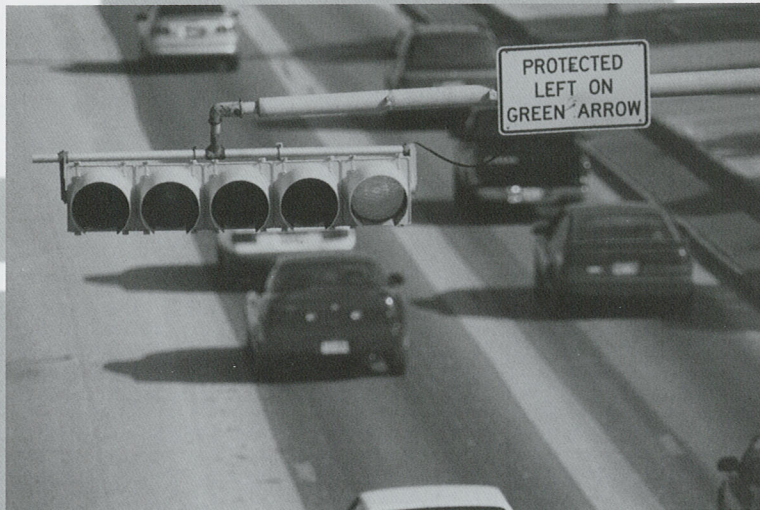


TEXAS TRANSPORTATION Researcher

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TRAFFIC SIGNAL GUIDELINES GET A "GREEN LIGHT"

TTI researchers took an in-depth look at how traffic signals are justified.

HAVE YOU EVER wondered what prompted installation of a new traffic signal on a familiar route? Or wished for one as you sat idling in line at an intersection?

Deciding what conditions warrant traffic signals — instead of less restrictive means of traffic control — requires transportation officials to consider a wide variety of factors. Complaints, special requests or current events may initiate the process. The decision to locate a signal, however, must not simply respond to complaints or special requests, but reflect sound engineering judgment and a thorough analysis of the situation.

The warranting process for traffic signals has evolved with changing technology and traffic needs over the last 60 years.

Continued on Page 2

A 1997 accident involving a school bus prompted the Texas Department of Transportation (TxDOT) and Texas Transportation Institute (TTI) researchers to take an in-depth look at the warrants which help determine traffic signal justification. The project's outcome is a set of comprehensive, uniform guidelines for conducting traffic signal warrant analyses.



The guidelines clarify issues open to interpretation, improve the consistency of decisions and provide a way to explain resulting outcomes.

Based on these clarifying guidelines, the warranting process provides reliable, consistent results that offer a clear indication of whether the conditions justify further consideration of a traffic signal. The process leaves room for all evaluations that affect the decision to place or remove a traffic signal and promotes statewide consistency in the warranting process.

"Through our survey of TxDOT traffic engineers, we realized implementation of the warrants has a lot of variability," says Paul Carlson, assistant research engineer with TTI's Operations and Design Division. "The language of the warrants is vague, so an engineer in one district could be making very different assumptions from an engineer in another district."

Signal justification can be complicated and, often, misunderstood. The new guidelines provide transportation officials with detailed information about conducting a traffic signal warrant analysis. They clarify issues open to interpretation, improve the consistency of decisions and provide a way to explain resulting outcomes.

"There are a lot of clarifications in the guidelines that traffic engineers probably know instinctively but have never seen officially interpreted. This document brings warrant clarification to the state and provides a means for more consistent traffic signal analyses," notes Carlson, who conducted the project with Gene Hawkins, Jr., division head of the Operations and Design Division.

Uniform signal placement and operation lead to consistent driver recognition and potentially greater safety for all roadway users. When installation of a traffic signal is properly justified, and it operates effectively, the signal can have many advantages for a community. Ineffectively placed or improperly operated traffic signals, on the other hand, can be costly and unsafe.

In order to ensure that advantages outweigh disadvantages and to provide some consistency in the application of traffic signals, warrants identified in the national Manual on Uniform Traffic Control Devices (MUTCD) and Texas MUTCD establish minimum criteria for traffic signal placement. They also list measures to identify candidate locations that may benefit from further analysis of the need for a traffic signal.

If one or more of the MUTCD warrants are met, the proposed

location merits additional consideration. If none of the warrants are met, the location is better suited to another type of less restrictive traffic control. Researchers in the current project determined that existing warrants covered necessary aspects of traffic signal decisions, but needed expanded definition.

"This project has received a considerable amount of attention. It was selected by TxDOT officials as a 'Top Ten' research product last year. We printed 225 copies of our guidelines. They were gone in no time, and we've received requests for more. We've also been asked to computerize the guidelines and are in the process of determining the feasibility of this request," says Carlson.

The guidelines publication was sent to TxDOT districts in September, so it is too early to hear of specific cases that have used the clarified process. The quick requests for more reports and software indicate that transportation officials welcome the assistance provided by the new guidelines. Once in place, a more consistent warranting process could improve signal placement throughout the state and result in increased safety for Texas travelers. ●

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Related publication:
Report 3991-2: Guidelines for Conducting a Traffic Signal Warrant Analysis

TTI research helps reinforce Texas bridges

Cracks. We see them everywhere — in drinking glasses, doors, sidewalks and buildings. Cracks in asphalt can cause a bumpy car ride over highways, country roads or bridges. Deep, widening cracks in bridge foundations under the asphalt can threaten bridge stability. Designers need to know how they can modify bridge designs to prevent cracking. The Texas Transportation Institute (TTI) has recently diagnosed some causes of cracking and created equations that will help designers guard against it.

For over 30 years, the Texas Department of Transportation (TxDOT) has been using a bridge design of concrete, box-shaped beams joined together by a “shear key” element. In the late 1980s, designers added a concrete deck slab on top of the box beams and eliminated the shear key to reduce the deck weight. These bridges developed more cracks sooner than ones *with* shear keys.

TTI researcher Harry Jones and fellow researchers have inspected bridges throughout Texas, developed models for various bridge designs, and then tested these models in computer simulations to determine the causes of

cracking and ways to predict it.

