

Researcher

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Improving our
INFRASTRUCTURE



ON THE COVER: The Highway 6 flyover in College Station is expected to relieve the congested and dangerous intersection that existed in the above photo.



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TEXAS TRANSPORTATION
Researcher

A PUBLICATION OF



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Transportation, like many things in life, is easily taken for granted.

As part of its bid to stimulate the national economy, the Obama Administration is focusing on improving our national transportation infrastructure. This discussion, while new to some, is actually part of a lengthier dialogue as old as the United States itself.

Though there was, as yet, no formal U.S. transportation system, George Washington, an engineer by trade, and Thomas Jefferson were both interested in establishing a national infrastructure to support commerce. This growing political interest led the U.S. Senate to commission its Report of the Secretary of the Treasury Albert Gallatin on the Subject of Public Roads and Canals (1808), in which Gallatin envisioned a federally backed system to support the national defense and economy. As the nation “went West, young man,” it got there on roads, waterways and railroads that existed, many would argue, because of Gallatin’s groundbreaking report.

In the most famous example of expanding the U.S. transportation system to facilitate commercial and military interests, the Eisenhower Administration created the Interstate

Highway System in the 1950s. President Eisenhower understood the need to move troops quickly and efficiently for national defense, but he also wanted to get the farmer “out of the mud” and to market more easily. Many consider the Interstate Highway System the most ambitious (and effective) public works project in history, and its pivotal role in U.S. commercial development over the past 60 years is undisputed.

A 2009 report by the American Society for Civil Engineers (ASCE) gave our national infrastructure a “D” average across 15 categories. The ASCE estimates it will cost some \$2.2 trillion in the next five years to simply make our system “adequate.” Texas’ own 2030 Committee released a similar report in January, identifying the Lone Star State’s transportation needs over the next two decades. With the U.S. economy in crisis, facilitating commerce through transportation is more important than ever to our nation’s future.

In this issue you will learn how the Texas Transportation Institute (TTI) has focused on three research areas in particular — planning, construction

and maintenance — to help improve our nation’s infrastructure. Among other topics covered, you will learn how using TTI-developed sustainable transportation performance in long-range planning will improve the synergy of the multimodal system. The smarter construction methods highlighted here reduce costs and increase competition. And green technologies — like warm mix asphalt and full depth reclamation (or 100 percent recycling) of pavements — prove we can do more with less while protecting the environment.

It is easy to take what you see every day for granted. So try looking at the transportation system through the eyes of a researcher. The next time you’re stuck in traffic, ask yourself how the system could be improved. Pass along those ideas to your local transportation agencies. And remember, that infrastructure is there to keep you safe. It’s there for your prosperity. But it wouldn’t be there at all without innovative and implementable research. ■



by Dennis Christiansen
TTI Director

Edwards announces Mobility Initiative at TTI

Rep. Chet Edwards detailed the “Bryan/College Station Mobility Initiative” — a unique agreement designed to improve the quality of transportation in smaller communities — during a news conference at the Texas Transportation Institute (TTI) on January 30.

Edwards secured \$1 million in funding for the initiative, which will house a traffic management system at TTI’s TransLink® Laboratory, in partnership with the cities of Bryan and College Station, Brazos County, Texas A&M University, the local Texas Department of Transportation district, the Bryan/College Station Metropolitan Planning Organization and TTI.

“This [Bryan/College Station Mobility Initiative] is about growth, it’s about quality of life for our families, it’s about air quality and it’s about safety,” Edwards said. “Improving roads and easing congestion are vital to Bryan/College Station.”

The population of Brazos County has nearly doubled in the last 30 years



Rep. Chet Edwards explains his Bryan/College Station Mobility Initiative during a news conference on Jan. 30.



Rep. Chet Edwards (left of sign) and TTI Director Dennis Christiansen (right of sign) are flanked by officials from Bryan, College Station and the Texas A&M system.

to 170,000 residents. In addition, Texas A&M has experienced almost a 60 percent increase in visitors over the last 10 years.

Annual visitors to the Bryan/College Station community total about 3.7 million each year.

“If we are not visionary, we will be like Austin in the near future,” said College Station Mayor Ben White, who grew up in the Austin area and knows how quickly congestion can become a major problem.

The TransLink® Laboratory at TTI will be used to monitor traffic with cameras set up in key locations in the community. It will also help with the coordination of traffic signals, data collection and special events planning. Area traffic is especially congested during the numerous Texas A&M sporting events throughout the year.

“We have the equivalent of a big-city traffic operations system here at TTI,” Agency Director Dennis Christiansen told members of the news media and local dignitaries attending the event. “Although it will not take the place of

new road construction, the system will help increase capacity on area roadways by up to 20 percent.”

Edwards told the crowd that the cooperation among the entities that make up the Bryan/College Station Mobility Initiative could become a model for other small city regional transportation planning efforts.

Following the news conference, Edwards, along with members of the news

media, attended a crash test that was held on TTI’s Proving Grounds located at the Riverside Campus. He witnessed a pickup truck crashing into a concrete barrier at 62 miles per hour. “This was my first crash test,” Edwards said. “It’s amazing the work that the researchers are doing for the safety of our motorists. TTI is truly an American treasure.”

“This [Bryan/College Station Mobility Initiative] is about growth, it’s about quality of life for our families, it’s about air quality and it’s about safety. Improving roads and easing congestion are vital to Bryan/College Station.”

*Rep. Chet Edwards,
17th Congressional
District of Texas*



MORE INFORMATION
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TTI contributes to 2030 Committee's Texas Transportation Needs Report

On February 26, the Texas Transportation Commission adopted the 2030 Committee's *Texas Transportation Needs Report*. The 221-page report concludes that meeting Texas' transportation needs between 2009 and 2030 will require \$315 billion, or about \$14.3 billion per year.

The 2030 Committee is comprised of 12 Texas business and civic leaders appointed in May 2008 by Texas Transportation Commission Chair Deirdre Delisi. She charged the committee with providing an independent, comprehensive analysis of the state's future transportation needs. In addition to TTI's substantial contribution, researchers from the Center for Transportation Research at The University of Texas at Austin and The University of Texas at San Antonio also conducted research for the report.

The report forecasts costs and the resulting benefits in 2008 dollars from highway maintenance (pavements and bridges), urban mobility, and rural mobility and safety. The committee's timeframe did not allow for an in-depth analysis of other transportation modes that could complement traditional highway capacity, but the report includes overviews of public transportation, freight and intercity passenger rail, ports and waterways and airports, along with recommendations for further study.

TTI researchers wrote chapters on urban mobility, rural mobility and safety and the overview sections. TTI staff edited and designed the report and executive summary, as well as built and maintained the committee's website. In addition, TTI organized the 2030 Committee meetings and public hearings, while also monitoring and compiling public comments during the report's nine-month development period.

"It was a personal privilege to have the opportunity to be engaged in this important effort with such an outstanding group of fellow Texans," says Dr. C. Michael Walton, chair of the committee. "Each gave freely of their expertise and their time in the highest interest of Texas and transportation needs for our state."

