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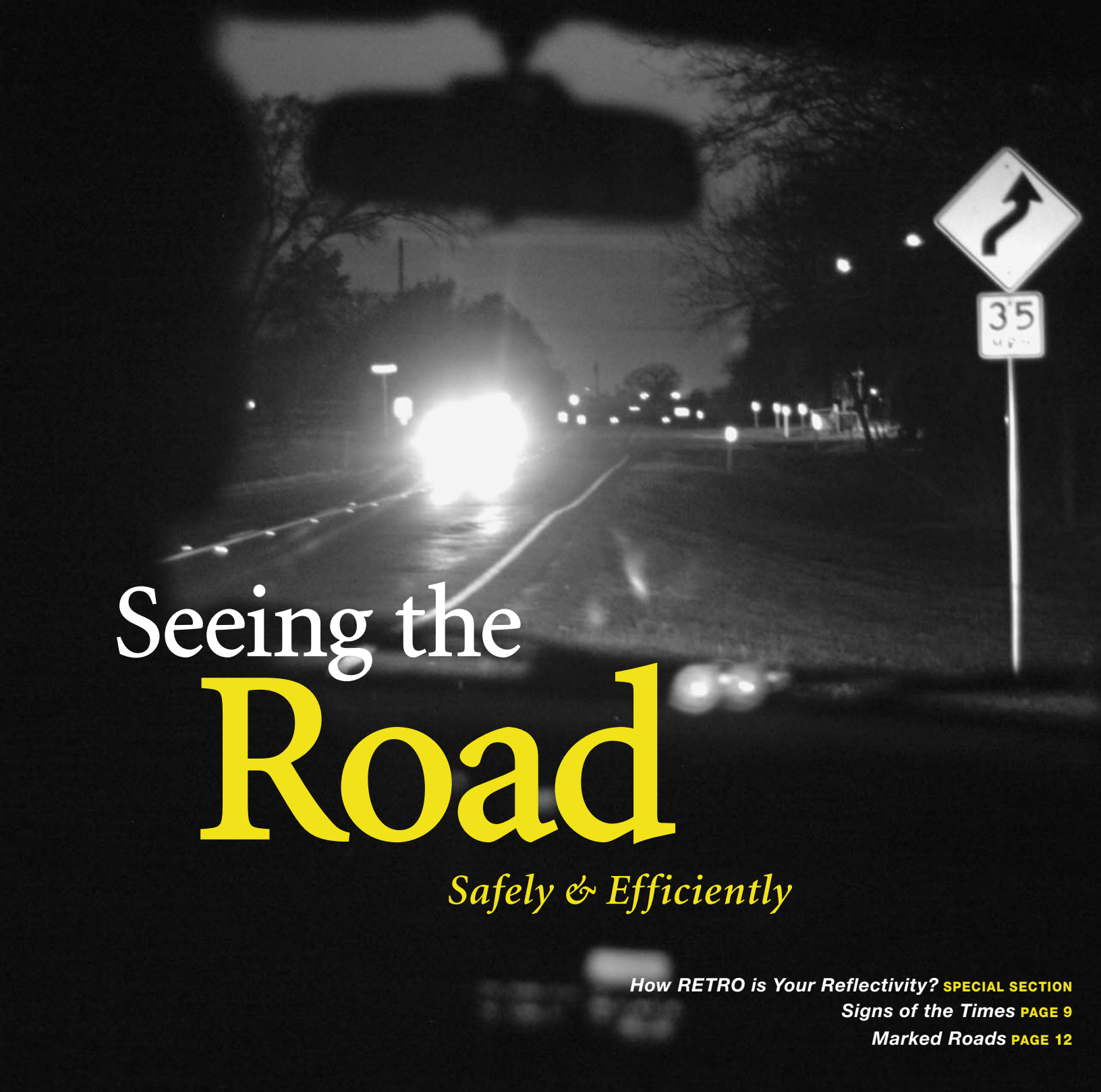

Seeing the Road

Safely & Efficiently

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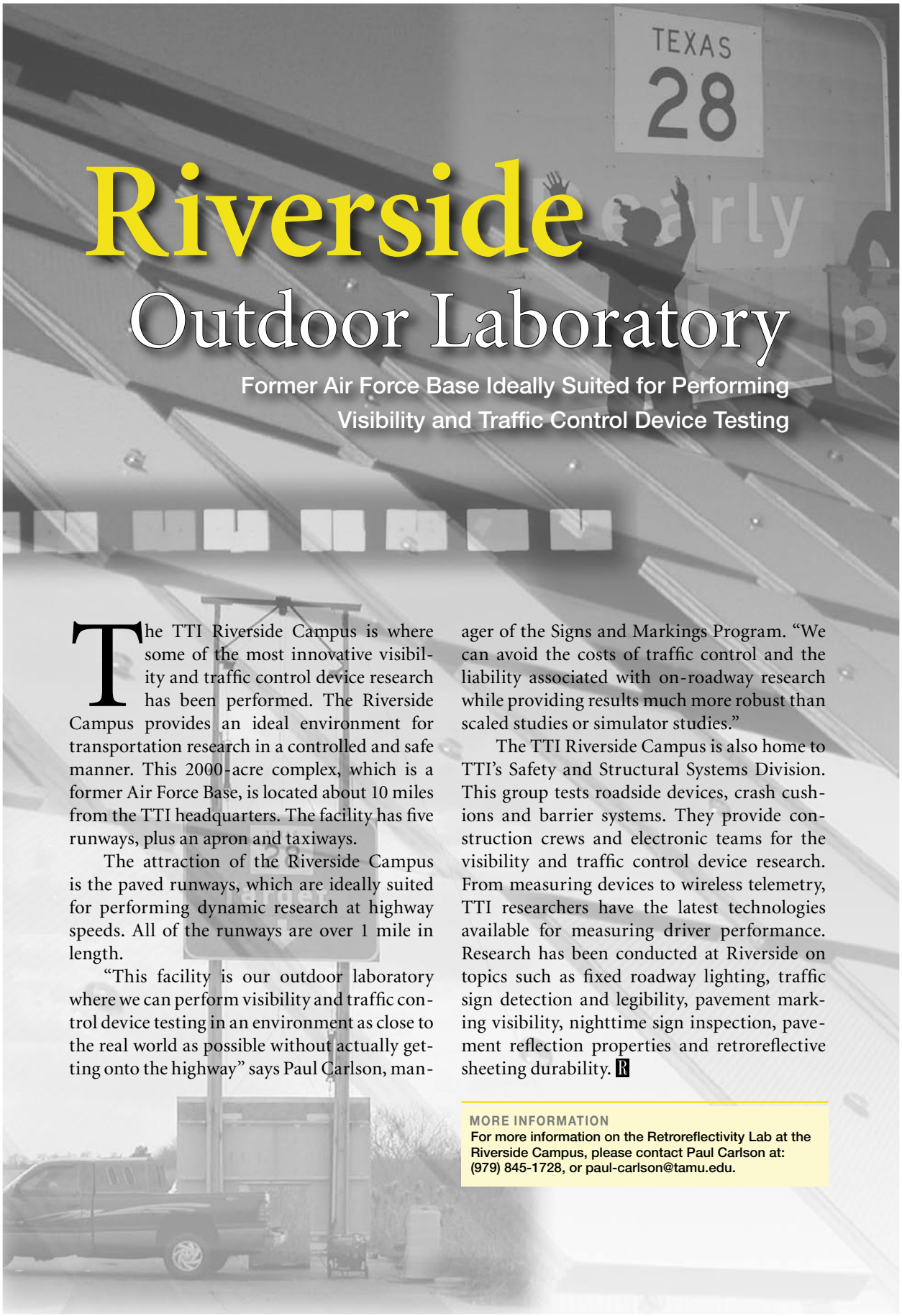
Seeing the Road

Seeing the road and everything around it while driving is not a preferred option, rather it is an *essential* component of safe driving. Driving is a visual activity, and as we make our way down a road, we all look at a wide range of visual inputs—the roadway, the surrounding terrain, other vehicles, roadside buildings and advertisements and traffic control devices such as signs, markings, and signals—to help us get where we are going. How we distinguish those visual inputs and maneuver the vehicle safely varies from person to person and can depend on quite a number of random, uncontrollable things—the weather, time of day, driver age, health and experience, as well as unexpected distractions inside or outside the vehicle—all can have an effect.

While we usually cannot do anything to direct or change these elements of the driving experience, researchers and traffic engineers are always working to improve and enhance those things that we *can* control and improve. Signs, roadway pavement markings, vehicle headlamps and roadway lighting are all things that we can control and that play a key role in the creation of a safe and visible driving environment. Also, while there are no exact figures, a rough estimate for Texas Department of Transportation's investment in traffic signs and installation is over $1 billion.

Over the last decade, researchers at the Texas Transportation Institute (TTI) have established a comprehensive research program related to the visibility of traffic signs and pavement markings. Our researchers have conducted numerous studies to evaluate how well drivers can see signs and markings, both during the day and at night, and how transportation agencies can improve signs and markings to meet the needs of drivers *and* other transportation agencies striving to build, maintain and enhance our roadways. TTI research in this area cuts across other important areas of transportation research—older driver issues, work zone safety, and larger vehicle considerations—all are part of the picture when it comes to "seeing the road." R



Riverside Outdoor Laboratory

Former Air Force Base Ideally Suited for Performing Visibility and Traffic Control Device Testing

The TTI Riverside Campus is where some of the most innovative visibility and traffic control device research has been performed. The Riverside Campus provides an ideal environment for transportation research in a controlled and safe manner. This 2000-acre complex, which is a former Air Force Base, is located about 10 miles from the TTI headquarters. The facility has five runways, plus an apron and taxiways.