“We have determined that a shear key design does work toward reducing deck slab cracking,” says Jones. “Of the bridges we inspected, those with shear keys tended to be less severely cracked. While shorter bridges might not need this element, longer bridges do benefit from its use.”

The project also determined that two main factors cause cracking in the concrete deck: shrinkage due to drying and stresses from live load. The shrinkage from the concrete drying causes it to crack. Then, the stress or force of vehicles passing over the concrete, called the “transverse bending moment,” enlarges and deepens the cracks over time. Since concrete naturally shrinks as it dries, researchers focused their efforts on the factor that can be changed — the transverse bending moment.

The American Association of State Highway and Transportation Officials (AASHTO) code provisions do not address transverse moment in this type of structure, and researchers could not find any predictive equations in published research findings. Jones and other TTI researchers performed over

2,500 computer simulations and used data from these simulations to develop equations that determine the transverse moment. Designers can employ these equations in specific instances and accurately judge the thickness needed for each deck slab, as well as the amount of steel reinforcement the slab needs. According to Jones, providing quantitative information such as equations and tables to designers to help them design safer, better decks is the most significant achievement of this project.

“TxDOT can and will use this information to redo the box beam [bridge] standards,” says TxDOT Project Director Brian Merrill. By both identifying causes of cracking and creating equations to help lessen cracks in future bridges, TTI has helped increase bridge safety throughout Texas.

“We’ve succeeded in diagnosing some causes of the problem [deck cracking],” says Jones. “Further study will help determine more ways to minimize the transverse moment.” ●

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Lytton receives distinguished lectureship

The recipient of the 2000 Transportation Research Board (TRB) Distinguished Lectureship was Robert L. Lytton. Lytton is the F. J. Benson Chair, Department of Civil Engineering at Texas A&M University, Research Engineer at the Texas Transportation Institute, and Director of the Center for Infrastructure Engineering at the Texas Engineering Experiment Station.

This annual award recognizes an individual for his or her career technical contributions and achievements in an area pertinent to TRB's Technical Activities Division. Lytton is internationally recognized for his innovative approaches to modeling and predicting pavement performance. He has also made important contributions in the areas of pavement rehabilitation and maintenance, expansive soils and foundation design. Lytton delivered his lecture on “Characterizing Asphalt Pavements for Performance.”



Researchers have determined that a shear key design does work toward reducing deck slab cracking,

Study shows traffic worsening in a variety of ways and places

Getting a handle on just how bad traffic congestion is becoming in U.S. cities depends a lot on where — and how — you look at it, according to an annual study:

- ♦ The annual cost of traffic congestion per driver in about one-third of the cities studied exceeds the statewide average cost of auto insurance for those cities.
- ♦ Drivers in one-third of the cities spend at least half as much time stuck in traffic as they do on vacation each year.
- ♦ In more than half the cities studied, the amount of time drivers

The study shows that drivers in more than half the cities studied needed anywhere from 20 to 50 percent more time to complete the rush-hour journey in 1997. This peak-period time penalty more than doubled in the 68 urban areas between 1982 and 1997. This includes a 260 percent increase in areas between one and three million population and a 240 percent jump for cities between 500,000 and one million population.

Researchers also calculated the amount of delay each driver

gestion cost is composed of extra travel time and wasted fuel. The total amount of fuel wasted in 1997 was 6.6 billion gallons, more than twice the amount wasted 15 years before.

“Mobility levels are declining just about everywhere, but they’re declining fastest in those cities where transportation investment fails to keep pace with population growth,” says TTI researcher Tim Lomax. “As we see it, a healthy economy means more travel by people and freight. If transportation systems aren’t expanded, this travel takes longer and is less reliable.”

Researchers point out that cities must apply several strategies if they expect to prevent a continued decline in mobility levels.

For example, if building additional roadway capacity were the only option, the cities in the study would have to add an average of 37 more lane miles than they currently do to keep pace with only one year of increased traffic demand.

If carpooling were the only answer, the average city would have to increase its annual number of carpool trips by at least 100,000 every year.

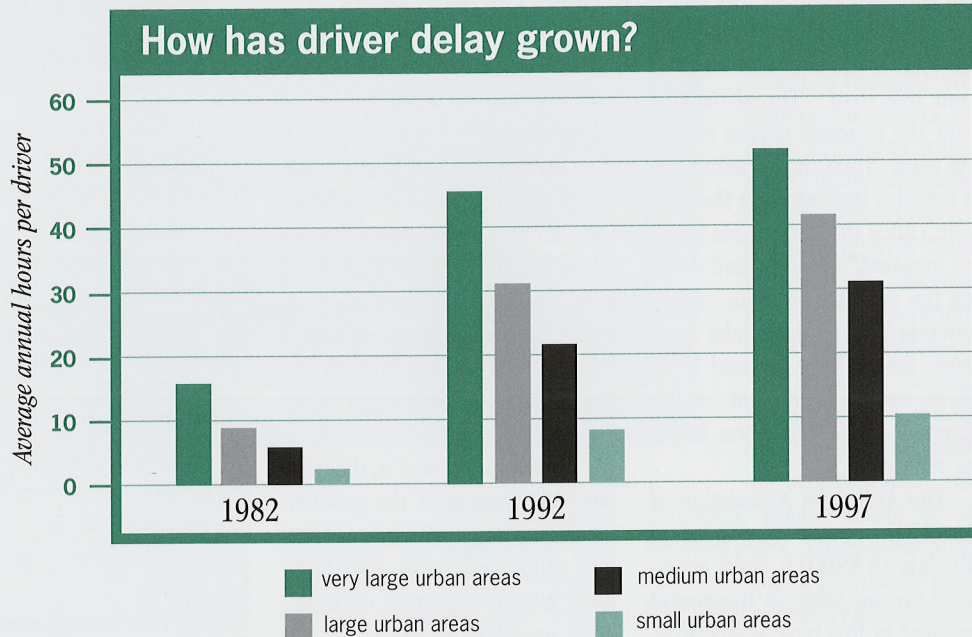
“There isn’t a need for one specific option so much as there is a need for consensus that transportation is an important element of our cities, and that something will be done to address the mobility issues,” Lomax says. “This starts at the local level with a discussion about which options are right for the area and how they will be funded.”

