Evaluating Road Types Improves Safety, Mobility in Rural Areas

Car Makers Join Researchers to Aid Flow through Traffic Signals

TTI Facilities Research Road Safety Devices, Technologies

TEXAS TRANSPORTATION
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Bridging Technology and Roadway Safety

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ON THE COVER: In theory, the best way to maximize traffic flow along busy urban streets is to coordinate the series of traffic signals that drivers encounter. Thanks to recent research supported by the Texas A&M Transportation Institute, traffic engineers are a big step closer to that lofty aspiration.

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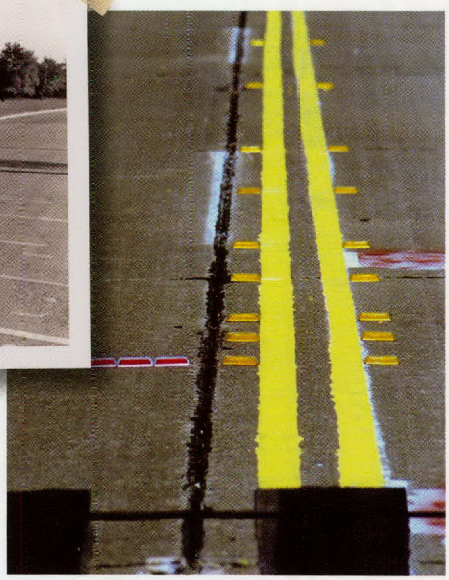


PAVEMENT MARKINGS

NEWLY PAVED ROAD

Seeing the Road

Though highway striping technologies have evolved in the past 80 years, one constant has remained the same: Clear and highly visible highway markings ensure safety for drivers. 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.

Researchers at the Texas A&M Transportation Institute 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.

SEEING THE ROAD IN Low-Visibility Conditions

During the daytime and in clear weather conditions, these roadway markings typically provide adequate delineation that road users can follow. However, these same markings need to be readily visible to drivers at night and in adverse weather conditions (e.g., rain) — especially in areas with little or no road lighting — to keep drivers safe.

Seeing the road is an essential component of safe driving.

Drivers depend on a continuous flow of information as they move along the roadway to properly position their vehicle. Centerline and edge-line markings delineate the vehicle lane for drivers, while other markings such as stop bars and railway crossings provide key safety information and alert drivers about the conditions ahead.

During the daytime and in clear weather conditions, these roadway markings typically provide adequate delineation that road users can follow. However, these same markings need to be readily visible to drivers at night and in adverse weather conditions (e.g., rain) — especially in areas with little or no road lighting — to keep drivers safe. Wet-night conditions considerably reduce the performance of roadway markings and increase the risk of run-off-the-road crashes.

An extensive overhead spray apparatus enabled the test track to simulate a rainy night. Sample pavement markings were placed in the road for visibility rankings.

The Texas A&M Transportation Institute (TTI) completed the research project Pavement Markings — Wet Retroreflectivity Standards. Led by TTI Signs and Markings Program Manager and Associate Research Engineer Adam Pike, the project was sponsored by the Local Road Research Board and the Minnesota Department of Transportation (MnDOT).

The project's main objective was to establish quantitative performance standards for pavement marking wet

retroreflectivity. To do so, researchers also needed to determine drivers' visibility needs (i.e., the minimum pavement marking brightness drivers need to see markings in wet-night conditions). Researchers conducted the following investigations:

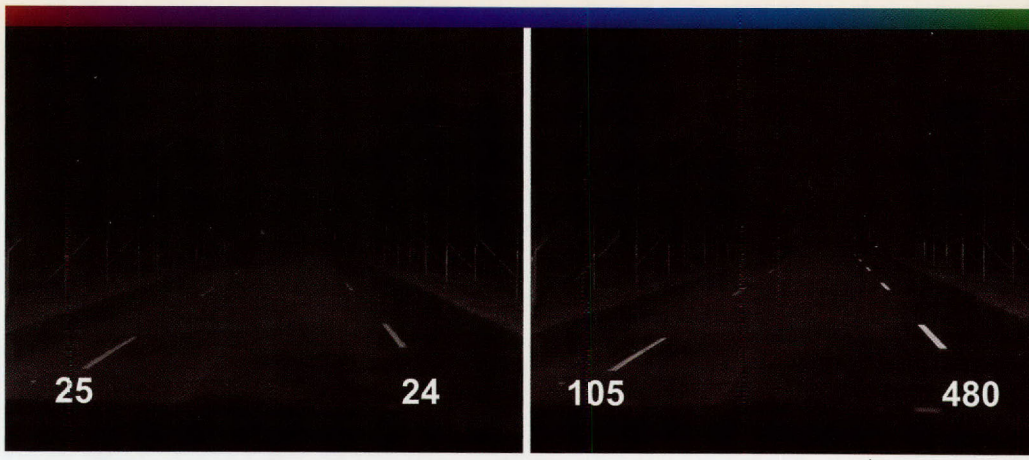
- a comprehensive review of past literature,
- a human factors study,
- photometric measurements of pavement marking samples, and
- a comparison of driver visibility needs to the collected human factors data and to data from the literature.

The human factors study included 43 participants — with an average age of approximately 60 years old — from the general population. Each participant was tasked with evaluating the quality of pavement markings in simulated rain and dry conditions on a closed-course test track in Minnesota. Researchers then used retroreflectometers and imaging colorimeters to measure the reflectivity of the observed pavement marking samples. The coefficient of retroreflected luminance, expressed as millicandelas per square meter per lux (mcd/m2/lux) (i.e., how much light will be reflected at a given illuminance), and observed marking luminance (mcd/m2) were evaluated.

Researchers determined that pavement markings must have at least a continuous retroreflectivity level of 50 mcd/m2/lux to be adequately visible in wet-night conditions. For newer markings, researchers determined an initial value of 200 mcd/m2/lux should be used to obtain an average lifespan of four years before degrading to the minimum level.

"Ensuring drivers can see roadway markings both during the day and at night — regardless of weather conditions — is critical to keeping our roadway users safe. Establishing these performance standards can help inform agencies to ensure that adequate pavement marking visibility is provided through routine maintenance."

Adam Pike
TTI Signs and Markings Program Manager and Associate Research Engineer



Luminance-only images of pavement marking samples.

"Ensuring drivers can see roadway markings both during the day and at night — regardless of weather conditions — is critical to keeping our roadway users safe," says Pike. "Establishing these performance standards can help inform agencies to ensure that adequate pavement marking visibility is provided through routine maintenance."