"I am extremely proud of our overall involvement in this independent review of Texas' transportation needs over the next two decades," says TTI Executive Associate Agency Director William R. Stockton. "This is one of the most



To view the *2030 Committee Texas Transportation Needs Report and Executive Summary*, visit <http://texas2030committee.tamu.edu/>. For more information, please contact Bill Stockton at (979) 845-9947 or stockton@tamu.edu.

important and visible projects that TTI has ever undertaken, and the individuals who developed and produced the report spent countless hours to ensure it was accurate and understandable by the public." ■



TTI 2030 Development Team Members

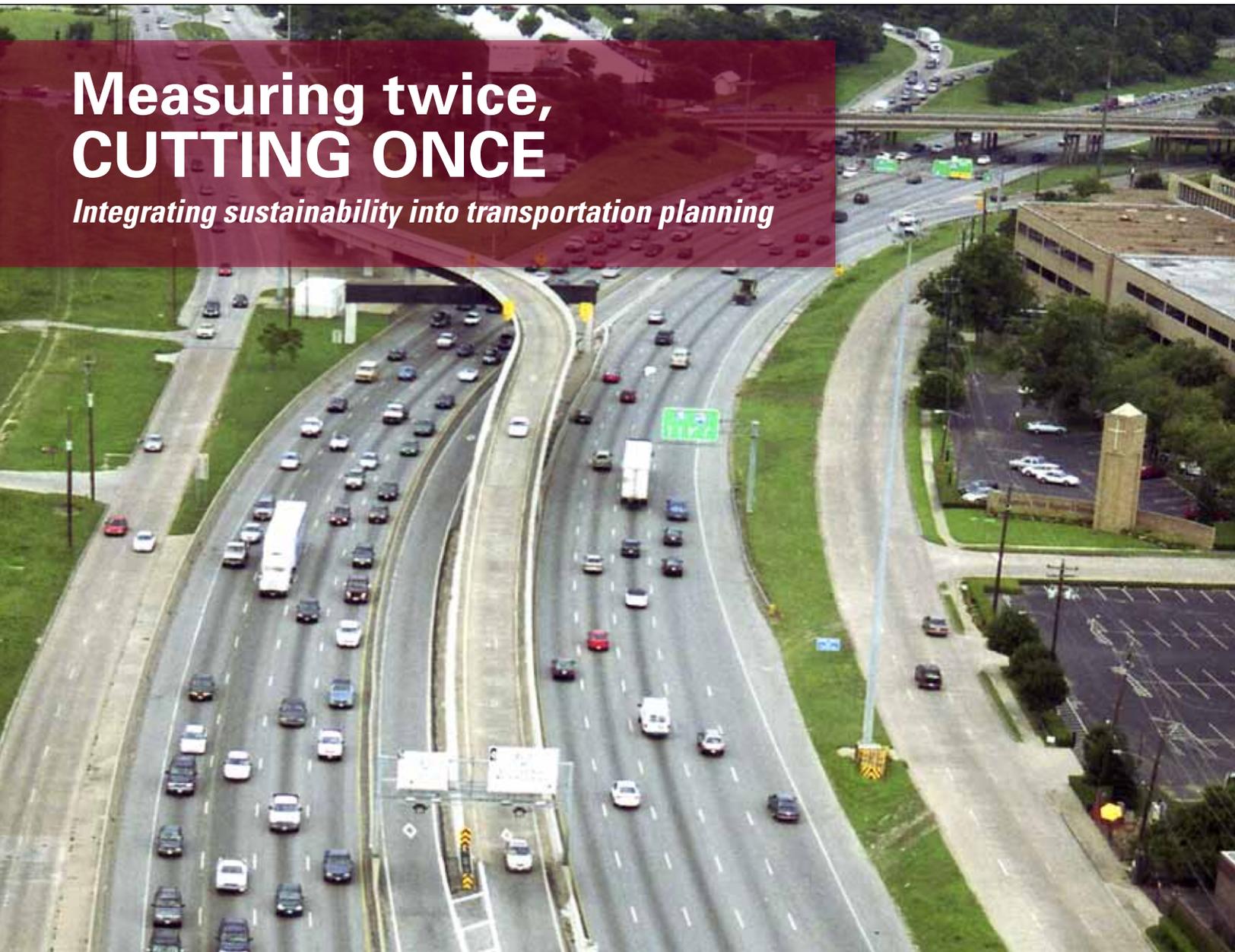
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Measuring twice, CUTTING ONCE

Integrating sustainability into transportation planning



Tailoring and transportation share at least one thing in common — the better the planning, the better the product.

When tailors measure cloth twice before cutting, they're maximizing efficiency and minimizing waste by first calculating carefully. In the transportation planning arena, that's what sustainability is all about.

"Sustainable transportation" means different things to different people. In its recent project for the Texas Department of Transportation (TxDOT), the Texas Transportation Institute (TTI) defined it as "the provision of safe, effective and efficient access and mobility into the future while considering economic, social and environmental needs." These needs are often called the "three pillars" of sustainability.

By measuring and applying these principles, a more sustainable — or safer, more effective — transportation system can be established. It's easy enough to dream of sustainability, but without specific performance measures, it's much more difficult to quantify and implement its principles.

"The three pillars are tied together by many cross-cutting issues, including how they affect and are affected by the development of our transportation system," explains Joe Zietsman, director of TTI's Center for Air Quality Studies. "What we've done is to figure out how we can measure these pillars of sustainability using data that's already available."

Zietsman's team used TxDOT's own strategic goals as a framework for defining how the pillars interact. With these goals in mind, the team developed sustainability objectives, created 13 sustainable

"TTI's research on this project provided a valuable planning method that is both practical and easy to use. The project findings are now being rolled out as an implementation project through a series of workshops in Texas' largest metropolitan areas."

*Bill Knowles,
TxDOT project coordinator*

SUSTAINABILITY: A concept, not a technology

“Sustainability” is an idea comprising multiple goals that need to be related to one another and quantified. Unlike an innovative technology — like a new kind of crash barrier on the roadside — it’s a concept, not a piece of equipment. And sometimes that makes it difficult to understand.

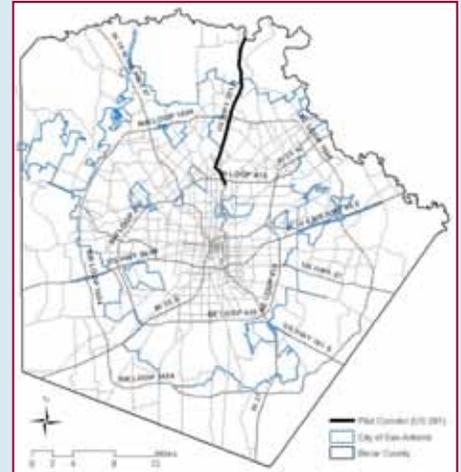
Through this project, TTI researchers made the abstract more concrete by identifying objectives and performance measures organized around TxDOT’s five goals: reducing congestion, enhancing safety, expanding economic opportunity, increasing the value of transportation assets and improving air quality.

