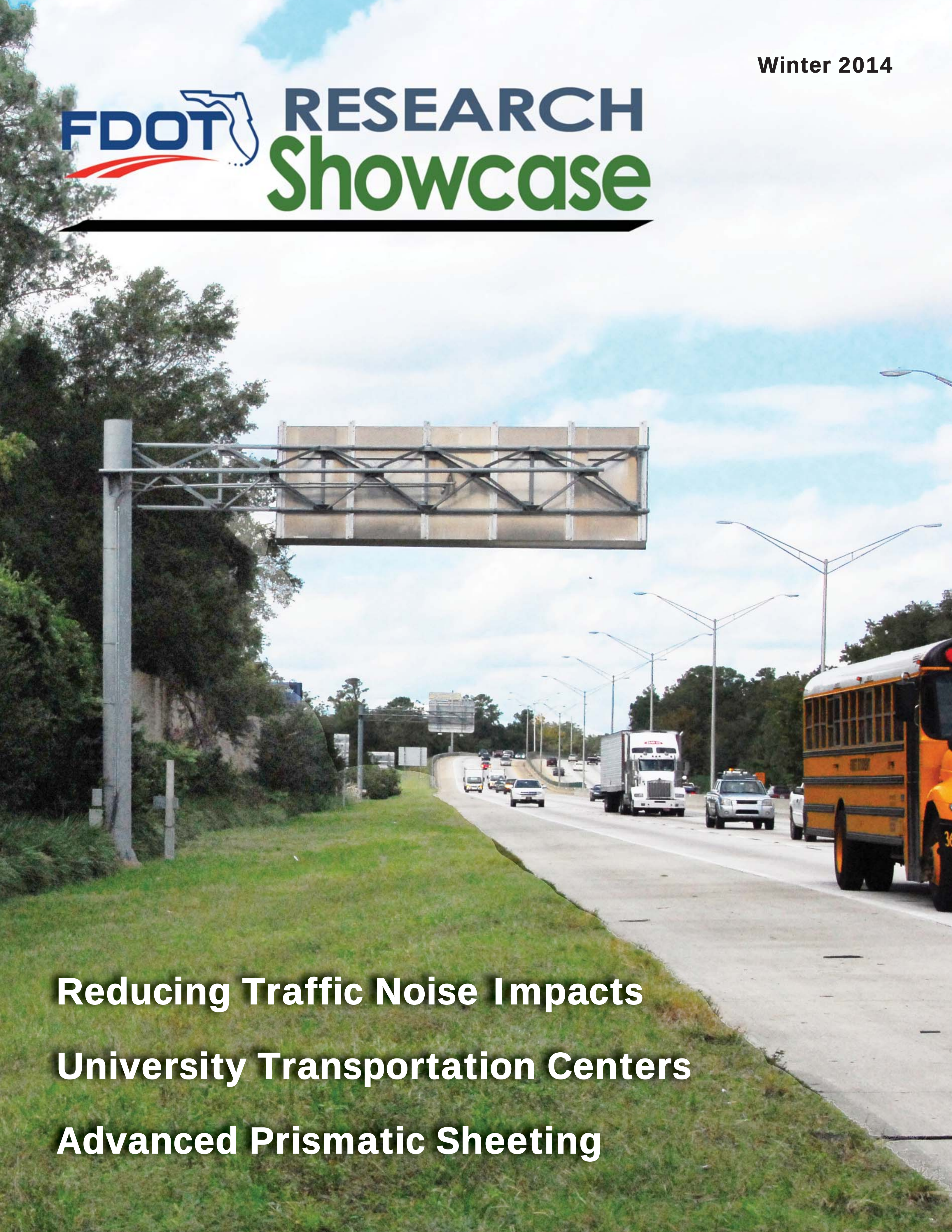
Winter 2014

FDOT RESEARCH Showcase



Reducing Traffic Noise Impacts

University Transportation Centers

Advanced Prismatic Sheeting

Winter 2014

The Florida Department of Transportation (FDOT) Research Showcase is published to provide information regarding the benefits of FDOT-funded research.

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FDR Expressway in Jacksonville with noise barrier wall

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In This Issue

This issue of Research Showcase features articles on two successful research efforts, one on quiet pavements and the other on the benefits of prismatic sign sheeting, and an article on university transportation center participation in Florida.

Quieter Pavements: Over the years, FDOT has conducted research on various aspects of highway noise. A common method to mitigate highway noise in populated urban areas is to build costly noise barriers. Findings from research conducted over the past decade indicate that certain types of pavement reduce noise caused by the tire/pavement interface. Using its newly fabricated onboard sound intensity (OBSI) system, FDOT is developing an acoustical inventory of Florida's pavements with the intent of participating in the Federal Highway Administration's (FHWA) Quiet Pavements Pilot Program. If found to be an effective mitigation method, FDOT could potentially save millions of dollars by using quieter pavements and reducing the dimensions of noise barriers.