Pike notes, "Recommendations from this project should result in improved wet-night visibility of pavement markings, both initially and over the life cycle of the markings, leading to fewer wet-night crashes and increased driver comfort."

The findings from this study provide MnDOT with critical guidance for pavement markings that will be included in the department's standards and specifications for roadway pavement markings moving forward.

"MnDOT's goal — as stated in the MnDOT Provisions for Pavement Marking Operations Technical Memorandum — is to provide an appropriate pavement marking on all state trunk highways, 365 days a year," says Ethan Peterson, state pavement marking and crashworthy engineer at MnDOT. "This is always a challenge with inclement weather. It's with that goal in mind I believe MnDOT's newly established specifications will help the traveling public more safely navigate Minnesota's roadways." ■

For more information, contact **Adam Pike** at a-pike@tti.tamu.edu.

TRAFFIC SIGNAL TECHNOLOGIES Improve Pedestrian, Bicyclist Safety in Texas

Crossing signage, in addition to technologies like bus-turning alerts, can help pedestrians and bicyclists stay safe near intersections.

College campuses like Texas A&M often have high pedestrian and bicyclist activity, which makes them a key location for road safety projects.

The Lone Star State has experienced an increase in the number of pedestrians and bicyclists who have lost their lives in roadway crashes. Within the last decade, pedestrian and bicyclist fatalities rose by 69 percent in Texas. These statistics — but, even more so, the real people behind the numbers — present a safety concern for reducing crashes, especially in urban areas.

The Texas A&M Transportation Institute (TTI) conducted the innovative research project Automated and Connected Vehicle (AV/CV) Test Bed to Improve Transit, Bicycle and Pedestrian Safety. Texas Department of Transportation (TxDOT) Project 0-6875-03 was a multi-year, three-phase cooperative effort by TTI, with Texas A&M University, the City of College Station, and the Brazos Transit District providing support.

The project focused on ways to improve safety involving buses, bicyclists and pedestrians using AV/CV technologies. Providing alerts to pedestrians and bicyclists that buses are turning at signalized intersections is one approach tested in the project.

The Mobileye/Rosco Shield+™ collision-avoidance system has four different cameras that are essentially aimed at the blind spots on the bus and where pedestrians and bicyclists are most likely to show up and be in harm's way.

"Anytime we can reduce the risk of a crash — especially between a large vehicle and a vulnerable roadway user — it's a success. We have an opportunity to use technology to avoid some almost certainly fatal crashes, so it's our responsibility to advance and share that technology."

Bonnie Sherman
Bicycle and Pedestrian Program Supervisor, Public Transportation Division, Texas Department of Transportation

TTI Executive Associate Director Katie Turnbull notes, "The first phase of the project looked at defining the issues, and we held 25 meetings throughout the state, a variety of workshops, and roundtable forums to really help define the issue, the problems, and where conflicts among buses, bicyclists and pedestrians are occurring."

Phase I also allowed for research on AV/CV technologies to help address the issues. In Phase II, researchers developed and piloted a smart intersection at the Texas A&M-RELLIS campus. The team performed a proof of concept with the Brazos Transit District's buses to evaluate visual and audio alerts to pedestrians and bicyclists that a bus was turning.

During Phase I, the Rosco MobileEye® Shield+™ collision-warning system was piloted on one Texas A&M bus. The system uses cameras and sensors to detect if a pedestrian or bicyclist is too close to the bus and a collision might occur. The bus operator is alerted by yellow and red lights and a buzzer to take appropriate action. During Phase III, upgraded MobileEye systems were installed on new Texas A&M buses to continue the pilot.

Phase III included installation of the technology at Penberthy Boulevard and George Bush Drive, an intersection close to busy campus activity. Texas A&M Transportation Services and the City of College Station collaborated with TTI during this phase. Ten Texas A&M buses were equipped with dedicated short-range communications radios, and the City of College Station allowed the use of the traffic signal system.

Supporting projects using AV/CV technologies could make intersections and urban areas safer for buses, pedestrians, bicyclists and other road users across Texas.

"Anytime we can reduce the risk of a crash — especially between a large vehicle and a vulnerable roadway user — it's a success," says Bonnie Sherman, bicycle and pedestrian program supervisor in TxDOT's Public Transportation Division. "We have an opportunity to use technology to avoid some almost certainly fatal crashes, so it's our responsibility to advance and share that technology." ■

For more information, contact **Katie Turnbull** at k-turnbull@tti.tamu.edu.