The attraction of the Riverside Campus is the paved runways, which are ideally suited for performing dynamic research at highway speeds. All of the runways are over 1 mile in length.

"This facility is our outdoor laboratory where we can perform visibility and traffic control device testing in an environment as close to the real world as possible without actually getting onto the highway" says Paul Carlson, manager of the Signs and Markings Program. "We can avoid the costs of traffic control and the liability associated with on-roadway research while providing results much more robust than scaled studies or simulator studies."

The TTI Riverside Campus is also home to TTI's Safety and Structural Systems Division. This group tests roadside devices, crash cushions and barrier systems. They provide construction crews and electronic teams for the visibility and traffic control device research. From measuring devices to wireless telemetry, TTI researchers have the latest technologies available for measuring driver performance. Research has been conducted at Riverside on topics such as fixed roadway lighting, traffic sign detection and legibility, pavement marking visibility, nighttime sign inspection, pavement reflection properties and retroreflective sheeting durability. R

MORE INFORMATION

For more information on the Retroreflectivity Lab at the Riverside Campus, please contact Paul Carlson at: (979) 845-1728, or paul-carlson@tamu.edu.

How RETRO is your *reflectivity*?

TTI research contributes to national standards

After a number of years of outdoor exposure, a sign may no longer reflect enough light to be visible by most drivers. Signs should be replaced before they reach that point. But at what point does a sign become questionable for nighttime use? Answering this question has been at the heart of several recent TTI research projects conducted for the Federal Highway Administration (FHWA).

SETTING THE STANDARDS

Traffic signs serve vital functions, providing road users with regulatory, warning and guidance information about the roadway and surrounding environment. There are a large number of signs and even more guidelines on how these signs should be designed, installed and maintained. These guidelines are contained in a document called the *Manual on Uniform Traffic Control Devices*, or MUTCD. The guidelines in this document address appearance (size, shape, color), placement (height, lateral, and longitudinal) and maintenance (visibility, position, damage). One of the MUTCD requirements for signs is that they be made from *retroreflective* materials or that they have sign lights. Virtually 100 percent of modern signs are manufactured from retroreflective sheeting, which makes these signs visible at night. However, retroreflective sheeting deteriorates with time.

Improving nighttime visibility and replacing signs that do not reflect light well is an important element of improving the overall visibility of the nighttime driving environment. This is the concept behind FHWA's nighttime sign visibility research, which began in the 1980s. The FHWA sign visibility research program was provided additional emphasis with the 1993 Department of Transportation Appropriations Act, which stated that: "*The Secretary of Transportation shall revise the MUTCD to include a standard for a minimum level of retroreflectivity that must be maintained for traffic signs and pavement markings which apply to all roads open to public travel.*" Since that legislation became law, the focus of the FHWA program has been on developing minimum guidelines for nighttime visibility and the accompanying MUTCD language.

TTI researchers Paul Carlson and Gene Hawkins have played a significant role in the development of those guidelines and MUTCD guidelines through a series of research projects on minimum sign retroreflectivity for the FHWA. These projects have focused on identifying how much light signs need to reflect for drivers to see them at night and on working with transportation professionals about implementing the research into practice. There have been three key efforts in this research: 1) performing field studies of drivers' nighttime visibility needs, 2) developing a computer model for calculating mini-

mum retroreflectivity levels and 3) conducting workshops and training sessions as an implementation and improvement effort.

Field studies of drivers' sign visibility needs

Retroreflectivity can be described as the efficiency of a sign at reflecting light back to the driver. Generally speaking, a sign with high retroreflectivity will be brighter than one with low retroreflectivity. The key question is determining when a sign's brightness degrades to a point that it is no longer effective. TTI researchers evaluated this question at Texas A&M's Riverside Campus (see page 7) using full-scale traffic signs along a simulated highway section. They asked 30 older drivers to read traffic signs during the nighttime while the brightness of the signs was varied by a research technician in the passenger seat of the test vehicle. For each sign, the brightness level was initially set so that the sign would be just noticeable but not legible. The brightness was then increased until the older drivers could successfully read the sign. The data that was obtained through this experiment was used to define the minimum brightness needed by older drivers.

A computer model for determining minimum retroreflectivity

The data from the field studies told the researchers how bright signs need to be for older drivers. They combined this sign brightness information with modern headlamp performance data, sizes of modern vehicles, typical locations of traffic signs, and the efficiency of modern reflective sign sheeting, to calculate the minimum retroreflectivity properties that a sign needs to have. The calculation process was streamlined by using the TTI Minimum Retroreflectivity Model, a computer program developed by TTI researchers. Using this model, minimum levels were calculated for a wide range of conditions, then consolidated so that they would be easier for transportation agencies to understand and use. The result of the effort was a simple table of minimum retroreflectivity levels. TTI is involved in additional work to help agencies implement these levels in a manner that minimizes the impacts on the agencies. For more information on minimum retroreflectivity levels, see http://safety.fhwa.dot.gov/fourthlevel/pro_res_retrore_report.htm.

Helping to implement the research

Retroreflectivity is unfamiliar territory for many transportation professionals. That's because it is not taught in most university engineering programs. So educating the profession has been an important focus of the implementation effort. TTI researchers Gene Hawkins and Paul Carlson have conducted train-the-trainer classes to prepare a core of instructors that can educate professionals in their home states. They also conducted workshops for FHWA to educate practitioners on retroreflectivity science and to solicit input on how to best implement the minimum retroreflectivity research findings.

Keeping an eye on rulemaking

In 1993, Congress directed the FHWA to revise the MUTCD to include minimum levels of retroreflectivity for signs and markings. The TTI research recommendations have been at the center of the FHWA's effort to revise the MUTCD. Not only have TTI researchers provided the recommendations on minimum levels for signs, they have also helped the FHWA identify the needs and concerns of public agencies and the private sector and create proposed MUTCD text that will improve the nighttime visibility of signs while minimizing the burden on public agencies. The FHWA is currently working to finalize a proposed rule, which is expected to be published in the *Federal Register* in the near future.

SIGN SCIENCE

There is a great deal of science behind the retroreflectivity, or visibility, of signs and markings. The nighttime traffic fatality rate is much higher than the daytime rate (see Figure 1), and customer satisfaction surveys from several states have found that the visibility of signs and markings is valued highly by the users of their roadways.

Nighttime visibility is like a tripod. One leg is the driver that is looking beyond the vehicle's windshield. A second leg is the environment beyond the windshield, including objects like the road, other vehicles, and traffic control devices. The final leg is the light provided by a vehicle's headlamps or by roadway lights. The performance of each of these legs largely defines nighttime visibility.

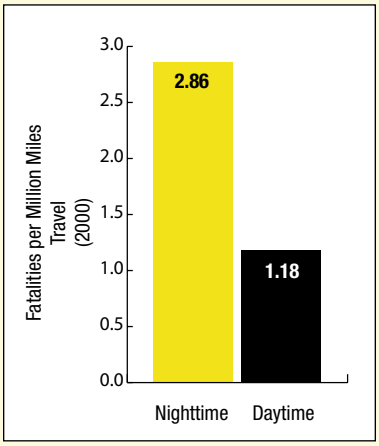


Figure 1. Nighttime traffic fatality rate versus daytime.

Aging eyes need more light

Almost everyone knows by now that the driving population is getting older. While there are always individual exceptions, the general trend is that beginning in the early 20s, driver vision begins to deteriorate. The amount of light needed to see in the dark gradually increases, eventually doubling every 13 years (see Figure 2). This means that older drivers need a brighter roadway environment, including signs and markings, than a young driver does. These numbers make sign and pavement marking visibility research even more vital to the safety of our driving environment. Using older drivers for visibility research helps to provide a roadway environment that will be visible for all drivers.

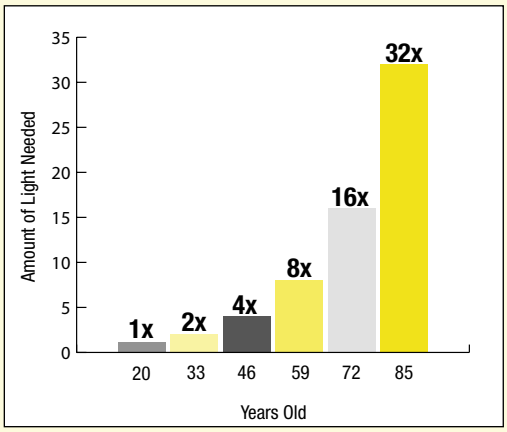


Figure 2. Chart illustrating the amount of light needed to see in the dark.

Signs and markings are improving

The earliest traffic signs and markings were made with paint, and they could not be seen at night until the vehicle was very close to the painted surface. Today, there are sign and marking materials that are visible at long distances because they are designed to reflect light back to the driver. The ability of a sign to reflect light back to the driver is called "retroreflectivity" (see retroreflectivity sidebar on page 7). There has been a dramatic increase in the number of these materials (see Figure 3), and there are significant differences in the performance of individual materials. Research helps transportation agencies determine which materials are best to use in various roadway situations.

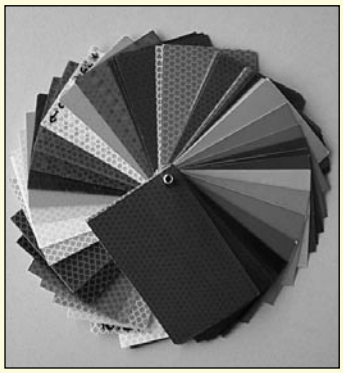


Figure 3. A few of today's retroreflective sign materials.

