

TEXAS TRANSPORTATION

Researcher

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From Texas to the Nation





ON THE COVER: For 50 years, the National Cooperative Highway Research Program (NCHRP) has provided the United States with innovative solutions to transportation problems. The Texas A&M Transportation Institute has conducted numerous NCHRP projects for half a century, providing national leadership in transportation research.



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What We've Done TOGETHER

TTI Celebrates 50 Years with NCHRP

In 2012, we celebrated the 50th anniversary of the National Cooperative Highway Research Program (NCHRP). As I'm sure you know, NCHRP sponsors research in a wide range of topics critical to state departments of transportation. Doing so saves time, effort and resources in solving common problems throughout the country.

A need to address critical transportation issues gave birth to NCHRP in 1962. You might even say the Texas A&M Transportation Institute (TTI), founded in 1950, grew up together with NCHRP. Historically, Texas — with its fickle weather, variable terrain and urban/rural environments — has offered a one-of-a-kind test bed for conducting transportation research. So partnering TTI's established expertise and unique research environment with NCHRP's vision for applying local solutions to national problems seemed inevitable.

In honor of NCHRP's golden anniversary, Crawford Jencks, deputy director of the Transportation Research Board's (TRB's) Cooperative Research Program (CRP) and manager of NCHRP, provides his perspective on the TTI-NCHRP relationship in this issue of the *Texas Transportation Researcher*. In that same section we highlight a few of the TTI-NCHRP milestones in the areas of recycled pavements, roadside safety, high-occupancy vehicle lanes and sustainability.

Most of this issue profiles current TTI projects with TRB's CRP and Strategic Highway Research Program (SHRP 2) divisions. Current NCHRP projects include improving techniques and testing procedures for warm mix asphalt, refining design guidelines for roadside barriers to better promote safety and counting motorcycles more accurately and reliably.



by Dennis Christiansen
Agency Director

The Institute has also worked with NCHRP's sister program, the National Cooperative Freight Research Program (NCFRP), to investigate how to better utilize our nation's waterways in moving cargo. Another of TTI's projects for this program looks at a national transportation data architecture, useful in planning transportation

projects and shaping effective policy.

TTI has extended its tradition of research excellence to SHRP 2, and you'll find a quick-reference list of our current SHRP 2 projects in these pages. We devote full articles to two of our current SHRP 2 projects: one looks at extending pavement life by better regulating temperature during the installation process; the second looks at ways to troubleshoot utility conflicts that can occur before construction begins, saving time and effort during those early project stages.

Our work at the national level has helped make the Institute the recognized transportation research agency in the Lone Star State, as evidenced by the amount of information and testimony requested by the Texas Legislature in recent years. Policy makers at all levels of government have come to rely on TTI for an honest, reliable, objective outlook on the Texas transportation system. This issue's center spread highlights a handful of the areas where TTI has provided empirical evidence to support informed decision making.

Based on our tradition of cooperative research excellence, TTI and our national sponsors are moving forward together to face challenges both familiar and new: the costs of increasing congestion, the symbiotic nature of economies and transportation, and the perennial problem of stretching finite funding to meet ever-expanding transportation needs. Let's pencil in an appointment for 50 years from now — my successor will be glad to update you on how we met those challenges together. ■



A Shared History of Meeting National Challenges

In a three-way agreement in 1962, the predecessor organizations of the American Association of State Highway and Transportation Officials (AASHTO), the Federal Highway Administration (FHWA) and the Transportation Research Board (TRB) established the National Cooperative Highway Research Program (NCHRP) as a state department of transportation (DOT)-driven, collaborative research program.

Via state-DOT financial support, AASHTO sponsors the program, TRB manages the program, and FHWA coordinates state-level research activity with its own. This approach promotes teamwork among members of the various AASHTO committees and state DOTs, experts from FHWA Headquarters and its Resource Center, and TRB expert panels and staff, strengthening the relevance of research results and their applications nationwide. Over its lifetime, NCHRP has leveraged state-DOT research to solve transportation problems important to all levels of government and private practice — its No. 1 goal.

In 1979, soon after my arrival at NCHRP as a project manager, I became acquainted with the Texas A&M Transportation Institute (TTI) through two fine gentlemen who set my high level of appreciation for the agency. I met Professor Robert Lytton, henceforth known as Bob, and soon visited TTI, Bob and Texas for the first time, where this Rhode Island native was soon humbled by what I believe were habanero peppers. That same year, I attended a TRB retreat in Virginia and had the opportunity to meet then-TTI Director Charley Wootan. I've since had many opportunities to visit and work with TTI's first-rate researchers as a project manager and, since 1992, as the manager of NCHRP.

TTI preceded the beginning of NCHRP by 10 years or so — a good thing for NCHRP. By 1962, the Institute had established itself as a very capable organization and has

remained competitive ever since (as evidenced by its 130 NCHRP contracts totaling more than \$38 million over the years). TTI has responded to transportation's evolving issues, keeping up with changes in (and helping to advance) technology, materials and various analytical procedures. During the early years of the Interstate Highway System, NCHRP focused research on the "hard subjects" of transportation and highway engineering. TTI continues to excel in these areas, innovating how we deliver, operate and maintain our transportation system. Exemplary examples of TTI's contributions that have really made a difference come to mind in the traffic, safety and pavement areas. And recently, TTI has taken on topics such as sustainability, better cost estimations and future scenario planning, which will help DOTs become more proactive, rather than reactive, to change.

And change is coming. Attention to the research basics will be a constant for NCHRP and TTI, but state DOT interests continue to broaden. As a result of the positives of advancing technology and the negatives of shrinking funding, state DOTs need to improve the way they do business. DOTs will need to think more outside the box to achieve bigger, better payoffs down the road. Some of that is happening now through NCHRP's 20-83 series of projects, entitled Long-Range Strategic Issues Facing the Transportation Industry. Once again, TTI was ready and has a research contract in the series.

Evidence exists on practically every road in America that the NCHRP initiative has achieved its goal. TTI has played a major role in that success. Tomorrow will present new challenges, but if past predicts future, both NCHRP and TTI stand ready to meet them. Meeting those challenges is what drives us to achieve research excellence. ■



by Crawford Jencks, Manager

National Cooperative Highway Research Program

Transportation Research Board of the National Academies

TTI Landmark NCHRP Reports That Set National Standards

NCHRP Report 708: A Guidebook for Sustainability Performance Measurement for Transportation Agencies (2011)

Sustainability has become a key component in transportation planning at all levels of government, but until now, few tools were available to help planners develop meaningful ways to measure the effectiveness of these efforts. Performance measurement has evolved over the decades into an effective way to quantify and communicate progress toward meeting goals and objectives. Developing these measures is often complicated. This guidebook offers transportation agencies a series of practical, easy-to-use tools to continuously integrate sustainability into current agency performance measurement programs. The guidebook is available at the Transportation Research Board website: <http://www.trb.org/Main/Blurbs/166313.aspx>. ■

NCHRP Report 414: HOV Systems Manual (1998)

This is a comprehensive, user-friendly guide that covers almost every topic pertaining to high-occupancy vehicle facilities — policy considerations, planning, designing, marketing, implementing, operating and enforcing. The largest report ever published at the time, this 4-inch-tall three-ring binder (now available online at <http://trid.trb.org/view.aspx?id=540319>) still serves as the resource recommended for planners, engineers, marketing specialists, transit operators and police responsible for all aspects of HOV facilities. ■



Implementing innovative ideas, like the HOV facilities in Minnesota pictured here, improved mobility dramatically in the United States.