Sharing INNOVATION

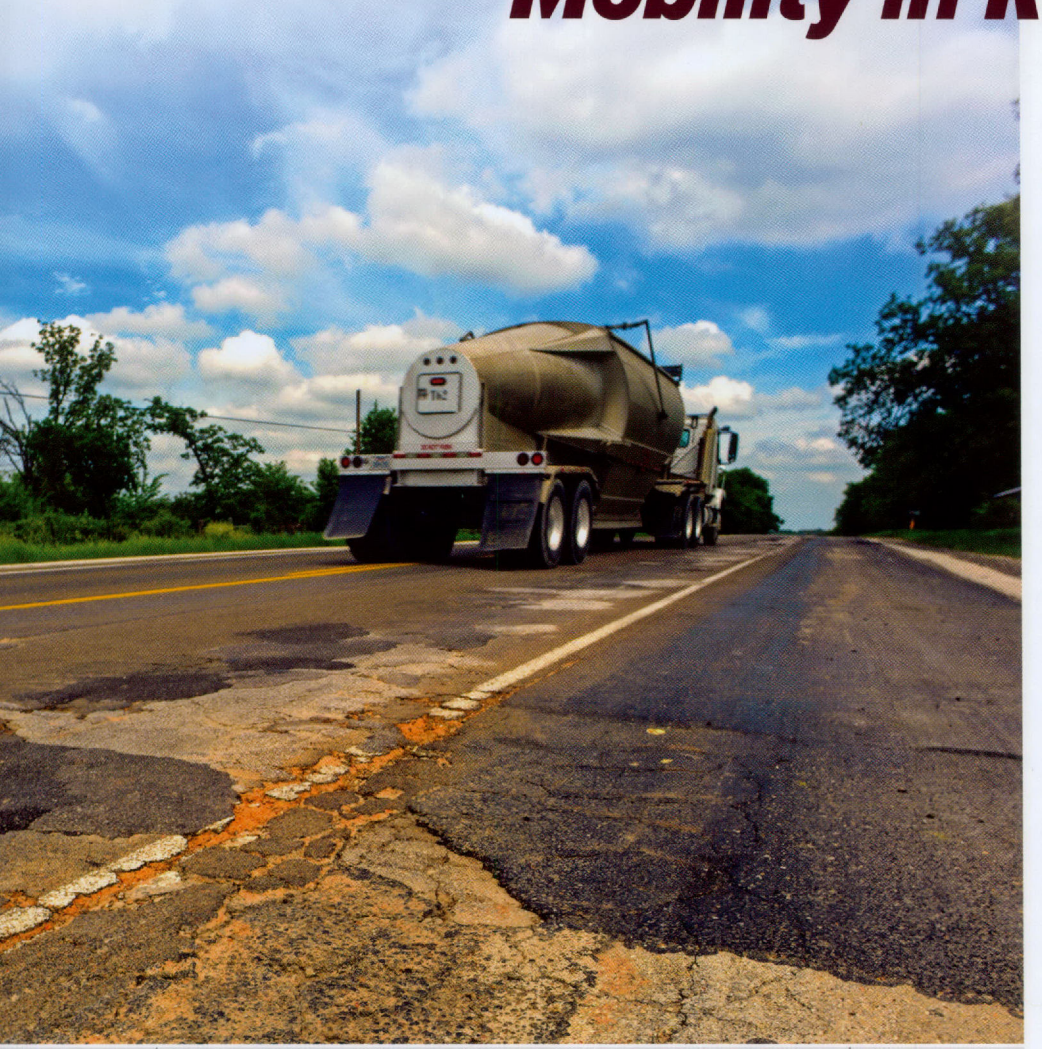
Video Summary Report

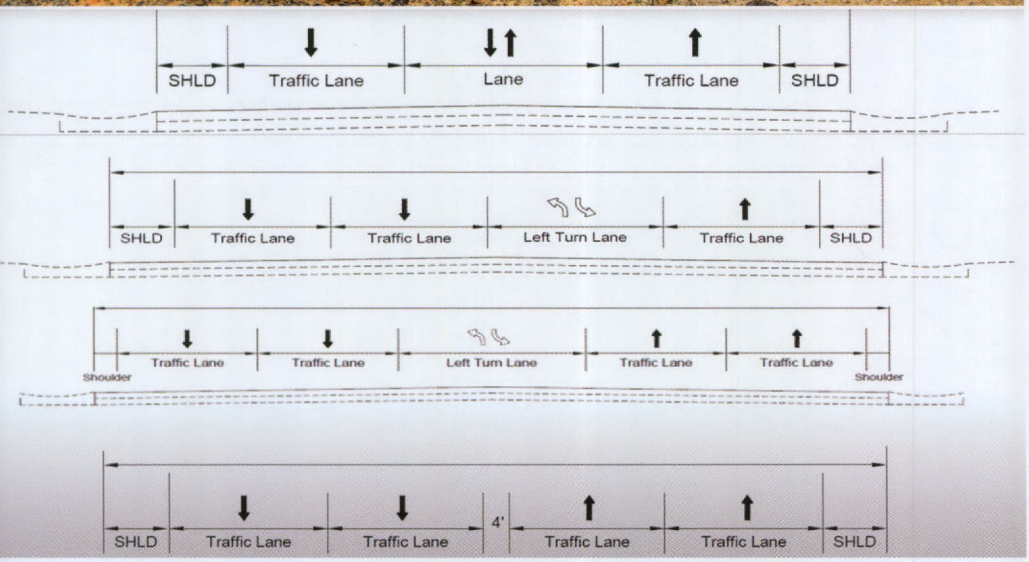
TxDOT PROJECT NO. 0-6875-03

Watch TTI's Video Summary Report

TTI produced a video summary report for the Automated and Connected Vehicle Test Bed to Improve Transit, Bicycle and Pedestrian Safety project. View the video on TxDOT's YouTube channel: https://youtu.be/3eYwOuGETSI.

Evaluating Road Types Improves Safety, Mobility in Rural Areas





The research team collected and analyzed data for traditional four-lane undivided sites and compared their safety and operational performances with other alternative cross-sectional designs.

Rural roadways often have a high number of crashes, especially severe crashes. To help decrease that number, researchers have focused safety and mobility studies on rural areas that experience increased truck traffic and road usage during certain economic booms — like oil booms.

The Texas Department of Transportation (TxDOT) Odessa District experienced an oil boom over the last decade and increased truck traffic, along with a rise in crashes. A district engineer at the time, John Speed, now a Texas A&M Transportation Institute (TTI) research engineer, identified the issue and worked with TTI to develop a problem statement. TTI conducted the project Examine Trade-Offs between Center Separation, Shoulder Width Allotment for Roadway Width (TxDOT Project 0-7035) to improve safety in rural areas in Texas.

TTI Research Engineer Srinivas Geedipally notes, "It's proven that four-lane undivided roads in rural areas have a poor safety performance."

TTI examined several cross sections for two-lane undivided and multi-lane undivided roadways. The purpose was to separate vehicles going in opposite directions so they would not hit each other in the middle of the road. Keeping them farther apart might prevent crashes from truck drivers on an undivided roadway knocking off side mirrors or swerving to avoid side mirror debris in their direct path on the road.

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Video Summary Report

TxDOT PROJECT NO. 0-7035

Watch TTI's Video Summary Report

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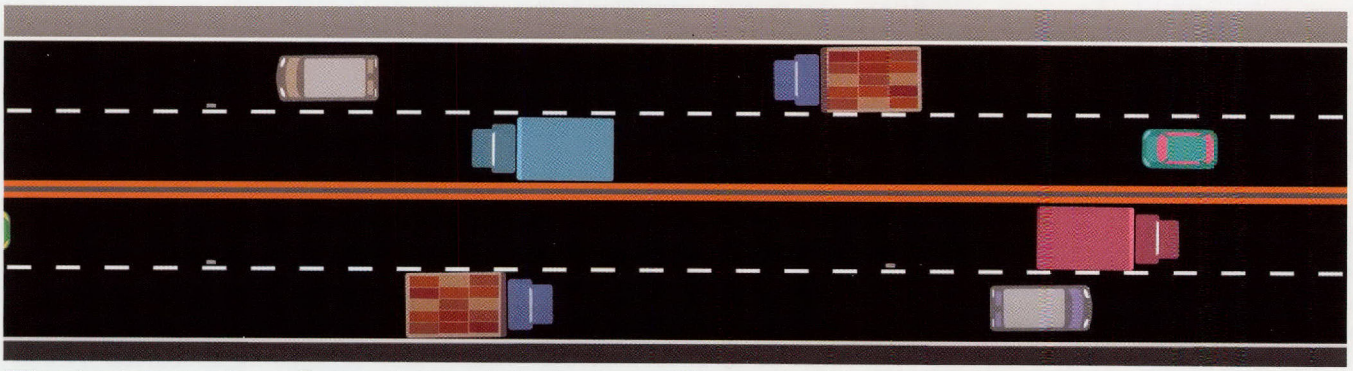


TTI analyzed cross sections on Texas roadways, including four-lane undivided roads with a centerline stripe.