Using their spreadsheet in a case study in San Antonio, the TTI team projected that the overall sustainability of the corridor got worse over time despite proposed capacity enhancements. In this example, the calculator gave TxDOT specific information about why sustainability actually got worse along the corridor. It also helped them understand how their strategic goals were affected by those results and where the problem occurred along the corridor.

“Using data that’s readily accessible, our analysis tool gave us important information on how TxDOT can improve the sustainability of the test corridors,” says Zietsman. “Using the calculator, TxDOT can proactively identify remedies that will actually make a difference before ever beginning a project.”

Traffic Volumes for Base Case and Future Case Scenarios: US-281

Link	Length (miles)	Daily Volume (2005)	Number of lanes (2005)	Daily Volume (2025)	Number of lanes (2025)
1	3.89	101,364	6	156,129	6
2	5.22	77,314	6	169,629	6
3	3.97	36,884	4	102,067	6
4	1.85	33,887	4	75,261	6



Location of study corridor for US-281 Case Study. It stretches from IH-410 in downtown San Antonio in the south to the Comal/Bexar county line in the north.



Study section of US-281 near downtown San Antonio.

transportation performance measures and a methodology for benchmarking them, and derived a method for combining those measures in one index for comparative purposes. This whole process was coded into a user-friendly Microsoft Excel®-based calculator.

Since the performance measures and their underlying methodology are uniform, researchers can compare different corridors and different sections of the same corridor in terms of their relative sustainability. A comparison can also be made over time between baseline and future conditions. This output can then be used by TxDOT to enhance the relative sustainability of their transportation corridor projects while ensuring the efficacy of their strategic goals.

“The 13 measures can help TxDOT see a more realistic portrait of the transportation system by simultaneously considering all three dimensions of sustainable transportation,” says Zietsman.

Researchers refined the methodology by evaluating case studies involving transportation corridors in San Antonio,

Houston and Amarillo. That field work proved the flexibility and effectiveness of TTI’s approach in rural, urban and suburban environments.

Bill Knowles, TxDOT’s project coordinator, notes, “TTI’s research on this project provided a valuable planning method that is both practical and easy to use. The project findings are now being rolled out as an implementation project through a series of workshops in Texas’ largest metropolitan areas.”

As the United States looks to improve its transportation infrastructure, proactive planning tools like these will prove vital to getting the most from its transportation dollar.



MORE INFORMATION

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Evaluating the 4Ts

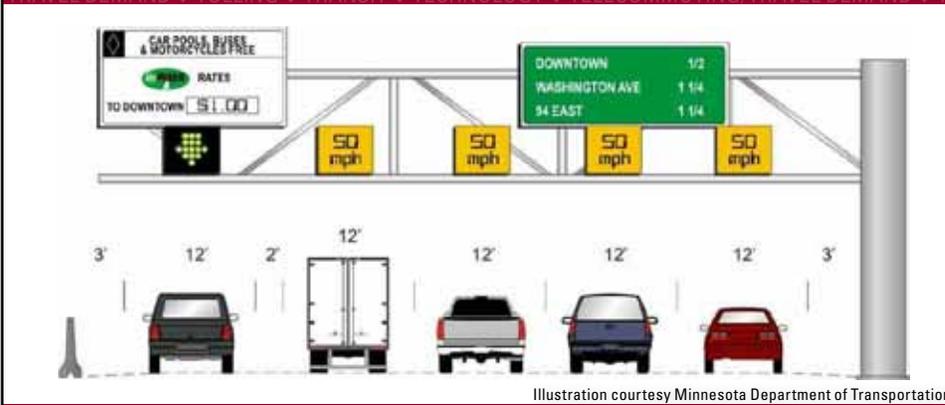


Illustration courtesy Minnesota Department of Transportation
 Priced Dynamic Shoulder Lane in Minnesota.

UPA/CRD National Evaluation Team

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What impacts do tolling, transit, technology and telecommuting/travel demand management have on reducing traffic congestion in major travel corridors? Researchers at the Texas Transportation Institute (TTI) are part of a team helping the U.S. Department of Transportation (U.S. DOT) answer that question.

The U.S. DOT is funding congestion reduction strategies at multiple sites throughout the country through the competitive Urban Partnership Agreement (UPA) and the Congestion Reduction Demonstration (CRD). Both programs are part of the U.S. DOT's Congestion Initiative.

The selected sites — which include the metropolitan areas of Miami, Minneapolis-St. Paul, San Francisco, Los Angeles, Seattle and Atlanta — are implementing a wide range of innovative strategies. Examples of projects include high-occupancy toll (HOT) lanes, a priced dynamic shoulder lane, new and expanded park-and-ride facilities, dual downtown bus lanes, real-time transit information and lane guidance for shoulder running buses. Other strategies include variable pricing on existing freeways, active traffic management systems, variable priced on-street and off-street parking, improved regional 511 traveler information systems and telecommuting and flexible work arrangements.

The U.S. DOT also selected a national evaluation contractor through a competitive procurement process to assess the effectiveness of the various UPA/CRD strategies. The Battelle Memorial Institute team, which includes TTI, was selected to conduct the national evaluation.

“The national evaluation is assessing the impacts of the UPA/CRD projects in a comprehensive and systematic manner, as well as the specific impacts of technology, tolling and transit elements,” notes Shelley Row, director of the U.S. DOT’s Research and Innovative Technology Administration (RITA), ITS Joint Programs Office. “The evaluation results will benefit other metropolitan areas interested in deploying similar strategies and will support future federal policy and program development related to mobility and congestion and the role of pricing, transit and intelligent transportation systems.”

“The national evaluation is assessing the impacts of the UPA/CRD projects in a comprehensive and systematic manner, as well as the specific impacts of technology, tolling and transit elements. The evaluation results will benefit other metropolitan areas interested in deploying similar strategies and will support future federal policy and program development related to mobility and congestion and the role of pricing, transit and intelligent transportation systems.”

*Shelley Row,
 Director, U.S. DOT’s Research and
 Innovative Technology Administration
 (RITA), ITS Joint Programs Office*

“We are working with representatives from the local agencies and the U.S. DOT in developing and conducting the evaluation,” notes Katie Turnbull, TTI executive associate director and lead on the Minnesota UPA site evaluation. “The team approach is critical to successfully evaluating the influence of these innovative programs.”

Other TTI researchers are serving as technical experts, providing assistance across all sites. Kevin Balke, research engineer, is the technology expert and David Ungemah, associate research scientist, is the tolling expert.

“Some projects, such as the HOT lanes in Miami and the Transit Advantage bus bypass lane in Minnesota, are in operation,” states Row. “Most of the projects will be implemented in late 2009, 2010 and early 2011. The national evaluation will

provide preliminary results after the projects come online, as well as a comprehensive final assessment.”



MORE INFORMATION

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Black top served hot:

TTI research helps lengthen road life



A maintenance crew oversees an asphalt overlay project.