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spend stuck in traffic has grown by at least 350 percent over the past 16 years.

These and other trends are illustrated in the *1999 Annual Mobility Report*, published by the Texas Transportation Institute (TTI). Researchers David Schrank and Tim Lomax use a variety of data to measure mobility in several different ways. The data come from state and national sources and show conditions from 1997, the most recent year for which information is available.

One measure, the Travel Rate Index, shows the difference between a trip taken during peak travel times and the same trip made in uncongested conditions.

experiences. Drivers in roughly one-third of the cities spent more than 40 hours over the course of a year stuck in traffic. The amount of delay experienced by each driver in the urban areas studied has nearly tripled since 1982. Drivers in small- to medium-sized cities have seen delay increase far more quickly than drivers in the nation’s largest cities have.

The financial cost of congestion exceeds \$72 billion per year, up from \$66 billion in 1996. Almost half the urban areas studied had congestion costs of more than \$500 million per year, and congestion costs per driver ranged from \$50 in Brownsville, Texas, to \$1,370 in Los Angeles. The con-

In more than half the cities studied, the amount of time drivers spend stuck in traffic has grown by at least 350 percent over the past 16 years.

New Superpave center headquartered at TTI

The South Central Superpave Center (SCSC), now headquartered at the Texas Transportation Institute (TTI) in College Station, is designed primarily to assist state departments of transportation and other asphalt paving industry members in the central U.S. as they implement the Superpave asphalt mixture design and analysis systems.

The SCSC is a partnership between TTI and the Texas Department of Transportation (TxDOT), with additional funding support from the Federal Highway Administration (FHWA). Senior Research Engineer Joe Button manages the new center.

"TTI hosts one of the largest university-based asphalt and flexible pavements research programs in the United States," Button said.

He added that as a result, the SCSC has access to at least 14

engineers and scientists with specific expertise in the physical and chemical properties of asphalt, bituminous materials, asphalt mixture design, flexible pavement structural design, aggregates, petrography, experiment design, forensic analysis, recycling and all other areas of asphalt pavements. Button is assisted by Dallas Little, Charles Glover, Robert Lytton, Cindy Estakhri, Amy Epps, Tom Scullion, Roger Smith, Thomas Freeman, E.G. Fernando, Richard Davison, Shondeep Sarkar, Patrick Harris, Arif Chowdhury and John Ragsdale.

Superpave (SUPERior PERforming Asphalt PAVements) is a performance-based system for designing asphalt pavements to meet the demanding roadway needs of the next century. This performance-based approach holds the promise of more durable pave-

ments that can withstand extremes of temperature and heavy traffic. Superpave implementation will allow highway agencies to spend scarce public funds more efficiently by extending pavement life and lowering maintenance costs. The bottom line for the driving public is safer, smoother rides on better roads at a lower cost.

Particular regional challenges will continue to evolve as Superpave implementation proceeds.

"Superpave has moved beyond the preliminary needs associated with introducing the technology, but it still faces field application and long-term performance challenges," Button said.

Other issues include implementation of proposed specification changes based on current research efforts, certification and quality control. The SCSC offers continuity, regional and national

expertise and other resources as state departments of transportation and industry in the central U.S. deal with Superpave issues.

The laboratory is fully equipped with all of the Superpave binder and mixture analysis equipment. The FHWA provided a Superpave shear tester (SST), indirect tension tester (IDT), Superpave gyratory compactor and binder direct tension tester (DTT). This loaned equipment gives the SCSC unique capabilities since it has both Cox and Interlaken brand SSTs as well as IPC and Pine gyratory compactors.

TTI is the only laboratory in the country with two Superpave SSTs. In addition, TTI has a full complement of other state-of-the-art asphalt laboratory research equipment, including an asphalt pavement analyzer, a 1/3-scale mobile load simulator and an overlay tester unique to TTI. ●

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"Superpave has moved beyond the preliminary needs associated with introducing the technology, but it still faces field application and long-term performance challenges."

— Joe Button, senior research engineer and manager of the South Central Superpave Center

TTI initiative recognizes highway safety as public health issue

Professionals from the following agencies are involved in the Public Health and Highway Safety Initiative

TTI
College Station

Texas Agricultural Extension Services — Family & Consumer Science
College Station

FHWA
Austin & Fort Worth

TxDOT
Austin

University of Texas School of Public Health
Houston

Texas Department of Health
Austin

University of Texas — El Paso
El Paso

Baylor College of Medicine — Pediatric Injury Prevention Programs
Houston

Texas A&M University — Safety Education
College Station

Texas A&M School of Medicine
College Station

Texas Alcoholic Beverage Commission
Austin

Scott & White — Family Medicine Research
Temple

South Texas Injury Prevention Center — UTSA
San Antonio



Approximately 35 professionals from several Texas agencies attended the Public Health and Highway Safety Forum in College Station.

Although much of Texas is rural, it has three of the 10 largest cities in the country and 13 million licensed drivers. Over 3,500 Texans are killed in highway crashes each year, including 250 children under 15 years of age. Highway crashes are the fifth leading cause of death in the U.S., killing approximately 40,000 and injuring 5 million people every year. These crashes cost society \$150 billion annually — \$11 billion in Texas alone.

Texas Transportation Institute (TTI) engineers have made Texas roads safer through advances in lighting, signing, roadway design and roadside safety devices. However, a new initiative at TTI's Safety and Structural Systems Division will focus more on the human element in highway safety.

TTI's Public Health Initiative (PHI), in partnership with the University of Texas School of Public Health (UTSPH), promotes the idea that motor vehicle injuries are a preventable highway safety and public health problem. The initiative aims to identify the

causes and reduce the burden of traffic-related injuries and fatalities through multidisciplinary collaboration among engineers, behavioral scientists, medical personnel and public health professionals.

The initiative has been in operation for about one year. Senior Research Scientist Lindsay Griffin heads up the initiative. "We are working with health professionals and community groups around the state to see to it that motor vehicle injuries are recognized as a preventable public health problem," he says.