Researchers evaluated the cross sections of different roadways across Texas — from four-lane, undivided roads with only a centerline stripe in the middle to keep opposite-direction traffic in their lanes, to two-lane roads built as Super 2s for the added benefit of a passing lane for vehicles driving at faster speeds. The research team assessed the safety performance of these roadway types and the efficiency of each type to accommodate traffic volume, speed and flow.

The TTI team produced guidelines and recommendations for what roadway type or feature has the potential to improve safety and mobility in different locations. TTI's recommendations can serve as a methodology for how to develop and expand roadways in rural regions across the state.

"The guidelines can be used everywhere," says Geedipally. "But they're especially important for rural areas like the Permian Basin."

If the volume of traffic increases in a rural area, this project's results can inform decisions about what types of roadways could alleviate issues with the rise in traffic and provide a safer environment for road users. Those decisions could involve reducing the shoulders on a rural roadway, decreasing the number of lanes for a road section, or adding a 4-foot median buffer in the middle.

"This study can help you develop location-specific tools to reduce risks at hot spots where crashes continue to occur," says Speed. "That's the part that we think is so exciting about all this — it's not something that's just for the Permian Basin. It's something that can be used in any rural setting with unusual traffic movements or roadway configurations." ■

The TxDOT Odessa District noticed an increase in traffic on SH 349 and SH 158, which led TTI to perform a safety and mobility study.

For more information, contact **Srinivas Geedipally** at srinivas-g@tti.tamu.edu.

Car Makers Join Researchers

TO AID FLOW THROUGH TRAFFIC SIGNALS

In theory, the best way to maximize traffic flow along busy urban streets is to coordinate the series of traffic signals that drivers encounter. In practice, that's far easier said than done. But with the completion of recent research supported by the Texas A&M Transportation Institute (TTI), traffic engineers are a big step closer to that lofty aspiration.

Under a subcontract, TTI's work on the project — Traffic Optimization for Signalized Corridors (TOSCo) — was led by TTI Senior Research Engineer Kevin Balke. The work was sponsored by the Federal Highway Administration and accomplished by the Collision Avoidance Metrics Partners LLC through a consortium of automakers that includes Honda, Ford, Nissan, Hyundai, General Motors and Volkswagen. IAV GmbH, a Germany-based engineering firm, also assisted in system development and integration.

The TOSCo system involves a series of applications using wireless communications from both the infrastructure and connected vehicles to optimize traffic flow on signalized arterial thoroughfares. The system considers the length of each queue of vehicles and the time remaining in each green or red phase, along with other factors. This information is sent to approaching connected vehicles 10 times per second, enabling strings of vehicles to determine and adjust to optimal speeds, proceed en masse, and minimize the likelihood of stopping.

If stopping is unavoidable, the waiting TOSCo vehicles will launch collectively when the signal turns green, keeping the vehicle string intact. By keeping the vehicles in close proximity to each other as they launch on green, the system can maximize the count of vehicles proceeding through the intersection. The TOSCo system works with the vehicle's cooperative adaptive cruise control function, and the driver can take control at any time.

"I like to call it next-generation cruise control," Balke says. "It's very difficult to build new capacity in roadways, so we're trying to eke out as much capacity in the system as we can possibly get through these advanced technology projects."

The TOSCo work began in 2015 with concept development, followed by simulation models focused on vehicles, infrastructure and performance, along Plymouth Road in Ann Arbor, MI, and SH 105 in Conroe, TX.

Outcomes from the simulations showed significant benefits. Results showed substantial reductions in stop delays and the number of stops along both the low-speed Ann Arbor corridor (40 percent decrease) and the high-speed Conroe corridor (80 percent decrease). Similar reductions in the total number of stops were recorded along both corridors. The TOSCo system did not cause substantial changes in total delay for travelers, and travel times and speed were not significantly affected.

"I like to call it next-generation cruise control. It's very difficult to build new capacity in roadways, so we're trying to eke out as much capacity in the system as we can possibly get through these advanced technology projects."

Kevin Balke
TTI Senior Research Engineer

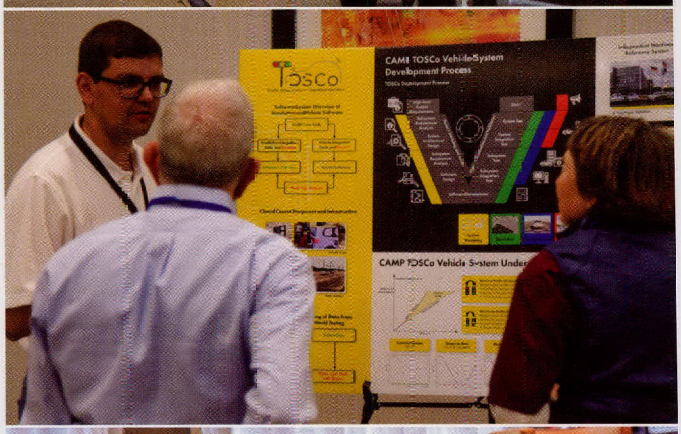
Because average speeds were not affected in the simulations, there was no substantial impact on vehicle emissions or fuel consumption, although the TOSCo system did produce minor reductions in hydrocarbons and nitrogen oxide.

In a second phase of the work, researchers built a closed-course test site on the Texas A&M-RELLIS campus at TTI. Favorable results from the simulations enabled researchers to fine-tune the system there before proceeding to a real-world deployment on FM 1960 in Houston in spring 2022.

"We run the scenarios on the test track, we come back and analyze the data, and we see if there's any room for improvement so the system can perform better," says Shah Hussain, a system architect at Ford Motor Company. "Then we go back to the test track, and we do the same process again and again. It's quite exciting and fun to watch things perform exactly as we expect from what we see in the simulations."

Like many other mobility enhancement efforts, TOSCo intends to maximize the usefulness of existing infrastructure — a goal underscored by industry partners on the project.

