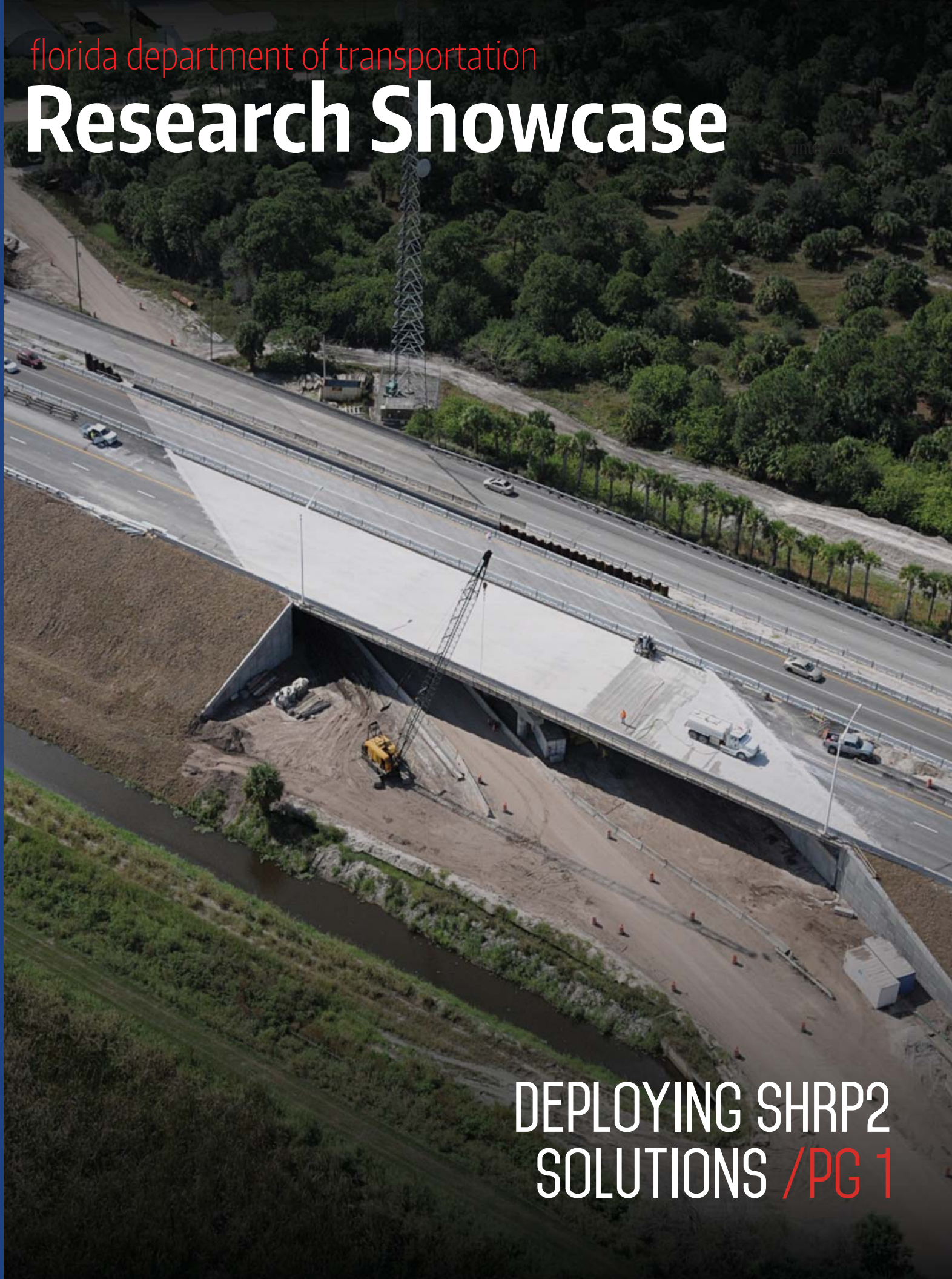
SPRING 2015

florida department of transportation

Research Showcase



DEPLOYING SHRP2 SOLUTIONS /PG 1

florida department of transportation

Research Showcase

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

Managing Editor
Darryll Dockstader

Editor
Jessica VanDenBogaert
jessica.vandenbogaert@dot.state.fl.us

Writers/Graphic Design
Charles Brown
Vicki Morrison
Jessica VanDenBogaert

Printer
Harvest Printing

Front Cover
Bridge Construction in District Four
seefloridago.com

Governor
Rick Scott

Secretary of Transportation
Jim Boxold

FDOT Research Center
605 Suwannee Street, MS 30
Tallahassee, FL 32399-0450
(850) 414-4615
http://www.dot.state.fl.us/research-center/

Centennial FDOT 1915 ★ 2015

IN THIS ISSUE

SHRP2: TACKLING TOUGH TRANSPORTATION PROBLEMS

In 2005, Congress, as part of the SAFETEA-LU Act of 2005 – Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users – authorized the Transportation Research Board (TRB) to administer the second Strategic Highway Research Program (SHRP2) in order to conduct research to address some of the most pressing needs of the nation's highway system.