NCHRP Report 708 provides users with an easy approach to meeting their self-defined goals to help progress toward a sustainable transportation system, contributing to economic and community vitality while also improving safety, air quality and reliability.



NCHRP Report 350 was the standard for crash testing for 16 years, providing a wider range of test procedures and including a 3/4-ton pickup in place of the 4,500-pound passenger car.

NCHRP Report 350: Recommended Procedures for the Safety Performance Evaluation of Highway Features (1993)

This report, which updated its 1980 predecessor *NCHRP Report 230*, served as the full-scale crash-testing and evaluation standard from 1993 to 2009. The report responded to changes in the vehicle fleet, the emergence of new barrier designs, safety belt policies and laws, and advances in computer simulation and other evaluation methods. The publication accomplished its goal of effectively meeting the needs for national uniform safety performance evaluation procedures in the

21st century and was twice the size of its predecessor, providing a wider range of test procedures for a wider range of devices, and using a ¾-ton pickup in place of the 4,500-pound passenger car. ■

NCHRP Report 224: Guidelines for Recycling Pavement Materials (1980)

Directed at practicing highway engineers, this landmark publication is still considered the “bible of asphalt recycling,” encompassing all portions of the pavement maintenance cycle, beginning with early detection of pavement problems, establishing the cause(s) of the problems and presenting the most effective methods of rehabilitating pavement. These comprehensive guidelines also cover the full range of pavement recycling, including various recycling approaches and procedures, equipment needs, environmental effects, energy requirements, and the economic effects. ■



FOR MORE INFORMATION

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Warming Up to New Ideas: The Pros and Cons of Warm-Mix Asphalt

As states look for ways to reduce the costs of maintaining their transportation networks, innovative ways to perform maintenance activities are gaining ground. Using warm-mix asphalt (WMA) in lieu of its hotter alternative is one such innovation. Yet, nagging questions remain about WMA's durability.

The biggest concern is the amount of water left on the aggregate due to lower processing temperatures. Is the asphalt trapping excess water as it coats the aggregate? If so, what are the long-term effects?

"A number of surveys from our project as well as others indicate this is not a problem with warm mix," says Texas A&M Transportation Institute (TTI) Associate Research Engineer Amy Epps Martin, principal investigator on NCHRP 09-49: Performance of WMA Technologies. The project is assessing whether WMA technologies adversely affect the moisture susceptibility of flexible pavements, and is developing guidelines for identifying and limiting moisture susceptibility in WMA pavements.

To effectively reproduce field conditions in the lab for accurate testing, TTI closely examined specimens that were mixed and compacted in the lab, and compared those to specimens that were mixed at the plant and compacted in the lab, and then to field cores, which are plant mixed and field compacted.

"The compaction differs between the field and the lab," Epps Martin notes. "Conditioning and curing in the lab are key issues in proper testing of lab specimens. Properly simulating what's happening at the asphalt plant and on the road is critical."

Epps Martin says that this was one of the most complex asphalt research projects she has ever been involved with, requiring the help of departments of transportation in Iowa, Texas, Montana and New Mexico.

Researchers are also looking at what's called a time horizon. "Many people think there's a period in the early life of the pavement where warm mix hasn't caught up to hot mix. We have seen that, too. After about a year's time, warm mix seems to perform just as well as hot mix in terms of stiffness and moisture susceptibility," Epps Martin explains.

Testing is under way to determine whether current moisture susceptibility tests capture any differences between warm mix and hot mix. An example question is: does the addition of anti-stripping agents — which are additives like lime or liquid chemical packages — help alleviate any moisture sensitivity problems if there are any?

"So far, we've determined proper curing times and temperatures for WMA. For example, at the design stage, two hours at 240 degrees helps simulate what's going on in early life in the field," Epps Martin says. The final report will include guidelines for testing with additives or foaming technologies.

"The work that Dr. Epps Martin is performing through this project is critical to the implementation of WMA by state and local agencies," says Kim Willoughby, research manager for the Washington State Department of Transportation's Construction, Materials, Bridges and Maintenance Research Office. "Being able to answer the question of whether WMA is more susceptible to moisture than hot-mix asphalt will facilitate the acceptance of these technologies throughout the nation." ■

Additional Warm-Mix Projects: NCHRP 09-52, NCHRP 09-53

TTI-led research into warm-mix asphalt continues in two just-launched NCHRP projects: 09-52 (Short-Term Laboratory Conditioning of Asphalt Mixtures) and 09-53 (Properties of Foamed Asphalt for Warm Mix Asphalt Applications) under TTI Senior Research Scientist David Newcomb. NCHRP 09-52 seeks to develop lab procedures and criteria for improving lab simulations of real-world conditions for testing asphalt mixtures. NCHRP 09-53 looks specifically at key properties of foamed asphalt binders and seeks to develop lab protocols related to the foaming of asphalt binders and lab mixing processes. The *Texas Transportation Researcher* will feature findings from these projects in future issues.



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National Crash-Testing Standards:

TTI Makes a Big Impact with 18-Wheelers



An 18-wheeler crashes into a concrete barrier at TTI's Proving Grounds. For the first time, the test was streamed live via the Internet for clients across the country.

On Sept. 26, 2012, at the Texas A&M Transportation Institute's (TTI's) Riverside Campus crash facility, a fully loaded 18-wheeler traveling at 50 mph slammed into a concrete barrier placed on top of a retaining wall. The data from the unique crash test will prove vital for increasing safety and decreasing construction costs for this type of barrier application. The test was broadcast across the country via the Internet as a first-ever streaming event.

The mechanically stabilized earth (MSE) wall — where a truck barrier sits atop a retaining wall — is being used more often by state departments of transportation. TTI Research Engineer Roger Bligh and his team of researchers, including renowned geotechnical expert Jean-Louis Briaud, measured the impact of the collision on the barrier system and MSE wall as a key task on NCHRP 22-20(02): Design Guidelines for TL-3 through TL-5 Roadside Barrier Systems Placed on MSE Retaining Walls. Bligh, manager of TTI's Roadside Safety Program, and Briaud are co-principal investigators on the project.

Findings from this first-of-its-kind crash test will have major implications. "There is no information available that tells industry how to design the barrier foundation system and the retaining wall to accommodate an impact from a large commercial truck," Bligh notes.

According to Briaud, manager of TTI's Geotechnical and Geoenvironmental Program, retaining walls have become more popular due to space limitations in and around urban areas. "Those walls, and the concrete barriers on top of them, are necessary when there is no room for earthen slopes. But until now, researchers and construction companies could only guess the force that's applied to the wall from a fully loaded 18-wheeler." Briaud conducted computer simulations of crashes for months on the project.

"This was a crucial test for refining barrier design procedures and standards to ensure the safety of the traveling public."

Mark S. Bush, NCHRP senior program officer

Without guidelines to help determine the appropriate size and type of wall and barrier, road designers and construction firms were often overly conservative in their choices. Bligh says the data from the test will help take the guesswork out of the equation.

Peter Anderson, vice president for technical development of the Reinforced Earth Company (RECO), a design and supply firm considered a market leader in the MSE retaining wall industry, assisted with the project. Bligh says RECO's involvement in the test dramatically lowered project costs thanks to the donation of materials needed for the test installation.

Attending the crash test was Mark S. Bush, NCHRP senior program officer overseeing the research project. Bush says numerous steps have to be taken before new guidelines for this application will be adopted.