"It's going to come to a point where we cannot build our way out of congestion; there's only limited space to put in new roads," says Roy Goudy, the project's principal investigator and a senior principal engineer at Nissan. "So in order to deal with our growth, we'll have to rely on technological solutions to improve our transportation network mobility, our fuel economy and our emissions reduction efforts." ■



For more information, contact **Kevin Balke** at k-balke@tti.tamu.edu.

A TTI research team evaluates traffic control devices in the Visibility Research Laboratory.

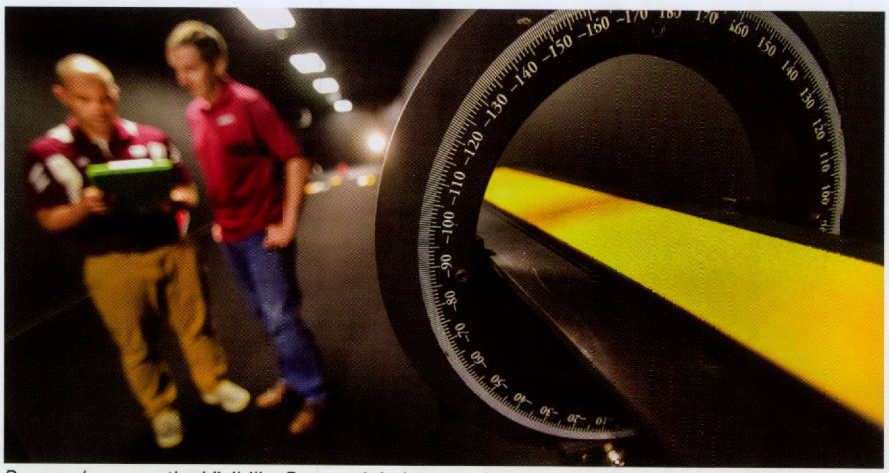
TTI Facilities Research Road Safety Devices, Technologies

The Texas A&M Transportation Institute's (TTI's) Visibility Research Laboratory and smart intersection explore how improvements in road markings, signals and equipment can keep road users safe.

Through the Eyes of the Visibility Research Laboratory

Researchers in TTI's Visibility Research Laboratory evaluate retroreflective materials, lights, coatings and other technologies designed to provide nighttime visibility. The lab is a 140-foot-long by 15-foot-wide corridor in TTI's headquarters building on the Texas A&M-RELLIS campus. Ventilation systems allow full-size vehicles to operate in the lab during human factors testing and headlamp studies. To simulate a dark environment, lighting controls can turn off all lighting, and the walls, floor and ceiling are all black.

The lab leverages advanced technologies such as retroreflectometers, high-megapixel imaging colorimeters, and light detection and ranging systems. With these tools, researchers can measure photometric characteristics (color and brightness as evaluated from a human eye) of sign sheeting, pavement markings, raised retroreflective pavement markers and other retroreflective devices to improve safety for all road users. Researchers can also test a vehicle's lighting system and how it may impact visibility on a roadway.



Researchers use the Visibility Research Laboratory's equipment to assess retroreflective characteristics of a pavement marking sample.

The Visibility Research Laboratory is home to a four-axis photogoniometer where researchers rotate various retroreflective devices to observe light intensity at specific measurement geometrics. Understanding how light interacts, especially from multiple angles, can inform specification design and potential safety improvements

A research team recently conducted the TOSCo project at TTI's smart intersection.

Studies conducted in the lab include:

- observing how drivers interpret various traffic control devices,
- calibrating data collection equipment for field applications, and
- conducting standardized and non-standardized evaluations of traffic control devices.

"The lab's research often results in guidance used to support development of and modifications to existing specifications for various traffic control devices," says Adam Pike, TTI Signs and Markings program manager and associate research engineer. "This guidance can improve the visibility, durability and safety performance of the devices."

"We often host student groups who tour the lab to learn about the research we do," says Pike. "We're able to show them how traffic signs and pavement markings are used to provide a safe driving environment and how we evaluate the devices' performance to make sure they are functioning properly."

Conversing in Data at the Smart Intersection

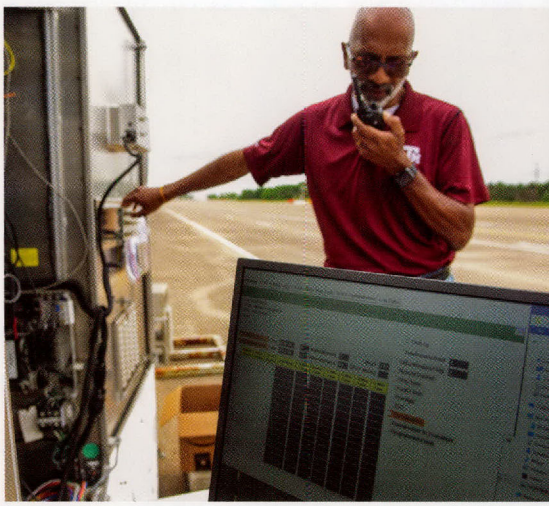
TTI's smart intersection project advances research in traffic signal control, detection technology and connected vehicle infrastructure to increase awareness and safety on roadways. Located on the RELLIS campus, the smart intersection is a fully actuated span-wire intersection with flashing yellow arrows and dedicated short-range communications (DSRC) equipment. TTI, Econolite, other vendors and the Texas Department of Transportation contributed to the intersection installation and additional research equipment.

The intersection's poles can accommodate detection and communication equipment for conducting a variety of tests. One cabinet houses a controller, and another contains additional research equipment. The intersection also includes a painted pedestrian and bicyclist crosswalk with signals at both ends. Other capabilities include:

- radar tracking for northbound and southbound approaches;
- video detection for all four approaches;
- a GRIDSMART® system for detecting pedestrians, bicyclists and vehicles at the stop bar; and
- numerous DSRC radios constituting the connected infrastructure.

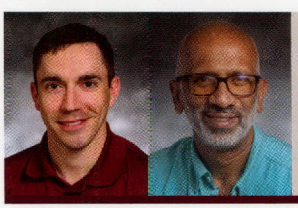
The smart intersection recently supported the TOSCo project to conduct end-to-end testing of all system components before TOSCo was deployed in real traffic along FM 1960 in Houston. The TOSCo project broadcasts signal phase and timing data after fusing queue length and green window information to allow TOSCo-capable vehicles to adjust their speeds approaching signalized intersections to minimize fuel consumption and emissions.

Researchers use the smart intersection to install and evaluate advanced signal control, detection, DSRC/cellular vehicle-to-everything and other connected infrastructure equipment. In light of the increasing interest in connected vehicle applications, this intersection helps research teams test the interoperability of signal control with connected infrastructure, which could inform policy making and transportation planning.