Products stemming from this research, named SHRP2 Solutions, are now being made available to transportation agencies by the Federal Highway Administration (FHWA) and the American Association of State Highway and Transportation Officials (AASHTO) through a funding initiative program to encourage testing, application, and refinement.

The first SHRP program, conducted from 1988 to 1993, focused on materials and construction and led to many advances in these areas including Superpave, a widely used system for specifying the components of asphalt concrete, asphalt mixture design and analysis, and asphalt pavement performance prediction.

As the second iteration of the SHRP program, SHRP2 focused research in areas that have not been viewed as traditionally highway-related. Susan Martinovich of the Nevada Department of Transportation and a member of the SHRP2 Oversight Committee explains, "We've gotten good on the technical side and continue to grow in it, but what about opportunities in the safety area, congestion, economic development, reliability – those hard-to-quantify areas?"

Thus, SHRP2 casts a wide net to engage new types of solutions. Whereas research by its very nature must often have a narrow focus, SHRP2 addressed highway needs from a systems perspective, taking a broader view in order to examine more elements of highway infrastructure – including construction, administration, and data management – in seeking solutions. This solution-focused approach encourages robust interaction between research and technology efforts.

The specific issues of concern for SHRP2 – safety, aging infrastructure, and congestion – have been identified as critical needs. Many highways have become more and more congested and statistics have shown that the collision rate, a crucial indicator of safety, has begun to rise again. The nation's aging infrastructure has been highlighted and reinforced by inspection programs that have documented the extent of the problem.

In laying out the scope of the research program, the SHRP2 committee chose four themes:

R **Renewal**: Develop design and construction methods that cause minimal disruption and produce long-lived facilities to renew the aging highway infrastructure

L **Reliability:** Reduce congestion and improve travel time reliability through incident management, response, and mitigation

C **Capacity:** Integrate mobility, economic, environmental, and community needs into the planning and design of new transportation capacity

S **Safety:** Significantly improve highway safety by understanding driving behavior in a study of unprecedented scale

Within each of these themes, a technical committee and task groups have outlined subthemes. For example, under Renewal, there are seven subthemes; e.g. Bridge and Structure Design, Construction, and Preservation, Construction and Project Management, Nondestructive Testing and Evaluation. Then, for each theme, there is a series of research projects; in the case of Renewal, these are designated R01, R02, etc.

SHRP2 SOLUTIONS
TOOLS FOR THE ROAD AHEAD

The SHRP2 Solutions cover a wide variety of transportation sectors including accelerated bridge construction techniques, nondestructive methods of concrete testing, as well as geotechnical products and processes.

Implementation Assistance

With a wide array of products ready for refinement, testing, and implementation, FHWA, in collaboration with AASHTO, is providing implementation assistance to help state departments of transportation, metropolitan planning organizations, and other interested parties deploy the results of SHRP2 research.

Beginning in 2013, SHRP2 Solutions have been offered in five implementation rounds. More than 400 applications have been received from 49 state DOTs, the District of Columbia, 38 metropolitan planning organizations, and several tribal communities as well as local transportation agencies, and the FHWA Federal Lands Highway divisions.

Implementation selections are based on geographic diversity, demonstration of a culture open to new products or processes, past interest or participation in similar efforts, a high commitment to making institutional or organizational changes, commitment to conduct demonstration workshops, and a willingness to share their experience with their peers.

Assistance is awarded at a series of levels including:

Proof of Concept

Assistance projects at this level are for products that may require additional testing or refinement before full implementation is possible. The Proof of Concept level offers highway agencies the opportunity to help evaluate the readiness of a product and to gain more experience in the use of the product.

User Incentive

Projects at this level provide assistance to organizations that are interested in a product but are not prepared to implement it. This level offers an opportunity for an organization to assess the product and make organizational changes that may be needed to facilitate future product implementation.

Lead Adopter Incentive

As lead adopters, organizations take a more active role in product implementation, may assume a greater risk in implementing the product, and may be called on to help communicate the use of the product and assist with implementation for other interested organizations.

Through this implementation assistance structure, promising methods are moved out into the field in as many venues as possible.