***Prismatic Sheeting*:** Results of a recent FDOT-sponsored research effort have led to the implementation of another cost-savings strategy, this one concerning the use of prismatic sheeting instead of lighted overhead highway signs. The use of advanced prismatic reflective sheeting reduces the need to illuminate highway signs in many situations, and effective January 2014, FDOT requires Type XI prismatic sheeting to be used on all new or replacement overhead signs and to eliminate lighted signs except when warranted due to roadway geometrics.

University Transportation Centers (UTC): Funded by the U.S. Department of Transportation's (USDOT) Research and Innovative Technology Administration (RITA) and located at institutions of higher learning throughout the U.S., UTCs perform research that supports the USDOT's strategic goals and train future transportation professionals. Since 1998, several Florida universities have hosted and/or participated as members of several UTCs. In 2013, four Florida universities were awarded tier one UTCs, and several more are consortium members on national, regional, and tier one UTCs, making Florida one of the most active states in the UTC program.

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Quieter Pavements Reduce Traffic Noise Impacts

Traffic noise is the undesirable sound produced by a combination of vehicle engines, exhaust, and the tire/pavement interface. The loudness of traffic noise depends mainly on traffic volume—roads with more vehicles and higher speed limits are generally louder—but vehicle mix also plays a role.

According to the Federal Highway Administration (FHWA), if 2,000 vehicles per hour are traveling on a given stretch of road, the noise level will be twice as much as if 200 vehicles were counted in the same time. Traffic moving at 65 miles per hour will generate noise that is twice as much as traffic traveling at 30 miles per hour.

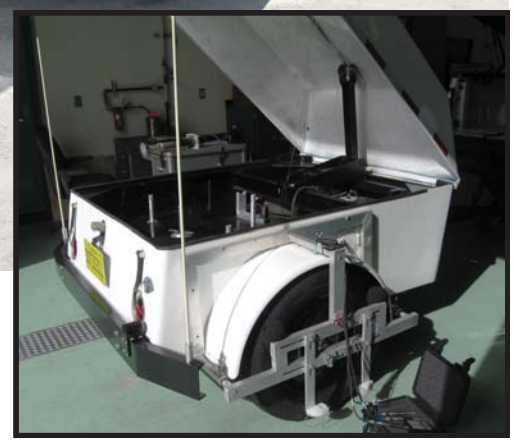
There are two general ways to manage highway traffic noise: (1) control land uses adjacent to highways so that traffic noise does not adversely impact residential areas and (2) abate highway traffic noise. Traffic noise is not usually a serious problem for people who live more than 500 feet from heavily traveled freeways or more than 100-200 feet from lightly traveled roads. However, when highways are close to people, traffic noise can adversely impact quality of life.

Title 23 of the U.S. Code of Federal Regulations Part 772, *Procedures for Abatement of Highway Traffic Noise and Construction Noise*, requires transportation agencies to identify highway traffic noise impacts, examine potential abatement measures, and incorporate reasonable and feasible highway traffic abatement measures into highway projects. According to Part 2, Chapter 17 of FDOT's *Project Development and Environment Manual*, traffic noise impacts occur when the predicted traffic noise levels either approach or exceed the noise abatement criteria (NAC) established by the FHWA, or when predicted traffic noise levels substantially exceed the existing highway traffic noise levels, even though the modeled levels may not exceed the NAC. FDOT has determined that the NAC is approached when the traffic noise level is within one dB(A) of the appropriate NAC, and that a substantial increase occurs when the increase over existing conditions is 15 dB(A) or greater.

If transportation agencies determine that traffic noise will approach or exceed the FHWA noise abatement criteria, several mitigation strategies are available to abate impacts. Agencies can try to reduce anticipated noise while they are designing the road by shifting it away from affected properties. If that is not possible, agencies may reduce the speed limit, restrict heavy truck traffic, lower (or raise) the vertical alignment through the affected area, or provide a noise barrier—the most common type of noise abatement measure.

Traffic noise abatement is considered on Type 1 projects (new highway, substantial vertical or horizontal alteration of an existing highway, addition of through traffic lanes or auxiliary lanes, addition of an interchange, addition to or substantial alteration to park and ride, rest areas, weigh stations, or toll plaza) only if the predicted traffic noise levels approach or exceed

While noise barriers can be effective noise mitigation measures, they can be costly due to design considerations such as construction method, terrain, utilities, safety, bridges, overpasses, or similar difficulties. Quieter pavements could reduce the dimensions of noise barriers.



Above: FDOT's on-board sound intensity (OBSI) trailer, designed by researchers at the University of Central Florida, is equipped with phase-matched microphones mounted side-by-side at the leading and trailing edges of the right tire. The microphones collect noise generated from the tire/pavement interface.

Right: The trailer compartment of the OBSI trailer holds electronic monitoring equipment, the microphone mounting bracket when not in use, and weights to simulate vehicle weight.

abatement levels in the NAC, or if predicted noise levels substantially exceed existing noise levels. While being an effective mitigation measure, noise barriers can be quite costly depending on barrier type, terrain, the presence of utilities, safety issues, bridges and other structures, drainage, or other factors.