The PHI hosted a Public Health and Highway Safety Forum November 4 at the Gibb Gilchrist Building in College Station. The forum fostered professional relationships that could lead to more productive collaborations to reduce traffic-related injuries. Approximately 35 professionals attended from several agencies, including the Texas Department of Transportation (TxDOT), the Federal Highway Administration (FHWA), the Texas Department of Health,

Baylor College of Medicine and Scott & White.

"Motor vehicle crashes are a leading cause of death and injury in the United States and Texas. These crashes represent not only the pain and suffering of families and friends, but also a tremendous economic burden on us all," says Griffin.

Over the past 60 years Texas has experienced a decrease in the number of people killed in motor vehicle-related crashes. According to Griffin, these reductions are in part a result of safer vehicles, better road designs and changes in driver behavior.

"The challenge now lies among a variety of professionals, in particular those in the highway safety and public health fields, to form a united front to uphold and improve on these motor-vehicle safety advancements, identify new obstacles and increase multidisciplinary, collaborative research." ●

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A COMMITMENT TO COOPERATION

*TTI and consulting engineers identify ways to work together
to advance common interests*

Through a series of ongoing meetings, the Texas Transportation Institute (TTI) and the transportation consultants in Texas have worked together to better understand the proper role for a large, university-based research program. This dialogue has resulted in an agreement, signed by all parties, that helps clarify the role of TTI in advancing transportation in the state.

Dennis Christiansen, deputy director of TTI, noted, "Perhaps the most positive outcome of this process has been the establishment of an ongoing and continuing dialogue between the consultants and TTI. We better understand their concerns, and they better understand our programs. The continuing dialogue allows for the timely resolution of any issues that may arise."

The Consulting Engineers Council of Texas, the Consultants Council of the Texas Section of the Institute of Transportation Engineers, and TTI prepared a paper describing the process that has occurred over the past two years and the results and benefits of that process. This paper, which may provide a framework to be followed in other states, is presented on the following pages.

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CONSULTING ENGINEERING PROFESSION AND THE UNIVERSITIES: MOVING TOWARD A MUTUALLY SUPPORTIVE RELATIONSHIP IN TEXAS

Steve Stagner

Executive Director
Consulting Engineers
Council of Texas

Dennis L. Christiansen

Deputy Director
Texas Transportation Institute
The Texas A&M University System

Joseph Short

President
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Texas Section, ITE



Training and educating the next generation of transportation professionals, traditionally a university role, is more critical than ever in meeting the professional needs required to effectively implement transportation programs authorized by the Transportation Equity Act for the 21st Century (TEA-21). Consulting engineers depend on universities to develop talent, and the universities depend on research as a key means of supporting and enhancing the educational process.

The university role of providing a trained work force is clearly important to the consulting engineering profession. However, as the *American Consulting Engineering Magazine* noted in its August/September 1998 issue in an article entitled "Building Bridges to Academe," the university research component can raise concerns. As the author notes, "Engineering schools, traditionally valuable partners for engineering firms, are now seen by consulting engineers as sources of growing competition." Texas, with large research universities, is not immune to these concerns. Indeed, as the *American Consulting Engineering Magazine* article noted, Texas was one of those states where consulting engineers were inquiring about the university programs.

This paper reviews how three interested parties in Texas—the Texas Transportation Institute (TTI), a state agency and a member of The Texas A&M University System; the Consulting Engineers Council (CEC) of Texas, which represents over 300 consulting firms; and the Consultants Council of the Texas Section of the Institute of Transportation Engineers (CCTexITE), which represents 27 consulting firms—collaborated to openly address possible issues and concerns.

BACKGROUND

The Texas Transportation Institute is the largest university-affiliated transportation research center in the nation. In addition to its headquarters on the Texas A&M University Campus in College Station, the Institute maintains permanent urban research and implementation offices in five of the larger Texas cities. Through both involvement in professional activities and project work, TTI staff has frequent contact with numerous consultants.

Over several decades, an effective, informal dialogue had developed between many of the consulting firms that specialize in transportation planning and engineering and TTI. By the early 1990s, these informal discussions were occurring with increasing frequency, particularly with those transportation-oriented consulting firms represented by CCTexITE. In 1992, TTI and CCTexITE worked together to develop a consensus position paper that helped to define the role of TTI in advancing transportation in the state.

The Consulting Engineers Council of Texas, which represents many more firms than CCTexITE, was not a party to the 1992 discussions. Many CEC firms knew less about TTI than did CCTexITE firms, and many CEC firms were unaware of the discussions that had occurred between TTI and CCTexITE. In addition, membership in CCTexITE has grown since 1992. Thus, a need existed to both update and expand the 1992 position paper.

THE PROCESS

The CEC initiated the dialogue with universities in the state. It became apparent that an open exchange of information and concerns would be key to addressing all of the issues on the table. In response to CEC inquiries, the Institute made available all of its contractual documents for their review. In May 1998, the leadership of TTI met with the CEC state legislative committee and presented an overview of TTI and the TTI research programs. TTI met with CCTexITE in June 1998 for a similar briefing. These briefings provided an overview of the TTI organizational structure as well as information on the size and a breakdown of the Institute's contract expenditures.

From these initial meetings, it was agreed that an ongoing dialogue is desirable, and both CEC and CCTexITE appointed representatives to work with TTI to thoroughly address and resolve all issues. In August 1998, the three parties met at the CEC offices to discuss specific programs and projects in depth. TTI prepared a "white paper" for this meeting in an effort to both provide pertinent information and answer relevant questions. These three parties met again in October 1998 and in July 1999. During the meetings, a wide range of topics were discussed. The next meeting will be in College Station in December 1999, and TTI will present its research program to a larger group of interested consultants.

THE OUTCOME

As a result of the meetings and the information that was exchanged, a positive relationship developed between the three parties. A recognition has developed that the universities and the consultants have mutual interests and can help each other in a variety of different ways, some of which, as shown below, have already been manifested.