Vehicle headlamps are changing

Not too long ago, vehicle manufacturers had a simple choice in headlamps—round or rectangular — and they all provide similar levels of light. Today, there is a wide range in the way that vehicle headlamps shine light on the roadway environment. Many of the most modern headlamps have a sharp "cutoff"—a very noticeable difference in the area where the light shines and where it does not shine. Figure 4 compares these two styles of headlamps, with the second figure illustrating a vehicle with "cutoff" headlamps. The cutoff headlamps project less light at signs, making them appear dimmer to the driver than they would appear with older style headlamps. Research has been evaluating the impact of newer style headlamps on sign visibility.

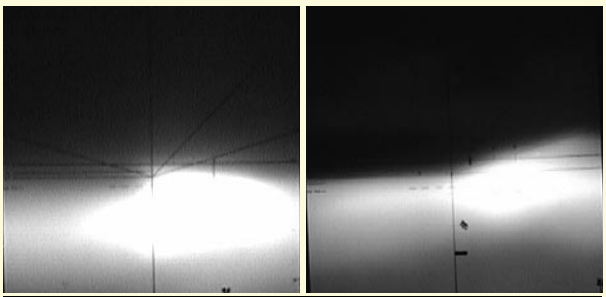


Figure 4. Comparison of older (left) versus the newer "cutoff" headlamps.

Putting the pieces together

Drivers, signs, and headlamps — each has an important contribution to the overall visibility of the nighttime driving environment. But the recent trends for each of these are not moving toward making the nighttime environment more visible (see Figure 5). Trends for drivers and headlamps are making signs less visible, leaving it up to sign improvements to make up the difference. This is why the idea of maintaining signs so drivers can see them at night is an important concept and an important element of the TTI visibility research program. R

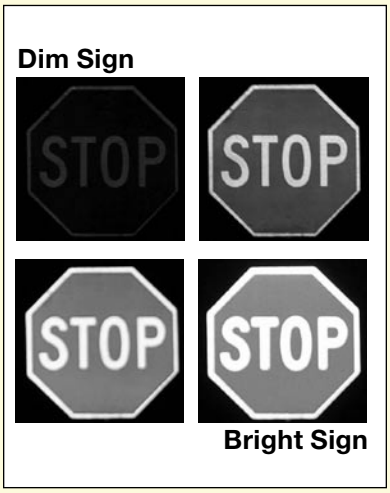


Figure 5. Older drivers and modern headlamps equal dimmer signs. Younger drivers, modern sign sheeting and older style headlamps equal brighter signs. Thus, the trends for drivers and headlamps are making signs less visible, leaving it up to sign materials to make up the difference.

What is RETRO reflectivity?

All surfaces reflect light, but different types of surfaces reflect light in different ways. Figure 6 shows three different types of reflective surfaces. A diffuse reflector scatters light in all directions as shown in Figure 6.a. A plain sheet of paper is an example of this type of surface. A specular reflector reflects light like a mirror. The angle of the reflected light is the same as the angle of the light hitting the surface. In Figure 6.b, angle A equals angle B. Signs and markings are effective at night because they have been designed to reflect light from a vehicle's headlamps back to the driver. The technical term for this characteristic is "retroreflectivity"—because the light is reflected back toward the vehicle. There are several ways to make a device retroreflect light, but it is commonly accomplished by embedding small glass beads in the pavement marking or sign, as shown in Figure 6.c. This makes the device more visible at a much greater distance at night. But for drivers, it simply means that they can see signs and markings several hundred feet away at night, when almost everything else at that distance appears to be a black hole that they are driving into. But there are limitations on the performance of a retroreflector. The farther away a driver gets from the vehicle's headlamps, the less bright a sign or marking will appear. Figure 7 illustrates this concept. A sign will appear the brightest when it is oriented at a right angle to the light source and when the driver is as close as possible to the light source. The brightness of a sign or marking decreases as it is rotated off of a right angle, and as the driver moves further away from the light source.

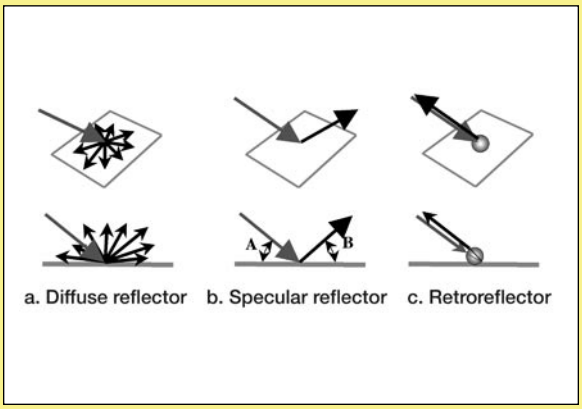


Figure 6. Three different types of reflective surfaces.

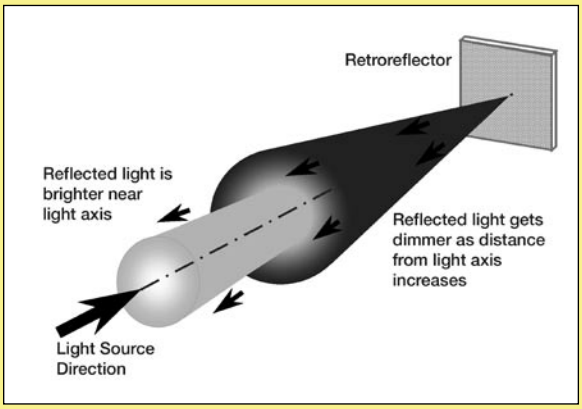


Figure 7. This illustration shows the farther away a driver gets from the vehicle's headlamps, the less bright a sign or marking will appear.

Studies show "Clearview" provides a Clear View

The typeface used on highway signs has not changed since it was conceived in the 1950s. However, partly because of research sponsored by the Texas Department of Transportation (TxDOT) and conducted at the Texas Transportation Institute (TTI), the first alternative typeface will soon be approved by the Federal Highway Administration (FHWA). The new typeface is called "Clearview" and has been under development and testing for over 10 years.

"Clearview was developed primarily for the older drivers" says Paul Carlson, manager of the Signs and Markings Program. "It provides faster recognition, improved legibility, and reduced halation (sometimes called overglow or blooming)." Halation can cause individual features of some letters to be fizzy or washed out, resulting in slower recognition and reduced legibility.

Three studies sponsored by TxDOT and conducted by TTI focused on optimizing sign recognition and legibility. In the initial study, TTI tested Clearview using full-scale guide signs for the first time. The research showed initial signs of promise. Two additional follow-up studies were completed to optimize the design parameters. In these studies, the researchers worked with the developers of Clearview, Don Meeker and the Pennsylvania Transportation Institute, to optimize the letter spacing. The researchers also analyzed the impacts of various combinations of reflective sheeting materials to determine how to obtain the faster recognition and longest legibility distances, while minimizing the costs.

As a direct result of this research, TxDOT has implemented the Clearview typeface for all new and refurbished green guide signs. TxDOT is now establishing research to evaluate the use of Clearview on white, yellow, and orange signs.

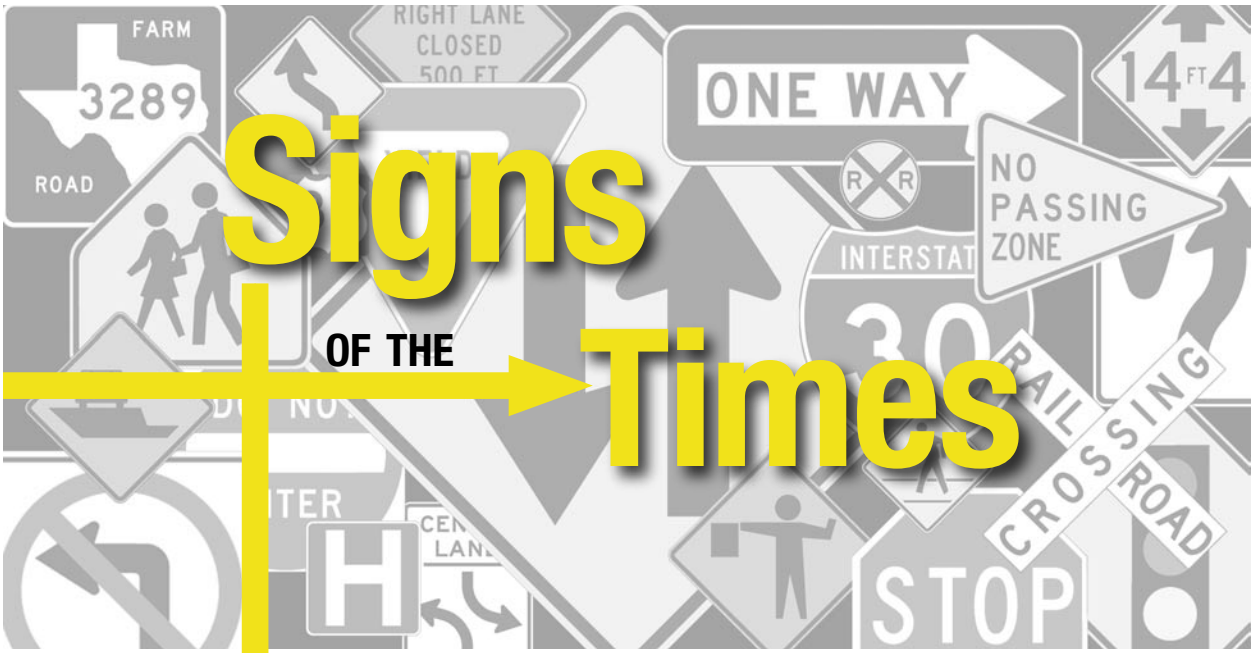
"Research which demonstrates the effectiveness of a new or revised design is the basis for consideration of any proposed addition or change to the MUTCD. The research results on the new Clearview alphabet letter shapes and letter spacing conducted by TTI demonstrate the value of Clearview as an alternative lettering style and provide the FHWA the necessary data to consider the addition of Clearview in the MUTCD," says Fred Ranck who is responsible for traffic signs in the MUTCD.