Potholes in the road cause more problems than commuters just spilling their coffee. Potholes are also a safety hazard and an expensive burden to the taxpayers footing the bill for repairs.

Thermal segregation, one major cause of potholes, occurs in isolated, low-density areas when the temperature differs greatly during placement of the new overlay. Hot-mix asphalt, the most common surface layer in Texas, requires a uniform application temperature to achieve uniform density and a long life. These “cold spots” are major defects that can cause rapid failure.

“Cold spots look like regular spaced blotches along the road; the surface appears much coarser when you look at it. If you drive over them, you can sometimes feel dips in the road. Over time, water gets in there, and the pavement fails earlier than it should,” explains Tom Scullion, senior research engineer with the Texas Transportation Institute (TTI). “Large differences in surface temperature can severely reduce the life of the pavement.”

Detecting temperature uniformity problems early in any paving job is critical so that corrective action can be taken. Engineers began using handheld temperature guns and infrared cameras to take thermal profiles of new pavement, and this practice is still standard.

“The asphalt layer is the most expensive and most visible layer to the public. Drivers judge a road by the way it looks and the smoothness of the ride. Research like this may help us minimize maintenance in the future and produce longer road life.”

*Richard Izzo,
Transportation Engineer,
TxDOT Construction Division*

These methods have limitations since they only provide localized data and require an operator’s constant attention. To eliminate these problems, agencies need other devices that provide 100 percent coverage and real-time feedback.

TTI researchers, led by Scullion and Assistant Research Scientist Stephen Sebesta, have developed an infrared temperature bar system called *Pave-IR*. The *Pave-IR* uses 10 infrared temperature sensors mounted to the back of the paver and does not need an operator.

Complete with a global positioning system (GPS) and custom software that collects the temperature data, *Pave-IR* provides a full-coverage thermal profile with real-time feedback. The contractor and agency get quantitative surface data in a color-coded chart of the hot-mix temperatures. The chart, which includes the GPS coordinates of all the very cold spots, provides a map of potential premature failures and assists the paving crew to determine where immediate corrections are needed.

By helping ensure the quality of new construction, *Pave-IR* allows TxDOT to save taxpayer dollars, improve safety and minimize commuter inconvenience due to closed roadways. “Agencies, contractors and the public all benefit if we construct better quality, longer-lasting pavements. *Pave-IR* is a tool that will help reach that goal,” confirms Sebesta.

Currently, TxDOT requires a thermal profile of new overlays using a handheld temperature gun. Sebesta and the team are working with TxDOT to update test specifications and regulations to include *Pave-IR* with the thermal profile requirement.

“The asphalt layer is the most expensive and most visible layer to the public. Drivers judge a road by the way it looks and the smoothness of the ride,” says Richard Izzo, transportation engineer with the Flexible Pavements section in TxDOT’s Construction Division. “Research like this may help us minimize maintenance in the future and produce longer road life.” ■



MORE INFORMATION

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RECYCLING THE ROAD:

Full-depth reclamation uses old roadways to make new



“When people run into problems with FDR, it’s usually because the existing roadways are so variable. You’re trying to make this into a uniform support structure, so upfront testing and performance-related design tests are critical.”

*Tom Scullion,
TTI Senior Research Engineer*

Not only is recycling good for the environment, it is good for our pocketbook. Recycling is the process of turning used products into raw materials for making new products. With thousands of miles of roadway in place — many needing rehabilitation — reusing the existing pavement materials can make a big cash difference.

Full-depth reclamation (FDR) is a rehabilitation technique that has been around for several years. The process involves pulverizing the existing roadway materials, mixing it with a stabilizing agent and using it to form a foundation layer for the new roadway. FDR provides structural benefit to the new roadway, conserves raw materials and quickly returns the facility to service. However, the process can be difficult to get just right.

“The Bryan and Lubbock Districts [of the Texas Department of Transportation, or TxDOT] have been leaders in using FDR. Both have recycled many miles of roadway,” says Tom Scullion, manager of the Texas Transportation Institute’s (TTI’s) Flexible Pavements Program. “More of the districts are getting involved, and it’s really accelerating, but some districts have little experience with FDR. TxDOT



Full-depth reclamation (FDR) allows departments of transportation to recycle old roads with potholes into new, smooth roadways.

wanted a comprehensive study and guidelines on how to test, design and construct FDR projects.”

The first task in using FDR is conducting nondestructive tests on the FDR candidates. Usually this process is accomplished by using ground-penetrating radar and falling weight deflectometers. These tests measure uniformity and overall existing strengths. Next, designers take samples of the existing materials and test them in order to select the optimal type and amount of stabilizer to use. This includes both strength and moisture susceptibility testing. Then, during the construction phase, everything needs to be done correctly — using the right amount of stabilizer, mixing it correctly, spreading the mixture uniformly and verifying that the result meets the design.

“When people run into problems with FDR, it’s usually because the existing roadways are so variable,” Scullion says. “You’re trying to make this into a uniform support structure, so upfront testing and performance-related design tests are critical.”

The Bryan District, for example, has been designing pavements using FDR since the 1990s and has done over 1,000 miles of roadway.

“It’s a good process that allows us to construct economically,” says Darlene Goehl, the project director and the pavement and materials engineer in the TxDOT Bryan District. “We test the existing roadway to determine how good the material is. We’ll probably recycle it no matter its condition, but the tests tell us how to design the total pavement structure and where we include that existing material.”

Another issue researchers are examining is the different stabilizers that are available. Most districts use lime or

cement, but some districts want to use fly ash, asphalt emulsions and other materials.

Environmental concerns also play a part in the design process. Engineers attempt to minimize the amount of dust blowing around during construction. Slurry (materials mixed with water) is now used, and researchers are working with manufacturers of slurry equipment to determine the best way to apply the materials.

“The final part of the study is following up and getting feedback,” says Scullion. “We’re going to test projects that were done recently to determine their strengths and weaknesses, and then see how we can improve the whole design process.”

The study will produce guidelines, training sessions and demonstration projects. Researchers will work closely with TxDOT districts on FDR, offering input and getting feedback in return.

As the United States works to improve its infrastructure, initiatives like FDR will prove critical. Not only is it a “green” process that benefits the environment, it is also an efficient, cost-effective re-use of roadway materials.

“Doing more with less’ could be this technique’s slogan,” says Scullion. “As we refine FDR with feedback from practitioners, we should end up with a rehabilitation technique that can benefit Texas and the nation for years to come.” ■

“It’s a good process that allows us to construct economically. We test the existing roadway to determine how good the material is. We’ll probably recycle it no matter its condition, but the tests tell us how to design the total pavement structure and where we include that existing material.”

*Darlene Goehl,
Pavement and Materials Engineer,
TxDOT Bryan District*



MORE INFORMATION

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STREAMLINING THE CONSTRUCTION PROCESS:

TTI researchers find ways to cut costs

State departments of transportation (DOTs) throughout the country are battling the same worsening problems: a lack of funds for road construction and soaring prices for materials like steel and concrete. When funds are available, these rising costs have DOTs scrambling for dollar-stretching ideas.