TTI's smart intersection features a variety of tools and resources for connected infrastructure and traffic signal research.

TTI Research Engineer Srinivasa Sunkari says, "The smart intersection is undergoing a significant improvement in conjunction with the runway renovations at the RELLIS campus. The smart intersection will have a mast-arm configuration, with radar and video sensors installed on mast arms to significantly improve detection capabilities and hence support a more robust testing environment." ■



For more information, contact **Adam Pike** at a-pike@tti.tamu.edu or **Srinivasa Sunkari** at s-sunkari@tti.tamu.edu.

PREVENTING ROADWAY CRASHES

Before They Occur

"A good research project always leads to more research. For the positive results that came out of this project, we double down on what works. If we know texture works on shoulders, then we continue to find ways to do that — whether it's through construction or safety funds — to ensure that we're implementing the things that we know are working well."

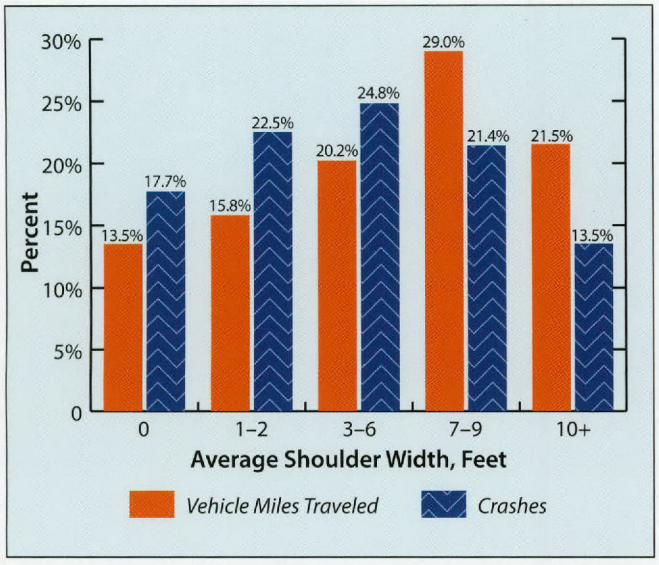
Rebecca Wells
Director of Transportation Operations, TxDOT Atlanta District

Roadway departure crashes make up a significant number of the crashes on Texas roadways each year. In 2016 alone, Texas roads experienced 61,973 roadway departure crashes, most of which occurred on two-way two-lane (TWTL) highways (92 percent). These numbers — especially in a state that just saw its second-deadliest year on record for road fatalities (2021) — prompt the need to effectively identify and deploy countermeasures that can prevent future crashes.

The Texas A&M Transportation Institute (TTI) conducted the research project Evaluation of Roadside Treatments to Mitigate Roadway Departure Crashes. Sponsored by the Texas Department of Transportation (TxDOT), Project 0-6991 was a multi-year project led by researchers at TTI.

Researchers focused on rural TWTL highways and examined roadside features to recommend appropriate countermeasures for systemic implementation in Texas. These recommendations are intended to serve as a framework for TxDOT districts to use when prioritizing sites that are at risk for a roadway departure crash. By prioritizing sites that are most at risk, districts can make safety improvements proactively (e.g., improving guardrails and barriers) rather than reactively (e.g., based on crash history).

"When a roadway departure crash happens, it's a chain of events that typically starts with things that we as engineers can't control, like a distraction or a mechanical malfunction," says Raul Avelar, TTI research scientist and lead researcher on the project. "When a crash happens, everything in the past that you did on the road to make it safe is not useful anymore. This means you must go to plan B and have the roadside protected."



Systemic crash trend for shoulder width (narrower shoulders tend to have crashes overrepresented).

Crashes in rural areas are significantly affected by the random nature of crash occurrences. This is more prevalent in crash types such as rollovers, guardrail hit crashes and other fixed-object collisions. Using a systemic approach that focuses on high-risk roadway features rather than the crash record at specific locations, it is possible to anticipate which locations are likely to experience crashes based on their roadway characteristics known to be associated with higher crash risk.

After identifying 420 roadway segments across the state using a balanced stratified sample, researchers examined key safety variables including average daily traffic, average daily truck traffic, shoulder width, lane width and speed limit at each segment. These factors were then weighted based on site and traffic characteristics to help identify at-risk areas.

According to Avelar, roadway departure crashes can be prevented by:

- designing roadways with geometric parameters that make it less likely a driver will depart from the lane (e.g., wider lanes and softer horizontal curves);
- giving feedback to a driver who is departing from the lane (e.g., rumble strips and profile edge markings);
- widening the length of the shoulder to increase the likelihood of a driver returning to the roadway; and
- using more forgiving roadside designs, like providing flatter foreslopes, wider clear zones, and guardrails protecting against hazardous conditions such as walls, trees and poles.

"A good research project always leads to more research," says Rebecca Wells, director of transportation operations for the TxDOT Atlanta District. "For the positive results that came out of this project, we double down on what works. If we know texture works on shoulders, then we continue to find ways to do that — whether it's through construction or safety funds — to ensure that we're implementing the things that we know are working well." ■

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Video Summary Report

TxDOT PROJECT NO. 0-6991

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Raul Avelar
TTI Research Scientist

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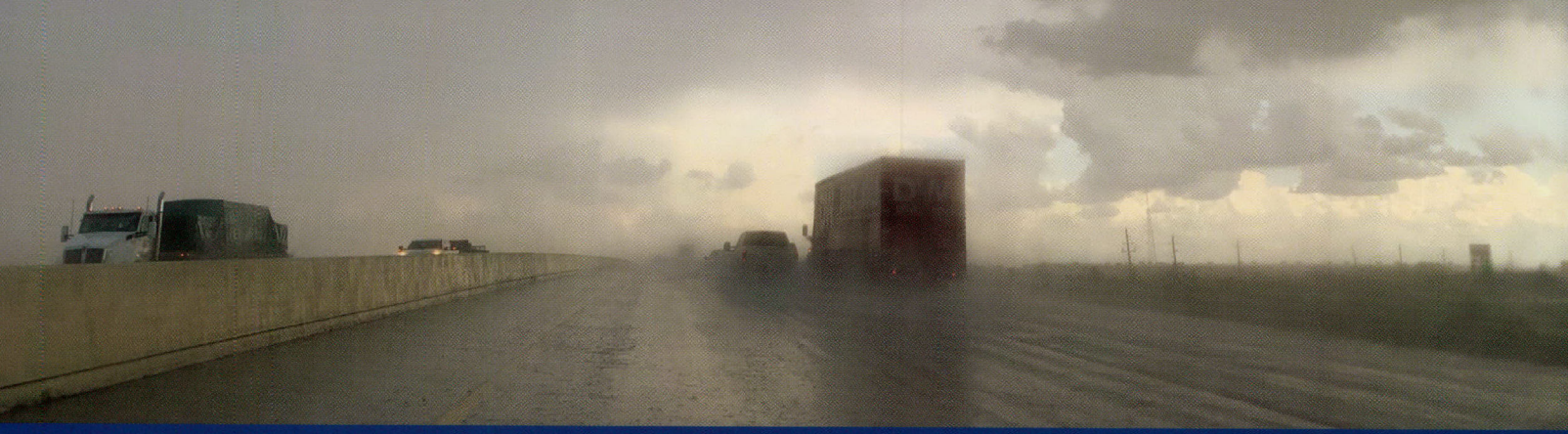