Series E (Modified) Alphabet.

Clearview Alphabet.

MORE INFORMATION

For more information on Project No.: 0-1276, *Assessment of Motorist Needs for Legible Freeway Legends*, Project No.: 0-4049, *Evaluation of Clearview Alphabet with Super High Intensity Prismatic Sheeting* or Project No.: 0-1796, *Impacts of Retroreflectivity on Sign Management, Maintenance, and Design*, please contact Paul Carlson at: (979) 845-1728, or paul-carlson@tamu.edu.



Signs OF THE Times

Driving down the highway, it's easy to take the scenery—the cornfields, the trees, even the road signs—for granted. Often we only notice the center stripe when deciding whether it's safe to pass the car in front of us. Missing a sign—say, for a turn-off you wanted to take—can be annoying, forcing you to waste time and burn gasoline unnecessarily. More importantly, missing signs can compromise safety, especially at night, when drivers are likely more fatigued and visibility is much more limited.

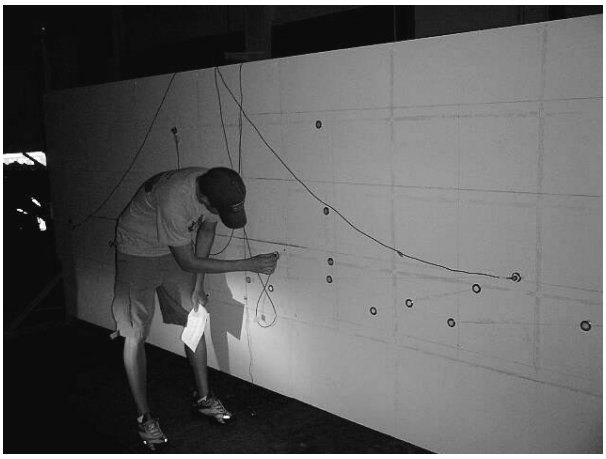
TTI has a long history of sign visibility research and researchers are currently working on numerous projects to improve the visibility and usability of road signs at night. From how reflective the sign materials are to how easily the signs are read to how driver behavior is affected by specific types of signs, these projects address the fundamental question of how to improve driver safety at night by enhancing the effectiveness of road signs.

Can You See Me Now?

The Texas Department of Transportation (TxDOT) recently sponsored research conducted by TTI that assessed the relationship between sign reflectivity and the management, maintenance, and design of signs. The project looked at a wide range of sign visibility issues for TxDOT, with the intent of helping TxDOT make signs easier to see at night.

One facet of this research evaluated the legibility of small signs. Sue Chrysler, TTI research scientist, led a team to assess the responses of older drivers (aged 55-75) to signs made from different materials and with different fonts. "TxDOT wanted to know if recent advances in sign materials and font design could lead to improvements in sign visibility," explains Chrysler. The study determined that, for certain classes of signs, the typefaces currently used by TxDOT are just as legible as the newer typefaces.

Researchers also developed guidelines for determining when lighting can be eliminated from overhead freeway signs, evaluated vehicle headlamp performance,



A TTI employee checks the results of a headlamp field test.

and assessed signing operations in TxDOT districts. For example, by installing signs without exterior lighting, TxDOT can potentially save Texans significant tax dollars. In the Twin Cities area of Minnesota alone (an area one-third the size of Houston), the Minnesota Department of Transportation saved approximately $20,000 a month in electricity bills when they replaced their exterior lighting with higher brightness reflective sign materials.

This is but one example of the many recommendations resulting from this project that will help to ensure that TxDOT's state-of-the-practice continues to account for advances in sign material and automobile technology. Rick Collins, TxDOT's technical director for this project states, "This project has provided TxDOT with numerous benefits that will help us to improve the quality and effectiveness of our signing."

Don't Space Out

In a related study sponsored by TxDOT, TTI researchers looked specifically at the use and spacing of delineators and Chevrons (types of pavement markings) to simplify TxDOT's maintenance procedures and policies. For example, it can be difficult for field crews to properly assess the radius of a curve in order to place delineators, as current procedures require. The research team developed a user-friendly device that can be used in any vehicle to instantaneously determine the radius of the curve with one pass at highway speed. "The beauty of this device it that it is simple to use but still accurate within three percent," says Paul Carlson, TTI's research supervisor on the project.

Another complexity of TxDOT's current guidelines deals with placing delineators in curves and on straightaway sections approaching and departing curves. Delineator spacing along straightaway sections is variable, based on the size of the curve. Not only are these guidelines difficult for field crews to implement correctly, it's not clear whether drivers benefit from the variable spacing.

"If TxDOT crews could install these posts using a fixed spacing interval, it would make the maintenance process more efficient," explains Chrysler. "We just need to make sure that the visibility of the curve isn't affected and that safety isn't compromised."

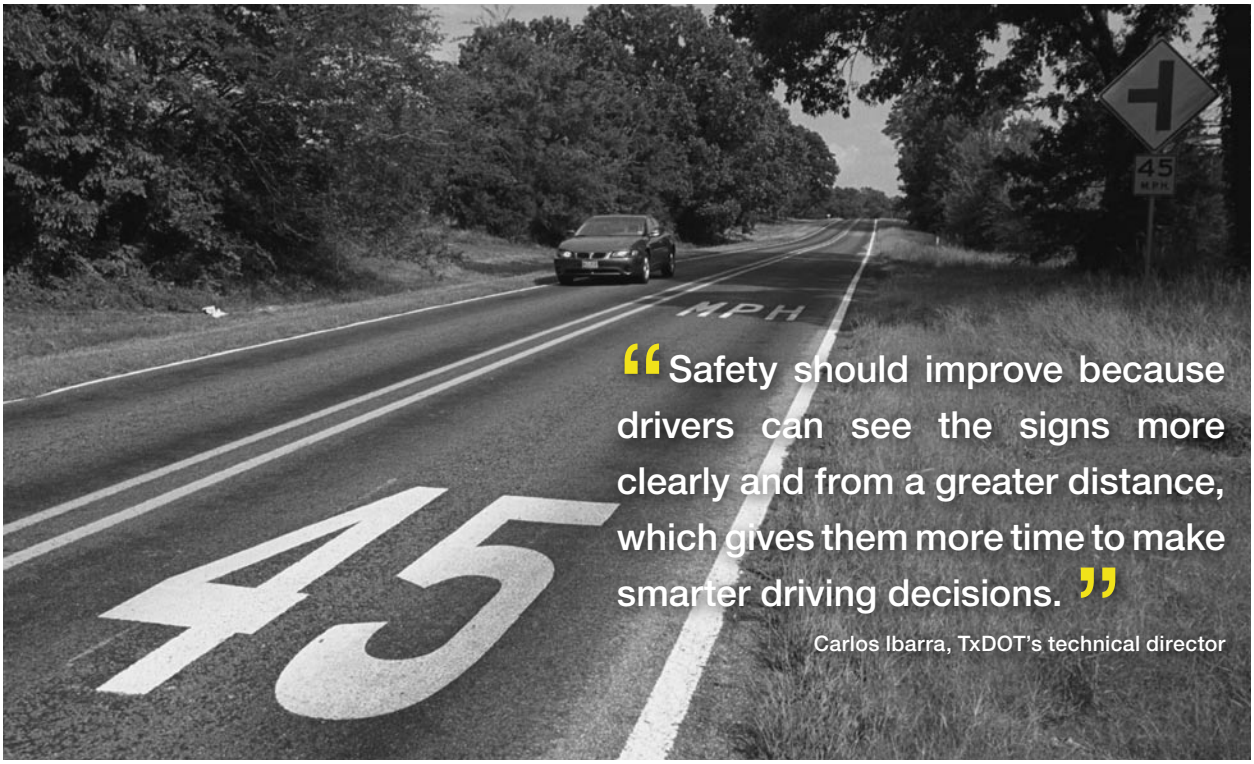
The researchers used the Texas A&M Riverside Campus to delineate four different full-scale highway curves. They studied how drivers perceived the severity of the curve as a function of the delineation spacing and delineator size. The research team found that there is very little difference in driver reactions when comparing the current, more complicated policy with the proposed, more simplified one. They also found that there is little difference in the driver rating of curve severity as a function of delineator size. By streamlining its policy, TxDOT can save significant dollars associated with the staff hours needed to maintaining posts.

Researchers also evaluated the spacing of Chevrons in horizontal curves on Texas highways. Unlike the delineator spacing guidelines, the current guidelines for spacing Chevrons are vague. TTI researchers evaluated driver response to various Chevron spacing settings, initially developed based on sight distance restrictions.

> "The overriding concern in this study was that safety not be compromised in the interests of efficiency, and the research results prove that procedures can be streamlined while improving safety."
>
> Larry Colclasure, director of transportation operations in TxDOT's Waco District

The research team developed a Chevron spacing table that can be integrated into the already existing delineator spacing table. Based on this research, TxDOT design engineers and field crews now have guidelines that can be easily implemented.

"The delineator and Chevron recommendations that were developed as part of this research will make the design and maintenance of curve delineation much easier and more consistent around the state," says Larry Colclasure, director of transportation operations in TxDOT's Waco District. "The overriding concern in this study was that safety not be compromised in the interests of efficiency, and the research results prove that procedures can be streamlined while improving safety."



"Safety should improve because drivers can see the signs more clearly and from a greater distance, which gives them more time to make smarter driving decisions."

Carlos Ibarra, TxDOT's technical director

Which Is Better: Number One or Number Two?

Assessing the effectiveness of road signs in improving safety really determines how the signs themselves attract driver attention and improve responsiveness. In another study sponsored by TxDOT, TTI researchers examined how signs made of more visible materials affected traffic operations and driving behavior.

