traffic moving smoothly.

will expand to include vehicle classification, traffic management, and ITS applications.

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Related documents: Field Test of Monitoring of Urban Vehicle Operations Using Non-Intrusive Technologies and numerous articles and proceedings papers

For further information, visit: www.ctr.vt.edu/research/NITWEB/index.htm.

MAKING SURE YOU GET TO WORK ON TIME

In addition to the traveler information systems that provide travel information via pagers, e-mail, handheld PC's, kiosks, the Internet, and cable TV in the four Model Deployment Initiative metropolitan areas, there are similar efforts in less populated areas. For example, the Arizona I-40 Traveler and Tourist Information System and the Branson (Missouri) Travel and Recreational Information Program (TRIP) also initiated service in FY 1998. Both systems provide information to tourists through Highway Advisory Radio, the Internet, kiosks, telephones, or changeable message signs.

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USING A HIGHWAY DECONGESTANT

Since keeping roadways free of traffic congestion helps increase national productivity, FHWA developed and implemented prototype traffic control algorithms that respond in real time to changes in traffic patterns, such as those caused by accidents, special events, or rush-hour traffic. Known as Adaptive Control Software, or ACS, this technology was field-tested on a roadway in Northern Virginia where before and after data were collected and analyzed. Our preliminary results have been presented, and three other sites throughout the Nation are scheduled for instrumentation and testing next year.

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KEEPING TABS ON OUR OWN PRODUCTIVITY

Interim guidance was issued implementing the TEA-21 requirement that all ITS projects funded from the Highway Trust Fund conform to the National ITS Architecture and standards. This guidance reflects input received from Federal, State, local, and private sector stakeholders in conjunction with national transportation association forums and 10 outreach sessions held across the Nation last spring. The intent of the interim guidance is to foster integration, encourage incorporation of ITS into the transportation planning process, and focus on near-term projects of regional significance. It

is expected to be in effect for 1 year while a final policy is developed through formal rulemaking.

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MAXIMIZING ECONOMIC EFFICIENCY

The Surface Transportation Efficiency Analysis Model, or STEAM, is a new software tool created by FHWA. This advanced tool assesses alternative transportation investments and policies to assist transportation decisionmakers in selecting the most economic alternatives. Before the development of STEAM, planners could not easily compare economic benefits from alternative modal investments and demand-management strategies when developing their transportation plans, programs, and projects. This new software tool allows the development of monetary impact estimates for a wide range of transportation investments and policies, including major capital projects, pricing, and travel demand management. STEAM also performs risk analysis to clearly describe the level of uncertainty that may be present in STEAM projections.

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GUIDING PROGRAM REVISIONS

FHWA is attempting to help the States achieve optimum productivity in real estate operations. Through our Quality Management Study, we are examining the successful practices applied by the realty services staffs of five States—Florida, Louisiana, Oregon, Pennsylvania, and Wisconsin. By tapping the spectrum of experience represented by these States, we will define how each State has implemented its quality initiatives while integrating organizational restructuring, staff downsizing, or funding priorities. The recommendations of this study will form a guide for other States to use when undertaking similar program revisions.

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PROMOTING KNOWLEDGE-SHARING AND KNOWLEDGE MANAGEMENT

FHWA productivity often rests on our ability to deliver transportation technology and know-how so it can be put into immediate practice. To enhance our ability to present information according to the customer's point of view and to enable easy retrieval of information, we have initiated the development of a transportation knowledge network. This knowledge network is intended as a forum for the highway community to share knowledge, as a repository of valuable highway innovation information, as a means of accessing technical and industry developments, and as a resource for training and education. Knowledge-sharing has the potential to speed the delivery of transportation technology to FHWA's customers and partners, as well as to provide access to cumulative expertise on specific topics. Our partners in this ongoing project are the Bureau of Transportation Statistics, AASHTO, the Civil Engineering Research Foundation, and the Transportation Research Board.

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Strategic Goal 4:

HUMAN & NATURAL ENVIRONMENT

Mobility and productivity need not be achieved at the expense of public health and the preservation of our natural environment. To safeguard public health and the environment, we are monitoring and regulating noise levels, pollutants, and encroachments on wetlands. Good transportation planning and operations do not sacrifice our natural resources.

LESSONS LEARNED

FHWA worked with the Metropolitan Washington, DC, Council of Governments to produce a video that describes enhanced public outreach activities. Reaching Out to Everyone: Techniques for Inclusive Transportation Planning shares the practical lessons this metropolitan planning organization learned from an intense effort to reach a broader range of citizens than previously participated in long-range transportation planning. This 20-minute video shares lessons that can be used by transportation planning and implementation agencies around the country to develop transportation investments that enhance the community and support community values. This tool can also be used to improve public satisfaction with highway investments.

