Spring 2009

RESEARCH Showcase

Wind Resistant Signs and Signals

Cell phones help special needs riders

New simulator training for commercial drivers and safety inspectors

...and more

RESEARCH Showcase

Spring 2009

The Florida Department of Transportation (FDOT) Research Showcase is published to inform transportation professionals and friends of FDOT about the benefits of FDOT-funded research.

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Back Cover: Commercial driver training simulator

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From the Director…

This year marks the 20th anniversary of the Research Center. When I was asked to establish the office in 1989, FDOT, like most DOT programs across the country, conducted mostly concrete and asphalt research. FDOT has since expanded its research activities to just about every area of transportation. The Research Center works with most offices within FDOT and most universities in Florida's State University System, in addition to other state agencies, private consultants, and other organizations. In this issue, you will read about research in the areas of Structures, Traffic Operations, Transit, Motor Carrier Compliance, Trucking, and Roadway Design. Several different universities and research institutions performed the work. Indeed, we have come a long way.

Our accomplishments and the value that research has provided to FDOT are in large part due to the great efforts of many research project managers (PMs) throughout our agency. Some PMs are partially or entirely dedicated to research, such as our colleagues in the State Materials Office, the Structures Research Lab, and the Traffic Engineering Research Lab. Many, however, do the work above and beyond their normal workloads, to enhance safety, improve processes, reduce costs, and otherwise improve FDOT business. We owe much to our PMs and to management for the support it has provided over the years, both for recognizing the potential for research to improve transportation in Florida and for providing the support necessary to carry out a vibrant and valuable program. Most of all, I want to acknowledge the Research Center staff. Without their efforts and strong desire to improve Florida's transportation system, none of this would have been possible.

Richard Long

Contents

Wind Resistant Signs and Signals

Design changes help traffic move safely after damaging storms

High velocity storm winds in Florida historically have caused many wire-suspended traffic signals and large cantilevered sign poles to break and fall. The disruptions to traffic flow that result from damaged signs and signals can slow down emergency response efforts, especially if emergency personnel have to spend their efforts directing traffic.

Replacing damaged structures can also be a financial burden on local agencies. When Hurricane Andrew struck south Florida in 1992, it damaged traffic signals throughout Miami Dade County, well beyond the hurricane's landfall site. The storms that hit Florida during the 2004-05 hurricane seasons cumulatively brought even more destruction, resulting in the loss of 15,442 traffic signals statewide.

University of Florida civil engineering professor Ron Cook specializes in the effects of wind loading on structure anchoring. Through his research, Cook has determined the cause of the sign pole and signal failures. He also has identified structural design changes that could improve safety, lower the incidence of failure, and reduce post-storm recovery costs.

Cracks in the cement base can result in loosening of the pole supports, as shown here.

Signs: A Polymer Wrap Makes All the Difference

The 2004-2005 storms damaged several poles used to support cantilevered signs along interstate and state arterial roadways. The poles typically are installed over a large, embedded cylindrical concrete footing. They are fastened with anchor bolts that extend up to 6 feet into the concrete base. Wind loading on the cantilever arm twists the structure, creating torsional forces that can cause the concrete foundation to fail where the anchor bolts are located.

The face of this test shaft illustrates the yielding of bolts, breakout cracks around perimeter, and torsion cracks in center.

The researchers viewed several of the failed structures and concluded that concrete breakage around the bolts had been the source of structural failure. Subsequent testing verified this conclusion. The crumbling concrete could not hold the bolts, which were pulled out of the foundation. They were not twisted or broken, but had remained straight.

In addition to design procedures for new construction, Cook and Marc Ansley, manager of the FDOT Structures Research Lab and project manager for the study, developed a repair and retrofit technique that can be applied to existing poles that are not scheduled for replacement. The technique is fairly straightforward: Dig around the concrete foundation to a depth of about 18

inches, wrap fiber reinforced polymer (a material similar to fiberglass) around the concrete, and epoxy it in place. When the epoxy is dry, rebury the foundation.