"This project, led by former TTI researcher Tim Gates, evaluated how effective current signs are when compared to signs designed and constructed with the newer materials," says Gene Hawkins, TTI division head and research engineer. "It's worth noting that we found several signs that had significant positive effects on traffic safety and we found no negative effects when using the new sign materials."

For example, fluorescent yellow Chevrons produced a 38 percent reduction in vehicles leaving the lane, and a flashing LED (light-emitting diode) Stop sign reduced the number of vehicles failing to fully stop at an intersection by 29 percent.

"As a result of this study, TxDOT has issued the statewide mandate that all warning signs use the new, fluorescent yellow material," explains Carlos Ibarra, TxDOT's technical director on the project. "Safety should improve because drivers can see the signs more clearly and from a greater distance, which gives them more time to make smarter driving decisions."

The RadiusMeter is mounted on a vehicle's dashboard and is used to measure the radius of a curve.

MORE INFORMATION

For more information on Project No.: 0-1796, *Impacts of Retroreflectivity on Sign Management, Maintenance, and Design*, please contact Gene Hawkins at: (979) 845-6004, or gene-h@tamu.edu.

For more information on Project No.: 0-4271, *Applications for Advanced Sign Sheeting Materials*, please contact Gene Hawkins at: (979) 845-6004, or gene-h@tamu.edu.

For information on Project No.: 0-4052, *Guidelines for the Use and Spacing of Delineators and Chevrons*, please contact Paul Carlson at: (979) 845-1728, or paul-carlson@tamu.edu.

TTI Researchers study the effectiveness of pavement markings

Pause for a second to think about driving down a roadway without pavement markings at night or in bad weather. There are no reflective center stripes to keep you in the proper lane and safely away from oncoming traffic. Should you have to pull over, there would be no markings that show the shoulder of the roadway. And if you started to feel sleepy while driving, there would be no rumble strips on the roadway shoulder or approaching curves to alert you to potential danger.

Pavement markings provide one of the primary means of communicating information to drivers. Unlike traffic signs and signals, pavement markings are continuous and provide motorists with the vital guidance they need to properly position their vehicle on the road. Researchers at the Texas Transportation Institute (TTI) are involved with several studies that examine the effectiveness of pavement markings, and how they can be improved to make the roadway safer for all drivers in all conditions.

Marking Guidebook

Pavement markings are different from signs in that they are typically manufactured at the location where they are applied instead of being manufactured in a factory. The problem with this method is that without the proper information on site, it introduces the possibility of reduced reflective performance based on the type of pavement marking selection for the roadway.

"There is a lot of information out there about pavement markings, but it can be confusing and it certainly is not all presented in one place. That makes it more difficult for a DOT person to figure out what marking material to use on a given roadway," says Gene Hawkins, division head and research engineer with TTI.

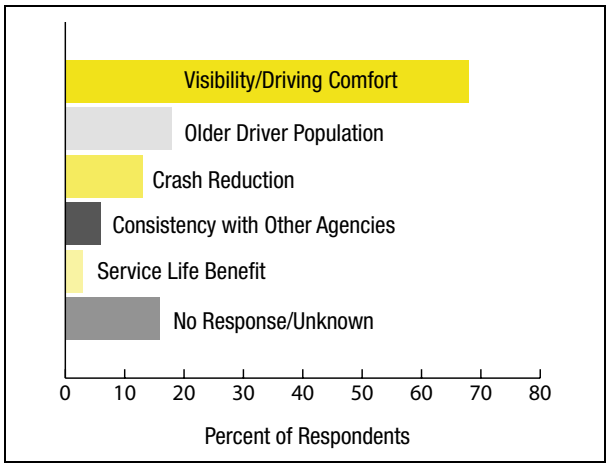
Since one of the key characteristics of a pavement marking is its reflective performance, or how well a driver can see it at night or during inclement weather conditions, it is important that anyone involved with pavement markings has the right information for a successful installation. The Texas Department of Transportation (TxDOT) recently sponsored research that TTI conducted evaluating key aspects of pavement marking effectiveness.

The findings of the project were implemented through the development of the Texas Pavement Marking Handbook. The purpose of the handbook, developed by TTI researchers with significant input from a panel of TxDOT staff and the contracting community, is to be a single source of information for anyone involved with pavement markings in Texas. The handbook contains guidance, procedures, and recommendations addressing many different aspects of pavement marking material selection, as well as installation inspection.

Wider Markings

According to the National Highway Traffic Safety Administration (NHTSA), there were 19.1 million licensed older (70+) drivers in the United States in 2001 — a 32 percent increase from the number in 1991. As the aging driver population trend continues to rise, highway agencies are beginning to examine ways to make the roadways safer by examining driver visibility needs.

One of the steps being taken by some highway agencies is using longitudinal pavement markings that are wider than the four-inch minimum. The term longitudinal pavement marking refers to the yellow or white lines that run parallel to the roadway and which help guide traffic. For example, white lines on a roadway separate traffic moving in the same direction and yellow lines separate opposing traffic. Currently, the minimum standard width for these markings is four inches.



The observed benefits from the wider markings survey.

The American Glass Bead Manufacturers Association recently sponsored a TTI study to determine the use and the benefits of wider pavement markings. The researchers gathered input from all 50 state departments of transportation (DOTs) and other groups. They found that 29 out of 50 state DOTs use wider markings, with a slight increase in striping costs the only drawback cited. Among the observed benefits from the DOTs responding were favorable public response and improved roadway visibility.

Bump in the Road

Another type of traffic control device involves not only what drivers see but what they hear and feel too. Rumble strips—rows of continuous raised bumps or depressions either along the shoulder or centerlines of highways—are starting to appear on roadways in greater numbers. Rumble stripes—pavement markings applied over rumble strips—are a more recent evolution of rumble strips gaining popularity among the states. And with good reason: studies show that rumble strips have significant benefits in terms of reducing crashes.

One of the purposes of rumble strips is to serve as a "wake up" call to weary motorists who may be losing their concentration due to fatigue. The NHTSA estimates that more than 100,000 crashes occur annually as the result of drowsy driving. For this reason, research into the effectiveness of rumble strips on Texas highways is important.

In a multi-year project for TxDOT, TTI researchers are currently testing various rumble strip applications. One of the focus areas is centerline rumble strips. These rumble strips are similar to the shoulder rumble stripes installed along many existing roadways except they are used in the center of the roadway to alert motorists drifting into the opposing lanes. The application of centerline rumble strips is relatively new, and their impact on passing maneuvers, pavement durability, and pavement marking visibility is not fully understood.

"We are currently focusing on two types of centerline rumble strip applications for Texas highways," says Paul Carlson, manager of the Signs and Markings Program at TTI. "Because of our southern climate, we're able to experiment with raised centerline rumble strips as well as milled centerline rumble strips." Paul and his colleagues at TTI are currently investigating how centerline rumble strips impact passing maneuvers on undivided highways marked for passing.

As part of this research project, the TxDOT Brownwood district recently installed the state's first milled centerline rumble strips while the TxDOT Austin district completed installation of several sections of raised centerline rumble strips. Howard Holland, director of Transportation Operations in the Brownwood district said, "We have a problem on many of rural highways with motorists drifting across the centerline resulting in either head-on accidents or jerking the steering wheel to return to their lane and losing control. We have high hopes that this research will decrease these severe crashes without introducing side effects such as premature pavement degradation along the pavement joint."

"I think it is very important for research like this to be conducted to give us consistent guidelines," says Brian Stanford, the project director and traffic operations engineer at the Traffic Operations Division of TxDOT. "What we're hoping the research will do is show us what patterns work the best to warn motorists and not have 25 or 30 different patterns being installed in the field." R

MORE INFORMATION

For more information on Project No.: 0-4150, *Evaluation of Pavement Marking Effectiveness*, please contact Gene Hawkins at: (979) 845-6004, or gene-h@tamu.edu.

For more information on Project No.: 0024-0, *The Use of Wider Longitudinal Pavement Markings*, please contact Gene Hawkins at: (979) 845-6004, or gene-h@tamu.edu.

For more information on Project No.: 0-4472, *Evaluation of Edge-Line and Centerline Rumble Strips*, please contact Paul Carlson at: (979) 845-1728, or paul-carlson@tamu.edu.

Research improves highway work zone "sights"

Texas leads the nation in the number of fatalities and injuries in highway construction work zones. However, the construction sites themselves aren't necessarily the cause. In Texas, contributing factors include a longer construction season and more highways under construction at any given time. Also, in a majority of cases, driver inattention and carelessness within construction sites contribute significantly to safety problems. Visibility and a driver's ability to easily detect upcoming work zones are critical safety issues. The sooner drivers become aware of highway construction sites, the sooner they can maneuver safely through them. Research sponsored by the Texas Department of Transportation (TxDOT) and conducted by the Texas Transportation Institute (TTI) is revealing helpful techniques that improve safety for workers and increase visibility of work zones for motorists.

Lights, drums, synchronize … ACTION!

Looks like there's trouble ahead on the highway. Often, it's just road construction—the first "sighting" of which may be those flashing yellow warning signals on top of a drum … or it may be just a sign telling you to move from one lane or the other. A new method of warning drivers of approaching work zones is proving to be safer and easier to understand from greater distances. The approach was developed as a part of a TTI research project that was sponsored and implemented by TxDOT. It utilizes a series of synchronized flashing lights attached to the drums that form a lane closure taper. The flashing lights illuminate in a sequence from the beginning to the end of the taper.

> "It's a safety issue. If we improve safety conditions in work zones, we help protect motorists and workers from hazards such as drop-offs, narrow lanes and heavy equipment use."
>
> Project director Greg Brinkmeyer and TxDOT's engineer for policy and standards

The method has now been in use for a couple of years at a number of multi-lane construction sites in the Houston area. "We've found the lighting system makes drivers more aware of a lane closure ahead," says project director Greg Brinkmeyer and TxDOT's engineer for policy and standards. "It alerts drivers as they approach a work zone, encouraging them to slow down and move out of the affected lanes sooner," he said.