The SHRP2 Solutions are made available in a series of funding rounds, four of which are complete. Round 5 closed in February and Round 6 will open for application in June 2015. For more information, please visit the SHRP2 Solutions website at: *http://www.fhwa.dot.gov/goshrp2*

SHRP2 and Florida Transportation

With over 19 million residents and more than 90 million visitors a year, Florida has one of the most heavily used transportation infrastructure networks in the country and continues to be proactive in its search for improvement.

As a longtime transportation research leader, the Florida Department of Transportation (FDOT) has been an active participant in SHRP2 research and implementation. In SHRP2's 2014 year-in-review report, Florida was described as a "strong proponent of innovation... championing numerous SHRP2 products."

In the first four rounds of implementation assistance, Florida has been awarded implementation assistance for ten projects.

RENEWAL

Managing Risk in Rapid Renewal Projects (R09)

Rounds 1/2/4: Multiple Levels

In Rounds 1, 2, and 4, FDOT has been awarded implementation assistance to apply its risk management practice to rapid renewal projects, which are more vulnerable to cost and time impacts due to accelerated scheduling, complexity, and innovative methods. From proof of concept through lead adopter to user incentive levels, FDOT will use the R09 products, including the *Guide for the Process of Managing Risk on Rapid Renewal Projects* and its accompanying electronic tools.

At the proof of concept level, FDOT applied the R09 product to the Gateway Expressway Project, a toll road planned for Pinellas County (District 7), currently scheduled for a 2017 construction start. As a lead adopter, FDOT is using the R09 product as a means of updating risk analysis and management implementation policies and procedures. In this phase, risk management analysis will be applied to the widening of SR-40 in Marion and Volusia counties. In addition, FHWA Facilitator Training was conducted and commercial risk analysis software was purchased for use statewide. At the user incentive level, FDOT plans to purchase a risk repository system to capture statewide risks, impact costs, probabilities, etc. for future project risk assessments. It will also be used to develop and report on various metrics for evaluating the performance of FDOT's risk management program and other reports as required by FDOT management. In addition, a post-response mitigation was conducted for the Gateway Expressway Project.

Through participation in this part of SHRP2, FDOT will increase its risk management analysis capacity and make its methodologies more widely available throughout the state.

Point of Contact: Greg Davis, Central Office ▪

GeoTech Tools (R02)

Round 3: User Incentive

FDOT is facilitating a series of workshops and webinars across the state, training users to select the most appropriate geotechnical recommendations that are site-specific and within budget using the Geoconstruction Information and Technology Selection Guidance website. FDOT District 4 will coordinate with other district geotechnical engineers to perform a series of webinars and workshops to present geotech tools and share best practices.

The website provides a number of tools to assist geotechnical, structural, and pavement engineers. A catalog of technologies details 46 methods and products with fact sheets, photographs, case history, design guidance, quality control/quality assurance procedures and guidance, specification guidance and examples, and cost information.

As part of this project, the Accelerated Bridge Construction (ABC) Center at Florida International University (FIU) hosted a webinar in February 2014. The workshop was also made available to a national audience as a live preconference workshop at the 2014 National Accelerated Bridge Construction Conference, hosted by the ABC Center. These events demonstrate how a SHRP2 project works to improve transportation engineering practice, in this case, by bringing together geotech technologies, web-based information systems, and accelerated bridge construction.

Point of Contact: Matt Gisondi, District 4 ▪

Nondestructive Testing for Concrete Bridge Decks (R06A)

Round 4: Lead Adopter

Florida's coastal environment and many rivers and streams mean that the Sunshine State is home to hundreds of bridges. The great majority of these bridges have concrete decks which are subject to accelerated deterioration due to the humid and salty environment. A comprehensive inspection program is important, especially because damage to bridge decks often occurs internally, where it cannot be seen during a visual inspection.

FDOT has been awarded lead adopter implementation assistance to support bridge rehabilitation through the use of technologies that can detect and quantify concrete defects for plan production. This SHRP2 technology will become a part of FDOT's routine bridge inspection process and lead to increased efficiencies in bridge inspections and problem detection.

Point of Contact: Ross Hammock/Melissa Morgan, DIstrict 2 ▪

RELIABILITY

Organizing for Reliability Tools (L06/L01/L31/L34)

Round 1: Lead Adopter

Florida is one of only eight states with a state-level transportation systems management and operations plan (TSM&O). The plan is based on performance measurement, active management of the multimodal transportation network, and improved safety and mobility for Florida's traveling public. By connecting management and operations organization to performance outcomes, TSM&O offers ways to optimize the use of limited transportation funding to maximize transportation efficiency and effectiveness.