"Now that this critical crash test has been conducted, TTI will complete the analyses and finish a detailed final report to be reviewed by an expert NCHRP panel for publication and committees from the American Association of State Highway and Transportation Officials for adoption," Bush says. "This was a crucial test for refining barrier design procedures and standards to ensure the safety of the traveling public." ■



FOR MORE INFORMATION

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Demanding a Recount on Motorcycle Crashes



Are we counting motorcycles accurately?

Statistics from 2000 and 2008 indicate that motorcycle fatalities increased by 83 percent. During the same time period, the vehicle miles traveled (VMT) by motorcycles increased by only 38 percent. Is this a deadly trend, or are the VMT numbers valid?

“The numbers we’re counting don’t reflect the rise in crashes, injuries and fatalities,” notes Texas A&M Transportation Institute (TTI) Research Engineer Dan Middleton. “Are we counting motorcycles well enough? The answer is no.”

NCHRP Project 08-81, Improving the Quality of Motorcycle Travel Data Collection, tasked Middleton with reviewing current traffic detection methods, investigating new technologies and reporting on which count motorcycles the best.

“Motorcycle fatalities are increasing on our roadways, but data haven’t shown much change in VMT for several years,” explains Christopher Hedges, NCHRP senior program officer. “That gives us a perception — one that is quite likely erroneous — that higher fatalities are resulting from some characteristics of the rider, the road or the motorcycle itself.”

Current detection technologies are divided into two categories: intrusive and non-intrusive. Intrusive detectors, like

piezoelectric cables, require some modification of the pavement. Non-intrusive detectors, like passive infrared systems, are mounted above or beside the roadway.

Which ones work best? According to Middleton, piezoelectric cables work fine (particularly when brand new), but they require lane closures for installation and maintenance. Also, many agencies install sensors covering only half the lane width, allowing motorcycles to be missed. Preliminary results from recent tests on passive infrared systems in Florida indicate that infrared sensors distinguish motorcycles from cars and count the former correctly.

The methodology used to count motorcycles is also at issue. For example, consider the two distinct rider groups: commuters and recreational riders. Each group has a distinct riding pattern. Count locations for recreational riders are probably different from those for commuters.

“If you want to get a representative sample, you can’t just count urban areas. Commuters ride on weekdays, but recreational riders ride on weekends and holidays, and often on back roads,” Middleton says.

Middleton is using motorcycle crash reports to determine whether crash loca-

tions are good identifiers of count sites. Preliminary evidence from two states indicates that this method will work.

“Crashes happen where motorcycles travel. We used data to create a map that shows both motorcycle crash locations and motorcycle counts along all roadways. We haven’t found anything else that predicts where to count in these rural areas,” Middleton says.

The project couldn’t have come at a better time since states are now required to report motorcycle travel to the federal Highway Performance Monitoring System.

“Until we have a good understanding of true motorcycle volumes, we won’t have a good measure of exposure rates — the number of crashes and fatalities as a factor of actual motorcycle miles traveled,” Hedges says. “Without that kind of knowledge, it’s impossible to develop safety programs that address real needs and the right risk factors. This project has the potential to make a real difference in our understanding of motorcycle safety.” ■



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Should We Move More Cargo via America's Marine Highways?

NCFRP 17

Moving freight along waterways is nothing new in the United States. In fact, historically speaking, waterways were more important to U.S. commerce than any other mode until the advent of railroads. With highways more congested than ever and safety and environmental concerns associated with moving hazardous materials via rail, some are seeing America's waterways as an attractive, alternative mode.

To evaluate their potential as a substitute for road and rail, the U.S. Maritime Administration has launched the North American Marine Highways (NAMH) Initiative. Despite situations that would seem to favor short-sea shipping and the development of marine highways, the freight community has not embraced the idea of moving a larger share of its cargo over water. Jim Kruse, director of the Texas A&M Transportation Institute's Center for Ports and Waterways, recently co-authored a white paper examining the whys and wherefores of moving freight via marine highways.

"In this report, we examined both successful and unsuccessful shipping ventures, shipper requirements, vessel considerations, legislation and obstacles impacting NAMH," says Kruse.

The white paper, *NCFRP 17: North American Marine Highways (Report 5)*, results from an extensive literature review and interviews with a diverse group of stakeholders, and examines the many facets that go into the planning and operation of current and future marine highway services. Kruse concludes that numerous obstacles stand in the way of marine transport start-up businesses, including:

- lack of statistical data regarding trade flows,
- lack of equipment that qualifies under current statutes and regulations,
- shippers unfamiliar with the process or the benefits, and
- flow-imbalance issues (significant volume of cargo differences moving in both directions).



Moving freight via U.S. waterways is being reevaluated as a cost-effective alternative to congested roadways.

Kruse's findings make it clear that in most instances marine highway shippers and operators are not currently cost competitive with existing alternatives. "There will be no major development of a marine highway system until the overall framework changes," Kruse states.

In his foreword to the report, Transportation Research Board Staff

Officer William Rogers says it will help stakeholders better understand how use of today's marine highway system could be improved. "The report is especially valuable for its assessment of the conditions of feasibility; its analysis of the economic,

technical, regulatory, and logistical barriers inhibiting greater use of the marine highway system; and proposed solutions for barrier elimination," writes Rogers.

In a second phase of the project, Kruse explored the possibility of transporting heavy and hazardous shipments over water — specifically chlorine and anhydrous ammonia, classified as toxic inhalation hazard (TIH) materials. *NCFRP 17: Marine Highway Transport of Toxic Inhalation Materials (Report 18)* examined

chlorine and ammonia because of their widespread use — ammonia, in the agricultural industry, and chlorine, in 45 percent of all commercial products. The study sought to develop a business case for transporting a larger share of these materials via waterways. The findings weren't encouraging.

"Unless there are major market or regulatory shifts, we do not anticipate a diversion of TIH materials from rail to marine highway transport," Kruse concludes. He says the biggest obstacles to marine transport are that the TIH market is not growing and users of the materials are so geographically dispersed, making it difficult to achieve economical load quantities. ■



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TTI Supports Texas Policy Makers

Basing Informed Decisions on Reliable Research

Public policy serves the greatest good when based on objective information. Texas A&M Transportation Institute (TTI) research supports the legislative process by providing science-based findings to facilitate informed decisions and actions.

Panama Canal Expansion

The expansion of the Panama Canal promises implications for global shipping patterns, including those influencing Texas ports. By any measure, those ports are critically important to the Texas economy, accounting for nearly 1.4 million jobs and more than \$82 billion in personal income each year. The Texas Department of Transportation (TxDOT) formed the Panama Canal Working Group in 2012 and sponsored a research study conducted by TTI to assess opportunities associated with the canal expansion, particularly the potential impacts on ports and landside infrastructure, including roadways, railroads and intermodal facilities. TTI examined previous studies on the canal expansion and heard from shippers, ports, carriers, industry groups and other stakeholders at a series of meetings. The overarching finding from the study is that the Panama Canal expansion — coupled with continued population growth in Texas, energy-sector developments and the emergence of new trading partners throughout the world — represents opportunities to expand Texas' position as a global gateway for the nation. By providing a low-cost, reliable, safe, secure, multimodal and environmentally sustainable supply chain, the state can increase its global trade, create new jobs, and expand the state and national economies. ■



Rapid growth in the energy industry creates both pros and cons for the state.