Another mitigation strategy to abate traffic noise, which has been the subject of much nationwide research in recent years, is to reduce noise caused by the tire/pavement interface. Research shows that certain types of pavement produce less noise than others. Therefore, determining the acoustic properties of pavement types is important in identifying which types are least noisy.

Texture and porosity are the two primary pavement factors affecting tire/pavement noise. Texture is characterized by wavelength, which can be visualized as the distance between alternating peaks and valleys. When pavement has a lot of texture, it can be loud. To reduce noise, this texture should be flattened with respect to the roadway surface. However, pavement must have some fine, closely spaced texture, which helps to absorb sound. Porosity in the pavement surface also can reduce tire/pavement noise.

In 2007, FDOT contracted with the University of Central Florida (UCF) to (1) investigate the noise created by the tire/pavement interface, (2) determine the tire/pavement noise levels of Florida open-graded asphalt pavement roadways and how they correlate with wayside noise levels, (3) identify the trends related to the various pavement types measured, and (4) explore modeling possibilities when predicting noise impacts.

The leading method in the U.S. for measuring tire/pavement noise at the source is the on-board sound intensity (OBSI) method. OBSI measurements provide an efficient, standardized way to compare the noise-reduction benefits of different pavement types and also to evaluate changes in tire/pavement noise over time. The traditional OBSI method collects sound data using acoustic monitoring equipment and phase-

Left: North Carolina Agricultural and Technical State University (NCAT) OBSI test system. Right: Illingworth & Rodkin, Inc., OBSI test system.

matched microphones mounted in a side-by-side, vertical configuration at the leading and trailing edges of a test vehicle's right rear tire near the tire/pavement interface. This location is considered ideal for measuring tire/pavement interactions. The vehicles also employ a radial standard reference test tire mounted on the test wheel. Once OBSI data is collected, noise characteristics of different pavement surfaces, textures, and types can be compared and ranked by the amount of sound generated by the tire/pavement interface.

As part of the UCF project, researchers designed a different type of OBSI data collecting method. Rather than mounting OBSI equipment on a vehicle, UCF researchers, working with FDOT's State Materials Office, designed and constructed a trailer-mounted OBSI system. As with the OBSI vehicles, two sets of phase-matched microphones are mounted at the leading and trailing edges of the right rear tire. The main advantage of a trailer-mounted OBSI system is that weight in the trailer can be adjusted to simulate a constant vehicle weight, which provides better consistency of measurements over long periods. Also, the trailer can be towed by a variety of vehicles.

As part of the research project, researchers also measured wayside noise levels using the statistical pass-

Left: A radial standard reference test tire. These tires are used as a reference for braking action, snow traction, and wear performance, and may also be used for other evaluations, such as pavement roughness and noise.

Right: A microphone with wind screen mounted to the FDOT OBSI test trailer.

by method concurrently with OBSI measurements. The pass-by method employs microphones placed up to 50 feet away from the edge of the pavement at various elevations. Researchers will use the data collected to correlate wayside noise data with the OBSI data.

The database developed as part of this research will include OBSI intensity levels, matching wayside noise levels, highway information, pavement texture characteristics, and weather data. Researchers developed a preliminary formula to predict the wayside noise levels from the OBSI measurements, indicating a strong possibility for future modeling of wayside noise levels based on OBSI testing.

In a recent follow-up project, FDOT contracted with researchers at the USDOT Volpe Center to continue gathering noise data about Florida pavements and to further test the OBSI trailer to compare and validate sound intensity data with OBSI systems used elsewhere in the U.S. Researchers invited three organizations that are conducting tire/pavement noise research to participate in an “OBSI rodeo.” In addition to FDOT, participants included the acoustical engineering firm of Illingworth & Rodkin, Inc., from California, Auburn University’s National Center for Asphalt Technology (NCAT), and the Virginia Tech Transportation Institute. The rodeo provided participants with an opportunity to continue testing their OBSI equipment and to compare their respective noise intensity data with data obtained using the Florida OBSI trailer.

Rodeo participants performed the testing on four, 0.8-mile-stretches of asphalt pavement on U.S. 19 in Levy County, Florida. Teams performed three repeat runs along each section at 60 mph. Data gathered included tire pressure, tire hardness, sound intensity value for each test section in dB(A), speed and, if possible, frequency spectra.

FDOT is using the sound intensity data to create an acoustical inventory of Florida’s pavements with the intent of participating in FHWA’s Quiet Pavements Pilot Program (QPPP). The QPPP is intended to demonstrate the effectiveness of quiet pavement strategies and to evaluate any changes in their noise mitigation properties over time. Current knowledge on changes of pavement noise properties over time is extremely limited. Thus, program participants collect acoustic, texture, and friction characteristics for at least a 5- to 10-year period, after which FHWA will determine if policy changes to a state DOT’s noise mitigation program are warranted.