The Organizing for Reliability tools are a set of products that can assist in evaluating and improving systems management and operations.

In Florida, four reliability products are going to be tested:

- L02: Establishing Monitoring Programs for Travel Time Reliability
- L05: Incorporating Reliability Performance Measures into the Transportation Planning and Programming Process
- L07: Evaluation of Costs and Effectiveness of Highway Design Features to Improve Travel Time Reliability
- L08: Incorporation of Non-recurrent Congestion Factors into Highway Capacity Manual Methods

FDOT will work with private firms to apply these SHRP2 tools in multimodal corridors in Orlando and Broward County. The goal is to assess the usefulness of the products and suggest any potential refinements.

This project will improve FDOT's tools and methods for planning for operations by making available from the SHRP2 library several new tools and methods for reliability analysis and by providing a framework for testing on a state and national level. This project will also take advantage of ongoing national tests of the SHRP2 tools to further improve the robustness of its conclusions.

Point of Contact: John Moore, District 5 ▪

Reliability Data and Analysis Tools (L02/L05/L07/L08/C11)

Round 4: Proof of Concept

The products in this implementation focus on measurement and analysis. FDOT, already a leader in travel time reliability analysis and performance measures, was awarded proof of concept implementation assistance to advance mobility monitoring and reliability forecasting activities.

Products in this group include:

- L02: Guide to Establish Monitoring Programs for Travel-Time Reliability
- L05: Handbook for Incorporating Reliability Performance Measures into Transportation Planning and Programming
- L07: Reliability by Design
- L08: Incorporating Travel-Time Reliability into the Highway Capacity Manual
- C11: Tools for Assessing Wider Economic Benefits of Transportation

FDOT has gained a detailed knowledge of reliability products during previous pilot tests and anticipates permanently including them in its processes. As part of the proof of concept assistance, FDOT plans to focus on the products that relate to the prediction and use of reliability (L05/L07/L08/C11), and as part of its internal efforts, use data processing methods in L02 to build a monitoring system that supports statewide performance measurement.

FDOT is conducting a review of all the reliability products in this group through the FDOT Statistics Office's Multimodal Mobility Performance Measures contract. The review includes a summary of data requirements, software requirements, relevant applications, types of outputs, and additional work needed to make them "implementation ready." Products will be selected for implementation partially based on the level of effort needed to incorporate them into FDOT's and local agencies' existing processes. To accomplish this implementation and testing, FDOT is developing detailed implementation plans.

Point of Contact: Dana Knox, Central Office ▪

CAPACITY

Expediting Project Delivery (C19)

Round 2: Lead Adopter

FDOT has been awarded lead adopter implementation assistance to focus on strategies developed through SHRP2 to expedite the planning and environmental review of transportation projects, specifically on strategies to improve resource agency involvement, improve internal communication, and streamline decision making. FDOT will assess the current practice, further explore the strategies developed in the C19 product, and incorporate them where possible to improve the efficient delivery of its projects.

Further refining the dispute resolution process will also avoid stalling projects. FDOT also anticipates developing strategies to minimize major changes to projects as they advance through phases in order to expedite project delivery.

Point of Contact: Steve Braun, District 4 ▪

Freight Demand Modeling and Data Improvement (C20)

Round 3: Proof of Concept

Port Everglades handles 24 million tons of cargo annually and is the 11th busiest port in the nation. Much of this tonnage is petroleum products: asphalt, gasoline, diesel, propane, and crude oil. FDOT has been awarded proof of concept implementation assistance to conduct a pilot study using Port Everglades to develop new methods of data collection and better understand the supply and demand chain for petroleum commodities.

The data collected through the Port Everglades Petroleum Commodity Flow Pilot Study will help FDOT improve decision making when considering infrastructure capacity improvements. In addition, the data will help emergency management and transportation agencies manage restoration of the transportation system following significant weather events so that impacts to the petroleum supply can be minimized. Most importantly, the effort will facilitate refinements to the regional travel demand model to allow for modeling freight movements in the future for all project partners.

Point of Contact: Min-Tang Li, District 4 ▪

SAFETY

Concept to Countermeasure: Research to Deployment Using SHRP2 Safety Data

Round 4: Proof of Concept

In 2012, more than 2 million people were injured in motor vehicle crashes in the United States. More than 90% of these injury-causing crashes are attributed to driver behavior as the primary cause, yet little is known about how this behavior contributes to crashes. One mission of SHRP2 is to develop significant data collections that can answer critical questions about the factors that lead to crashes. This SHRP2 safety project is focused on creating two databases: a Naturalistic Driving Study (NDS) database and a Roadway Information Database (RID).