Impact of the Energy Sector on Roadways

It's hard to overstate the energy sector's impact in Texas. The industry directly employs nearly 225,000 Texans in oil and gas exploration and production, accounting for almost 13 percent of all new jobs added in the state over the past year. The rapid growth of wind-power generation has further bolstered the energy sector's contributions. But impacts can also be negative. Countless trucks carrying construction materials, heavy equipment, fracking water, petroleum products and other supplies strain roadways literally to the breaking point, necessitating extensive and expensive pavement repairs. Many truckloads are overweight, further exacerbating the problem. TTI researchers have worked with TxDOT to measure and project the impact of this wear and tear, which TxDOT estimates at roughly \$2 billion per year for state and county road systems. TTI recommendations included donation agreements with energy companies, procedural changes related to early notification of development activity, and better coordination of road maintenance and repair. ■



Officials are positioning Texas to capitalize on the Panama Canal expansion.



Travelers, shippers and businesses are the focus of My 35 communication efforts.

Mobility Investment Priorities

Traffic congestion in Texas is choking our highways and economy. In our most congested cities, lost time and wasted fuel now cost us nearly \$10 billion a year. However, this is not just a big-city issue. Stop-and-go traffic that slows down freight in our major cities will make small-town Texans pay more for groceries, clothes and countless other goods. Recognizing the growing urgency of this problem, the Texas Legislature set aside \$300 million to get the state's highest-priority roadway projects moving. TTI was assigned to help TxDOT and local agencies advance those projects with the most potential to improve mobility and strengthen local economies in the most congested regions of the state, as well as to help identify the most publicly acceptable options to pay for those projects. The Lone Star State's population is growing, while transportation revenues are shrinking. TTI's Mobility Investment Priorities project is assisting state leaders in closing that gap. ■

My 35 Expansion Project

In one of the most ambitious roadway improvement projects in the state's history, TxDOT is expanding a 96-mile section of I-35 in Central Texas from four to six lanes. The effort is designed to alleviate traffic congestion that wastes both fuel and time for motorists, businesses and shippers. In addition, the expansion will help accommodate future increases in population, traffic volume and commercial activity as Texas continues to grow at a rapid pace. The collection of 17 separate but integrated construction projects will require \$2.5 billion and five more years to complete. The massive effort also requires getting information — lots of information — to drivers and shippers planning trips and navigating lane closures and work zones characteristic of roadway expansions. To that end, TTI is providing TxDOT with a first-of-its-kind traveler information system that integrates three methods for capturing traffic data and forecasts congestion to provide that information to anyone who needs it. ■

For every dollar spent on transportation, the state realizes at least \$6 in economic benefits.

Measuring the “Cost of Doing Nothing”

As Texas grows, demand for roadway space grows with it — even as available revenue and funding options become more limited. The cost of meeting future mobility needs is substantial, but the consequences of doing nothing to meet them are even greater. TTI calculated that expense in a number of ways, illustrating what life would be like in a state without transportation investment:

- Over the next 15 years, congestion would cost the state an average of \$20 billion each year.
- Over the same time period, the delays experienced by commuters would double from 37 hours to 74 hours each year.
- The additional 37 hours of delay would cost each household another \$800 annually, increasing with each passing year.

Conversely, for every dollar spent on transportation, the state realizes at least \$6 in economic benefits. ■



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Efficient border crossings are essential to the El Paso region's economic prosperity.

Border Security and Mobility

For border-crossing users, time delays are inconvenient and costly. More accurate border wait times can help users plan additional travel times or adopt alternatives to reduce delays. Using radio frequency identification tags, researchers at TTI's Center for International Intelligent Transportation Research in El Paso developed a website that combines delay performance measures with economic factors. Combining this information allows users to determine departure time and port-of-entry selection to help reduce delay costs. The website's information also benefits policy makers by providing a way to track and analyze trends associated with delay costs at ports of entry. ■

Toward a National Freight Data Architecture

TTI Researches the First Steps

Freight transportation is a powerful cog in our nation's economic engine. Given the critical role that freight transportation — cargo moved by air, rail, truck, water and pipeline — plays in the nation's prosperity, freight movement disruptions can have severe economic and national security ramifications. Although much information exists on all aspects of freight movement and their intricacies, a comprehensive catalog of freight-related data sources does not exist.

“Freight transportation is a huge enterprise, and we don't really have a clear, comprehensive picture of freight movements in this country,” says Cesar Quiroga, manager of the Texas A&M Transportation Institute's (TTI's) San Antonio Office. “Integrating all of that comprehensive data is vital for transportation planners and decision makers. Looking into what's needed in order to develop a national freight data architecture was the basis of our two-year project.”

NCFRP Project 12: Guidance for Developing a Freight Transportation Data Architecture identified numerous benefits that could result from such an architecture. For example, coordinated data sharing would aid overlapping government jurisdictions by offering information about how freight activities might affect them as they initiate new transportation improvement projects. An integrated freight data architecture would also provide a better understanding of supply chains and business processes while potentially eliminating freight data redundancies and inefficiencies.

“It's important to note that we weren't attempting to develop the freight data architecture,” Quiroga says. “Our goal in this project was to develop the framework, requirements and specifications for the architecture.”

Quiroga and his team conducted surveys of planners, analysts, shippers and motor carriers to better understand their needs and how they use current data. Borrowing elements from other data architecture initiatives, the team defined a national freight data architecture as “the manner in which data elements are organized and integrated for freight-transportation-related applications or business processes. The data architecture includes the necessary set of tools that describe the related functions or roles, components where those roles reside or apply, and data flows and components at different domain and aggregation levels.”

Part of the research effort was to identify challenges that could hinder the implementation of a freight data architecture at the national level. For example, some freight stakeholders, particularly in the private sector, may be reluctant to share data with their government counterparts. Likewise, some data might be available from data aggregators, but accessing this information could be very expensive. Along with identifying challenges, the team developed a catalog of strategies and recommendations for dealing with those challenges.

“Building a comprehensive data architecture from the outset would be extremely difficult,” Quiroga explains. “That's why we recommended starting with just one element of freight transportation, like commodity flows, and then building up the architecture using strategic stepping stones.”

According to Transportation Research Board Senior Program Officer Bill Rogers, funding has been approved for a new project tentatively entitled Implementing the Freight Transportation Data Architecture: Data Element Dictionary, which will create and define a catalog of current freight data elements currently being collected. The dictionary will provide managers of data programs with an invaluable reference for identifying differences among variables and building bridges among data sets.

“The work that TTI did on this project was vital in articulating the value of establishing an architecture for linking data across transport modes, subjects and levels of geography to obtain essential information for transportation decision making,” Rogers says. ■



The efficient interdependency of moving freight by truck, rail and sea is more important than ever. Facilities like the Port of Tacoma in Tacoma, Wash., play a vital role in ensuring the nation's economic prosperity.



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TTI's Current Work with the SHRP 2 Program

The Texas A&M Transportation Institute (TTI) has been an integral part of the Strategic Highway Research Program 2 (SHRP 2) applied research team, addressing some of the nation's most important needs for our transportation system concerning safety, renewal, reliability and capacity. In addition to the two projects profiled in more detail in this issue, TTI is currently conducting research in the following areas.

SHRP 2 C03: Interactions between Transportation Capacity, Economic Systems and Land Use Merged with Integrating Economic Considerations Project Development

Transportation planners can use a high-level case-based impact tool developed in this research to gain insight into the potential economic impacts of a transportation project. TTI provided background work supporting the framework aspects and metrics to be considered in the project.

SHRP 2 C11: Development of Improved Economic Analysis Tools Based on Recommendations from Project SHRP 2 C03

TTI helped develop tools to determine the value of access to markets. This information — including where changes in access can be expected and if that access can contribute to economic potential — can help inform decisions about transportation investments and strategies.