“Construction costs have almost doubled between 1998 and 2006,” says Ivan Damnjanovic of the Texas Transportation Institute (TTI), who headed up a one-year study for the Texas Department of Transportation (TxDOT) to examine current practices and suggest improvements to the construction process. “DOTs have little control over external factors like the rising cost of fuel and asphalt, but they do have control over the bidding and design process.”

“The purpose of the research was not only to investigate those things that impact prices and methods of lowering those costs, but to make sure the quality of work is not jeopardized as a result.”

*Ivan Damnjanovic,
Assistant Professor,
Department of
Chemical Engineering*

Damnjanovic discovered that not much formal research has been done on cost-cutting methods. As a result, his team’s research could be the most extensive methodological study yet on cost-saving measures in road building. Originally, TxDOT’s Construction Division developed a list of some cost-reduction methods. Then Damnjanovic and his team expanded the list to identify 56 items.

“This report could almost be viewed as an extensive reference guide,” says TxDOT’s Duane Schwarz, project director for the study. “There are so many strategies offered in the report; it helps us to evaluate the way we do business. It puts a lot of ideas into one handy place and is extremely valuable for all of us, but especially for our younger designers.”

Researchers conducted interviews with road construction engineers and fact-finding workshops. Of the 56 methods derived from the study, 21 suggestions would require TxDOT to make policy changes at the program level. On a project-specific level, Damnjanovic and his team identified 35 potential cost-reduction methods that do not require a change in policy.

“In general terms, it’s very important to have a systematic approach to cost reduction,” says TxDOT Research Engineer German Claros. “And this study provides that for us.”

“The purpose of the research was not only to investigate those things that impact prices and methods of lowering those costs, but to make sure the quality of work is not jeopardized as a result,” says Damnjanovic.

Even without implementing any of the cost-reduction techniques outlined in the study, TxDOT received an unexpected gift when fuel prices fell from their \$4.00 a gallon peak last summer to under \$2.00 in December. “We do expect some of the problems to work their way out of the system,” says Claros. “However, we know that construction costs go up very quickly, and they take a long time to come down.”

DOTs across the country are also breathing a collective sigh of relief about the recently approved stimulus bill that will pump funds into infrastructure improvements. “At this point, there’s a high degree of uncertainty over just how much money we’ll receive, so cost-cutting measures will likely remain a priority,” Claros says. ■



MORE INFORMATION

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Varying seal-coat asphalt rates across the roadway

As the winter months wind down, Texas Department of Transportation (TxDOT) district offices throughout the state will complete planning for the hectic summer seal-coat season. Best applied when the weather is warm, seal coats are by far the most popular preventative maintenance treatment used in Texas.

A recently completed research project, sponsored by TxDOT and conducted by the Texas Transportation Institute (TTI), examined methods for improving the safety and durability of seal-coated roadways. The project developed guidelines for how and when to vary the amount of asphalt being applied across the width of a pavement.

“A roadway does not wear evenly across the surface because traffic is usually channelized,” says Paul Krugler, research engineer with TTI. “The difference in surface texture may result in new seal-coat aggregate not bonding adequately outside of the roadway wheel paths, or the asphalt may rise to the surface in the wheel paths. Either situation diminishes roadway quality, and the loss of skid resistance in the

wheel paths can be a safety issue. Asphalt rising to the surface in the wheel paths is commonly known as flushing, and it’s what we’re trying to prevent by varying the amount of asphalt sprayed on the roadway.”

Transversely varying asphalt rates (TVAR) works by designing the asphalt shot rate specifically for the wheel path conditions. If the wheel paths are worn down or exhibiting flushing, the proper asphalt rate is somewhat lower. Then, the asphalt shot rate is increased for the areas outside of the wheel paths. Additional asphalt is needed there to fill the greater surface texture and still have adequate asphalt available to ensure proper bonding of the aggregate. The goal of TVAR is an even coating of aggregate that is well-bonded across the entire width of the

roadway but without causing flushing. This bonding optimizes skid resistance and makes the roadway safer.

Last summer, researchers interviewed TxDOT maintenance personnel throughout the state to gather information on how often and what criteria they used to set these transversely varied asphalt rates. The result of the

“We want more asphalt on the road, but we don’t want to get flushing in the wheel paths when we do it. By using the set of guidelines developed by TTI, our construction inspectors and maintenance crews can achieve this goal and optimize our seal-coat applications, while also making the roadways safer for the traveling public.”

*Paul Montgomery,
Director of Maintenance,
TxDOT Lufkin District*

project was a comprehensive guidebook with step-by-step instructions on the TVAR process. For the implementation phase of the project, the research team is hitting the road this spring, teaching five workshops on TVAR.

In addition, roadways that underwent TVAR seal coats last year will be evaluated in the future for effectiveness in eliminating reoccurring flushing. “We can adjust the numbers in our guidebook if necessary,” says Krugler.

“The whole concept of TVARs is to put more asphalt on the road,” says Paul Montgomery, who served as the project director and is the TxDOT director of maintenance for the Lufkin District. “We want more asphalt on the road, but we don’t want to get flushing in the wheel paths when we do it. By using the set of guidelines developed by TTI, our construction inspectors and maintenance crews can achieve this goal and optimize our seal-coat applications, while also making the roadways safer for the traveling public.”



This photograph shows wheel path aggregate embedment slightly higher than usually desired after a day or two of traffic.



MORE INFORMATION

For more information, please contact Paul Krugler at (512) 467-0952 or p-krugler@ttimail.tamu.edu.

CARING FOR CONCRETE



The pocket field manual, field survey and field guidelines developed by TTI researchers will aid maintenance crews in identifying concrete distresses like the ones shown above and at the bottom of the page.

It's easy enough to fix a pothole, but how easy is it to actually prevent them from appearing at all? Given the number of cracks and potholes that plague Texas roadways, there is no question about the value that a successful preventive maintenance could have in delaying more serious problems.

Various methods exist to identify distresses in concrete and asphalt concrete overlaid pavement, and simple patching is usually a good temporary fix. But less-experienced engineers may miss the signs of early serious structural damage to the pavement because of a lack of experience or a decision-making process based only on visual distress surveys.

"By the time a visual inspection shows distress, it's time for a major overhaul," says Texas Transportation Institute's (TTI's) Tom Freeman, engineering research associate. "In this project, we collected the last 30 years of field experience and developed tools that engineers can fit in their pockets."

The research team developed a pocket field manual, a field survey and

field guidelines. As engineers retire from TxDOT, too often their expertise goes with them. Freeman's work has captured some of that corporate knowledge, making the maintenance process more efficient overall.

"By the time a visual inspection shows distress, it's time for a major overhaul. In this project, we collected the last 30 years of field experience and developed tools that engineers can fit in their pockets."

*Tom Freeman,
TTI engineering research associate*

The field manual provides a standard for maintenance crews to use in determining and describing the problems they may encounter; it also includes pictures, possible causes and recommended lab tests. The team also used a survey to evaluate the effectiveness of full-depth repair, various joint repair techniques, joint resealing and dowel bar retrofit with diamond grinding.