In developing the technique, Cook and his team applied torsion loading to a sample concrete foundation until the concrete developed cracks around the bolts. Then they applied the retrofit and ran the torsion test to the point of failure. The cause of the failure was was not the repaired concrete foundation. Cook thinks that using this technique on new pole installations will effectively prevent concrete failure due to torsional forces. "Using the wrap, the poles will fail only when something other than the concrete base fails," Cook said. "The base is no longer the weakest link."

Torsion cracks formed along the length of the test shaft.

Signals: One Wire is More Effective than Two

Traffic signals in Florida, and in some areas of Georgia, use a dual-cable suspension system. The traffic signal hangs from an upper, or catenary, cable, which supports the signal's weight. A lower cable, the messenger, carries the electrical wiring to the signal. A quick disconnect box allows the signals to be easily installed or removed. In high winds, the signals rotate and put tension on the cables, which can result in damage to the signal hanger, usually made of aluminum, and to the quick disconnect box. Other Gulf Coast states and the Carolinas use a single-cable signal system that supports both the signal and its wiring. FDOT needed to know exactly why so many of Florida's signals failed and how effectively alternative systems, such as those used in other states, would resist severe wind conditions. FDOT contracted the University of Florida to conduct the research. Marc Ansley served as FDOT project manager.

Cook and his team conducted 31 wind tests on dual- and single-cable systems, each with a five-head traffic signal. They evaluated the signal rotation and cable tension of each system under wind loads of up to 115 mph. The signal rotation test showed that both systems allowed at least half of the lit signal to be visible at wind speeds up to 75-80 mph. The two systems did not, however, perform equally well during the tension tests. The messenger cable in the dual-cable system experienced considerable tension, causing high stresses in the hangers and quick disconnect box in every test. In the tests, the point of breakage was always near the messenger cable where it crossed the hanger. The single-cable system did not experience similar tension on the cable, but swung back and forth like a pendulum.

This study demonstrated that the performance of existing dual-cable signals can be improved by replacing the flexible aluminum signal hangers with pipe hangers and reinforced quick disconnect boxes. However, even with these enhancements, the single-cable system performed better. "It was pretty clear that from a structural viewpoint, the single cable system is preferable," Cook said. ⬣

Signals were subjected to wind load testing at the University of Florida.

A New Travel Assistant Device for Special Needs Bus Riders

Transit riders with special needs may soon be able to use cell phones to help them travel on their local bus systems. Researchers at the Center for Urban Transportation Research (CUTR), University of South Florida (USF) are developing a cell phone-based Travel Assistance Device (TAD) that they hope will be available in the near future.