With the development of FDOT’s OBSI trailer and acoustical inventory, FDOT is poised to become a major contributor to FHWA’s quiet pavements research program. ⬣

In addition to collecting OBSI data, researchers collected wayside noise data from passing vehicles by placing microphones up to 50 feet away from the edge of the pavement at various elevations. Researchers also gathered weather data such as temperature, humidity, and wind direction with a weather station (top right). The FDOT OBSI test trailer is towed by an FDOT State Materials Office vehicle, bottom left.

UTCs Plan for Transportation Needs of Tomorrow

The U.S. Department of Transportation's (USDOT) Research and Innovative Technology Administration (RITA) funds the University Transportation Centers (UTC) program, which was established in 1987 by the Surface Transportation and Uniform Relocation Assistance Act with the authorization of 10 centers, one in each of the federal regions. Since then, the program has evolved and changed in structure with successive transportation acts.

Most recently, the Moving Ahead for Progress in the 21st Century Act (MAP-21), enacted on July 6, 2012, authorized $72.5 million per year from Federal FY 2013-2014 funds to establish and operate up to 35 new UTCs throughout the nation. Under MAP-21, five national, 10 regional, and 20 tier one centers are authorized and in 2013 were competitively selected by USDOT. These UTCs must align their research themes with one or more of USDOT's priority focus areas: safety, livable communities, state of good repair, economic competitiveness, and environmental sustainability. They must provide 50- to 100-percent match funding for every federal dollar, depending on the type of UTC (national and regional centers must provide match equal to the federal funding received, whereas tier one centers have to provide half the award amount as match). State DOTs are often the primary match partners to the centers.

UTCs maintain vital partnerships with local, regional, and state transportation and transit agencies and help find solutions to local, regional, and national issues. Their research and education programs address critical national transportation challenges while developing the next generation of transportation professionals. In 2009, the centers trained 32,000 practicing transportation professionals.

Since the 1990s, Florida has been host to at least two UTCs. The Transportation Equity Act for the 21st Century approved funding for two Florida-based centers, the National Center for Transit Research (NCTR) at the University of South Florida (USF) and the Center for Advanced Transportation Systems Simulation (CATSS) at the University of Central Florida (UCF). FDOT contracted match projects with these UTCs and with the two centers awarded to the University of Florida from the mid-2000s: the tier one Center for Multimodal Solutions for Congestion Mitigation (CMS) and its successor, a regional UTC, the Southeastern Transportation Research, Innovation, Development and Education Center (STRIDE).

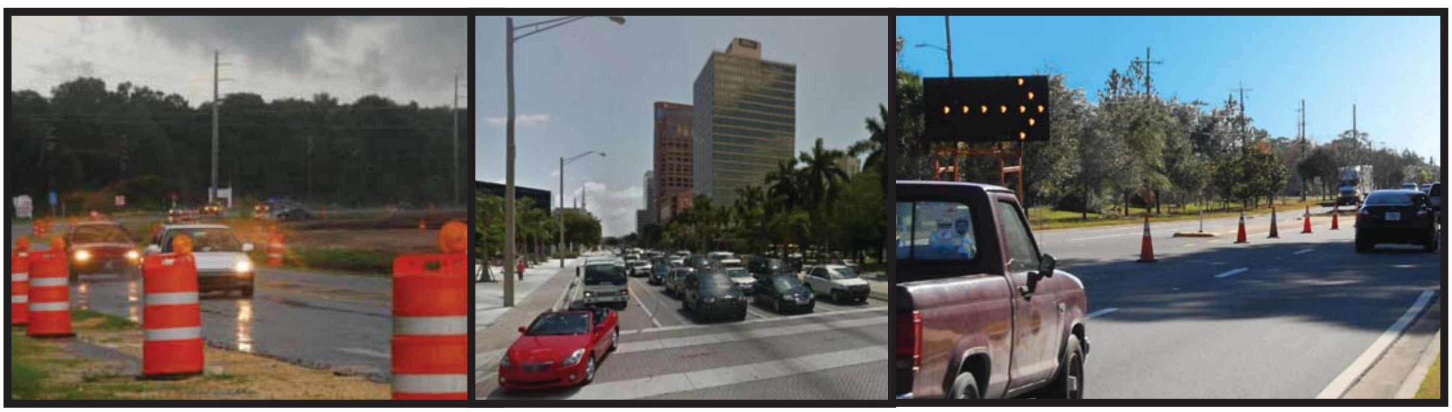
Researchers at the University of South Florida's Center for Urban Transportation Research (CUTR) conducted research on a wide variety of urban transportation issues including transportation demand management, transit planning, and public transit safety.

In the most recent competition, four Florida universities were awarded tier one UTCs, and six schools participate variously as consortium members of national, regional, and tier one UTCs. The four awarded UTCs receive $1.4 million per year to conduct transportation-related research. These most recently awarded centers include the following:

Florida International University's (FIU) Accelerated Bridge Construction (ABC) UTC. Consortium members include the University of Iowa and the University of Nevada, Reno. The focus of FIU's UTC is to promote and expand the use of ABC technology by providing the necessary resources to support cost-effective design and build projects, to identify areas of needed research and resources, and to develop new bridge construction and repair technologies.