- The 1992 agreement with CCTexITE was reviewed, modified and updated. This led to a joint position paper entitled "Defining a Role for the Texas Transportation Institute in Advancing Transportation in Texas." This paper was signed by all three parties. This paper is a dynamic document that helps to define the types of work that should and should not be undertaken by a research university.

- TTI, which is governed by The Texas A&M University System Board of Regents, modified its formal charter to clarify its relationship with the private sector, and that charter has been officially approved by the Board.

- TTI, working with CEC, planned and executed for CEC members a seminar addressing some of the latest advances in traffic management. Based on the initial success of this endeavor, a series of additional seminars is being discussed.

FUTURE COMMITMENTS

Perhaps the most positive outcome of this process has been an agreement among the three parties to continue to meet on a regular basis to discuss issues of mutual interest and to continue to identify ways to more effectively work together. Many areas of collaboration, such as mutual support on legislative issues and further pursuit of professional development activities, have already been identified. Through an open and extended dialogue, CEC, CCTexITE, and TTI have been able to turn a potentially divisive and acrimonious relationship into a mutually supportive and beneficial one. This collaborative effort in Texas may offer a framework for addressing similar issues in other states.

Agencies work together toward school safety

An innovative pilot program introduced by the Texas Department of Transportation's (TxDOT) Dallas District may reduce the chances of students being killed or injured in traffic-related incidents occurring near schools. The program, Precious Cargo, is designed to facilitate communication and cooperation between TxDOT and local schools in the effort to establish the safest possible traffic environments around schools.

Mark Ball, public information officer for TxDOT's Dallas District, emphasizes that the Precious Cargo program is about communication and cooperation between the state and local school districts. "We all want to do what we can to make our roads safer especially near our schools," he said. "That involves all of us working together."

The Precious Cargo program will allow TxDOT staff, when asked by local school districts, to review site plans of future school facilities and make recommendations for improving traffic safety and efficiency before a problem ever oc-

curs. The program also proposes that unbudgeted road improvements requested by school districts might be accomplished through a partnership, with a community providing materials while TxDOT supplies equipment and labor.

The Texas Transportation Institute's (TTI) Information & Technology Exchange Center (ITEC) worked with TxDOT officials from the program's initiation to provide communications support, define the problems involved, identify critical issues and develop creative solutions.

"This is a project where we've been involved from concept to rollout," says Sue Lancaster, the director of ITEC. "ITEC helped characterize the problem, create and pull the program together, and prepare materials. Everyone involved worked together to open a productive dialogue, which will prevent dangerous situations for the state's school children."

State Senator David Cain, who helped TxDOT introduce the Precious Cargo program in Dallas, says

the program encourages teamwork between public agencies. "As we dedicate our time and resources to ensuring that our children have the best education from the finest teachers and administrators, we can't forget our duty to protect them while they're at school," he says. "The most effective solutions to traffic problems at our schools will come about when public entities work together. TxDOT is committed to listening to specific problems and working to address them under the Precious Cargo program."

Many school zone traffic problems, particularly in urban districts, result from dramatic population growth. In some areas of the Dallas District, for example, school enrollment increased as much as 30 percent between 1990 and 1998. During the same period, some county populations grew more than 50 percent. In regions with such dramatic growth patterns, new schools are often built in areas that were once remote rural neighborhoods. These schools may be built on or near

high-speed, two-lane highways that were not originally designed to handle the traffic patterns and volumes associated with schools.

Almost a dozen school districts requested meetings with TxDOT following the kickoff of the program in the Dallas District. Since the program was introduced, several areas across the state have taken steps to customize the program for their own regions. The San Antonio District plans to launch the program in January. TTI continues to work with TxDOT and the school districts as the Precious Cargo program expands. ITEC is preparing an informational brochure about the program available early next year.

"School safety has always been a major concern, and we hear even more about it these days," says Lancaster. "The Precious Cargo program opens up the channels of communication and establishes a connection between organizations that can help increase safety around our schools. It's very rewarding to be a part of this program." ●

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The Precious Cargo program will allow TxDOT staff, when asked by local school districts, to review site plans of future school facilities and make recommendations for improving traffic safety and efficiency before a problem ever occurs.

Easy licensing for low-profile barriers

The sturdy concrete barriers lining highway work zones throughout Texas are changing. Once standing 32 inches high, the barriers were tall enough to protect workers from errant vehicles. But as researchers in the Texas Transportation Institute's (TTI) Safety Division discovered, drivers couldn't see over the barriers as they were entering traffic from side streets and driveways. Now, thanks to TTI, drivers across the state are encountering a new low-profile portable concrete barrier (PCB) that stands only 20 inches from the ground.

Developed by TTI researchers and patented by TTI to address both cross-traffic visibility problems and worker safety, low-profile PCBs have been available in Texas since 1991. Also available have been the TTI-designed sloped end treatments meant to protect motorists in head-on collisions with the barriers. Until recently, however, jurisdictions and contractors outside the state have not taken advantage of these new designs.

Use of the low-profile PCBs requires a license because the technology is patented. Terry Young, executive director of The Texas A&M University System's Technology Licensing Office (TLO), says patenting research results is a way to protect TTI's investments, as well as investments of industry partners in product development. "Without patent protection, TTI's products might not otherwise get to market," says Young. Texas contractors are offered a royalty-free license because TxDOT provided partial funding for development of the PCB. But highway contractors outside the state have not had a simple way to access the barrier technology. Young gladly welcomed the opportunity to make other states aware of TTI's low-profile PCBs. He notes, "Our

agency is not only responsible for protecting the System's intellectual property, but for promoting technology transfer for public benefit."

Greg Schertz, Safety Engineer for the Federal Highway Administration's (FHWA) Western Resource Center, also played an integral role in recognizing the need to encourage low-profile PCB development outside the state of Texas. Young says, "While conducting training courses in several states, Mr. Schertz learned of the need for a low-profile barrier in urban work zones, just like the one TTI had invented." He saw TTI's barrier listed in the American Association of State Highway and Transportation Officials (AASHTO) Roadside Design Guide and learned that the technology was patented but not utilized outside Texas. After contacting TTI to discuss the possibility of a simplified license agreement, the TLO and TTI came together to develop the idea, providing a simple mechanism for obtaining a license to the proprietary technology.