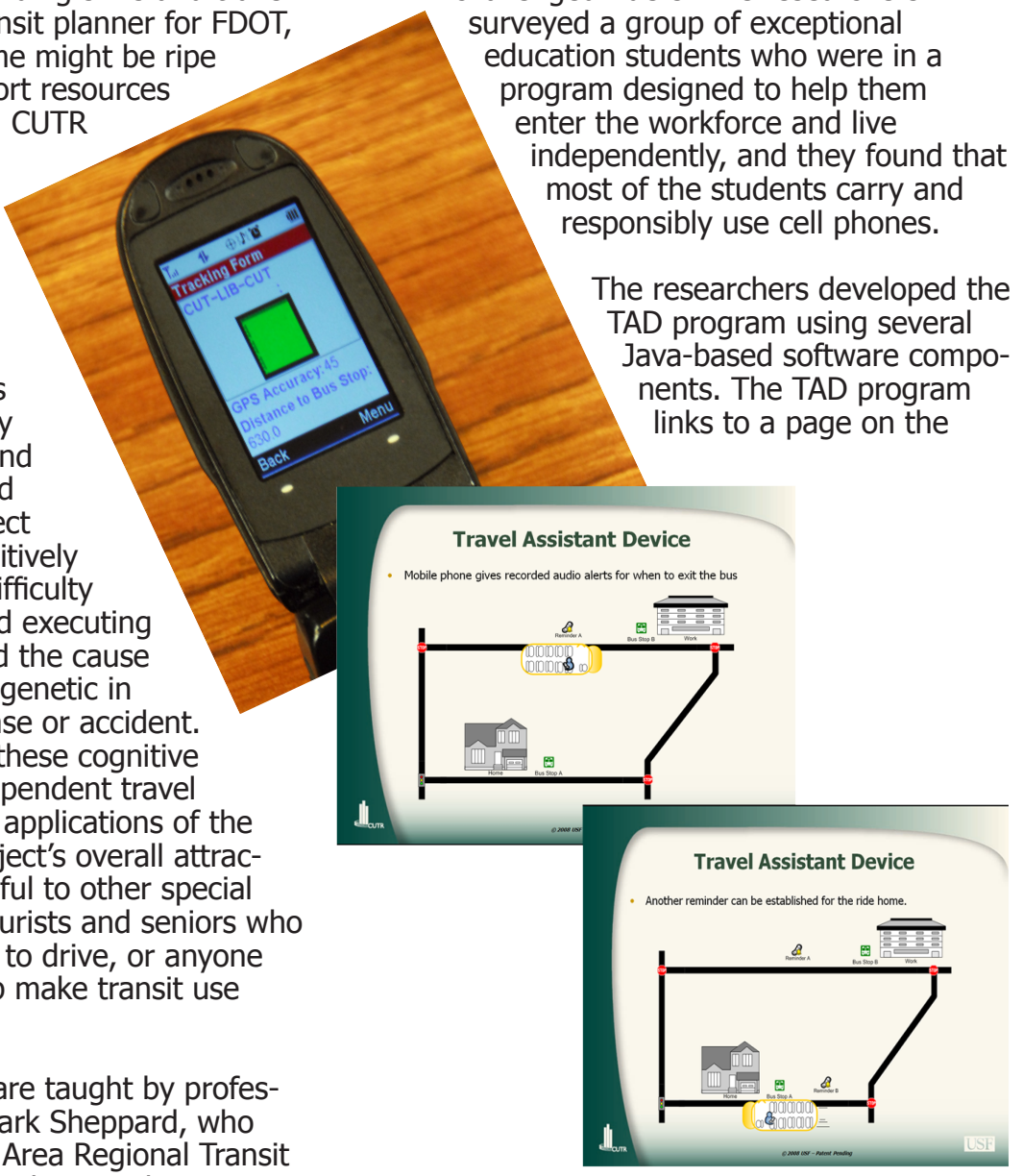
The idea for developing this kind of system occurred when researchers at CUTR casually sent information regarding bus riding skills and travel training to Amy Datz, a transit planner for FDOT, who suggested that the time might be ripe to develop additional support resources using current technologies. CUTR has taken Datz's idea from concept to reality.

CUTR assembled a research team to develop assistive software that can run on standard GPS-enabled cell phones. It was designed to help cognitively challenged persons learn and perform the skills they need to ride the bus without direct personal supervision. Cognitively challenged persons have difficulty learning, remembering, and executing a series of instructions, and the cause of these difficulties can be genetic in origin or the result of disease or accident. The TAD compensates for these cognitive challenges and makes independent travel possible. Potential broader applications of the software increased the project's overall attractiveness. TAD could be useful to other special needs travelers, such as tourists and seniors who no longer want or are able to drive, or anyone desiring a travel aid to help make transit use easier.

Currently, bus riding skills are taught by professional travel trainers like Mark Sheppard, who works for the Hillsborough Area Regional Transit (HART) Authority. Riding the bus can be more difficult than one might think. Riders need to master 30 separate skills to travel independently. Sheppard, who lent his expertise to this project, has found the most difficult task for his cognitively challenged clients is learning when to pull the signal cord in order to exit the bus at the correct location.

The first order of business, however, was to determine if cell phones were an appropriate medium to deliver travel assistance to cognitively challenged riders. The researchers surveyed a group of exceptional education students who were in a program designed to help them enter the workforce and live independently, and they found that most of the students carry and responsibly use cell phones.