Florida State University's (FSU) Center for Accessibility and Safety for an Aging Population (ASAP) UTC. Consortium members include Florida A&M University (FAMU) and the University of North Florida. The goal of FSU's ASAP UTC is to provide safe and accessible transportation to an aging population. ASAP will focus on accessibility and community connectivity among older adults; human factors affecting older adults, especially the acceptance of emerging technologies; geometric design research, especially with respect to elder crash mitigation; and health, wellness, and safety of seniors as they relate to multimodal transportation and emergency operations.

"Safety and mobility of the aging population have been a matter of increasing concern for transportation officials," says John Sobanjo, a professor at the FAMU-FSU College of Engineering and director of the ASAP center. "Older drivers are disproportionately involved in crashes and suffer more severe injuries compared to other age groups due to growing frailty, the need to navigate increasingly complex driving environments and, frequently, reduced fitness to drive due to health concerns."



Researchers at the University of Florida's Center for Multimodal Solutions for Congestion Mitigation (CMS) and the Southeastern Transportation Research, Innovation, Development and Education Center (STRIDE) conducted research in the areas of transportation safety, travel time reliability, congestion management, and optimizing traffic operations.

University of Central Florida's (UCF) Electric Vehicle Transportation Center (EVTC) UTC. Consortium members include Tuskegee University and the University of Hawaii. The EVTC UTC's focus is environmental sustainability and, in particular, conducting research that will help transportation planners prepare the nation's highways for the anticipated increase in the number of electric and plug-in electric vehicles, while developing smart-grid applications that will strengthen the ability of the electric utility system to accommodate the power demands of electric vehicles.

University of South Florida's (USF) National Center for Transit Research (NCTR) UTC. The focus of the NCTR UTC is on livable communities. Consortium members include Florida International University, Texas A&M University, and the University of Illinois, Chicago. The 2013-14 grant allows NCTR to continue to fund research in public transportation, non-motorized transportation, demand management, and livable communities. The research will emphasize making public transportation safe, efficient, effective, desirable, and secure.

"This award reflects the breadth of experience our research faculty has gained through the years through our extensive work with local transit authorities, commuter assistance programs, the Florida Department of Transportation, and the Federal Transit Administration," says NCTR's director Joel Volinski. "It is a genuine privilege to participate in the national UTC program, and we look forward to being able to contribute to solutions for mobility issues while sharing our results in as many forums as possible."

Beyond state school involvement with Florida-led UTCs, USF participates in two national centers, Portland State University's National Institute for Transportation and Communities and Rutger's Center for Advanced Infrastructure and Transportation; UCF and USF both participate in the University of Tennessee's regional UTC, the Southeastern Transportation Center; UCF participates in the University of Iowa's Safety Research Using Simulation Center; and the University of Miami participates in the Missouri University of Science and Technology's Center for Research on Concrete Applications for Sustainable Transportation.

Florida is a dynamic environment for transportation research and is well-positioned to help address the state's and the nation's transportation challenges well into the future. ⬣

Advanced Prismatic Sheeting Reduces Need for Lighted Overhead Signs

Effective highway signage is an important component of driver decision making, comfort, and safety. Given the number of elderly drivers in Florida, nighttime visibility of highway signs is especially important. FDOT and many transportation agencies across the country use lighted overhead signs to ensure sign visibility. However, the availability of newer and more efficient retroreflective materials, such as high intensity prismatic sheeting, has caused transportation agencies to reexamine the need for lighted signs.

Most U.S. transportation agencies agree that in rural areas, lighted signs are not needed where long and straight expanses of highway provide sufficient distance for drivers to interpret signs illuminated by vehicle lights. However, there is concern about removing overhead lighting for signs in developed areas, along highways with unique geometrics, or in areas of frequent dew, fog, or frost.

While FDOT requires overhead signs to be made with Type III high intensity retroreflective materials, recent research has demonstrated that newer prismatic reflective sheeting is more visible at greater distances and to a wider range of drivers than high intensity retroreflective sheeting. FDOT recently contracted with researchers at the University of North Florida (UNF) to determine whether replacing Type III high intensity retroreflective sheeting with prismatic reflective sheeting and eliminating sign lighting would be a safe and effective modification to overhead highway sign design. Eliminating or reducing the number of lighted overhead signs could significantly reduce capital investment, maintenance costs, and energy consumption.

The earliest overhead signs were constructed with non-reflective porcelain enamel materials. To increase visibility, round plastic retroreflective buttons made of transparent plastic were placed in rows following the contours of sign legend elements, such as letters, numbers, arrows, and borders. At night, light from approaching vehicle headlamps struck the buttons and reflected back to the driver.

In the early 1970s, FDOT and other transportation agencies phased out the use of button copy in favor of high intensity retroreflective sheeting on overhead signs. High intensity retroreflective sheeting is constructed with tiny glass beads that reflect light. Several grades of high intensity retroreflective sheeting are used today for a variety of street signs, ranging from less reflective roadside signs to high intensity overhead signs.