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PREDICTING HIGHWAY TRAFFIC NOISE

In March 1998, FHWA released a new Highway Traffic Noise Prediction Model that was the culmination of more than 6 years of research incorporating advancements in computer technology and more than two decades of improvements in our ability to predict highway traffic noise. This model uses entirely new acoustical prediction algorithms, many of which are based on newly measured vehicle-emission levels for automobiles, medium trucks, heavy trucks, buses, and motorcycles. Early validation of this new model shows a marked improvement in noise-prediction accuracy and the ability of this tool to help sustain the quality of the human and natural environments while meeting the transportation needs of communities. Work was performed with the assistance of the Volpe National Transportation Systems Center.

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PROVIDING A CLEAR FRAMEWORK FOR ADVANCEMENT

FY 1998 marked the first release of FHWA's Strategic Plan for Environmental Research. This plan identifies the 1998 through 2003 research priorities for the Environmental Research Program. The plan is the result of a comprehensive strategic planning process, intense evaluation of research programs and activities, and input from a wide range of external customers and stakeholders. Our strategic objectives of reducing on-road mobile-source emissions and increasing net wetland acreage are highlighted in the plan. Public and private sector transportation, environment, and planning experts participated in the development of this plan.

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WORKING WITH UNIVERSITIES TO CONDUCT RESEARCH

FHWA's Transportation Environmental Research Program (TERP) awards grants of $20,000 to $50,000 to universities to conduct research projects, ranging from 6 months to 2 years in duration. Participation by historically black colleges and universities is encouraged.

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Strategic Goal 5:

NATIONAL SECURITY

Ensuring that our highways remain in a state of military readiness is a responsibility we have to our Nation. Perhaps, the greatest example of intermodalism is reflected in the mobilization and deployment of military forces and equipment. Military personnel must assemble rapidly at selected military bases from which military units, equipment, and supplies move initially over roads to air bases and seaports from which they deploy overseas.

In addition, when a natural disaster or emergency occurs, the condition of our roadways can mean the difference between life and death for Americans in need. The help upon which we rely during our most desperate moments most often is received via an emergency medical vehicle, fire truck, or police car.

Virtually all FHWA programs that are designed to help to move people and goods efficiently over our Nation's highways have national security implications.

IMPROVING NATIONAL DEFENSE MOBILITY

In FY 1998, we made considerable progress toward our goal to improve the Nation's national defense mobility. We renewed our coordination efforts with the Department of Defense's Military Traffic Management Command (MTMC) and our partner State transportation departments through periodic meetings concerning the status and well-being of the roads and bridges on the Defense Highway System, Strategic Highway Network (STRAHNET), and STRAHNET Connector systems to more than 200 critical military bases and installations. We also revitalized the Emergency Highway Traffic Regulation (EHTR) program and provided assistance to state transportation departments in their efforts to modernize and streamline their EHTR's to ensure an effective allocation of highway space to military movements on a priority basis during a national defense emergency and to safeguard the general public during extreme emergency situations.

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RESPONDING TO DISASTER

This year, FHWA recommitted itself to responding as rapidly as possible in the face of disasters that impact the safety of the system of highways and bridges used by the public. Through the agency's Emergency Relief (ER) and Emergency Relief for Federally Owned Roads (ERFO) programs, we committed millions of dollars and significant human resources to assist States, counties, and other Federal agencies to provide the fastest repair possible to severe infrastructure damage. Also, in an effort to reduce red tape and to provide assistance as quickly as possible, we initiated revisions to the ER regulations, clarified a number of policy directives, prescribed potential innovative contracting methods, and updated our ER Manual to make it more user-friendly.

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LETTING EMERGENCY ROOM DOCTORS RIDE THE AMBULANCE, VIRTUAL STYLE

As part of our FY 1998 TransGuide deployment, LifeLink provides two-way video teleconferencing and data links between ambulance and hospital. This technology allows the trauma center physician to see the patient, monitor important vital signs, and provide emergency medical services personnel with directions through which they are able to perform more complicated treatments than ever before in the critical moments before the patient arrives at the hospital.

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FREQUENTLY USED ABBREVIATIONS

AASHTO	*American Association of State Highway and Transportation Officials*
FHWA	*Federal Highway Administration*
ITS	*Intelligent Transportation Systems*
R&T	*Research and Technology*
TEA-21	*Transportation Equity Act for the 21st Century*