Data acquisition for the NDS, the largest project of this kind ever undertaken, was based in six U.S. cities, including Tampa, and followed the driving activity of over 3,000 drivers, using a variety of sensors. While NDS documents driver behavior, RID documents the roads these drivers used by combining existing data about a wide range of roadway characteristics from public and private sources with data that describe traffic operations. The two databases can then be linked to provide researchers with the broadest and deepest data set ever compiled for such studies.

FDOT has been awarded proof of concept implementation assistance to conduct a naturalistic driving study to further determine the interactions between drivers and pedestrian features at signalized intersections. Gender and age group information will be included in this research, which will cover four broad topics: vulnerable road users, roadway features and driver performance, intersections, and driver speeds.

The implementation process for the SHRP2 safety initiative is in three phases. Phase one, to be conducted in 2015, will feature proof of concept studies using a reduced data set. Florida is one of 10 states conducting phase one studies. Florida's phase one study will focus on acquiring data from vehicles passing by intersections with high pedestrian activity and/or crash frequency. Based on the results of phase one, phase two will begin, in which the full data set will be used for in-depth analysis and countermeasure identification. Phase three, to be conducted in 2016, will implement identified countermeasures on a national basis.

Following the success of NDS, USF researchers are applying this expertise and experience to another form of transit – bicycles. Researchers will collect data on the behavior of 100 cyclists from the Tampa Bay area and their interactions with other forms of transit using cameras and sensors. This data will then be analyzed and recommendations made to improve the safety of all who share the road.

Point of Contact:
Darryll Dockstader, Central Office ▪

AUTOMATING TRAFFIC SIGNAL CONTROLLER TESTING

A worker accesses a traffic control box at a typical Florida intersection. These ubiquitous cabinets house Actuated Signal Controllers that control the traffic signals, pedestrian signals, and other electronic devices and are used to regulate both vehicular and pedestrian traffic at intersections.

Testing traffic signal controllers for use at signalized intersections across Florida is a time-consuming and tedious job that can only be completed by highly experienced testing personnel. However, researchers at Florida State University (FSU) working together with the staff at the Florida Department of Transportation (FDOT) Traffic Engineering Research Laboratory (TERL) developed a set of automated testing tools which greatly simplify and speed up the testing process. Because the suite of testing tools conforms to the National Transportation Communications for ITS Protocol (NTCIP), this new method of testing is manufacturer-independent, which further shortens the time commitment required for thorough testing.

Traffic control signals and devices located at a typical signalized intersection are controlled by an Actuated Signal Controller (ASC), commonly known as a traffic signal controller. This controller is essentially a microcomputer that processes a number of input signals from several different types of sensors. These inputs are then interpreted and trigger changes to the traffic signals, pedestrian signals, and other electronic devices used to regulate the flow of vehicular traffic and pedestrians at an intersection.

As required by Florida Statute 314.0745, FDOT is required to test and certify all official traffic control devices as meeting federal and state standards and specifications before they can be used in Florida's intersections. Because these controllers can be programmed to accommodate a wide variety of intersection configurations, thoroughly testing new controllers is a challenging and time-consuming process. The testing methodology currently used for testing traffic controllers relies on manually operated "suitcase testers" and is extremely time consuming.

To simplify and enhance this testing process, FSU researchers, in conjunction with TERL staff, with input from leading controller manufacturers, have developed and constructed a computer-based automated testing tool for traffic signal controllers. Once implemented, it is anticipated that this automated system will dramatically reduce the staff time needed for testing and increase capacity to allow for more stringent performance and stress testing of controllers. Currently, it can easily take up to 80 hours thoroughly testing a new controller. Once the new automated testing is implemented, TERL staff will be capable of performing a complete test in under an hour. This will in turn provide more staff availability to further speed up the testing process.

At the close of the contract, the research team developed a user's guide and training manual to help others simplify and improve their traffic signal controller testing. For more information, contact project manager Jeff Morgan at the Traffic and Engineering Research Laboratory. ▪

Final Report available at: www.dot.state.fl.us/research-center

FDOT INTERN NOMINATED FOR PRUDENTIAL PRODUCTIVITY AWARD

Since 2013, FDOT's internship program has offered college students (sophomore through graduate) attending public and private universities and colleges an insiders' look at the transportation industry and a unique opportunity to develop skills and techniques they need to succeed professionally.