Also in the early 1970s, the first prismatic reflective sheeting was developed. Prismatic sheeting reflects light back to the source just like beaded sheeting, but prismatic sheeting does so much more efficiently. Instead of light entering a glass sphere, it enters a triangular micro prism. Micro prisms have straight sides that allow more light to enter and exit. Prismatic sheeting is about 80 percent efficient, while glass bead sheets are about 30 percent efficient. Today there are several grades of prismatic sheeting, with Type XI being the most reflective.

The earliest overhead signs were constructed with non-reflective porcelain enamel materials. To increase visibility, round plastic retroreflective buttons made of transparent plastic called “button copy” were placed in rows following the contours of sign legend elements. At night, light from vehicle headlamps struck the buttons and reflected back to the driver. Retroreflective materials replaced button copy in the 1970s.

Manufacturers make high intensity prismatic sheeting in a variety of colors and retroreflectivity grades.

Cost of both new and replacement materials is an important aspect of implementing new technology. Therefore, UNF researchers examined costs of upgrading sign lighting and sign sheeting. To evaluate the continued need for sign lighting, the researchers collected field data to assess the conditions of Florida signs in terms of Manual on Uniform Traffic Control Devices (MUTCD) minimum maintained retroreflectivity levels. They developed a luminance computation model to calculate sign luminance under various situations including different sign lighting methods, different roadway geometrics and sign locations, different vehicle headlamps, and different amounts of sign dirt and sign aging. They also compared the calculated luminance of specific signs in specific situations with legibility luminance levels to assess lighting needs required by older drivers.

FDOT and many transportation agencies across the country illuminate overhead signs with lights to ensure visibility. Recent research indicates that when Type VIII or Type XI high intensity prismatic sheeting is used on overhead signs, lighted signs along straight stretches of highway may not be necessary.

Overhead signs have a life cycle of approximately 20 years; therefore, researchers developed a life-cycle cost spreadsheet to calculate both the cost of replacing existing high intensity retroreflective signs with prismatic sheeting and installing and/or upgrading sign lighting. Researchers found that for straight and flat roadways or horizontal curves in both urban and rural areas, the most cost-effective approach to maintain luminance of existing signs that have not yet reached their replacement age is to replace mercury vapor luminaries with light-emitting diodes (LED).

Their research also demonstrated that, when replacing signs or installing new ones, a viable alternative to lighted signs would be to use either Type VIII or Type XI prismatic sheeting, which exceeds luminance levels required by older drivers, and forego sign lighting. The researchers demonstrated sign lighting would still be necessary even with Type XI prismatic sheeting along horizontal curves in rural areas with radii of 880 feet and horizontal curves in urban areas with radii of 2,500 feet or less.

Better sign technology offers many advantages to Florida's drivers and taxpayers. Based on this research, FDOT has updated its specifications to require Type XI prismatic sheeting on all new or replacement overhead signs and to eliminate lighted signs except when warranted due to roadway geometrics. The new specifications took effect January 2014. ⬣

Meet the Project Manager: Gail Holley, Safe Mobility for Life Program Manager

By 2030, the U.S. Census projects that 26 percent of Florida's population will be 65 or older. To address the needs of the aging road user, Gail Holley, with FDOT's Safe Mobility for Life Program, manages human factors research projects with the goal of making Florida's transportation network safer for older drivers and pedestrians.

In a recent project that Holley managed, Florida State University (FSU) Department of Psychology researchers compared aspects of sign and signal effectiveness for three driver and pedestrian age groups. The premise of the research was that effective signs and signals must attract attention, be legible, and be comprehensible soon enough for travelers to take appropriate action safely. Researchers studied message sign word order, sign fluorescents, use of pedestrian signals in intersections, auditory feedback devices, and the effect of message sign letter height.

"The research identified relevant data using human factors to help FDOT form policy that focuses effort, time, and funds on effective changes to traffic operations," says Holley. "It also enabled FDOT to implement beneficial changes more quickly and to develop education materials to help meet the needs of older adults." Based on the research results, FDOT adopted the use of fluorescent yellow sheeting on urban road signs to increase visibility, and decided not to install pedestal pedestrian signals at intersections after research demonstrated they had no impact on driver awareness. In recognition of the benefits achieved from this research, in 2013, the Research Advisory Committee (RAC) to the American Association of Highway and Transportation Officials (AASHTO) Standing Committee on Research (SCOR) selected this project as one of 16 out of 109 submitted by states as a high value research project and identified it as providing transportation excellence through research.

In another project, FSU researchers studied pedestrian behavior in parking lots and strategies pedestrians use to navigate parking lots and cope with potential hazards. They also equipped middle-aged and older pedestrians with mobile eye-tracking equipment to study their behavior in parking garages and parking lots. The equipment enabled researchers to record and analyze gaze positions and durations, and to examine pedestrian perception, attention, and multi-tasking activities. Based on the findings, Holley is working with the Florida Bicycle and Pedestrian Safety Coalition to develop a tip sheet for distribution to older drivers with information about how to safely navigate parking lots from both the driver and pedestrian perspectives. "The research has enabled the coalition and FDOT to work together to improve pedestrian and parking lot safety for everyone, not just older users."