SHRP 2 L03: Analytic Procedures for Determining the Impacts of Reliability Mitigation Strategies

By defining *reliability*, this project explains the importance of travel-time distributions for measuring reliability and recommends specific performance measures for reliability. The project also examined the various causes of nonrecurring congestion and identified actions to reduce it.

SHRP 2 L05: Incorporating Reliability Performance Measures into Transportation Planning

This project developed the means — including technical procedures — for state departments of transportation and metropolitan planning organizations to fully integrate mobility and reliability performance measures and strategies into planning and programming processes. This will allow operational improvements of all types, including for capital projects and other expenditures, to be considered in planning and programming, along with more traditional types of project investments.

SHRP 2 L14: Effectiveness of Different Approaches to Disseminating Traveler Information on Travel Time Reliability

Researchers developed a guide to provide information about travel-time reliability most useful to travelers in ways appropriate to the specific technology platform and communication channel used. A secondary goal involved improving transportation system reliability.

SHRP 2 L08: Incorporation of Travel Time Reliability

This effort examined how information on the impacts of causes of nonrecurrent congestion (incidents, weather, work zones, special events, etc.) can be incorporated into the *Highway Capacity Manual* (HCM). The methodologies contained in the HCM for predicting delay, speed, queuing and other performance measures are not currently

sensitive to traffic management techniques and other operation/design measures for reducing nonrecurrent congestion.

SHRP 2 R06: Plan for Developing High-Speed, Nondestructive Testing Procedures for Both Design Evaluation and Construction Inspection

This project generated plans to develop high-speed, nondestructive testing procedures for design evaluation and construction inspection of highway renewal projects. The research emphasized *in situ* testing, technologies and techniques that provide nearly complete coverage of infrastructure in real time or at least within 48 hours.

SHRP 2 R06(G): High Speed Nondestructive Testing

The research team identified nondestructive technologies for evaluating the condition (e.g., moisture, voids and corrosion) of various types of tunnel linings and their finishes, such as tile. Researchers evaluated identified technologies' applicability, accuracy, precision, repeatability, ease of use, capacity to minimize disruption to vehicular traffic, and implementation and production costs. Researchers also recommended test procedures and protocols for successful implementation.

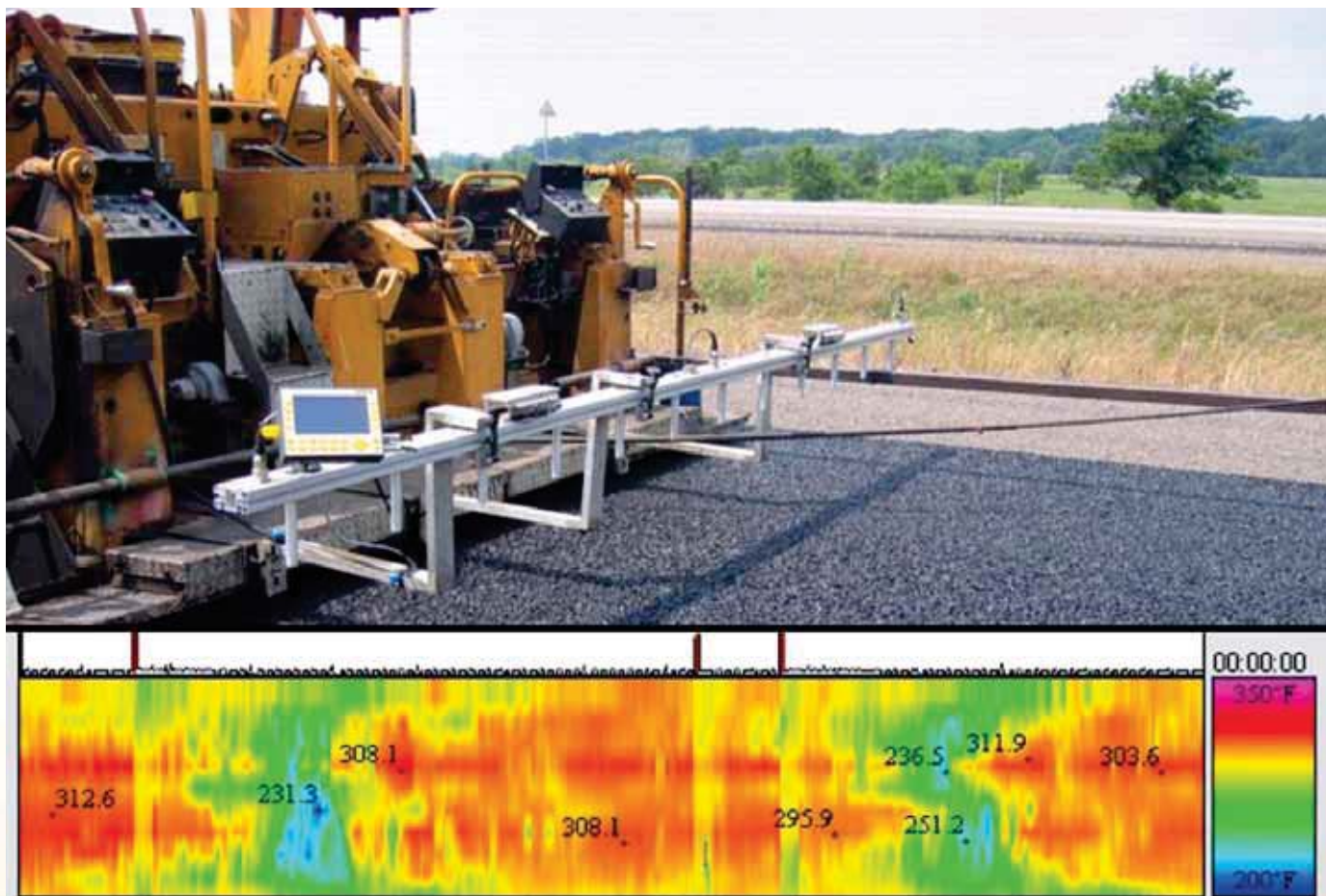
SHRP 2 R07: Performance Specifications for Rapid Renewal

Researchers developed a procedure for determining whether performance-based or methodology-based specifications should be used in specific circumstances for highway renewal. ■



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TTI Turns Up the Heat on Asphalt Cold Spots



A PAVE-IR system installed on the back of an asphalt laydown machine. Over 40 of these systems are now in use in the United States. The colors in the graph illustrate the temperature variations in the asphalt mat.

“The use of both technologies will really improve the quality of hot-mix asphalt pavements. Improving quality control during construction and fixing problems on the spot will save money because contractors won’t have to come back and replace trouble spots later.”

Monica A. Starnes, SHRP 2 senior program officer

One objective of SHRP 2 is to develop technologies that result in long-lasting transportation facilities. Researchers at the Texas A&M Transportation Institute (TTI) did just that.

Initial work on the new technology developed by TTI began nearly 10 years ago. A serious problem identified with black-top roads was cold spots forming in asphalt mats during the laydown process.

“We design these pavements for all these stresses and strains, but that’s not how they’re failing. They’re failing because of defects that are built in on day one during construction,” says TTI Senior Research Engineer Tom Scullion,

who manages TTI’s Flexible Pavement Program. Scullion says it’s the area beneath the pavement where problems develop first. “It may take 2 years; it may take 10 years. But moisture gets into those areas, sits there, and then the stones start to ravel out and it’s a failure.”

Researchers call it *thermal segregation*, which is a large problem nationally. “The story we get from the contractors is ‘We know it’s a problem. Give us a tool we can use,’” Scullion explains.