Positions are offered across the state in each of FDOT's districts, Central Office, and Florida's Turnpike Enterprise for students with such diverse majors as civil engineering, environmental science, business, public administration, planning, public relations, statistics, and communications. In the first academic year of the program, FDOT has employed 80 students through the internship program.

While students benefit from the opportunity to learn about the transportation industry firsthand, FDOT also benefits from their efforts and ideas. Recently, FDOT District 1 nominated one of its interns, Zachary Roach, to receive a 2014 Prudential Productivity Award. The awards program publicly recognizes and rewards Florida state employees and work units whose work significantly and measurably increases productivity and promotes innovation to improve the delivery of state services and save money for Florida taxpayers and businesses.

The 2014 awards competition attracted 568 nominations for innovations and productivity improvements worth $558 million in cost savings, cost avoidances, and increased revenue for state government. Over the past 26 years, award winners have posted a total of $8.7 billion in added value for Florida taxpayers and businesses.

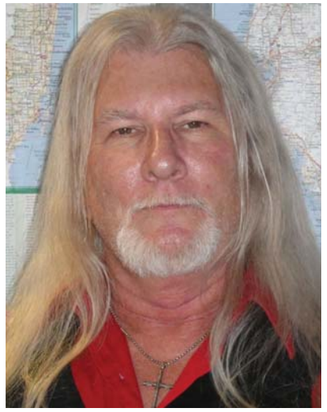
FDOT District 1 intern Zachary Roach with supervisor Donald Cashdollar.

Zach distinguished himself by developing a set of instructions (macros) for use with Excel spreadsheets to help improve the analysis of data collected during speed studies. Historically, traffic engineers have used pneumatic road tube counters to collect data, then compiled the data on spreadsheets listing date, time, and speed for each vehicle recorded. Engineers then determine the 95th, 85th, and 50th percentile speeds, the average speed, and the 10mph pace. Zach discovered opportunities to improve the current procedure by reducing the speed study data processing times and the size of workbooks using Microsoft Power Pivot, a powerful data analysis tool. He also developed a tool that reads a source file and imports the results into a template, creating a destination speed study file based on a 24-hour count that exceeds Florida Manual on Uniform Traffic Studies (FMUTS) minimum requirements.

FDOT District 1 performs an average of 200 speed studies per year. The district estimates that the total savings in time per study location by implementation of the tool is 20 man hours, resulting in an average savings of 4,000 hours per year. Using an average of $93.75 loaded rate (salary plus benefits, expenses, etc.), District 1 estimates the tool could save FDOT approximately $375,000 per year.

Prudential Productivity Award winners were announced in February 2015 and though Zach was not chosen for a Prudential Award, he was hired as a Bituminous Specialist position in the Districts 1 and 7 Materials Office. Welcome to FDOT, Zach! ▪

meet the project manager:
BOBBY WESTBROOK, PUBLIC TRANSIT ADMINISTRATOR



Bobby Westbrook, Transit Operations Administrator with FDOT's Public Transit Office, has managed numerous public transportation-related research projects under contract with the Center for Urban Transportation Research (CUTR) at the University of South Florida (USF). Since 1992, Westbrook also has served as FDOT's representative for CUTR's Transit Maintenance Analysis and Resource Center (TMAARC).

Westbrook's CUTR research team developed a tool to help TMAARC evaluate the Certified Transit Technician (CTT) program. TMAARC prepares transit technicians employed at Florida's 32 public transit agencies for National Institute of Automotive Service Excellence (ASE) certification. The tool, currently in use by TMAARC, provides information concerning the quality and level of classroom learning; the quality of course materials; the quality of instruction, including materials and presentations; and the quality of on-the-job experience, including repair quality, maintenance inspections, work habits, safety, and technical ability.

CUTR researchers also conducted a three-phase project that studied repair time standards for transit vehicles. In phase I, researchers reported and validated time standards for each step in the process for repairing the braking system. In phase 2, researchers established time standards for preventive maintenance and developed a database to compile information. In phase 3, researchers investigated and evaluated the vehicle engine removal and replacement system. The standards developed through this research are helping to make transit maintenance departments more efficient by reducing downtime and labor costs.

In addition to his work with the Certified Transit Technician program, Westbrook also helmed research related to the growing field of alternative fuel technologies. Many Florida transit agencies have introduced alternative fuel technologies to their fleets to address rising fuel costs and environmental concerns. However, these advancements have resulted in increased capital and operating costs for some fixed-route operators. In response, Westbrook's research team developed a data reporting tool for agencies to use to collect information on the costs and reliability of their alternative fuel vehicles, enabling agencies to track and evaluate the costs and benefits of investment in advanced transit technologies. In a related project, CUTR researchers developed a method for transit agencies to evaluate the performance of alternatively fueled buses. "The reporting and evaluation tools have greatly helped Florida transit agencies better understand the performance of advanced transit technologies," says Westbrook.