Holley's most recent project, also under contract with FSU, used a driving simulator to examine how quickly young, middle-age, and older adults comprehend and react to bicycle signs and makings. During simulation, drivers were shown Share the Road or Three Foot Minimum signs and presented with cyclists individually or in groups and on roads with and without marked bike lanes. Researchers recorded driver behavior for various traffic conditions. Based on the research, FDOT determined that Share the Road signs and Three Foot Minimum signs should feature a side profile of a bicycle to facilitate comprehension. Within six months, FDOT anticipates implementing the new sign designs and conducting a statewide public service campaign to familiarize drivers with bicycle signage.

Holley's other research projects include the development of a Safe Mobility for Life training course for elected officials, transportation planners, safety professionals, and others concerned with older road user safety and mobility, and the development of a Web-based fitness-to-drive screening measure for use by health care professionals, caregivers, and family members to help measure an elderly person's ability to drive.

Holley's research has helped FDOT improve safety for drivers and pedestrians of all ages. "It is important for roadway signage to be clear and visible to all, regardless of age," says Holley. "Human factors research helps ensure that we're developing the most appropriate standards and making the best decisions to improve roadway safety." ⬣

Meet the Principal Investigator: Atorod Azizinamini, FIU UTC Director

University Transportation Centers (UTC) are located at 75 institutions of higher learning across the U.S. Established in 1987 under the USDOT Surface Transportation and Uniform Relocation Assistance Act, their purpose is to facilitate transportation research and technology transfer.

Dr. Atorod Azizinamini, chair of Florida International University's (FIU) Department of Civil and Environmental Engineering, is also director of FIU's Accelerated Bridge Construction (ABC) UTC. Its focus is on advancing ABC technologies, which include innovative planning, design, materials, and construction methods to reduce interruption to traffic by minimizing onsite construction activities. Bridge components constructed using ABC technology are assembled offsite, then transported to the job site for assembly. However, ABC bridges have more joints, which can adversely affect service life. "The challenge is to not compromise service life when building with ABC," says Azizinamini.

"The USDOT anticipates that within the next 15-20 years, bridge construction using ABC will be widespread," says Azizinamini. "Therefore, FIU's UTC is preparing students to plan for this important advancement in bridge construction technology."

In addition to directing the work of the UTC, Azizinamini is the principal investigator for several research projects under contract with FDOT. Recently, he and his research team sought to develop new non-destructive testing (NDT) techniques that bridge maintenance engineers can use when inspecting post-tensioned steel strands in segmental concrete bridges. Currently, only visual methods are used for inspections. While bridges constructed using post-tensioned strands have many advantages, their cables and anchors are vulnerable to corrosion, exacerbated by Florida's hot, humid, and often salty environment. Further, bridge tendons are typically embedded in concrete, making visual inspection difficult.

As part of a recently completed project, Azizinamini and his research team conducted an in-depth review of possible techniques to inspect bridge tendons and developed a guide identifying inspection alternatives. The National Cooperative Highway Research Program (NCHRP) is using the research findings to develop inspection guidelines to assist bridge owners in selecting the most appropriate NDT method or combination of methods for assessing the condition of post-tensioning systems common in U.S. bridges.

In two related ongoing projects, Azizinamini and his research team are conducting NDT of segmental concrete bridges to evaluate the merits of various NDT technologies that could be used during bridge inspections to detect and assess corrosion of internal tendons and cable stays.

Florida has the nation's largest inventory of twin steel box girder bridges, whose components are often referred to as fracture critical, a family of bridges engineers believe will collapse if an important tension member breaks. These types of bridges are built over long waterways, making inspections difficult and expensive. Azizinamini and his research team are studying the feasibility of reducing the number of biannual inspections of fracture critical bridges based on advanced technology and analysis.

In another project, he and his research team are developing a set of recommendations, procedures, and instructions to address analysis, design, and construction issues related to cross frames and diaphragms of steel I-girder bridges, which could lead to uniform structural design of cross frames.

Azizinamini looks forward to helping FDOT get the most out of existing bridges and providing engineers and designers with best principles for designing bridges for a long service life.