The researchers developed the TAD program using several Java-based software components. The TAD program links to a page on the



The TAD website allows care givers to monitor travelers' route progress.

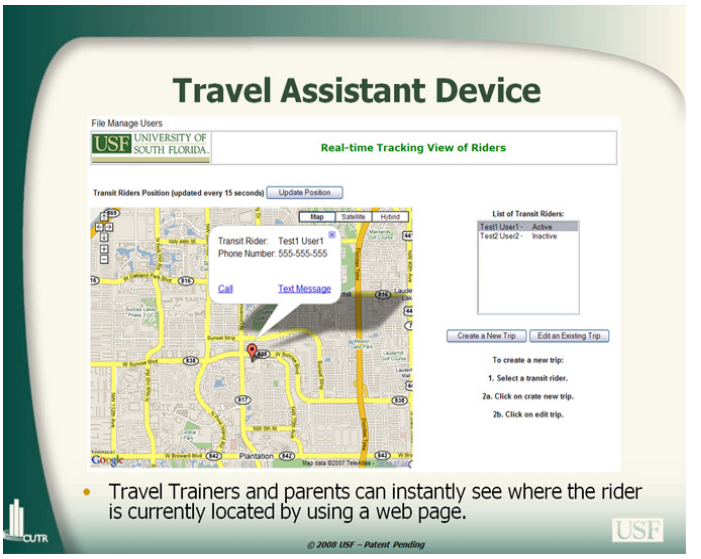
CUTR website, from which trip planning can be performed using a Google maps-based interface. The software conforms to cell phone software standards so that it is compatible with any GPS-enabled phone from any cellular carrier, although Sprint-Nextel currently is the only participating provider.

To use the TAD, the caregiver or travel trainer navigates to the website to create travel itineraries for the rider. The program supports itineraries of various levels of complexity, including trips that require transfers. The rider uses the cell phone to activate the program, which retrieves each itinerary separately from a database and shows it to the rider through a simple screen interface. The rider or caregiver selects the appropriate itinerary at the outset of the trip. After that, the process is automated. The TAD provides instruction (e.g., when to pull the cord or exit the bus) via audible alerts, either voice or tone. The alerts are reinforced by vibration signals. Once the programmed itinerary is initiated, the rider only needs to press a button to signal the system that the alerts have been received and understood. The program automatically closes at the rider's destination.

The TAD offers both rider and caregiver a sense of security. It tracks the real-time position of the rider, which the caregiver can view on the website. If the rider goes off route, the program alerts the caregiver, who can call the rider to provide appropriate direction to get back on route.

Training time for the riders varies based on their abilities. The researchers conducted a successful field test of the system with a small group of cognitively challenged riders in April 2008. The participants learned the system in a matter of hours. In a separate test, a rider of normal intelligence whose Asperger's Syndrome causes him normally to miss external cues proved equally successful. While the system has been shown to work, a pilot study is still needed to identify requirements for wide-scale implementation.

However, the promise is great, and the technology is attracting attention. The CUTR researchers have procured additional funding from the Innovations Deserving Exploratory Analysis (IDEA) Program overseen by the Research and Innovative Technology Administration of the US Department of Transportation (USDOT). The IDEA Program supports efforts to explore the feasibility of advanced but untested concepts and technologies in transportation. The IDEA funding is allowing CUTR to investigate whether automatic vehicle location (AVL) technology can be used to enhance the TAD by creating a redundancy feature that would use the bus's GPS position to prompt the rider in the event the cell phone's GPS signal is lost.



The software interfaces with Google maps.

Successfully implemented, the TAD could provide a broad range of benefits. Special needs riders could experience an increased sense of independence and mobility. Transit agencies could potentially reduce the amount of door-to-door paratransit service needed to serve the community by training greater numbers of clients to use fixed-route transit. The savings could be significant. Agency costs for paratransit vary from place to place, but according to Sheppard, the paratransit cost to HART is more than $35 per rider. HART's cost per rider on a fixed bus route is $2.30.