Proper Friction Equals Safer Roads

THE CORRECT AMOUNT OF PAVEMENT FRICTION IS CRITICAL FOR MOTORIST SAFETY, ESPECIALLY DURING WET WEATHER.

The Wet Surface Crash Reduction Program guidelines from the Texas Department of Transportation (TxDOT) Traffic Safety Division provide engineers with a framework for identifying existing pavement friction and the tools for specifying new pavement surfaces that will meet project-specific friction demand. During the past few years, there have been issues with some flexible pavements having lower-than-expected friction skid values. These concerns were for newly constructed pavements; normally, friction skid values decrease only several years after construction.

Researchers with the Texas A&M Transportation Institute (TTI) recently completed a synthesis study to evaluate Form 2088, the Surface Aggregate Selection Form, which is used to provide guidance on selecting proper roadway friction treatments.

"In TxDOT, we have a program called the Wet Surface Crash Reduction Program," says Robert Trevino Flores, director of the TxDOT Soils and Aggregate Section. "This program provides the framework for identifying existing pavement friction. Form 2088 is one of those tools used in the program to determine the friction availability and demand. This project tried to evaluate those criteria and make sure that the form is really helping us make the best decisions for our pavements."

This synthesis study searched available information pertinent to the criteria used for Form 2088 to find the surface aggregate classification and determine the criteria used by other states and governing agencies to determine the friction availability and demand.

With the proper guidelines in place for the Wet Surface Crash Reduction Program, the traveling public will benefit from safer roadways.

"What we wanted to look at was the criteria on the form to see if there had been research since the form was created in the late 1990s," says Darlene Goehl, head of the TTI Pavements and Materials Division. "Our goal was to update those criteria based on the latest research."

The project found improvements in the program that triggered two research statements. The first statement was the evaluation of surface types, pavement friction and wet weather accidents. The other project was incorporation of the findings in a different type of form.

"We also recommended that they look at the safety spreadsheet that TTI developed and the districts are starting to use," says Goehl. "A lot of the criteria that are on the form are also captured in that safety spreadsheet, so we think it's an efficient use of resources to just have that one form. We also made recommendations on the aggregate being used to include some friction values."

With the proper guidelines in place for the Wet Surface Crash Reduction Program, the traveling public will benefit from safer roadways.

"Safety is our priority here at TxDOT," notes Flores. "It is critical to address the safety of the traveling public, and it is important that we are using the correct criteria on the form to make the pavement surface optimized for correct friction values." ■

For more information, contact **Darlene Goehl** at d-goehl@tti.tamu.edu.

Tooley Honored with University of Arkansas College of Engineering Distinguished Alumni Award

Melissa Tooley, TTI director of external initiatives, received a Distinguished Alumni award April 9 at the University of Arkansas College of Engineering Alumni Awards Banquet. The Department of Civil Engineering chose Tooley as its award recipient, one of the highest honors given to College of Engineering alumni.

According to the award documentation, the College of Engineering Distinguished Alumni Award "honors the exceptional professional and personal achievements of University of Arkansas College of Engineering graduates. Recipients have achieved distinction in their fields and have provided outstanding leadership and service to the College of Engineering and to the organizations and communities to which these distinguished alumni belong."

Tooley serves as the head of the TTI Federal Affairs Division. She is a former vice chairman at large of the American Road and Transportation Builders Association and serves on its board of directors. She has over 30 years of experience with the University Transportation Centers (UTC) program, served as a UTC director at the University of Arkansas and TTI, and is a former national president of the Council of University Transportation Centers. She earned her M.S. and Ph.D. in civil engineering from the University of Arkansas. Tooley worked as an assistant professor of civil engineering at the University of Florida and the University of Arkansas and has been a member of the Arkansas Academy of Civil Engineering since 2006. ■

Melissa Tooley receives her award. Left to right: Dean Kim Needy, College of Engineering; Tooley; Pam McGinnis, chair of the Dean's Advisory Council.

TTI Researchers, Staff Members Appointed TRB Committee Chairs

Dixon

Eisele

Finley

Frawley

Hansen

Kuhn

Prozzi

Sharma

Tsapakis

Villa

The Transportation Research Board (TRB) recently appointed TTI researchers and staff members as chairs and co-chairs of TRB committees and groups. These newly appointed chairs and co-chairs started their term April 15. Committee chairs may serve two consecutive three-year terms and group chairs a three-year term.

TTI's recently appointed chairs and co-chairs include:

- Karen Dixon, head of the TTI Traffic Operations and Roadway Safety Division, as co-chair of ACS20, Standing Committee on Safety Performance and Analysis;
- Bill Eisele, head of the TTI Mobility Division, as chair of AT000, Freight Systems Group;
- Melisa Finley, TTI senior research engineer, as chair of ACP55, Standing Committee on Traffic Control Devices;
- Bill Frawley, manager of the TTI Urban Analysis Program, as chair of AEP10, Standing Committee on Transportation Planning Policy and Processes;
- Todd Hansen, TTI associate research scientist, as co-chair of AME50, Standing Committee on Accessible Transportation and Mobility;
- Beverly Kuhn, Regents Fellow and head of the TTI System Reliability Division, as chair of ACP20, Standing Committee on Freeway Operations;
- Jolanda Prozzi, head of the TTI Multimodal Planning and Environment Division, as chair of AT030, Standing Committee on Agriculture and Food Transportation;
- Sushant Sharma, TTI research scientist, as chair of AT015, Standing Committee on Freight Transportation Planning and Logistics
- Ioannis Tsapakis, TTI research scientist, as chair of ACP70, Standing Committee on Highway Traffic Monitoring; and
- Juan Villa, head of the TTI Mexico City Division, as chair of AT020 Standing Committee on International Trade and Transportation. ■

TTI Youth Transportation Safety Program Awarded Two-Year Grant from Union Pacific Railroad

Union Pacific Railroad has awarded the TTI Youth Transportation Safety (YTS) Program a two-year grant to continue funding transportation safety initiatives tailored to educating young people. The grant serves as an extension of a three-year partnership between YTS and Union Pacific and will contribute tremendously to the expansion of programs and projects dedicated to saving lives and reducing injuries of America's youth. Through the Texas A&M Foundation, YTS secured $235,000 in funding.