"Because of its investment in research, FDOT is at the forefront of technology," says Azizinamini. "I want to help ensure that the bridges we build today will perform better and last longer than those currently in service, and that we save money and resources for generations to come." ⬣

FDOT's Workforce Development Internship Program

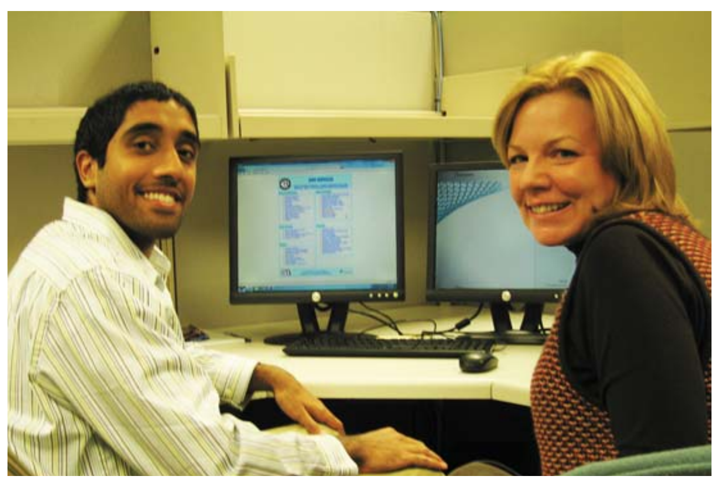
FDOT unveiled a redesigned internship program during the 2013 fall semester and received over 250 applications. FDOT's seven districts, Central Office, and Florida's Turnpike Enterprise each are allotted six intern positions and FDOT's Materials Office one position, for a total of 55 positions per semester. Only half the positions are in the engineering field, demonstrating the diversity of opportunities at FDOT. The positions are advertised on FDOT's website and on Twitter and Facebook social media prior to the beginning of each semester. Students at the sophomore through graduate level who meet grade point average (GPA) requirements may apply. Currently, 49 of the available positions are filled. FDOT has hired two former interns into full-time positions.

The internship program is an integral part of the Department's workforce development efforts. The program offers students an insider's view of the transportation industry and an opportunity to develop skills and techniques directly applicable to their professional development. The positions include opportunities for students in areas of architectural, civil, mechanical, electrical, environmental, industrial, and structural engineering; aviation; biological and environmental sciences; business administration; communications; computer science; economics; finance and accounting; geotechnical studies; government; human resources; law; logistics; planning; political science; public administration; real estate; and surveying and mapping.

FDOT's Research Center leads the program and serves as the liaison between FDOT district contacts and university and college career centers around the state. The Research Center also coordinates with FDOT central or district office personnel to create internship positions. FDOT's Human Resources Office funds positions and coordinates and assists with hiring and other personnel-related issues.

The idea for the redesigned internship program began in early 2013 through discussions with Florida State University and FDOT managers who envisioned developing an improved partnership among FDOT and Florida's universities and colleges with the goal of extending internship opportunities to students beyond those in the engineering field. While recruiting transportation engineers in a variety of disciplines is critical to fulfilling FDOT's mission, FDOT has numerous opportunities for students majoring in other academic fields. Offering a variety of internship opportunities enhances FDOT's relationship with colleges and universities for mutual advantage and exposes students to the diversity of FDOT's programs.

For more information about FDOT's workforce development internship program, contact Darryll Dockstader, Manager, FDOT Research Center, 850-414-4617, or FDOT's human resources office at 850-414-5321. ⬣



L-R: Justin Kinsley, FSU engineering graduate student with David Wagner, Engineering Specialist III, at FDOT's Marcus H. Ansley Structures Research Center; Aasim Arif, FSU business undergraduate student with Lisa Wilkerson, Statewide Grants Coordinator, in FDOT's Office of the Comptroller.

FDOT Research Center Rolls Out New Search Engine

The FDOT Research Center recently developed an online search engine to help customers locate active and completed FDOT-funded research projects by keyword. For example, customers can search by FDOT office name (construction, design, environmental, geotechnical, materials, maintenance, operations, planning, safety, structures, transit, turnpike), project number, date, project manager or principal investigator name, project completion year, project status (active or completed), or subject matter key words such as “asphalt,” “bicycle,” “bridge,” “bus,” “concrete,” “sign,” “traffic,” etc.

Prior to implementation of the search engine, FDOT active research projects and final reports were listed on individual Web pages organized by project status and office. Implementation of the search engine has resulted in a more efficient website by eliminating 30 Web pages.

To locate research projects using the FDOT search engine, visit http://www.dot.state.fl.us/research-center/documents.shtm. FDOT employees may also use the Department’s Sharepoint site to locate research projects. ⬣

For More Information

Quieter Pavements

BDT06, On-Board Sound Intensity (OBSI) Study
Charles Holzschuher, Project Manager
Roger Wayson, Principal Investigator

BD550-09, Pavement Noise Research: Modeling of Quieter Pavements in Florida
Mariano Berrios, Project Manager
Roger Wayson, Principal Investigator

EMO-01-06, Pavement Noise Research: Modeling of Quieter Pavements in Florida, Phase II and III
Mariano Berrios. Project Manager
Roger Wayson, Principal Investigator

University Transportation Centers

For more information about University Transportation Centers, visit http://www.rita.dot.gov/utc/

Prismatic Sheeting

BDK82-977-07, Use of High Intensity Reflective Sheeting in lieu of External Lighting of Overhead Roadway Signs
Richard Kerr, Project Manager
Mike Jackson, Principal Investigator