The USF research team was led by Philip Winters, Director of the Transportation Demand Management Program, and CUTR research associates Sean Barbeau and Nevine Georggi. The team included several faculty members and students from USF's Department of Computer Science and Engineering. Both FDOT and the USDOT provided funding for the project to the National Center for Transit Research, the university transportation center located at CUTR/USF. ⬣

Our Research Partner: RAPTER at UCF

Research in Advanced Performance Technology and Education Readiness, University of Central Florida

RAPTER's truck driver training simulator at the Institute for Simulation & Training, University of Central Florida.

Simulator Training Enhances Safety

The reliable operation of commercial carriers plays an important role in keeping Florida's highways safe and its economy healthy, which is why FDOT has worked with the Research on Advanced Performance Technology and Education Readiness (RAPTER) group at the University of Central Florida (UCF) to develop two innovative, computer-based training programs for commercial motor vehicle drivers and state motor carrier compliance officers (i.e., safety inspectors), respectively.

The first program is the Virtual Check Ride System (VCRS), a commercial driver's license (CDL) training and testing program for truck drivers who want to refine their skills and prepare for recertification tests. The second is the Web-based Safety Inspector Training and Certification Program, which provides a similar service for the state's motor carrier safety inspectors. The programs were unveiled in 2008 and have been well received by the trucking industry and enforcement agencies.

The Partnership

RAPTER is one of several research groups that collectively constitute the Institute for Simulation and Training (IST) at UCF. RAPTER's mission is to enhance human performance through the application and furtherance of advanced performance technologies. The group is staffed by a team of instructional designers, subject matter experts, engineers, technical editors, and technology wizards who work in modeling and simulation, network applications, and web design.

RAPTER Director Ron Tarr

RAPTER has performed work for sponsors as diverse as the Department of Defense, NASA, the National Center for Forensic Science, the Florida Department of Education, and the Orlando Regional Workforce Initiative. RAPTER has also partnered with the Center for Advanced Transportation Simulation Systems (CATSS) and performed transportation research for the US Department of Transportation (USDOT) and FDOT in the areas of motor carrier compliance, security, and anti-terrorism. In fact, RAPTER Director Ron Tarr also serves as the director for the CATSS Simulation and Performance Technologies for Advanced Transportation Applications program.

RAPTER's work with FDOT began in 2003, when Lt. Col. David Binder, FDOT Motor Carrier Compliance Office (MCCO), identified a need for cost- and time-effective training solutions for some critical issues facing the trucking industry. The USDOT requires that all commercial carrier drivers possess a valid CDL. To obtain a CDL, an applicant must pass written and driving skills tests with a minimum score of 80%. When the current CDL program began in 1992, however, some drivers were grandfathered in without being tested. Commercial carriers needed a testing procedure to certify the legacy drivers, to recertify currently licensed drivers, and to reduce the potential for a driver to use a fraudulent license.

Col. Binder also saw an opportunity to advance training opportunities for the state's commercial vehicle safety inspectors. The USDOT mandates that safety inspectors perform 32 roadside inspections each year to maintain their certification. However, the existing training program did not provide all inspectors with a statewide method to ensure consistency of training and inspection skills. Tight budgets and staff reductions made it difficult for MCCO to provide anything more than limited training to its inspectors, and increased workloads cut into the time available for inspectors to receive training. Binder felt that computer-based training could provide the solution.

RAPTER possessed the facilities and provided the expertise to develop these programs using simulation, interactive web, and virtual technology tools like those used in electronic games. The developed programs evaluate and provide immediate feedback to the student. They also feature embedded glossaries of terms to enhance learning and study.

Virtual Check Ride System

The Virtual Check Ride System is designed to help commercial carriers provide training to their drivers. The VCRS includes review materials from the current CDL examination, a multiple-choice test on general operator knowledge, and an interactive truck inspection test. A simulation-based driving skills test helps prepare drivers for the actual on-road test in a vehicle of the type they plan to operate. Training specialists from several commercial carrier companies, the Florida Trucking Association, and MCCO provided input on the VCRS content. VCRS was tested by commercial carrier trainers in the Orlando area and is now being tested by national trucking companies, including Hunt, Maverick, Schneider National, Swift, and Werner.