> "The reporting and evaluation tools have greatly helped Florida transit agencies better understand the performance of advanced transit technologies

The availability of a well-maintained bus fleet is critical to a transit agency's ability to provide high quality, reliable, and safe service. Key to this effort is the maintenance department, which must have properly defined staffing plans and adequate staffing levels. CUTR researchers studied bus maintenance staffing practices and compiled guidelines and approaches from transit agencies across the U.S. for maintaining optimal staffing levels. They also identified critical inputs transit agencies should consider when either staffing a new program or evaluating and realigning an existing program. "All of Florida's transit agency maintenance departments are finding this tool useful in helping them determine staff levels," says Westbrook.

Recently, Westbrook's research team studied rear-end bus collisions and identified possible preventive measures. "This project helped us understand the frequency of car/bus collisions," says Westbrook. CUTR researchers studied whether car/bus collisions were increasing and under what conditions, what strategies can reduce the number and severity of collisions, and how yield-to-bus laws and pull-out bays affect collisions. The research findings will help reduce the number and severity of car-bus collisions.

"FDOT-funded research has enabled Florida's transit agencies to implement strategies that make public transit safer and more efficient," says Westbrook. "I look forward to working with researchers on future innovative projects." ▪

meet the principal investigator:
H. R. HAMILTON, UNIVERSITY OF FLORIDA

H. R. Hamilton, professor of civil engineering at the University of Florida, Department of Coastal and Civil Engineering, has served as Principal Investigator on over 20 FDOT-funded research projects since 2001. His projects focus on issues involving the interaction of materials and structures.

A critical subject is concrete permeability, which determines how fast chloride ions in saltwater can penetrate concrete and reach steel reinforcing bars. The rate of permeability helps bridge engineers choose the most suitable concrete mixes and methods, and gives them an indication of the repair and replacement timelines for bridge components. In one project, Hamilton compared five laboratory methods used to determine concrete permeability. He and his research team conducted lab measurements on cores near the tide line of bridge piers to help improve test methods. The research helped improve testing methods for this critical parameter.

Closely related to Hamilton's work on permeability are long-term bridge monitoring projects, such as the Key Royale Bridge study in southwest Florida. In that project, individual piles were constructed using concrete mixes containing different formulations of supplementary cementitious materials (SCM). These materials included fly ash, silica fume, and metakaolin, among others. Using instrumentation incorporated into piles, researchers monitor permeability under realistic exposure conditions, instead of relying on accelerated laboratory methods. Additional durability segments also were suspended from the piles, allowing them to be cored at multiyear intervals to allow direct examination of chloride penetration. The five-year report on these segments was completed in 2013. FDOT continues to monitor this bridge and collect data.

Hamilton has conducted a number of projects related to tensioning cables and pre- or post-stressed concrete bridge members. These projects have included stress testing of pretensioned beams, replaceable unbonded tendons, and shear performance of prestressed concrete bridge girders. But many research efforts have led back to the material that protects tensioning cables from corrosion: grout.

Grout is critical to the performance and protection of tensioning cables inside concrete bridge components. In a series of projects, Hamilton has begun to clarify the relationship between handling and storage of grout products and their behavior in the field. This subject has important implications for the long-term performance and maintenance costs of bridges.

In a current project, "Evaluation of Shelf Life in Post-Tensioning Grouts," Hamilton is studying the effect of aging on the bleed and segregation characteristics of both plain and commercially available pre-packaged post-tensioning grouts. A previous project on the subject of grout bleed had pointed to storage issues as a possible cause of grout problems.

In another current project, "Replaceable Unbonded Tendons for Post-Tensioned Bridges," Hamilton is studying alternative grouting methods to protect tendons from corrosion. Tendons typically are grouted with concrete to protect them from corrosion. However, the tendons may corrode if the concrete coating deteriorates. An alternative grouting method, widely used in European countries, involves placing bare strand in a duct and injecting the duct with an alternative material such as grease, petroleum wax, or gel. "I am excited about the use of this technique and the potential to save millions of dollars," says Hamilton.

In addition to the rewarding experience of his research, Hamilton praises the hands-on engagement of FDOT project managers he has worked with and the effective partnership that it helps create. "It's more of a collaboration than me being a contractor," he said, "and an important reason that my work with FDOT over the years has been so satisfying."