Increasing public awareness, the TLO has put together more than 50 marketing packages to inform agencies in every state about low-profile barriers. While no jurisdiction has had time to respond yet, when they do, they will encounter a very simple process to gain access to the PCBs.

An interested party enters into an agreement with the Texas A&M University System, releasing it from all liability related to the use or manufacture of the barriers. The party also pays a \$1,000 license fee and a product fee of two dollars per linear foot of barrier. Dr. Charley Wootan, director emeritus of TTI and currently in



A very simple licensing process will now allow other states to use the low-profile portable concrete barriers developed at TTI.

charge of TTI's patents and licensing agreements, says the product fee counts against the original license fee. "In effect this means that once the license fee is paid, there is no royalty charged on the first five hundred feet produced," says Dr. Wootan. Once the agreement is signed and the fees paid, the licensees take on the responsibility for manufacturing the barriers according to patent specifications and then using or selling them as they see fit.

With low-profile PCBs now promoted to other states, a prod-

uct meant to improve safety will more easily make its way into highway work zones. ●

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TTI public transit research improves the ride

Do you ride buses, the subway, public vans or other forms of public transportation? Can you find and figure out bus schedules easily? Do you know the bus or subway emergency plans for crisis situations? If you've answered "no" to any of these questions, you're not alone. Many Americans don't use public transportation on a regular basis. Those who do sometimes have problems reading signs and schedules. And some transit systems don't have predetermined emergency plans that coordinate with local authorities.

Public transportation, however, benefits our communities. It reduces exhaust fumes and traffic from overcrowded highways. Efficiently run buses, vans and subways save passengers and individual drivers time and money. The more people who use transit, the better the ride for the driving public. Public transit affects everyone, and Texas Transportation Institute (TTI) guidebooks and research have recently helped boost public transit in three areas: information services, emergency management and marketing.

Passenger Information Services

Passenger information materials offered by transit systems throughout the U.S. and Canada are often not easily available, user friendly, or up to date. TTI has examined public transit information aids — such as bus schedules, maps and signs — in an effort to improve their usefulness to the public. Research has included designing a prototype system map and route map timetable, testing them alongside other maps and timetables, and then adjusting the design guidelines and prototypes as needed. Based on this research, TTI developed *Passenger Information Services: A Guidebook for Transit Systems* to help improve



Texas Transportation Institute guidebooks and research have recently helped boost public transit in three areas: information services, emergency management and marketing.

passenger information services.

Laura Higgins, one of the primary authors, says, "We developed this guidebook to give small transit systems information they could use to get the most out of their efforts and resources." The guidebook addresses basic information needs, such as route data and decision making during a trip. It also discusses information-aid design and format details, including fonts, graphics, use of color and symbols and map legends.

Emergency Management

TTI also investigated the emergency management aspect of public transit. Public transit has helped in crisis situations both in Texas and throughout the country. Unfortunately, many local jurisdictions do not include transit systems in their emergency plans. So researchers studied possible roles and activities transit systems might play in crises. The study produced *Emergency Management Planning for Texas Transit Agencies: A Guidebook* to help transit systems plan for emergency situations and coordinate their plans with other city and county agencies.

"There's a lot of emergency planning literature out there," says Laura Higgins, the primary author. "We've tried to give transit systems an introduction to all the literature — a bird's eye view of what they need and where to get started."

Besides offering basic recommendations for integrating the transit agency into emergency plans already set by the city and/or county in which it operates, the guidebook also gives resources for further information on specific emergency planning activities, examples of procedures and documentation from existing emergency plans.

Transit Marketing Strategies

A third recent focus at TTI is marketing strategies for promoting public transit use. Researchers have collected innovative, low-cost marketing techniques proven effective in public transit systems in the U.S. and other countries. The result is *A Handbook of Proven Marketing Strategies for Public Transit*. Even though the research has covered a broad range of transit systems, this handbook emphasizes ideas

most appropriate for rural and small urban public transit properties, those with minimal marketing budgets. The handbook includes examples of promotions and strategies such as cooperative promotions, projects to introduce new services, media relations and problem-solving projects. It offers existing information, such as instructive materials and samples for developing a marketing plan, evaluating marketing programs and planning successful events.

According to Cinde Weatherby, the research supervisor, "This handbook puts proven marketing strategies that work into the hands of personnel at small urban and rural transit systems." ●

For more information:

Contact: Katie Turnbull

Phone: (409) 845-6005

E-mail: k-turnbull@tamu.edu

Related Publications:

TCRP Report 45: *Passenger Information Services: A Guidebook for Transit Systems*, National Academy Press, Washington, D.C., 1999

TCRP Report 50: *A Handbook of Proven Marketing Strategies for Public Transit*, National Academy Press, Washington, D.C., 1999

Report FHWA-TX-00/1834-4:

Emergency Management Planning for Texas Transit Agencies: A Guidebook, October 1999

TTI dedicates Gibb Gilchrist Building

On Nov. 11, Texas A&M University and Texas Transportation Institute (TTI) administrators joined the family of Mr. Gibb Gilchrist, TTI staff, state officials and other special guests to dedicate the Gibb Gilchrist Transportation Research Building. Located at 2929 Research Parkway in the Texas A&M University Research Park, the Gibb Gilchrist Building is the first building solely occupied by TTI and designed specifically to meet the needs of researchers working on the leading edge of transportation research.

TTI Director Herb Richardson presided over the naming and dedication ceremony, which included remarks by Texas A&M System Chancellor Howard Graves, Texas A&M University President Ray Bowen and Commissioner of Transportation David Laney. Don Aviles, a member of the Texas A&M University Board of Regents, presented the new fa-

cility to Bowen, and Henry Gilchrist, Gibb Gilchrist's son, spoke on behalf of the family.

Commissioner David Laney commented, "This state has had many great state highway engineers. Each one has stood on the shoulders of Gibb Gilchrist and built on his accomplishments. He was truly one of a kind."