The guidelines include non-destructive test procedures for subsurface layers, such as the falling weight deflectometer and ground penetrating radar (a technique developed at TTI). The guidelines also provide discussion

on each maintenance stage, promoting the best standard practices and specifications used by state departments of transportation across the country. A step-by-step repair method and decision-making process gives engineers the options of preventative maintenance, functional or structural concrete pavement repair or full resurfacing.

"Routine maintenance at the right time can extend pavement life in a cost-effective manner," says Freeman. "It takes longer to repair a section of very poor pavement, while with the same amount of resources, an agency can maintain far more sections of pavement in good and fair condition."

These tools are timely since there is a renewed federal interest in improving transportation infrastructure, which is good news to state departments of transportation. Freeman's next project will work with TxDOT to develop a class that will teach engineers around the state the decision-making processes found in these products.

"This research defines another set of tools for TxDOT engineers to economically maintain pavements on an aging transportation system with decreasing funding," says TxDOT's Paul Montgomery, director of maintenance. "These tools help us along the path of progress in pavement management." ■



MORE INFORMATION
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Warm mix is **HOT!**

Paving the way cleaner, faster and cheaper in Texas

What began in Europe is now the hottest thing in asphalt in Texas and the U.S. There are many ways to get there, but the goal is the same: to lower the temperature of asphalt by 35 to 100 degrees Fahrenheit prior to application.

“When we started the warm mix research project, I thought we’d have trouble getting test sections because we couldn’t get anybody interested,”

“Contractors see warm mix as a way to extend their paving season. If you can achieve compaction at the lower air and pavement temperatures, then you may be able to extend your paving time by a few months every year.”

*Cindy Estakhri,
TTI Program Manager*

says Cindy Estakhri, who conducted the first Texas study on warm mix asphalt. Estakhri manages the Texas Transportation Institute’s (TTI’s) Recyclable Materials Program. “It’s grown so much now that we have difficulty keeping track of all the projects now.”

Why is warm mix so popular? Using it reduces emissions at the plant and on site, lowers energy costs for the contractor and expedites construction time. These and other advantages have convinced Texas road builders, and the Lone Star State now leads the nation in warm mix asphalt tonnage.

“Contractors see warm mix as a way to extend their paving season,” explains Estakhri. “If you can achieve compaction at lower air and pavement temperatures, then you may be able to extend your paving time by a few months every year.”

There are some 17 different methods for creating warm mix asphalt worldwide, and the Texas Department of Transportation (TxDOT) will soon

fund a study to evaluate the chemistry involved in the different methods. “There’s a lot that’s new and proprietary going into the warm mix. You want to be sure that it won’t have some detrimental effect down the road,” Estakhri says.

One concern about using warm mix involves moisture content. In a regular hot mix, the aggregate is almost completely dehydrated. But laboratory testing has revealed that, if you use a moisture-susceptible aggregate, warm mix might be vulnerable to moisture damage. The significance of that potential problem is still a concern.

Jesse Fleming, TxDOT’s area engineer in Graham, Texas, is a warm mix supporter. His district recently used

warm mix on a section of U.S. 183 in Throckmorton County.

“Warm mix gives us a little more workability,” says Fleming. “We hope that it gives us more durability of the mix in the long run because we’re not cooking the lighter oils out of the warm mix.”

Using warm mix could also have a significant positive impact on transportation construction projects in and around air quality non-attainment areas. With warm mix technology, asphalt production plants can manufacture more tonnage without increasing plant emissions, a serious concern in an age of climate change. As the country gears up to repair its highways, the ability to create cleaner road construction materials is a strong selling point.

“The [performance] difference that we’ve seen between working with warm mix and working with hot mix is not significant,” says Fleming. “We believe that warm mix is going to have a big future in TxDOT.”



MORE INFORMATION

For more information, please contact Cindy Estakhri at (979) 845-9551 or c-estakhri@tamu.edu.



An infrared temperature gun shows a mixture placement temperature of 40° to 50° F below what is normally required to achieve compaction.

Hall of Honor makes room for two pioneers

Right: Marquis G. Goode, Jr., a 40-year employee of TxDOT, is joined by his family members as he holds his Hall of Honor induction plaque.

Below: Louis L. Heil, the former CEO and current chairman of the board of McDonald Transit Associates, and family members.



With long-lasting and pivotal contributions to the improvement of transportation in the Lone Star State and beyond, two Texans were inducted into the Texas Transportation Hall of Honor during a ceremony held in Austin.

On November 21, Marquis G. Goode, Jr., a 40-year employee of the Texas Highway Department (now the Texas Department of Transportation, or TxDOT) and Louis L. Heil, the former CEO and current chairman of the board of McDonald Transit Associates in Fort Worth, were honored during induction ceremonies at the Greer Building in Austin.

“This is by far the most significant and most meaningful recognition I’ve had in my life,” Heil told the crowd gathered at the event. “I accept this award with a great deal of humility and with a huge amount of gratitude.” Heil was instrumental in bringing public transportation to Fort Worth and supervised the initiation of new public transit systems throughout the United States. Having joined the company as its vice president in 1972, he served as CEO for McDonald Transit Associates for 23 years.

Goode, who retired from the Texas Highway Department in 1986 after managing the fastest period of growth in road

construction in the department’s history, also addressed the crowd in Austin. “Here in Texas, the people in transportation have all worked together. So, thanks to all of you and the part you played in the plaque that has been given to me today.” As engineer-director for the department, Goode initiated a recruiting and training program that opened doors for women and minorities.

“Our state is blessed to have an outstanding transportation system that has helped to attract economic growth and offered Texans a high quality of life,” Dennis Christiansen, Texas Transportation Institute (TTI) director and chair of the Texas Transportation Hall of Honor, said at the ceremony. “The individuals we are recognizing today clearly deserve this honor.”

The Texas Transportation Hall of Honor was established in 2000 by TTI. Inductees are honored with a plaque that bears their likenesses and is on permanent display in College Station. ■

“Our state is blessed to have an outstanding transportation system that has helped to attract economic growth and offered Texans a high quality of life. The individuals we are recognizing today clearly deserve this honor.”

*Dennis Christiansen,
Director, Texas Transportation Institute*

Senate and Legislative Ladies Day a smashing success

Right: Chancellor Mike McKinney (second from left) observes the demolished guardrail following the crash test along with members of the Senate and Legislative Ladies Clubs and TTI staff.

Below: TTI Director Dennis Christiansen, Lou Ann McKinney (second from left) and Mike McKinney (third from right) and others discuss the crash test.



On March 4, 67 wives of Texas Legislators visited the Texas Transportation Institute (TTI) and the Texas Engineering Extension Service (TEEX) for Senate and Legislative Ladies Day.