According to closed-course studies at TTI's Riverside Campus in College Station and roadway tests in Houston, drivers responded more positively to the synchronized flashing light system than to the normal traffic control setup used at construction sites in Texas.

"When the synchronized flashing warning light system was activated there was a one-fourth reduction in the number of passenger vehicles 1,000 feet before the lane closure taper," says TTI researcher Melisa Finley. "However, we saw the largest impact on commercial vehicles. The new light system resulted in a two-thirds reduction in the number of large trucks in the closed lane 1,000 feet before the lane closure taper."

TxDOT's use of the lane closure system has received attention from the Federal Highway Administration (FHWA). Brinkmeyer presented results from its use in the Houston area to the FHWA last June and hopes to eventually get it adopted in the Manual on Uniform Traffic Control Devices (MUTCD).

"It's a safety issue," says Brinkmeyer. "If we improve safety conditions in work zones, we help protect motorists and workers from hazards such as drop-offs, narrow lanes and heavy equipment use."

New technology for changing messages

Maintaining effective portable changeable message signs (PCMSs) is a unique challenge. Whether or not every driver can see the messages depends not only on how bright the lights are, but also how bright they look under a variety of circumstances—weather, pollution levels, and time of day can all be a factor.

Increasingly, TxDOT is using light-emitting-diode or LED lights in arrow panels and portable changeable message signs (PCMS) to improve efficiency over the old incandescent bulbs. However, there were concerns regarding the visibility of the LED technology, especially since there was no quantifiable illumination standard for either device at the system level. Again, it is a work zone safety issue, so TxDOT turned to TTI for a research resolution to the problem.

Portable changeable message sign.

Prior to TTI's research, TxDOT subjectively evaluated the visibility of arrow boards and PCMSs. In the past, TxDOT personnel would go out to a highway, place an arrow board, mark off a certain distance, and look.

In a TxDOT sponsored study, TTI researchers developed a scientific, measurable and objective method to determine if the boards and signs could truly be seen by motorists. "If motorists can detect an arrow board is present a mile away from the construction zone and clearly understand it 1,500 feet from the taper, we've improved the level of safety allowing them to make important decisions as they approach lane closures," says Glenn Hagler, TxDOT's project supervisor. "We've raised the bar, translating safety benefits for the traveling public."

TTI researchers recommended a minimum illumination, or brightness, for daytime driving and at night. They considered vehicle speeds and roadway alignments, as well as night and day situations, in setting the standards. From this, TxDOT has created a test (TEX 880) that measures the visibility of arrow boards. "We now have a standardized method to determine the quality of our arrow boards and a tool to eliminate those that don't meet state and federal standards," says Hagler.

Using the results of this project, TxDOT has successfully tested arrow boards purchased from one manufacturer and will test others as they are procured. R

MORE INFORMATION

For more information on Project No.: 0-4940, *Arrow Panel and Portable Changeable Message Sign Requirements*, please contact: Mark D. Wooldridge, TTI Research Supervisor, m-woolbridge@tamu.edu, (979) 845-9902, or Melisa D. Finley, TTI, m-finley@tamu.edu (979) 845-7596.

For more information on Project No.: 0-3983, *Work Zone Lane Closure Warning Light System*, please contact: Melisa D. Finley, TTI, m-finley@tamu.edu, (979) 845-7596.

Sign research and placement is important for large trucks, school bus safety

No one has to tell hard working school bus and commercial truck drivers that they face special challenges out there on the road. These drivers work through a unique set of roadway situations every day when navigating their transportation titans.

Research sponsored by the Texas Department of Transportation (TxDOT) and conducted by the Texas Transportation Institute (TTI) studied two different aspects of the relationship between these larger vehicles and road signs. One study is looking at how well commercial truck drivers perceive vital information on road signs and the other at how sign improvements may alert oncoming vehicles to the presence of a school bus, which may be loading or unloading right around that corner up ahead, over the next hill, or right behind the billboard we just passed.

Freight movers see signs clearly

Stick a Ferrari in a competition against a freightliner, and the differences between the two are pretty obvious—sleekness and speed versus mammoth and mighty. These highly engineered and radically different vehicles often share the same roadways, utilizing signs and pavement markings most often designed for average-size passenger vehicles.

The best angle for viewing road signs, particularly at night, is one where the light reflecting off the sign bounces back to where the light originated—the headlamps. In most passenger vehicles, the driver is located near the headlamps. Light leaves the headlamps, strikes the sign, and returns near the headlamps and, fortunately, near the driver's eyes.

The situation is different for commercial truck drivers. Federal regulations mandate headlight placement for large trucks, which means drivers in the vehicle's cab are often several feet above the ideal angle for best viewing of the sign. At least that is the case according to the laws of physics. But in a recent study sponsored by the Texas Department of Transportation (TxDOT), TTI researchers discovered that most commercial vehicle truck drivers don't perceive that they are receiving less light and believe that the brightness of signs at night appears the same in both types of vehicles.

"We conducted surveys of commercial truck drivers at Texas truck stops on I-35 in Buda, I-45 in Huntsville, and I-10 in Brookshire," says Melisa Finley, an assistant research engineer at TTI. "To our surprise we learned that over half the participants didn't identify any problems with signs or pavement markings. However, we did receive comments concerning signs not being bright enough, visible, or reflective at night, as well as

comments about signs appearing faded and being hard to read."

While most drivers reported little problem seeing signs, TxDOT is pursuing added safety measures by upgrading the reflective sheeting on signs to improve visibility for all drivers even further.

"TxDOT is working hard to improve the driving environment for all roadway users," says Greg Brinkmeyer, policy and standards engineer for TxDOT's Traffic Operations Division. "This research project verifies that the improvements we implement are beneficial to all roadway users, commercial vehicles and passenger cars alike."

Safer stops for kids

Seeing the sign is an important area of transportation research. But, being seen because of a sign is especially important for the safety of school bus passengers on rural roads.

Curves, crops, and other agrarian elements can obscure a clear view of the road ahead and present a safety risk to slowing or stopped school buses. Signs that warn us of school bus stops ahead often fade into the background among the barrage of warnings and messages we pass every day. Mark Wooldridge, an associate research engineer at TTI, is studying a sign technology that he hopes will get our attention—but only when necessary.

"School buses, in general, are a very safe way to get kids back and forth to school," says Wooldridge. "And we know that school bus crashes are a fairly rare event, but there's a high severity if something happens."

Wooldridge's research team is studying an active warning device for rural school bus stops with limited visibility. The system consists of two flashing beacons mounted to "School Bus Stop Ahead" warning signs and a spread spectrum radio transmitter connected to the yellow flashing lights on all school buses. When a bus driver flips the switch to activate the yellow flashing lights—indicating that the bus is slowing to load or unload—a radio signal is transmitted to beacons on the warning sign, causing them to flash.

"Once the bus leaves, the beacons will turn off," says Carlos Ibarra, the TxDOT project director of this study and director of Transportation Operations for TxDOT's Atlanta District. "This type of system will increase the target value (visibility and awareness) of these school bus signs that today are frequently ignored."

TTI is installing these trial-testing systems on SH-21 west of Caldwell, Texas, and in TxDOT's Atlanta District. All TxDOT districts should display bus stop warning signs in areas with limited visibility if the bus stop cannot be relocated, according to the Texas Manual on Uniform Traffic Control Devices (TMUTCD). The flashing warning beacons could potentially be mounted to existing signs, although in most cases the sign support would have to be replaced.

"School bus stops in rural areas of the state—where speeds are high and the terrain is hilly—give parents great concern," says Ibarra. "This project should give us an extra, added safety factor that we can implement at those critical spots where the loading or unloading bus may not be seen at the required distance properly."

MORE INFORMATION

For more information on Project No.: 0-4749, *Development of Active Warning Device for School Bus Loading and Unloading Points in Areas of Limited Visibility*, please contact Mark Wooldridge at: (979) 845-9902, or m-wooldridge@tamu.edu.

For more information on Project No.: 0-4269, *Accounting for Large Trucks in the Design of Signs and Pavement Markings*, please contact Melisa Finley at: (979) 845-7596, or m-finley@tamu.edu.

School bus warning signs on rural roads often fade into the scenery.

A test site for an active warning device for rural school bus stops.

TEXAS TRANSPORTATION INSTITUTE

ADVISORY COUNCIL

The Texas Transportation Institute (TTI) wishes to recognize the members of the TTI Advisory Council by featuring their profiles in the *Texas Transportation Researcher*. The TTI Advisory Council meets once a year to hear updates on research projects and program initiatives, discuss critical transportation issues facing Texas, and provide guidance on potential future research efforts.

BOB LANIER served as Mayor of Houston, Chairman of Houston Metro, and Chairman of the Texas Highway Department. Earlier, he practiced law (highest honors graduate from the University of Texas, class of '49), owned and operated Texas Banks and Savings and Loans, and developed real estate (mostly subdivisions and apartments).

At a reduced pace, but not yet retiring, Lanier manages his real estate properties, lectures several times a year, oversees the annual Lanier Public Policy Conferences at University of Houston, and participates in various civic, academic and political activities where he feels he can be helpful.

The Texas NAACP presented him its "Texas Hero" award, and he also received the Hubert Humphrey Civil Rights Award. His work in transportation earned him the International Freedom of Mobility Award from the National Automobile Dealers Association; in finance the Bond Market Association Award; and in beautification, working with his wife, Elyse, two national awards for cleans up, environment and beautification. Lanier's work was also recognized by the Texas State Leadership and Houston Preservation. He has received special recognition from former President Clinton, Vice President Gore and former governor, now President Bush.