The success of the VCRS study led to FDOT's partnering with RAPTER to develop the safety

Three screen simulator for law enforcement officer training.

inspector training and certification program. Other potential applications that may develop out of the VCRS effort include training programs of interest to the Army. VCRS has potential to train soldiers how to drive ungainly vehicles like Hummers that are loaded with extra armor and have a machine gun and gunner perched on top. Conversely, the program could also be used to reteach conventional driving skills to soldiers who are returning to civilian life. Similarly, VCRS could also be adapted to teach conventional driving skills to new drivers. Such an application could be particularly valuable in states, like Florida, that currently have no mandatory driver's education requirement for licensing.

Safety Inspector Training and Certification

Traditional commercial vehicle enforcement officer training combines formal classroom lectures with a brief opportunity to observe a truck inspection. Students are tested at the end of the training. This type of training was resulting in a higher than acceptable failure rate, for two reasons. First, the lecture format assumed the students had more background knowledge than was frequently the case. Second, the students did not have sufficient time for hands-on practice of their new skills.

The Web-based training program developed at RAPTER uses blended media such as high fidelity images, animations, and audio and video clips to demonstrate how truck components work. Each visual is accompanied by a discussion of the regulation governing the component in question and the criteria for determining whether the vehicle should be removed from service. This packaging of the material allows the program to serve as more than a training resource; inspectors can use it in the field as a reference tool, accessing it from a laptop computer in the patrol vehicle. Moreover, the program can easily be updated so that the latest regulations are available to inspectors in a timely fashion and at a minimum cost to the enforcement agency.

This training program has been implemented in Florida and has resulted in an unprecedented 100% examination pass rate. Pilot tests of the program in Colorado, Ohio, and Michigan have also shown positive results.

Training Across the Digital Divide

Part of the success of these programs is due to RAPTER's basic educational philosophy, which

Detail screen from commercial driving simulator

The simulator can be used to teach students how to drive safely in bad weather conditions.

encourages all parties involved in the instruction process to focus on outcomes. "The education is not just for people who need to know how to drive large vehicles or to inspect them," Tarr said. "The education is also needed by those who do the training."

Tarr believes that the trainers and trainees are separated by today's digital culture. Tarr calls the trainees "digital natives," those born after 1980 who grew up using advanced electronic technology. The trainers, Tarr says, are often "digital immigrants," who learned to use the technology as adults. He believes the mental organization of the two groups is entirely different, which creates a major problem for trainers, who don't know how to connect with the trainees.

RAPTER's flexible, technology-based training programs for today's digitally sophisticated students are helping to bridge this gap by providing more effective training methodologies. The ultimate effect will be better trained operator and inspector communities, and safer highways in Florida. ⬣

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Meet the Project Manager

Marc Ansley, Chief Structures Research Engineer
FDOT Structures Research Laboratory

Marc Ansley manages the FDOT Structures Research Laboratory, situated in Tallahassee's Innovation Park and just a stone's throw from the National High Magnetic Field Laboratory. A Tallahassee native, Ansley attended Georgia Tech, where he earned his bachelor's and master's degrees in engineering. He returned to Tallahassee and, following a short stint as a structural engineer in the building industry, joined FDOT. Ansley has been with FDOT for some 20 years, the last seven at the structures lab.

Ansley leads a staff of seven engineers and technical specialists who fabricate and test structural specimens for FDOT research projects. The lab stays very busy doing in-house testing and assisting with contractor-led research projects. The lab deals with structures of all sizes, ranging from storage-bin-size fiberglass covers for roadside electronics to enormous marine bridges.

Ansley typically manages a dozen or more contracted research projects at any given time. He also oversees on-site load and stress testing of FDOT's bridges throughout the state. Ansley and his team can often be found in the basket of a crane, hanging over the edge of a tall bridge to check its underside, or doing vibration stress tests on the bridge roadbed with traffic passing alongside.