"We are committed to encouraging safe behaviors and preventing tragedies through education and awareness, particularly through projects focused on railroad crossing, driver, bicycle and pedestrian safety," notes Richard Zientek, senior director of public affairs at Union Pacific. "Continuing our partnership with TTI's YTS Program and its many initiatives is an important step toward building and sustaining a safety mindset, especially around transportation, among our nation's youth."

The YTS Program seeks to save lives and prevent injury among youth through education, empowerment and peer-led outreach. In addition to expanding current activities to reduce the number of transportation-related fatalities among youth, the grant will continue to develop the rail safety component of the YTS Program intended to address issues of driving and walking safely near railroad tracks.

Left to right: Robert Wunderlich, director of TTI's Center for Transportation Safety; Buck Russel, senior supervisor of public safety at Union Pacific; Russell Henk, TTI senior research engineer; Richard Zientek, senior director of public affairs at Union Pacific, Greg Winfree, TTI agency director; and Clint Scheibitzki, assistant vice president of public affairs for Union Pacific's southern region.

"We are very excited about our continued partnership with Union Pacific," says Russell Henk, TTI senior research engineer. "Year after year, young drivers continue to experience the highest rate of transportation-related injuries and fatalities on our roadways. The support and partnership with Union Pacific will help us continue to develop and deliver the nation's most comprehensive suite of transportation safety programs and projects addressing young driver and passenger safety." ■

TTI's Kong Receives Distinguished Graduate Student Award

TTI Graduate Research Assistant Xiaoqiang "Jack" Kong was recently presented a 2022 Association of Former Students Distinguished Graduate Student Award for Excellence in Research — Doctoral by Texas A&M University's Graduate and Professional School at an awards ceremony April 25 in the Rudder Forum. One of Texas A&M's highest honors, the award recognizes Kong's outstanding academic record and significant contributions in research, which rounded out a strong candidate application.

Jack Kong (left) with his academic advisor Dr. Yunlong Zhang (right), professor and associate department head of Texas A&M's Zachry Department of Civil and Environmental Engineering.

"I'm very humbled and honored to receive this prestigious award from the graduate school," says Kong. "To be recognized as a distinguished graduate student at a university where there are so many exceptional and talented graduate students in different departments makes it truly special."

Kong currently works in TTI's Mobility Division and is a Ph.D. student in Texas A&M's Zachry Department of Civil and Environmental Engineering. Since joining TTI in 2015, Kong has been a key contributor to the processing efforts for producing mobility analysis reports, including the *Urban Mobility Report* and the Texas 100 Most Congested Roadways List. In addition to his work in TTI's Mobility Division, Kong has published 21 peer-reviewed papers in various academic journals.

Bill Eisele, TTI senior research engineer and head of TTI's Mobility Division, notes, "Throughout his time at TTI, I have been amazed with what Jack has been able to accomplish over such a short period of time. In particular, Jack's dedication to big data analytics has greatly contributed not only to the Mobility Division at TTI, but to the entire transportation industry. I can't think of a graduate student more deserving of this honor than Jack." ■

For more information about TTI News, contact **Jack Wenzel** at j-wenzel@tti.tamu.edu.

Can't You Read the Sign?

In 1971, the Five Man Electrical Band, a crew of Canadian rockers, released the song "Signs," which vented the songwriter's disdain for certain examples of visual forewarning that he encountered. In the chorus, the singer belts out, "Do this, don't do that! Can't you read the sign?"

My colleagues and I at the Texas A&M Transportation Institute (TTI) share something in common with that songwriter. We, too, want to know if you can read the sign. More specifically, we want to know:

- Are those signs, signals and pavement markings visible?
- Is their message clear and understandable?
- Do they do the job they're expected to do?

Those questions are at the heart of research that we spotlight in this issue.

We highlight our work with reflective pavement markings, ensuring that those imprints guide you along a safe path — day or night, rain or shine. We share our new work with the Traffic Optimization for Signalized Corridors (TOSCo) system, designed to help automated and connected vehicles (AVs/CVs) adjust their speed and move in unison through signalized junctions. Using those same AV/CV technologies, we're enhancing traffic signal systems to alert transit bus drivers, pedestrians and bicyclists to dangers at intersections.

We present our latest efforts to maximize rural roadway safety, which consider things like aggregate selection to help prevent wet weather crashes and roadside treatments to minimize the chance of run-off-the-road collisions on two-lane/two-way thoroughfares, the most common type of crash on the most common type of pavement pathway in Texas.

In addition, we showcase TTI's Visibility Research Laboratory and our smart intersection, which advance our work in traffic signal control, detection technology and connected vehicle infrastructure.

Traffic signs, signals and lane markings have democratized mobility in the United States and around the world. By means of a universal language all their own, they've enabled self-governance in how we move ourselves and the things we need from one place to another. Vital as they are, they're easily taken for granted. The banal appearance of paint striping on asphalt, for instance, belies the vast amount of scientific discovery that made that pavement marking possible.

Just imagine roadway travel a century ago when Garrett Morgan introduced the first traffic signal in America. Only if we imagine the roadway environment ruled by chaos at that time can we fully appreciate the devices today that ensure road rule commonality from one state to the next. Best of all, our research ensures that those innovations will keep getting better. And in the interest of safe and smooth travel for us all, that's a very encouraging sign indeed. ■

Traffic signs, signals and lane markings have democratized mobility in the United States and around the world.

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Stream Now

When a Crash Is Not an Accident: *Staging roadside collisions to make them more survivable.*

Sometimes vehicle crashes can't be avoided, but it is possible to make them less life threatening. TTI Senior Research Engineer Lance Bullard joins us to discuss how research has been making roadsides safer for travelers for as long as we've had roadsides.

Stream Now

Beyond Skin Deep: The humble roadway is about more than asphalt and concrete.

Today's pavements bear little resemblance to the driving surfaces of the early 1900s. TTI Research Engineer Darlene Goehl explains how decades of experimentation have led to development of the modern streets and highways that are central to our daily lives.