In 2002, he was inducted into the Texas Transportation Institute's Hall of Honor at Texas A&M University. In 2000, he received the Leadership Houston Distinguished Service Award and the Urban Beautification Award from the American Horticultural Society.

He and his wife, Elyse, live in Houston, as do their seven children and ten grandchildren.

LAWRENCE OLSEN has been Executive Vice President of the Texas Good Roads/Transportation Association since January 1989.

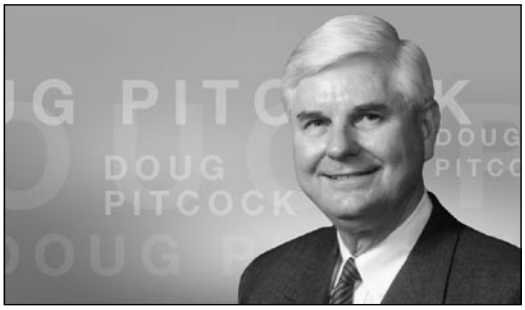
Olsen heads the daily operation of the 1,900 member non-profit association headquartered in Austin.

An Austin native, Olsen worked as a legislative assistant to U.S. Representative J.J. Pickle in Washington, D.C. from 1974 to 1978. He was Public Affairs Director for the Associated General Contractors of Texas, 1980 - 1989.

Olsen has an undergraduate degree in journalism and a master's degree in history, both from Southwest Texas State University in San Marcos. He also attended the University of Texas, the University of Americas (Mexico City) and George Mason University (Virginia). He is a veteran of the Texas Air National Guard.

His civic activities include Meals on Wheels, the Travis County Grand Jury Association and the Texas Society of Association Executives.

He has been married for 31 years and has two sons. The Olsens are members of the Westlake Hills Presbyterian Church.



JAMES D. (DOUG) PITCOCK, JR. graduated from Texas A&M in January 1950 with a degree in Civil Engineering. Upon fulfilling his obligation to the Army, he was employed by the construction company Farnsworth and Chambers. In 1955, Pitcock, along with Claude and John Williams, formed Williams Brothers Construction Company, where he is now the owner and Chief Executive.

Williams Brothers Construction, led by Pitcock, is recognized as one of the largest highway/heavy contractors in the nation. American Road and Transportation Builders Association named Williams Brothers the nation's best federal highway contractor two years in a row. The firm received the 2002 Build America Award in the Highway Renovation Category for the Queen Isabella Causeway reconstruction in Port Isabella.

Pitcock has been active in highway construction industry affairs for over 40 years. He has been National President of the Associated General Contractors of America, the President of the Texas Highway Branch of AGC on two different occasions, and is on the Board of Directors of numerous industry associations. He served on the Presidential Commission on Transportation Policy, the Governor's Texas 2000 Commission, the Texas Deep Water Port Authority, and as Chairman of the Houston Chamber of Commerce Highway Transportation Committee. Pitcock also served six years as a member of the Texas State Board of Registration for Professional Engineers.

MARY LOU RALLS is State Bridge Engineer and Director of the Bridge Division of the Texas Department of Transportation (TxDOT). Under her direction, the division oversees and provides assistance in bridge program and project development; structural and geotechnical design; standards and plan development; plans, specifications, and estimates review; safety inspection; and bridge construction and maintenance support to the districts. Her division administers the various programs for the 48,000 on-system and off-system bridges in Texas.

Ralls earned her bachelor's and master's degrees in civil engineering from the University of Texas at Austin in 1981 and 1984, respectively. She joined TxDOT in the Division of Bridges and Structures in 1984 and worked as an engineering assistant, bridge design engineer, bridge construction / maintenance engineer, and structural research engineer.

A member of the American Association of State Highway and Transportation Officials (AASHTO) Highway Subcommittee on Bridges and Structures, Ralls also chairs the Transportation Research Board's Structures Section Committee and has served on various National Cooperative Highway Research Program panels, including chair of the Future Strategic Highway Research Program's highway renewal panel. Awards include the *1994 Dewitt C. Greer Award* presented by Texas A&M University, the *1996 Woman of the Year Award* presented by Executive Women in Texas Government, the *2002 President's Award in Research Category* team award presented by AASHTO, and the *2003 Dr. L.I. Hewes Award* presented by the Western Association of State Highway and Transportation Officials. She is a member of the *Leadership Texas* class of 1995.

William J. Harris holds the resolution presented to him from Herb Richardson (left) and Dock Burke (right).

SWUTC Presents Resolution

A resolution establishing the **William J. Harris Award for the Outstanding Doctoral Student** was presented to Dr. William J. "Bill" Harris in January 2004 at the Cosmos Club in Washington, D.C. Texas Transportation Institute (TTI) Director Herb Richardson and Southwest Region University Transportation Center (SWUTC) Director Dock Burke made the presentation.

Dr. Harris held the *Snead Chair of Transportation Engineering* at Texas A&M and was an Associate Director of TTI from 1985 to 1995 where he contributed to the development of a national program in intelligent transportation systems. He was one of the intellectual founders of SWUTC and served for a decade as the chairman of its executive committee. In February 1997, Harris joined the **President's Commission on Critical Infrastructure Protection** and co-authored its important report on cyber-terrorism threats to the U.S. Now retired, he remains a *Distinguished Professor Emeritus* on the Texas A&M faculty.

"Bill Harris imbued his high standards of professionalism, intellectual dynamism, and collegial enthusiasm into the educational and research programs of SWUTC," says Burke, "and for that we will be forever enriched."

SWUTC established the Harris Award in October 2003. The first winner of the award was Jacqueline Jenkins, who completed her Ph.D. degree in the Department of Civil Engineering at Texas A&M University in August 2003. ■

TTI Employee Receives Honor

Grant G. Schultz is the recipient of the 2003 *Dr. Robert Herman Award* which is awarded annually to the Most Outstanding Student in the Southwest University Transportation Center (SWUTC). Schultz received his Ph.D. degree in the Department of Civil Engineering at Texas A&M University under the supervision of Dr. L. Rilett.

During his time at Texas A&M University, Schultz excelled academically and was the recipient of numerous scholarships and awards including the Southwest Region University Transportation Center (SWUTC) Outstanding Doctoral Student Award, the SWUTC Ph.D. Student of the Year in Transportation, the Institute of Transportation Engineering (ITE) District 9 Outstanding Student Award, as well as an Academic Excellence Award from Texas A&M University. Schultz was also selected as an Eno Fellow and attended the Eno Transportation Foundation Leadership Development Conference in Washington, D.C. Schultz had an opportunity to serve as the President of the Texas A&M University ITE Student Chapter from December 2001 to December 2002 and has been privileged to present the results of his research at several professional society meetings including the past three ITE Annual Meetings, the TRB 5th National Conference on Access Management, the Integrated Graduated Education and Research Traineeship (IGERT) Conference, and will present at the 83rd TRB Annual Meeting.

Schultz received a Bachelor of Science degree in Civil Engineering in April 1994 from Brigham Young University and a Master of Science degree in Civil Engineering in April 1995, also from Brigham Young University. Prior to attending Texas A&M University, Schultz was employed as a practicing engineer in the Salt Lake City office of the consulting firm Sear-Brown. In his role at Sear-Brown, Schultz was a Transportation Project Manager and head of the Traffic Studies Group for the Salt Lake City office. Schultz is a registered Professional Engineer in the state of Utah and a Professional Traffic Operations Engineer under the Transportation Professional Certification Board, Inc. Schultz has recently accepted a position as an Assistant Professor at Brigham Young University in Provo, Utah. Schultz has been married to his wife Karen for 11 years and enjoys spending time with his three children, Jessica, Courtney, and Tyler. ■

Miller rejoins TTI

Kim Miller rejoined the Texas Transportation (TTI) staff in March as the new manager of agency communications. Her responsibilities will include overseeing the writing, editing, distribution, digital media and presentation groups in TTI Communications. Miller will also facilitate the service the communication group provides to TTI researchers and the Research and Technology Implementation group at the Texas Department of Transportation.

Previous to coming to work at TTI, Miller was the assistant director of communications at the Texas Engineering Experiment Station. She also worked at TTI for nine years as a graphic designer. ■

Ledé Honored for Career Contributions

Dr. Naomi Ledé, a Senior Research Scientist with the Texas Transportation Institute, has been recognized as an African-American Hero in Transportation.

Ledé received the honor from the Port of Houston Authority, along with Captain Paul Brown of the Houston Pilots, the group responsible for navigation safety for the Port of Houston, and former Port of Houston Authority Commissioner Howard Middleton. The recognition was held in conjunction with the Teach Personal Freedoms Tour during its first stop on a five-city tour in observance of Black History Month. The event was co-sponsored by Procter & Gamble and HEB.

"The three African-American heroes in transportation that we have selected to honor have each made enormous professional contributions to the industry, helping create jobs, business opportunities, and economic prosperity for all," said Argentina M. James, as spokeswoman for the Port Authority. "Through all the daunting challenges and enormous opportunities that the transportation industry confronts, these three heroes are highly valued stakeholders and trusted partners providing uncompromising leadership and strength."

"A large part of the value of diversity in the transportation industry can be measured in the vital roles and abundant contributions of these African-American heroes. The industry's remarkable advancements are reflections of their commitment and dedication."

Ledé is a specialist in the fields of intelligent transportation systems and transportation planning. In addition to her work in transportation research, she has served in faculty and administration positions at Texas Southern University since 1982. Ledé holds degrees from Mary Allen College, Texas Southern University, the University of Texas at Arlington and the University of Houston.

Epps Martin Named Holder of Snead Professorship

Dr. Amy Epps Martin, associate professor of civil engineering, has been named holder of the E.B. Snead '25 Professorship II in Transportation Engineering at Texas A&M University.