The heavy equipment used for bridge testing often gets put to work in the lab to help university researchers study very large structure segments, including a recently load-tested bridge box girder large enough to support a roadway 16 feet wide. This structure tested the limits of the facility. "It maxed out our lab," Ansley said. "We thought it would take about 1.2 million pounds of load to fail it. It actually took less than a million pounds. The design didn't test out, but we were happy because we broke something. Testing things to failure is how you learn."

Finding the limits of materials provides important data that FDOT and the American Association of State Highway and Transportation Officials (AASHTO) can use to refine their structural design specifications. "The testing data impacts future designs, so it pays off in safety and reliability," Ansley said. He observed that FDOT structures researchers have had a hand in improving designs since the 1940s and '50s, when their work on pre-stressed concrete led to its use as a significant and reliable building material in Florida for over 50 years.

Now Ansley and his team are helping researchers evaluate new structural materials that are lighter and more corrosion resistant than steel: aluminum for movable bridge decks, carbon fiber for bridges, and fiberglass for rebar reinforcement. Ansley thinks many of these materials are suitable for structural repairs but would like to see more long-term testing before they are used in new structures.

Ansley has also been working on projects involving extensive electronic data gathering, and FDOT is seriously considering the use of full-time, electronic structural health monitoring for bridges. He regards development of software that can analyze and report on the data quickly a top priority, as it would help FDOT respond to problems in a timely manner.

From a perhaps more personal perspective, Ansley would like to see new bridge designs that allow easier access for physical inspections and maintenance. But even though structures testing can be difficult and complex and often just plain messy, Ansley still believes he has the best job in the world. "Who wouldn't want to do this?" he asked. ⬣

Meet the Principal Investigator

Paul Cosentino, Professor in Civil Engineering
Florida Institute of Technology

Paul Cosentino started doing research for FDOT when he joined the Florida Institute of Technology Civil Engineering faculty in 1990. His areas of expertise include soil mechanics, fiber optic signal sensors, and the use of recycled materials in pavement. Cosentino received his bachelor's and master's degrees from his home-town school, the University of Pittsburgh, and his doctorate from Texas A&M University.

Cosentino's interest in practical research of statewide value has led to innovative applications of his research. While doing research on the use of fiber optic sensors for measuring water pressure in soils, Cosentino saw an opportunity to explore the use of fiber optic devices for traffic signal sensor and traffic counter applications. FDOT now uses embedded fiber optic sensors at its weigh-in-motion truck stations. Trucks can be weighed without slowing down, saving industry and the state time and money by expediting the process.

FDOT recently implemented a standardized, automated pressuremeter Cosentino developed in a study that concluded in 2006. It produces more accurate estimates of soil properties for lateral load analysis than do traditional field testing methods. Better estimates result in safer, more cost-effective designs. This type of testing is infrequently performed and may not always result in less expensive designs; however, the few applications since implementation have resulted in smaller, less expensive pile foundations than would have been called for using traditional methods.

Currently, Cosentino is studying pile rebound. Certain Florida soils resist pile driving efforts and push piles back out after they have been driven into the ground. Severe rebound can delay construction and raise costs considerably. Cosentino is investigating how to identify and anticipate conditions where rebound may occur, improve design and construction, and avoid costly delays.

Cosentino has also researched the use of recycled materials as possible substitutes for some of the 20 million tons of limerock Florida requires each year for pavement aggregate. Most of Florida's limerock aggregate comes from several mines near Miami. The long-term concern over mine closures and the consequent potential reduction of aggregate supplies lends weight to this area of study. As traditional building materials become scarcer and more costly, the potential value of marginal materials increases. Cosentino has evaluated bottom ash, rubber tires, waste glass, and asphalt and concrete reclaimed from road replacement projects. He has determined that these materials can work as aggregates, although safe storage and limited availabilities, among other issues, keep them from general use.