The TTI research team's first goal was to measure the temperature of the mat the moment it's laid down. The result was the PAVE-IR bar. PAVE-IR includes an array of sensors mounted on the back of a laydown machine that allows contractors to detect temperature problems in real time and make adjustments.

"Normally, [the problem is] what's called truck end segregation . . . cold spots in the mat, usually at the end of every truckload. Essentially, you see [them] every 150 feet as you go down the road. These things are about 5 to 6 feet across. Once you're tuned in, you can see these everywhere," Scullion says.

Compacting a mat with cold spots is also hit or miss. "What we find is that some of the mixes we place are a lot more forgiving," observes Scullion. "They will stand that temperature variation and still compact reasonably. Other ones are completely non-forgiving. If it goes down cold, there's no way you can compact it."

PAVE-IR provides 100 percent coverage of mat temperature issues prior to rolling. The best way to get similar coverage and to detect low-density areas is with ground-penetrating radar (GPR). The TTI team is now focusing their efforts on developing a GPR-based density-measuring system, which can, in real time, provide close to 100 percent coverage of new mats. The challenge is to develop a GPR system that is small enough and tough enough to take the daily abuse of construction.

"What we're busy putting together right now is a three-antenna system, which can go on the back of a pickup truck. These are very small antennas, about the size of a cigar box. You'll drive over the section immediately after it's been rolled, and they'll tell you in real time if you have any low-density areas," Scullion said. A private-sector company helped develop the PAVE-IR system. That successful model is being used to develop the GPR system.

Monica A. Starnes, SHRP 2 senior program officer, is enthusiastic about the technologies. "The use of both technologies will really improve the quality of hot-mix asphalt pavements," she explains. "Improving quality control during construction and fixing problems on the spot will save money because contractors won't have to come back and replace trouble spots later."

Numerous states, including Texas, Florida and Pennsylvania, have volunteered to work with researchers during the field testing, which is scheduled to begin in spring 2013. Implementation is sure to follow.

Is this just the beginning for exciting new technologies in road building? Tom Scullion thinks so. "Some technologies don't work; others work very well. Over the years, it's been really encouraging and gratifying to see some of these new technologies coming along. Hopefully we can keep on [developing] products like this," he says.

Starnes adds, "I was in a recent meeting with our technical coordinating committee. At that meeting, Tom Baker, Washington State Department of Transportation materials engineer, mentioned that over 40 PAVE-IR units were already in use around the country. It's one of those technologies that is so ready for full deployment and implementation." ■



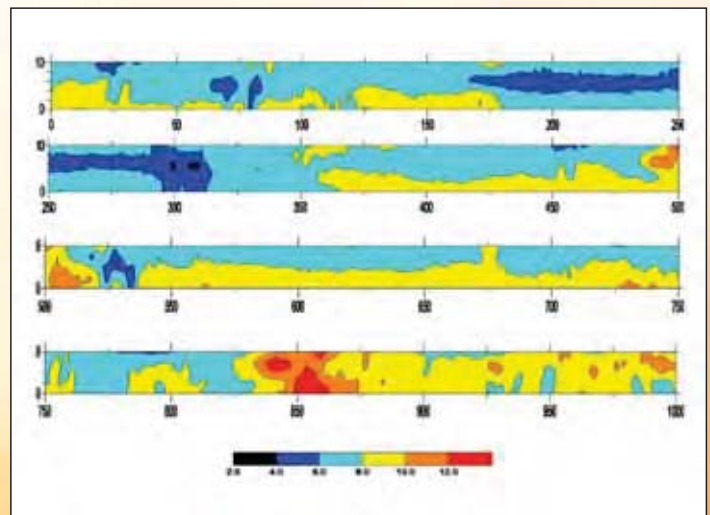
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"We design these pavements for all these stresses and strains, but that's not how they're failing. They're failing because of defects that are built in on day one during construction. It may take 2 years; it may take 10 years. But moisture gets into those areas, sits there, and then the stones start to ravel out and it's a failure."

Tom Scullion, TTI senior research engineer



A working prototype of a three-horn 2.6-GHz GPR system designed to be mounted on pickups and vans. This system was tested in November 2012.



This plan profile view of expected air-void distribution shows a 1,000-foot road section where the GPR was calibrated to hot-mix asphalt core air-void content.

Best Practices in Utility Conflict Management



Knowing how utilities will impact a project early in the planning phase can save time and resources during the construction phase.

“For a transportation project, utilities are often an afterthought. If there isn’t a good process in place to deal with them early, then there could be a delay in the design or construction, added cost to the public, and possible unexpected outages.”

Edgar Kraus, TTI Associate Research Engineer

Good planning and attention to detail allow departments of transportation (DOTs) to predict the time and resources needed to complete a transportation project. But no matter what the size and scope, from relatively small (such as a new sidewalk) to large (adding lanes on a highway), almost every project encounters a conflict with existing utilities — telecommunication networks, gas lines and water pipes, etc. The Texas A&M Transportation Institute (TTI) recently completed SHRP 2 R15B: Identification of Utility Conflicts and Solutions, which examined best practices from around the country and developed tools for effectively managing and resolving these conflicts.

Frequently, conflicts result from inaccurate, incomplete information about existing utilities. In other cases, it’s due to ineffective coordination between a DOT and a utility company, or a lack of understanding of each other’s processes. “For a transportation project, utilities are often an afterthought. If there isn’t a good process in place to deal with them early, then there could be a delay in the design or construction, added cost to the public, and possible unexpected outages,” says TTI Associate Research Engineer Edgar Kraus.

Utility relocations are common when a conflict exists with a feature or phase of a transportation project. If not managed properly, utility relocations can be expensive, with taxpayers or ratepayers absorbing the costs. If the conflict is identified early in the development process, other strategies, such as redesigning or realigning the transportation project, are possible. While many states have an approach to utility conflict management, little research has been done to test and refine possible methods.

Led by TTI Senior Research Engineer Cesar Quiroga, manager of TTI’s San Antonio Office, researchers found that practices involving the use of utility conflict matrices vary widely across the country. Utility conflict matrices enable users to organize, track and manage utility conflicts. The team combined identified best practices into a model utility conflict matrix product. This tool helps

a DOT define what actions to take and when to take them in the project development and delivery process to avoid a utility conflict. This flexible database approach can be used to fit individual state DOT needs.

“For a DOT, the tool gives utility coordinators a better handle on how to manage utility conflicts effectively. For utility stakeholders, including utility companies, it shows them other options besides having to move a utility,” says Quiroga.

Along with the utility conflict matrix, the team developed a training seminar that covers utility conflict concepts and management. The implementation guidelines address topics such as audience for the products, research product leaders, activities necessary for successful implementation, and criteria for judging the progress of implementation. Researchers also identified and addressed potential roadblocks to implementation of the tool.

“There is a significant need for improvement and optimization of utility processes around the country,” says Kraus. “Our matrix focuses on the keys to avoiding and resolving utility conflicts — communication, coordination and cooperation.” ■



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Lady Bird Johnson, Benjamin Allin III Join the Texas Transportation Hall of Honor

Lady Bird Johnson

Lady Bird Johnson, former first lady of the United States and highway beautification advocate, was inducted into the Texas Transportation Hall of Honor at a reception and ceremony in Austin, Texas, Oct. 17. The event was co-sponsored by the Lady Bird Johnson Wildflower Center at The University of Texas at Austin and the Texas A&M Transportation Institute (TTI).

“Lady Bird Johnson’s commitment to roadside beautification affects the lives of our citizens every day,” said Dennis Christiansen, TTI agency director. “Her enormous contributions have made Texas roadsides the envy of the nation.”