Another reason is the support for research at FDOT through a very active research program and through state-of-the-art facilities like the State Materials Office in Gainesville and the Ansley Structures Research Center in Tallahassee. "FDOT is incorporating the latest science and engineering into its standards, specifications, and, ultimately, a transportation infrastructure for the 21st Century." ▪

Editor's Note: As a new feature of Research Showcase, we will occasionally revisit older research projects and take a look at how they have benefited the transportation sector since they were concluded.

Where are they now?
REUSE AND RECYCLE OF WASH WATER IN CONCRETE PRODUCTION

One of the challenges facing the ready-mixed concrete industry is the amount of water needed to clean out a concrete truck's drum at the end of each day. With each cleaning, this process can produce between 80 and 150 gallons of water which is classified as a hazardous substance by the Environmental Protection Agency (EPA). As such, truck wash water must be carefully handled and disposed of in settling ponds on-site at concrete plants.

As an alternative, the ready-mix industry turned to chemical additives to stabilize the mixture and slow the hydration process. This puts the cement in the water in a dormant state and allows the remaining water and cement to be reused and mixed with more concrete.

As sometimes happens, practices in the field were ahead of efforts to quantify and standardize procedures. Though preliminary studies had shown that mixing chemically stabilized wash water with fresh concrete can produce an acceptable product, a lingering suspicion of the negative effects any residual chemicals would have on concrete durability had been sufficient cause for FDOT to not allow the mixing of admixtures with fresh concrete. In 1998-99, FDOT contracted with researchers at the University of Florida's Rinker School of Building Construction to determine the effect of admixtures on concrete properties and to develop water quality standards to address the use of stabilized wash water in the production of fresh concrete.

Researchers developed a test program to investigate the effects of stabilized wash water in concrete production for various applications using different aggregates, admixtures, normal and high concrete placement temperature, and different classes of concrete. Researchers also evaluated the effect of stabilized wash water on early strength gain and thermal properties of concrete.

Concrete drums must be washed out at the end of each day, and the EPA classifies truck wash water as a hazardous substance, which must be disposed of in settling ponds on-site at concrete plants.

Through the course of the study, researchers found that stabilized wash water could be mixed with fresh concrete and produce an acceptable product. The study also found that the use of stabilizer reduced concrete mixture costs, increased concrete construction productivity, and reduced the costs and adverse environmental impacts associated with the disposal of wash water in slurry ponds and settling pits.

Following this series of studies, FDOT specifications for concrete were examined and revised. While FDOT still requires only fresh concrete for structural concrete applications, such as prestressed girders, pier columns, road surfaces, and other load-bearing applications, FDOT revised its specifications to allow the mixing of stabilized wash water with fresh concrete for non-structural uses, such as sidewalks, ditches, and other non-load bearing applications.

The findings of this study have recently been validated by NSF International. An analysis conducted in 2012 estimated the per truck cost of site disposal of returned concrete and wash water at $384.98. By contrast, stabilized returned concrete is estimated at $346.45 per truck, a savings of 10%. Reuse of stabilized concrete also reduces solid waste and water emissions by 9% and consumes less raw materials per truck.

As time passes, it is becoming increasingly necessary to look for new and different ways to keep both costs and environmental impacts as low as possible. Reusing stabilized wash water, as validated through FDOT research, is doing just that. ▪

Final Report available at:
www.dot.state.fl.us/research-center

FURTHER READING

SHRP2 Solutions

For more information on SHRP2 implementations, please visit the SHRP2 Implementation Assistance Program website at:
http://www.fhwa.dot.gov/goshrp2/ImplementationAssistance

Automated Traffic Control Signal Testing

BDK83-977-08 Development of Automated Testing Tool for Traffic Control Signals and Devices

BDK83-977-20 Development of Automated Testing Tools for Traffic Control Signals and Devices (NTCIP and Security)

BDV30-977-05 Development of Automated Testing Tools for Traffic Control Signals and Devices (NTCIP and Security), Phase 2

Project Manager: Jeff Morgan, Traffic Engineering and Operations
Principal Investigator: Leonard Tung, Florida State University

Florida Department of Transportation Internship Program

For more information on the FDOT internship program, please visit the Human Resources Internship Information website at:
http://www.dot.state.fl.us/humanresources/internship.htm

Reuse and Recycle of Wash Water in Concrete Production

BB889 Use of Stabilizer Agents in Mixer Drum Wash Water

Project Manager: Mike Bergin, State Materials Office
Principal Investigator: Abdol Chini, University of Florida

SPRING 2015

Research Center
605 Suwannee Street, MS 30 Tallahassee, FL 32399-0450
(850) 414-4615
http://www.dot.state.fl.us/research-center/