In attendance were Julie Straus, wife of Speaker of the House Joe Straus; Sen. Steve Ogden's wife, Beverly; and Michelle Dunnam, wife of Rep. Jim Dunnam of the House Transportation Committee. Chancellor Mike McKinney and his wife, Lou Ann, invited the ladies for a firsthand, inside look at The Texas A&M University System.

Following a detonation demonstration at TEEX's Disaster City, the group visited the Texas A&M University Riverside Campus and witnessed the crash test of a 2007 Chevrolet pickup truck into a standard steel guard rail at 62.5 mph. The test was a technological failure for the guard rail but succeeded in generating over 20 minutes of questions for Lance Bullard, head of TTI's Safety and Structural Systems Division.

The ladies were then treated to a luncheon at the Clayton W. Williams Jr.

Alumni Center, a performance by the Texas A&M University Singing Cadets and a video presentation about The Texas A&M University System. Also participating in the lunch were the mayors of Bryan and College Station and other local and System officials.

After lunch the ladies returned to TTI's Gibb Gilchrist building, where they received an overview presentation about the Institute. They also heard from Assistant Agency Director Steve Roop, who talked about his newly proposed elevated design for a Texas Universal Freight Shuttle System, and Assistant Agency Director Dean Alberson.

At the close of their visit, The Honorable Ben White, mayor of College Station, briefed the ladies on the Bryan/College Station Mobility

Initiative, and they took a tour of the TransLink® Laboratory Research Center, which will be the headquarters for the initiative.

"We are very pleased and honored that the chancellor provided TTI this important opportunity to tell our story to this distinguished group of ladies," said Agency Director Dennis Christiansen. "Numerous TTI staff members helped make the event a great success." ■



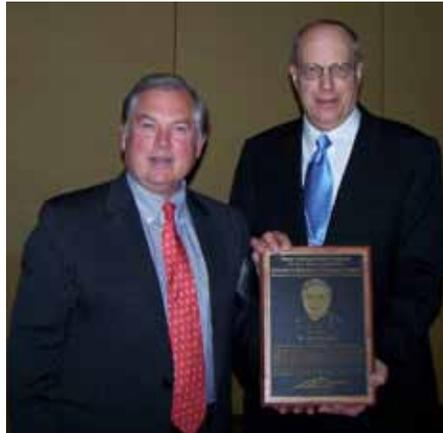
Lance Bullard, head of TTI's Safety and Structural Systems Division, briefs the group on the crash test they are about to see.

Horsley presented Director's Research Champion Award

John Horsley, executive director of the American Association of State Highway and Transportation Officials (AASHTO), was presented with the 2008 Texas Transportation Institute Director's Research Champion Award at TTI's January 11 reception at the Transportation Research Board Annual Meeting in Washington, D.C. The award is sponsored by Trinity Industries in memory of Kenneth W. Lewis.

The Director's Research Champion Award recognizes individuals at the national level who have been strong and effective advocates for transportation research. Horsley received the 2008 award for his leadership in advancing transportation research. From 1993 to 1999 he served at the U.S. Department of Transportation. As Associate Deputy Secretary, he was an advocate for intermodal policies, quality of life initiatives, and liaison to State and Local Governments, U.S. Congress, and transportation constituencies.

A native of the Northwest, Horsley was elected to five terms as County Commissioner in Kitsap County, a community just west of Seattle. He is a graduate of Harvard, an Army veteran, a former Peace Corps volunteer and



TTI Director Dennis Christiansen (right) presents John Horsley with the 2008 TTI Director's Research Champion Award.

Congressional aide, and did graduate study at Georgetown. He is Past President of the National Association of Counties and was founding Chairman of the Rebuild America Coalition. ■

2009 Texas Transportation Forum

On January 5, some 1,200 transportation professionals gathered in Austin, Texas, for the Fourth Annual Texas Transportation Forum. Executive Director of the Texas Department of Transportation (TxDOT) Amadeo Saenz told the crowd that finding adequate funding for transportation will be TxDOT's priority in the coming year. He referred to the recent findings of the 2030 Committee that showed Texas will need to spend \$315 billion to maintain the current quality of high-ways over the next 22 years.

Several of the forum speakers said it was time that Texas approved an increase in the fuel tax, or at least tied it to inflation. Since the early 1990s, the Texas Legislature has turned down similar proposals. Keynote speaker T. Boone Pickens, founder of BP Capital, detailed his now-famous plan to reduce our dependency on foreign oil with the help of wind power and natural gas.

TxDOT, the Texas Transportation Institute (TTI), the Associated General Contractors and the Texas Good Roads Transportation Association co-hosted the forum. The Fifth Annual Texas Transportation Forum will be held January 6-8, 2010, in Austin, Texas. ■



Work Zone Clearinghouse spreads safety worldwide

The effort to make highway work zones safer worldwide has led to a Global Road Achievement Award for the Texas Transportation Institute's (TTI's) National Work Zone Safety Information Clearinghouse. The International Road Federation award was presented in Washington, D.C., January 12.

"This global award is a great honor for TTI and all of the other groups involved in this endeavor," says Jerry Ullman, manager of TTI's Work Zone Program. "We have all come together to make a real difference in making work zones safer." (An estimated 1,000 people are killed and 45,000 injured in U.S. roadway work zones each year.)

The National Work Zone Safety Information Clearinghouse is the largest online resource for roadway construction safety. The clearinghouse is a joint effort of the American Road and Transportation Builders Association, the Federal Highway Administration and TTI. Since it went online in 1998, the clearinghouse has assisted half a million users from every state and 27 countries.

Visitors to the National Work Zone Safety Information Clearinghouse website "can find a wealth of information about crash data, laws and regulations, safety standards,



Receiving an International Road Federation award for their group's work on the National Work Zone Safety Information Clearinghouse are (from left to right) Morris Oliver of the Federal Highway Administration (FHWA), Brad Sant of the American Road and Transportation Builders Association, Joe Toole of FHWA, Research Librarian Hong Yu and Director Dennis Christiansen of TTI.

research publications, training courses and safety products...just about anything related to work zone safety," says Research Librarian Hong Yu, who maintains the website. "If they cannot find what they are looking for on our website, they can always contact us for help." ■

Button retires, can't say goodbye

Some 40 years later, Senior Research Fellow Joe Button knew he had made the right decision to start working for the Texas Transportation Institute (TTI) as a chemical engineering student in 1968. "TTI was created when I was six years old, but I got here as fast as I could," he told attendees of his retirement party December 12.

Former bosses, colleagues and people who worked for Button took turns at the podium but were a bit redundant in their descriptions of the man for whom they hold enormous respect — using words like "dependable," "professional," "devoted" and "reputable."

"You have to look a long time to find someone more sincere," said Assistant Agency Director Gene Buth, who was first to hire Button for TTI 40 years ago at the Riverside Campus. Buth was not surprised about Button's accomplishments. "He became one of the world's leading experts in pavements."

Earlier this year, Button was the recipient of the TTI/Trinity Industries Charley V. Wootan Career Achievement for Research Award, which was announced at TTI Day.