Reclaimed asphalt pavement (RAP) is of great interest because much is produced from repaving projects, and because the cost to make new asphalt has trended upwards over the last several years. While RAP is much less expensive than new asphalt, it has limitations. Cosentino's studies have shown that RAP tends to spread and deform under pressure, so it can only be used as a base under hard surface roadways. It can't be used to support structures such as retaining walls. FDOT has incorporated these findings into its official construction specifications.

FDOT geotechnical materials engineer David Horhota has observed that Cosentino's research is helping FDOT evaluate ways to make paving more environmentally conscious. "We are getting greener," Horhota said, and Cosentino's work is helping. ⬣

Successful Research and Partnerships Lead to the State of Florida Erosion and Sediment Control Manual

In 2005, FDOT sponsored a project with the Stormwater Management Academy at the University of Central Florida (UCF) to develop a Florida manual for erosion and sediment control (BD521-04). Objectives include identifying and assembling best management practices (BMPs) that would promote using the right tools for the right applications. Such a manual would allow a more flexible and context-sensitive approach, as opposed to a more static, one-size-fits-all use of BMPs.

From the outset, this project undertook to create a collegial network of partner-stakeholders to establish buy-in and overcome stereotypical developer-regulator relations. Indeed, the project has facilitated increasingly effective relations between FDOT and the Florida Department of Environmental Protection (FDEP), and the benefit of this working relationship is spilling over into collaborative efforts for developing a statewide stormwater rule. Beyond FDOT, FDEP, and UCF, partners to the project include the US Geological Survey, water management districts, and industry representatives.

Uncontrolled erosion can result in blocked drainage systems.

The use of proper control measures can prevent deep erosion in drainage areas.

While the first version of the manual was released in June 2007, it began providing benefits much earlier. FDOT used the material being assembled for the manual to provide on-site guidance to contractors who needed quick and effective methods to mitigate erosion and sediment problems on actual construction projects.

Ultimately, the manual reaches beyond transportation. It has been adopted by FDEP as the industry-wide standard for effective erosion and sediment control for construction in Florida. The manual is proving to be a valuable tool and will soon be updated for a new version release. It is available from FDOT at http://www.dot.state.fl.us/rddesign/dr/drainage.shtm ●

The new plantings at this Eola Park intersection are an example of effective erosion control

For more information

Wind Resistant Signals and Sign Poles

BD545-54 Anchor Embedment Requirements for Signal/Sign Structures
Ron Cook, Principal Investigator
Marc Ansley, Project Manager

BD545-57 Development of Hurricane Resistant Cable Supported Traffic Signals
Ron Cook, Principal Investigator
Marc Ansley, Project Manager

www.dot.state.fl.us/ research-center/Completed_ Structures.shtm

Travel Assistant Device

BD549-33 Travel Assistant Device (TAD) to Aid Transit Riders with Special Needs
Philip Winters, Principal Investigator
Amy Datz, Project Manager

www.dot.state.fl.us/research-center/Completed_PTO.shtm

RAPTER – Simulator Training

BD548-03 Proof of Concept for Simulation Based Re-Certification of Commercial Driver License
Ronald Tarr, Principal Investigator
David Binder, Project Manager

BD548-10 Simulation as a Tool for Enhancing Commercial Driver Skills and Recertification
Ronald Tarr, Principal Investigator
David Binder, Project Manager

BD550-04 Computer-Based Examiner Training and Certification Program
Ronald Tarr, Principal Investigator
David Binder, Project Manager

BD550-10 FDOT Safety Examiner Workforce Certification Test
Ronald Tarr, Principal Investigator
David Binder, Project Manager

www.dot.state.fl.us/research-center/Completed_MCC.shtm

Erosion and Sediment Control

BD521-04 Florida Manuals for Erosion and Sediment Control and the Creation of the Stormwater Management Academy Reseach and Testing Laboratory
Marty Wanielista, Principal Investigator
Rick Renna, Project Manager

www.dot.state.fl.us/research-center/Active_RD.shtm


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