Epps Martin came to Texas A&M in 1997 as an assistant professor in the Department of Civil Engineering. She is also an associate research scientist with the Texas Transportation Institute in The Texas A&M University System.

Her research interests are in the areas of pavement materials, design, behavior and performance; accelerated pavement testing; and recycled materials.

A registered professional engineer in Texas, Epps Martin is a member of the American Society for Engineering Education, the American Society of Civil Engineers (ASCE), the Association of Asphalt Paving Technologists, the International Society for Asphalt Pavements and the Transportation Research Board.

While an undergraduate at the University of California, Berkeley, Epps Martin was a member of the ASCE National Championship Concrete Canoe team in 1991 and 1992. In graduate school, she received a National Science Foundation Graduate Fellowship and a Dwight D. Eisenhower Graduate Fellowship from the Federal Highway Administration. The Texas A&M Montague Center for Teaching Excellence named Epps Martin a Scholar for 2000-01, and she received the Zachry Award for Excellence in Teaching for 2001-02. She also received the TTI/Trinity New Researcher Award in 2001.

Smith Named Holder of Kelleher Professorship

Dr. Roger E. Smith, a professor in the Department of Civil Engineering at Texas A&M University and a researcher with the Texas Transportation Institute (TTI), has been named holder of the Herbert D. Kelleher Professorship in Transportation.

Smith came to Teas A&M in 1986 as an associate professor. He previously was an officer in the U.S. Army Corps of Engineers, eventually reaching the rank of captain in 1970. In 1975, Smith returned to school, earning degrees in civil engineering from the University of Illinois.

Smith's areas of expertise are in pavement evaluation, rehabilitation, management and design; infrastructure management; transportation materials; and construction materials.

A registered professional engineer in Illinois and Texas, Smith is a Fellow of the American Society of Civil Engineers and a member of the Transportation Research Board, the American Society for Testing and Materials and the American Society for Engineering Education.

In February 2004, the Transportation Research Board appointed Smith member emeritus of its Committee on Pavement Maintenance. Smith received the Dick and Joyce Birdwell Endowed Teaching Award for 2002-03 in the Department of Civil Engineering at Texas A&M. And in 1997, Smith received the TTI/Zachry Senior Researcher Award in recognition of his research accomplishments and national standing in the field of pavement design, construction, maintenance and performance, and his continued leadership and support of research within TTI.

Marie Schoeneman relaxes in her retirement gift.

Carol Walters and Wallace Ewell from TxDOT Fort Worth District.

TTI Honors Retirees

The Texas Transportation Institute (TTI) bid a fond farewell to two of its employees in separate retirement ceremonies in December.

Marie Schoeneman began her career at TTI in 1966, and after brief stints with other state agencies, returned in 1983 to work in the business office. Schoeneman last served as the fiscal officer where she headed the financial accounting area in the business office and reported to Don Bugh. Among her duties were preparing the institute's annual financial report.

During his remarks at the ceremony, TTI Director Herb Richardson remarked that Schoeneman was a great role model and the kind of person that epitomizes the TTI staff.

Schoeneman's retirement plans include building a log cabin in Snook, and staying active in Relay for Life in Burleson and Brazos County.

Carol H. Walters was honored at a retirement reception in Arlington on December 19. Joining TTI in 1986, Carol was responsible for starting TTI's Arlington Office and initiating ongoing interagency projects with the Dallas, Fort Worth, El Paso, and Lubbock TxDOT Districts.

Carol was well known for her work in freeway bottleneck studies, high-occupancy vehicle lane assessments, and urban goods movement activities. Carol often provided an important link between planning and operations. Her work focused on testing practical applications of research findings on freeways in major metropolitan areas.

Terry Sams from the Dallas District and Wallace Ewell from the Fort Worth District recognized Carol's pioneering efforts and ongoing assistance to TxDOT at the ceremony. Herb Richardson, Dennis Christiansen, and Katie Turnbull, TTI management, paid tribute to Carol's leadership, technical capabilities, and innovative problem solving. ■

TRB Meetings Held in January

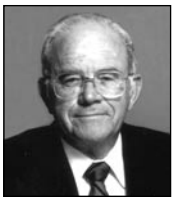
The Transportation Research Board held its 83rd Annual Meeting in Washington, D.C. in January.

A paper co-authored by Dominique Lord, associate transportation research scientist with the Center for Transportation Safety at the Texas Transportation Institute (TTI), was selected for the D. Grant Mickle Award at the Transportation Research Board Annual Meeting. The award recognizes the outstanding paper in field operations, safety, and maintenance. Lord was a co-author of the paper, *Development of a Procedure for Estimating Expected Safety Effects of a Contemplated Traffic Signal Installation*. Lord received the award on January 14, 2004, during the Chairman's Luncheon at the TRB Meeting. The D. Grant Mickle Award is named for the Board's Executive Director from 1964 to 1966.

Lord has been active in traffic safety studies including the development of safety performance functions, pedestrian safety, and the investigation of safety issues for urban road networks. Lord's primary interests include research on accident analysis methodology, and statistical modeling of crash data and evaluation techniques. He has published several papers and was one of the authors of the winning paper for the Mickle Award for 2001.

Also, two TTI researchers were appointed committee chairs. Beverly Kuhn, division head and research scientist in the System Management Division, was appointed chair of the User Information Systems Committee. Paul Carlson, program manager and associate research engineer in the Operations and Design Division, was appointed chair of the Signing and Marking Materials Committee. ■

New TRB Award Named after Charley V. Wootan



The Transportation Research Board (TRB) Executive Committee approved two new paper awards at its January 2004 meeting. One of the awards is named after Charley V. Wootan, TTI's former Director and Director Emeritus. The new award will be presented each year to the best TRB annual meeting paper addressing transportation policy and organization issues.

"Naming this new award after Charley is very appropriate," notes Robert E. Skinner, Jr., TRB Executive Director. "Charley served TRB in numerous capacities during his career. He was Chairman of the TRB Executive Committee in 1980 and was actively involved in numerous committees and special panels."

The new awards are part of the group and committee reorganization undertaken by TRB's Technical Activities Council in 2002 and 2003. The restructuring increases the number of groups from five to eleven to provide more visibility for modal committees and to enhance interaction among committees. The second new award, which will be given in the safety area, is named after Patricia F. Waller, former Director of the Transportation Research Institute at the University of Michigan. ■

TTI Day 2003— It's Hip to Be Square

The Institute's annual meeting was held on December 11 at the Brazos Center in College Station. The theme for this year's TTI Day was "HIP2B^2" and featured presentations about topics in the major focus areas for current and future TTI research.

Awards for outstanding performance were presented to the following TTI employees:

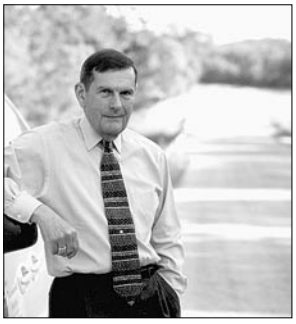
Administrative Support Staff Award – Tommy Clement
Division Administrative Support Award – Heather Ford, Maria Medrano
Administrative Technical Support Award – Nancy Stratta
Division Technical Support Award – Gary Barricklow, Todd Hausman
Administrative Professional Staff Award – Kassandra Agee-Letton
Trinity New Researcher Award – Marcus Brewer, Claire Fazio, Marc Jacobson
Trinity Researcher Award – Lance Bullard, Jr., William Eisele, Deborah Jasek
Trinity Senior Researcher Award – Carol Walters
Charles J. "Jack" Keese Career Achievement for Administrative/Technical Support Award – Barbara Lorenz. ■

2003 TTI Day Award Winners

Top Row (L-R): Herb Richardson, Claire Fazio, Carol Walters, Lance Bullard, Marc Jacobson, Barb Lorenz, Todd Hausman, Marcus Brewer, Bill Eisele, Tommy Clement.

Bottom Row (L-R): Gary Barricklow, Debbie Jasek, Kassandra Agee-Letton, Heather Ford, Maria Medrano, Nancy Stratta.

THE BACK ROAD



Most of us take highway and road signs and pavement markings for granted, and don't realize the extensive research, testing and evaluation that has produced these important guides. TTI has been one of the leaders in this area of transportation research for many years, and this issue of the *Researcher* highlights some of the work that has done so much to save lives and reduce injuries. TTI researchers have developed one of the preeminent research programs, conducting numerous studies that help determine and improve how well drivers see signs and markings. This is vital information for transportation agencies as they build or retrofit highways and roadways.

Texas leads the nation in work zone fatalities and injuries, primarily because we have a longer construction 'season' and more highways under construction at any one time. Since driver inattention and ability to see the work zone as early as possible are major causal factors, TTI research has focused on techniques that both improve worker safety and make it easier for drivers to see the construction or maintenance area as early as possible. One such improvement is a series of synchronized flashing lights that illuminate the drums, indicating a lane is 'tapering' down—say from two lanes to one. The lighting system makes drivers more aware of a lane closure ahead, encouraging them to slow down and move out of the affected lanes as quickly as possible.

I hope you'll also take time to read our *News* section, which recognizes just a few of the honors and awards received by TTI staff in recent months. Dr. Naomi Ledé, senior research scientist was recently honored as an African American Hero in Transportation by the Port Authority of Houston as part of the nationwide observance of Black History Month. Dr. Ledé is the former director of Texas Southern University's Center for Transportation Training and Research, and a specialist in the fields of intelligent transportation systems and transportation planning.

As always, we welcome your comments about the *Researcher* and hope you'll contact us if you'd like additional information on any of the subjects in this issue. Thank you for your continued interest.

Herb Richardson

TEXAS TRANSPORTATION Researcher

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