Johnson made improving the aesthetic appeal of U.S. highways her major initiative by promoting the Highway Beautification Act of 1965, nicknamed “Lady Bird’s Bill,” which introduced landscaping roadsides, limiting billboards and cleaning up junk yards near highways.

For 20 years, Johnson gave monetary awards to Texas Department of Transportation (TxDOT) districts that used native Texas plants to the fullest measure possible. She hosted the annual Texas Highways Beautification Awards ceremonies, presenting personal checks to award winners and treating them to a barbecue lunch. Five of the former award winners, all still TxDOT maintenance division employees today, were able to participate in the Oct. 17 ceremony.

Johnson’s focus on the advantages and beauty of native plants led her to create the National Wildflower Research Center in 1982, renamed the Lady Bird Johnson Wildflower Center in honor of her 85th birthday in 1997. She would have turned 100 years old this year.

“You look at the kids who stop to have their picture made in the wildflowers on the highways every spring, and they think the Indian paintbrushes and bluebonnets have always been there — that is how Texas has always looked to them,” said Phil Wilson, TxDOT executive director. “This is a legacy event and a great honor to recognize the teamwork and effort that Mrs. Johnson has put into place.” ■



Left to right: Glenn Biggs, family friend and member of the Lady Bird Johnson Awards Selection Committee; Susan Rieff, executive director of the Lady Bird Johnson Wildflower Center; Ellen Temple, family friend and member of the Lady Bird Johnson Awards Selection Committee; Luci Johnson, daughter of the former first lady; Neal Spelce, family friend and spokesperson; Dennis Christiansen, TTI agency director; and Phil Wilson, executive director of TxDOT.



Left to right: Allin grandchildren: Robert N. Blanchard, Patricia Zaske, Arthur A. “Sandy” Blanchard, Judith Allin, Elisabeth Shawl and Benjamin C. Allin.

Benjamin Casey Allin III

Benjamin Casey Allin III, the first general manager of the Port of Houston Authority, was inducted into the Texas Transportation Hall of Honor Sept. 12. All six of his grandchildren were present to accept the honor on his behalf at a luncheon in Houston co-sponsored by TTI and the Houston East End Chamber of Commerce.

During his 12 years as general manager (1919–1931), Houston’s Port Authority was transformed into the most efficient port in the country. Exports grew by 1,000 percent, and the port itself grew to become the sixth largest in the nation.

Former port Executive Director Tom Kornegay noted that Allin was an engineer who set out to design a port that could rapidly and efficiently load and reload ships, as well as provide vital access to an efficient rail system for moving goods inland. “This is a man who achieved more in just 12 years than most of us achieve in a lifetime,” said Kornegay. ■

TTI established the Texas Transportation Hall of Honor in 2000 to recognize visionaries who played pivotal roles in the advancement of transportation in Texas and the nation. Each inductee is recognized by a plaque on permanent display in the hall, which is located at TTI on the campus of Texas A&M University.

Christine Yager Presents at Human Factors Annual Meeting



Yager

TTI Associate Transportation Researcher Christine Yager gave a presentation, "The Effects of Reading and Writing Text-Based Messages While Driving," at the

56th Annual Meeting of the Human Factors and Ergonomics Society held Oct. 22–26. More than 1,450 participants from the United States and the world attended. TTI Senior Research Scientist Melissa Walden also attended the meeting.

Yager presented the results of a project that assessed the distraction potential of reading and writing text-based messages while driving under varying roadway and texting response demands. She says the biggest surprise of the research results was that the response times were even slower than expected compared to previous driving simulator research. "With the driving simulator, response times were 1–2 seconds, whereas our test track test bed showed an increased response time of 3–4 seconds," says Yager. ■

California High School Students Join Teens in the Driver Seat

In the first public event announcing the TTI-developed Teens in the Driver Seat (TDS) program in California, Franklin High School students in Elk Grove conducted a news conference for Sacramento-area media Sept. 19. The students outlined their efforts in combating teen car crashes, the No. 1 killer of teens across the country. In California, teen drivers were responsible for 1,744 fatal crashes between 2006 and 2010.

"The peer-to-peer approach of TDS has been very successful in Texas, and we think the program will be a big complement to our efforts in reducing teen crashes here in California," says Jill Cooper of the Safe Transportation Research and Education Center at the University of California–Berkeley.



Franklin High School student Marsela Young conducts a news conference about Teens in the Drivers Seat at her California school.

In addition to California, TDS is in high schools in Georgia, North Carolina and Montana. In Texas, where the program began, more than 500 schools have taken part in the peer-to-peer program. "With the success of TDS in Texas, we are happy to see the program expanding into other states," Russell Henk, TDS creator and TTI senior research engineer, says. "We are glad to be a partner in California's effort in reducing teen crashes." ■

For more information about these news items or other media inquiries regarding TTI research, please contact Rick Davenport at (979) 862-3763 or r-davenport@tamu.edu.

LSU and UNO Join the Southwest Region University Transportation Center

The Southwest Region University Transportation Center (SWUTC) — a consortium of five schools with transportation research and education programs founded in 1988 and headquartered at TTI — has recently added two universities to its roster.

"Louisiana State University [LSU] and the University of New Orleans [UNO] became a part of the SWUTC this year, bringing to the consortium their national leadership in hurricane traffic analysis, evacuation strategies and modeling," says Dock Burke, the SWUTC director and TTI research economist. "LSU and UNO offer high-quality resources in terms of their faculty, students and ongoing programs. We believe the entire Gulf Coast will benefit from this new alliance."

The SWUTC is a part of a national effort to foster university-based, long-term research and education initiatives. Its major goal of attracting and developing students to become first-rate transportation professionals and industry leaders sets it apart from other transportation research programs. As part of this year's grant funding from the U.S. Department of Transportation, the SWUTC will focus on projects that improve our quality of life through research. ■

John Maddox Joins TTI/UMTRI



Maddox

John Maddox has joined the University of Michigan Transportation Institute (UMTRI) and TTI as the director of collaborative program strategies. Maddox was formerly the associate administrator of vehicle safety research at the National Highway Traffic Safety Administration.

Maddox is based out of UMTRI's headquarters in Ann Arbor, Mich. His responsibilities include identifying areas where the two research organizations can effectively collaborate.

"TTI is the preeminent research organization when it comes to the roadway infrastructure side of transportation safety. Equivalently, UMTRI is the preeminent research organization for the vehicle side of that equation," says Maddox. "As technology in the automobile industry progresses, it is important to connect vehicles to infrastructure in a way that benefits safety, mobility and the environment."

According to Maddox, TTI is contributing to the automated and connected vehicle research work being conducted by UMTRI for the U.S. Department of Transportation. This 30-month safety pilot project will establish a real-world, multimodal test site in Ann Arbor for enabling wireless communications among vehicles and roadside equipment for use in generating data to enable safety applications. Passenger cars, commercial trucks and transit buses equipped with a mix of integrated, retrofit and aftermarket vehicle-to-vehicle and vehicle-to-infrastructure based safety systems will be studied. ■



TxDOT's Renewed Focus on Safety Emphasized at 86th Annual Short Course

Change was the dominant theme for the 86th Annual Short Course, which took place at Texas A&M University Oct. 16–17. The Texas Department of Transportation (TxDOT) event is hosted by TTI each year. Approximately 2,000 people attended the 2012 Short Course, which provides TxDOT and universities a forum for sharing research findings from the past year.