Richardson noted the appropriateness of naming this facility for Gilchrist. "Gibb Gilchrist was a pioneer in the field of transportation and had special connections to Texas A&M," Richardson said. "He served as state highway engineer twice during his career, and later became dean of engineering at Texas A&M, then president, and finally the first chancellor of the Texas A&M University System."

Richardson also noted that Gilchrist worked with State Highway Engineer DeWitt C. Greer to envision and create the Cooperative Research Program between the A&M College and

the Texas Highway Department, which ultimately led to the creation of TTI in 1950.

"The Cooperative Research Program has served the citizens of Texas well, saving lives, time and money. It is also one reason both TTI and the Texas Department of Transportation are recognized as national leaders in transportation," Richardson concluded.

Among the programs housed in the Gilchrist Building is the TransLink® Research Center's Laboratory, a national, multimodal, multi-agency public/private program of research, development and professional education designed to advance surface transportation system management. The TransLink® Laboratory uses state-of-the-art technologies that are developed in partnership with other agencies for the benefit of Texas.

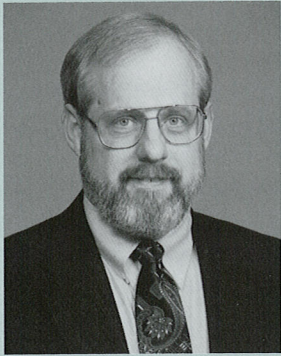
Other specialized research facilities include the Driving Environment Simulator (DESi), which consists of a complete full-size

1995 Saturn SL automobile outfitted with computers, potentiometers and torque motors connected to the accelerator, brake and steering. DESi provides a realistic feel of driving and offers connections to computers for data collection and image generation. TTI is one of the few research entities in the nation with this capability, allowing researchers to look at such issues as aggressive driving, the effects of alcohol use and abuse, fatigued or drowsy driving, the distractions of cell phone use and many others.

TTI's Information & Technology Exchange Center (ITEC) is also located in the Gilchrist building. ITEC is one of few fully integrated communications programs in the country, specifically networked to help implement research results. Digitally created documents, databases, graphics, video and animation are combined to form state-of-the-art web sites, presentations, videos and multimedia CD-ROMs and DVD products. ●



Herb Richardson, Henry Gilchrist and Ray Bowen unveil a portrait of Gibb Gilchrist to hang in the lobby of the new building.



Dan Fambro Scholarship Fund

A memorial scholarship fund has been established in memory of Dr. Daniel B. Fambro as a tribute to his internationally renowned work in transportation and civil engineering, his dedication to Texas A&M University, and his commitment to its students. If you would like to contribute to this fund in order to assist Texas A&M engineering students, please contact Carl Jaedicke with the College of Engineering (c-jaedicke@tamu.edu).

Or send contributions to:
Dan Fambro
Scholarship Fund
c/o Texas A&M Foundation
401 George Bush Dr.
College Station, TX 77840-2811

Jack Keese elected ITE'S 61st honorary member

The highest recognition of notable and outstanding professional achievement presented by the Institute of Transportation Engineers (ITE) is election to honorary membership. Since 1933, when the first honorary member was selected, only 60 individuals have been so honored. In October 1999, the Institute's International Board of Direction selected the 61st transportation professional for this high honor — C. J. "Jack" Keese, director emeritus of the Texas Transportation Institute (TTI).

Jack worked as an assistant professor and assistant research engineer at Texas A&M from 1948 to 1953. He then worked as a traffic engineer for the City of Midland from 1953 to 1955. After returning to Texas A&M in 1955 as an associate professor of highways and traffic engineering (another first), he was promoted to professor in 1958. Jack is generally credited with starting the traffic engineering graduate program at Texas A&M. Jack also helped establish TTI as a university-based transportation research center.

TTI was founded in 1950, but it was small and relatively unknown in 1955. One of Jack's first assignments in establishing a research program was recruitment and training of outstanding staff, which initially yielded

employment of such people as Don Capelle, Dick McCasland, Neil Rowan and Don Woods. By 1958, Jack was head of TTI's Highway Design and Traffic Engineering Division, a position he held until 1962.

From 1962 to 1976, Jack served as executive officer/director of TTI. Under his leadership, TTI became one of the top transportation-engineering research centers in the United States, growing to 200 employees and a \$3.9 million budget by 1976. During Jack's tenure as director, TTI researchers focused on basic research in highway materials, highway safety and traffic engineering, developing innovations such as breakaway sign supports, crash cushions, median barriers, culvert grates, guardrail end treatments, railroad-grade crossing inventories, freeway flow models, ramp metering and motorist information systems. Jack's vision of transportation as an interdisciplinary problem encouraged others to look beyond the traditional solutions to safety and transportation-system problems.

Jack joined ITE in 1954 as one of the 20 founding members

of the Texas Section. Over the next 20 years, he served on many TexITE committees and as TexITE secretary-treasurer, vice president and president from 1961 to 1963. He was honored as TexITE's Traffic Engineer of the Year in 1975 (the second person so honored). More than 45 years later, he is still a member of ITE.



C.J. "Jack" Keese

Many transportation professionals and ITE members worked under Jack's supervision. Those individuals are continuing to train others. His personal contributions to the transportation profession are numerous, notable and certain to last beyond his lifetime.

TTI to establish Texas Transportation Hall of Honor

As we approach the next century, it is appropriate that we look back and formally recognize that small group of individuals who have made truly exceptional contributions to developing and operating the outstanding transportation system we have in Texas. To that end, the Texas Transportation

Institute will create and maintain a Texas Transportation Hall of Honor.

This Hall, to be located in the main conference room in TTI's new Gibb Gilchrist building in the Research Park in College Station, will recognize individuals whose vision and leadership have

significantly advanced the multimodal transportation system in the state. Each individual inducted into the Hall will be recognized by a plaque that will be on permanent display in the Hall. The Hall will consider the time period since Texas statehood.

Anyone can nominate an in-

dividual to be considered for induction into the Hall. A five person committee will be establishing procedures for making formal selections.

For additional information, contact Dennis Christiansen (dennis-c@tamu.edu), TTI's deputy director.

TTI Publications Order Form

___ 187-28F, "Prediction of Expansive Clay Roughness in Pavements with Vertical Moisture Barriers," R. Jayatilaka, R. Lytton, 310 pp., \$51.00.