Despite his retirement, Button has decided four decades is not enough. He will continue working at TTI — on a part-time basis. ■



TTI Senior Research Fellow Joe Button and his family at a reception ceremony in his honor.

Tim Lomax honored by A&M System Board of Regents

World-renowned for his work on the Texas Transportation Institute's (TTI's) Urban Mobility Report, Research Engineer Tim Lomax has been awarded the Texas A&M University System Board of Regents' highest honor. Lomax was presented with the Regents Fellow Service Award during ceremonies held Dec. 4.

The Regents Fellow Service Award is reserved for those A&M System employees "who have provided exemplary professional service to society that has created large and lasting benefits to Texas and beyond."

"I am extremely honored to receive this award," Lomax said. "I'm not usually speechless, but how does one person accept an award that is a reflection of a team effort? My wife and son, researchers in the Mobility Analysis Program and many other colleagues at TTI have created

an incredible environment. It's easy to provide 'exemplary service' when you collaborate with creative, hard-working people on interesting projects for sponsors who appreciate our ideas—I am only a small part of that process."

The Regents Fellow Service Award was established in 1998. So far, 66 agency professionals have been named Regent Fellows including four others from TTI: Hayes Ross, Gene Buth, Dock Burke and Dennis Christiansen.

"I am in great company," Lomax observed.

At a dinner in their honor, Regents Fellows received a \$9,000 stipend, a commemorative medallion and a certificate. ■



Chairman of the Texas A&M Board of Regents Bill Jones (left) and Vice Chairman John White (right) pose with Tim Lomax and his wife, Jeannine, after Lomax was honored with the Regents Fellow Service Award.

SWUTC celebrates milestone, shared accomplishments

Since its beginning in 1988, the Southwest Region University Transportation Center (SWUTC) has grown into one of the most highly respected University Transportation Centers (UTC) in the U.S. DOT-sponsored program. Dock Burke, SWUTC director, is quick to identify the institutional sources of the center's accomplishments.

"There are two main reasons why SWUTC has flourished since October of 1988," Burke notes, "and those are our strong and continuous support from TTI [SWUTC is headquartered within the Institute] and the robust collegial relationship with our consortium partners: Texas A&M University; The University of Texas at Austin and its Center for Transportation Research; and Texas Southern University and its Center for Transportation Training and Research."

Established "to advance U.S. technology and expertise in the many disciplines comprising transportation through the mechanisms of education, research and technology transfer," SWUTC is one of 10 regional UTCs around the country founded with federal grants that must be matched on the state level.

In 1992, the Texas Legislature approved TTI's request for matching funds from the State of Texas. "That one act did more to stabilize our funding base than anything else," Burke says. More recently, TxDOT has become an active partner in the research project evaluation and selection process.

"With the 20-year anniversary of SWUTC upon us, it's time to reflect and re-emphasize the unique qualities of the UTC program. Our consortium colleagues on the teaching and research faculties provide the core energy for our enterprise. The students' educational experiences are greatly enhanced by their SWUTC activities." ■

TECHNICAL REPORTS

"Managed Lanes Handbook Training: Year 2 Report of Activities," by Beverly Kuhn, **5-4160-01-2**, March 23, 2009.

"Implementing GPS into PAVE-IR," by Stephen Sebesta, **5-4577-03-1**, March 17, 2009.

"Improvements to Video Imaging Detection for Dilemma Zone Protection," by Dan Middleton, **0-5774-1**, March 17, 2009.

"Potential Policies and Incentives to Encourage Movement of Containerized Freight on Texas Inland Waterways," by Jim Kruse, **0-5937-1**, March 17, 2009.

"Speeds in School Zones," by Kay Fitzpatrick, **0-5470-1**, March 17, 2009.

"Development of Frontage Road Yield Treatment Analysis Tool (FRYAT) Database Software," by Kwaku Obeng-Boampong, **0-4986-2**, March 16, 2009.

"Deploying Weigh-In-Motion Installations on Asphalt Concrete Pavements," by Emmanuel Fernando, **0-5551-1**, March 9, 2009.

"Establishing Advisory Speeds on Non Direct-Connect Ramps: Technical Report," by Steve Venglar, **0-6035-1**, March 4, 2009.

"Evaluation of Traffic Control Devices: Fifth-Year Activities," by Gene Hawkins, **0-4701-5**, March 2, 2009.

"Evaluation of Binder Aging and Its Influence in Aging of Hot Mix Asphalt Concrete: Literature Review and Experimental," by Charles Glover, **0-6009-1**, February 20, 2009.

"Synthesis on Construction Unit Cost Development: Technical Report," by Stuart Anderson, **0-6023-1**, February 16, 2009.

"Incorporating Safety into the Highway Design Process: Fifth-Year Report," by Jim Bonneson, **0-4703-6**, February 13, 2009.

"Development of a Precast Bridge Deck Overhang System for the Rock Creek Bridge," by David Trejo, **0-6100-2**, February 11, 2009.

"Operations-Oriented Performance Measures for Freeway Management Systems: Final Report," by Bob Brydia, **0-5292-2**, February 11, 2009.

"PAVECHECK: Integrating Deflection and GPR for Network Condition Surveys," by Wenting Liu, **5-4495-01-2**, February 10, 2009.

"Evaluation of Ways and Procedures to Reduce Construction Cost and Increase Competition," by Ivan Damjanovic, **0-6011-1**, February 2, 2009.

"Studies to Improve the Management of Regulatory Speed Limits in Texas Work Zones," by Melissa Finley, **0-5561-1**, January 12, 2009.

"Characterization of Self-Consolidating Concrete for Design of Precast, Prestressed Bridge Girders," by David Trejo, **0-5134-2**, January 7, 2009.

PROJECT SUMMARY REPORTS AND PRODUCTS

"Regional Transit Coordination Guidebook," by Carol Lewis, **0-5345-P1**, March 16, 2009.

"60-Minute Hands-on Training Module," by Kay Fitzpatrick, **0-5470-P1**, March 12, 2009.

"Traffic Signal Operations Handbook," by Jim Bonneson, **0-5629-P1**, March 12, 2009.

"Guidebook: Potential Policies and Incentives to Encourage Movement of Containerized Freight on Texas Waterways," by Jim Kruse, **0-5937-P1**, March 11, 2009.

"Laboratory and Field Procedures Used to Characterize Materials," by Fujie Zhou, **0-5798-P1**, February 13, 2009.

"PAVECHECK: Training Material: Updated User's Manual Including GPS," by Wenting Liu, **5-4495-01-P2**, February 13, 2009.

"Transfer Functions for Various Distress Types," by Fujie Zhou, **0-5798-P2**, February 9, 2009.

"Traffic Signal Operations Workshop: Course Notes and PowerPoint Presentation," by Jim Bonneson, **0-5629-P2**, February 4, 2009.

TTI PUBLICATIONS

A full catalog of TTI publications and other products is online at <http://tti.tamu.edu/publications>. You can find the publications by searching for either the title or publication number listed here. Most of these publications are available as free downloads in portable document format (PDF).

Printed, bound versions of these reports are also available through the URL above.



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