Presiding over the event, TxDOT Executive Director Phil Wilson talked about the department's numerous changes over the past year, which include his leadership approach, a restructuring of the organization, a modernization and streamlining effort, and a renewed emphasis on making the Texas transportation system safer for Texans.

"There's been a lot of change and a lot of new talent to complement what we've been doing," Wilson told members attending the Short Course luncheon. "I think it makes us a smarter, better and stronger agency going forward." He said the new team comes with new blood, a new vision, new ideas, better business practices and new ways to do things.

In addition to the various sessions that focus on different aspects of transportation, Short Course serves as a platform for the popular Extra Mile Awards, which recognize employees who helped save lives over the last year.

TTI Agency Director Dennis Christiansen, who spoke at the opening session, was quick to point out that TxDOT has a history of continuous improvement via change. "In 1927 [when the first Short Course was held], Texas had all of 1.4 million registered vehicles, compared to over 22 million today. The population of our state was 5.2 million," he said, noting that the population is five times that today. "You have always been a leader in how you provide the best transportation system in the world," he told the TxDOT personnel in attendance. ■



TxDOT Executive Director Phil Wilson.

Hawkins Honored with Educator Award



Dr. Gene Hawkins, associate professor in Texas A&M's Zachry Department of Civil Engineering, is the recipient of a prestigious educator award from the

Institute of Transportation Engineers (ITE). Hawkins, who is also a TTI research engineer, received the 2012 Wilbur S. Smith Distinguished Transportation Educator Award this summer at the ITE Annual Meeting in Atlanta, Ga.

ITE recognizes a transportation educator annually with the Wilbur S. Smith Award for his or her outstanding contributions to the transportation profession by relating academic studies to the actual practice of transportation. The award recognized Hawkins for his commitment to the professional development of his students.

During his three decades as an educator, Hawkins has been the Texas A&M ITE student chapter advisor from 2007 to 2010. Texas A&M ITE was awarded best chapter in the Texas District in 2008 and 2010, and the Texas A&M team won the inaugural ITE Traffic Bowl in 2010. ■

University Student Groups Start Peer-Based Driving Program

Based on TTI's Teens in the Driver Seat program, Texas A&M University–San Antonio (TAMU-SA) and the University of the Incarnate Word (UIW) have started the U in the Driver Seat (UDS) program, a new peer-based program that organizers hope will help reduce impaired driving among Texas college students. Car crashes are the No. 1 killer of Americans under the age of 25, and alcohol use stands out as a common contributor. In Texas alone in 2011, drivers under the age of 25 were responsible for 21 percent of all alcohol-related fatal crashes — the highest percentage of any age group.

"The STARS [Students Teaching and Advocating for Responsible Self-Growth] Peer Educators and other campus student leaders decided that [UDS] would become a key focus for our health education program at the University of the Incarnate Word," says Samantha Buentello, one of the program leaders.

TTI developed UDS and provides the science, materials and support for the program, while each student group determines how the program will work in its school. Funding is provided by the National Highway Traffic Safety Administration.



A few of the members of the UDS leadership team from TAMU-SA and UIW.

"We are proud to join with [TTI] and the University of the Incarnate Word on such an important program to raise awareness of safe driving for students of all ages," said Dr. Maria Hernandez Ferrier, president of TAMU-SA. ■

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VIDEO SUMMARY REPORTS

Video summary reports are available on the Texas Department of Transportation's Research and Technology Implementation Office's YouTube channel at [YouTube /user/bestpracticevrs/](https://www.youtube.com/user/bestpracticevrs/).

Developing a Testing Device for Total Pavements Acceptance, **0-6005**.

Development of Very Thin Overlay Systems, **0-5598**.

Evaluation of Modern Traffic Control Devices to Improve Safety at Rural Intersections, **0-6462**.

FDR (Full-Depth-Reclamation) Performance Based Design, Construction, and Quality Control, **0-6271**.

Performance Evaluation and Mix Design for High RAP Mixtures, **0-6092**.

TECHNICAL REPORTS

Alternative Methods of Flexible Base Compaction Acceptance, by Stephen Sebesta, **0-6587-1**, June 4, 2012.

Best Practice for Using RAS in HMA, by Fujie Zhou, **0-6614-1**, April 30, 2012.

Comprehensive Evaluation of Compaction of Asphalt Pavements and Development of Compaction Monitoring, by Emad Kassem, **0-6992-2**, April 19, 2012.

Continuous Prestressed Concrete Girder Bridges, Volume 1: Literature Review and Preliminary Designs, by Mary Beth Hueste, **0-6651-1**, July 12, 2012.

Developing a Mixture Design Specification for Flexible Base Construction, by Wenting Liu, **0-6992-1**, August 13, 2012.

Development of TTI's Asphalt Compaction Monitoring System, by Jon Epps, **0-6621-1**, July 3, 2012.

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Heatwux Patching at Two Locations in San Antonio, by Tom Freeman, **5-9043-01-1**, June 28, 2012.

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Implementation of Technology for Rapid Field Detection of Sulfate and Organic Content in Soils: Technical Report, by Chang-Seon Shon, **5-6362-01-1**, June 21, 2012.

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Laboratory and Field Performance Measurements to Support the Implementation of Warm Mix Asphalt in Texas, by Cindy Estakhri, **5-5597-01-1**, August 10, 2012.

MASH Test 3-11 on the T131RC Bridge Rail, by William Williams, **9-1002-12-1**, November 1, 2012.

MASH TL-3 Testing and Evaluation of a Steel Bridge Rail with Pickets, by William Williams, **9-1002-12-2**, November 7, 2012.

Performance Comparison of Various Seal Coat Grades Used in Texas, by Paul Krugler, **0-6496-1**, August 9, 2012.

Performance Monitoring Pavements with Thermal Segregation in Texas, by Stephen Sebesta, **0-6080-1**, April 19, 2012.

Synthesis of Port Related Freight Improvement Studies: Technical Report, by Katie Turnbull, **0-6808-1**, November 30, 2012.

Texas Flexible Pavements and Overlays: Year 1 Report — Test Sections, Data Collection, Analyses, and Data Storage System, by Lubinda Walubita, **0-6658-1**, July 13, 2012.

Texas M-E Flexible Pavement Design System: Literature Review and Proposed Framework, by Sheng Hu, **0-6622-1**, April 11, 2012.

Texas RPO Workshop Implementation Project Summary, by John Overman, **5-6483-01-1**, June 21, 2012.

Unknown Foundation Determination for Scour, by Jean-Louis Briaud, **0-6604-1**, May 3, 2012.

PROJECT SUMMARY REPORTS AND PRODUCTS

Accommodating Oversize and Overweight Loads: Instructor and Student Guide, by Dan Middleton, **0-6404-P2**, September 5, 2012.

Asset Management Guidebook for Safety and Operations, by Beverly Kuhn, **0-6390-P1**, October 4, 2012.

Best Construction Practices Video, by Tom Scullion, **0-6587-P2**, October 2, 2012.

Instructions for Detecting Sulfates Using the Veris 3150, by Chang-Seon Shon, **5-6362-01-P2**, July 23, 2012.

Rural Planning Organization Workshop Materials: Their Role in Transportation Planning and Project Development in Texas, by John Overman, **5-6483-01-P1**, June 21, 2012.

Strategies to Encourage and Facilitate Utility Owner Participation in Transportation Projects: Guidebook and Training Materials, by Cesar Quiroga, **0-6624-P1**, November 30, 2012.

Thin Overlay Mix Designs for West Texas Districts, by Tom Scullion, **9-1529-P1**, November 30, 2012.

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