___ 1288-S, "Real-Time Coordinated-Actuated Traffic Control During Congested Conditions," N. Chaudhary, K. Balke, 64 pp., \$12.00.

___ 1358-3F, "Modal Emissions Modeling with Real Traffic Data," J. Crawford, C. Jordan, G. Dresser, 80 pp., \$12.00.

___ 1366-1F, "Delineation of Bridges and Culverts in Texas," G. Ullman, V. Pezoldt, 89 pp., \$12.00.

___ 1378-S, "Development of a Profile-Based Smoothness Specification for Asphalt Concrete Overlays," E. Fernando, 164 pp., \$28.00.

___ 1403-S, "Compliance Testing of an End Treatment for the Low-Profile Concrete Barrier," W. Beason, W. Menges, D. Ivey, 136 pp., \$20.00.

___ TTI/ITS RCE-99/03, "Demonstration of a Mobile Application of CVO Weight Enforcement Screening," L. Ruback, D. Middleton, 42 pp., \$5.00.

___ 1703-3, "The Railroad System of Texas: A Component of the State and National Transportation Infrastructure," S. Roop, J. Warner, D. Rosa, R. Dickinson, 434 pp., \$67.00.

___ 1715-1, "Initial Evaluation of the Existing Technologies for Vehicle Detection," D. Middleton, M. Shafer, D. Jasek, 112 pp., \$20.00.

___ 1767-1, "Development of a Strategic Plan for Commercial Vehicle Operations in Texas," D. Middleton, J. Montufar, D. Jasek, 144 pp., \$20.00.

___ 1767-S, "An Overview of Development of a Strategic Plan for Commercial Vehicle Operations in Texas," D. Middleton, J. Montufar, D. Jasek, 34 pp., \$5.00.

___ 1770-2 FHWA/TX-99/1770-2, "Handbook of Speed Management Techniques," A. Parham, K. Fitzpatrick, 248 pp., \$36.00.

___ 1798-1, "Handbook of Selected Congestion Mitigation Techniques in the United States," J. Crawford, W. Frawley, A. Cothron, 301 pp., \$51.00.

___ 1813-S, "Development and Application of Criteria for Optimization of the Texas Airport System," J. Borowiec, G. Dresser, 94 pp., \$12.00.

___ 2927-1, "Development of Improved Guidelines for Frontage Road Driveway Access Location," M. Jacobson, R. Nowlin, R. Henk, 52 pp., \$12.00.

___ 2946-S, "Safety of Driveways in Close Proximity to Each Other," H. Ross, K. Mak, R. Lavingia, 58 pp., \$12.00.

___ 2964-S, "Detecting Stripping in Asphalt Concrete Layers Using Ground-Penetrating Radar," T. Scullion, E. Rmeili, 38 pp., \$13.75.

___ 2968-S, "Innovative Materials and Design of Soundwalls," P. Roschke, H. Yeh, S. Esche, 180 pp., \$33.00.

___ 3972-S, "Recommendations for Highway Construction, Maintenance, and Service Equipment Warning Lights and Pavement Data Collection System Safety," G. Ullman, J. Ragsdale, A. Chaudhary, 43 pp., \$5.00.

___ 2975-1, "Evaluation of Zero-Length Vertical Curves," M. Wooldridge, A. Parham, R. Nowlin, 84 pp., \$12.00.

___ 3913-S, "Electronic Lien and Titling," R. Reinhardt, 80 pp. \$12.00.

___ 3977-1, "Evaluation of Detector Placement for High-Speed Approaches to Signalized Intersections," D. Middleton, R. Nowlin, M. Shafer, A. Parham, D. Jasek, 114 pp., \$20.00.

___ 3991-2, "Traffic Signal Warrants: Guidelines for Conducting a Traffic Signal Warrant Analysis," H. Hawkins, P. Carlson, 64 pp., \$12.00.

___ SWUTC/98/167101-1, "Development of an Annunciation System for Rural School Bus Operations," C. Messer, M. Pacelli, 67 pp., \$0.00.

___ TTI/ITS RCE-98/01, "Downtown/Midtown Construction Traveler Information System Plan," G. Daniels, W. Stockton, K. Hall, 80 pp., \$12.00.

___ "Small City Synthesis of Transportation Planning and Economic Development: User's Guide," D. Schrank, S. Farnsworth, 52 pp.; \$5.00.

___ "The 1999 Annual Mobility Report," D. Schrank, T. Lomax, 130 pp.; \$24.95.

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To order any of the listed publications, complete this form by indicating quantity and send with check or money order made payable through a U.S. bank to the **Texas Transportation Institute** to:

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The Back Road



The Texas Transportation Institute (TTI) has one of the most diverse and wide-ranging research programs of any transportation research organization in the nation. You can look at almost any division or program and find a fascinating project underway — research that is paying significant dividends for Texas travelers.

We all know that cooperation among interested individuals and organizations is a key to improving our transportation system. In the past year, TTI, other universities and the Consulting Engineers Council have worked together to identify ways to advance our common interests. I'm confident that this strengthened relationship will ultimately benefit Texas consumers.

One of the studies that brings media interest to transportation each year is the annual TTI mobility report. The amount of extra time travelers spend in traffic has

more than doubled between 1982 and 1997. These increases have occurred in every population group and have been relatively consistent from year to year. The primary factors that change the mobility decline are investing in improvements to the transportation system (which decreases congestion) and economic growth (which almost always means more congestion). Improvements include clearing vehicle crashes and breakdowns, expanding the road and transit network, operating those networks more efficiently, encouraging travel when there is less congestion and, for the long-term, providing housing options so that more city residents can live closer to their jobs and shopping centers. In this issue, you can get the latest mobility data, as well as learn about a very successful set of guidelines developed by TTI that provides transportation officials with detailed information on conducting traffic signal analyses.

There are many other exciting things going on at TTI, including the new Southwest Superpave Center and work on reinforcing Texas bridges. I hope you'll find these and other stories to be of interest and use.

TEXAS TRANSPORTATION Researcher

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