FDOT Research Quarterly Summary, September 2020

Completed FDOT Research, July 2020 – September 2020

FDOT Geotechnical Office

• Quantifying Pile Rebound with Deflection Measuring Systems Best Suited for Florida Soils

Florida Institute of Technology researchers evaluated how the Inopiles PDM LASER deflection-measuring system, in conjunction with PDA deflections, can be used to quantify pile rebound in the viscoelastic fine Florida sands with silts and clays.

Project number: BDV28-977-07
Principal investigator: Paul Cosentino, Florida Institute of Technology
Project manager: Juan Castellanos, FDOT Geotechnical Office

[Read the Project Summary] ***[Read the Final Report]***

• Sinkhole Detection with 3-D Full Elastic Seismic Waveform Tomography

University of Florida researchers developed a 3-D full waveform inversion (FWI) method using surface-based seismic waves for detection of layering, properties and anomalies over any 3-D domain tested.

Project number: BDV31-977-82
Principal investigator: Michael McVay, University of Florida
Project manager: David Horhota, FDOT Geotechnical Office

[Read the Project Summary] ***[Read the Final Report]***

FDOT Materials Office

• Field Testing and Calibration of the Vertical and Horizontal In situ Permeameter

University of Florida researchers developed simple, but consistent, equations for estimating hydraulic permeability from VIP/VAHIP injection test results. They also performed field testing of VIP/VAHIP probes at multiple sites for validation and empirical correction of VIP/VAHIP permeability estimates versus existing Florida Department of Transportation (FDOT) permeability measurements from borehole methods.

FDOT Research Quarterly Summary is prepared by the University of Florida's UFTI-T2 Center as a public service. For full details of FDOT research, please visit the FDOT Research Center website.

Project number: BDV31-977-23
Principal investigator: Ana Mohseni, University of Florida
Project manager: David Horhota, FDOT Materials Office

[Read the Project Summary] ***[Read the Final Report]***

- **Implementation of Measuring While Drilling Shafts in Florida (FLMWDS)**

University of Florida researchers further validated methods developed in BDV31-977-30, investigating (1) any irregularities in strength prediction (socketed casings, variable rock formations, etc.) and/or construction monitoring (rig malfunction) and (2) specific energy vs. load testing. This project provided quantifiable data that supports cost savings as well as quality assurance in field monitoring drilled shaft installation like current driven pile construction practice. The researchers also investigated monitoring mechanically driven drill rigs and index testing through core sample analysis, which included dry unit weight, moisture content, porosity, and carbonate content vs. rock strength and axial shaft response.

Project number: BDV31-977-91
Principal investigators: Michael McVay and Michael Rodgers, University of Florida
Project manager: David Horhota, FDOT Materials Office

[Read the Project Summary] ***[Read the Final Report]***

- **Study of Anti-Strip Additives on Granite-Based FC-5 Asphalt Mixtures**

Auburn University researchers determined the combination of liquid anti-strip additives and additional hydrated lime that would produce longer lasting FC-5 mixtures. In an economic analysis, they found that the additional life of the pavement would offset the cost of the additional materials.

Project number: BE555
Principal investigators: Donald Watson and Fan Gu, Auburn University
Project manager: Howard Moseley, FDOT Materials Office

[Read the Project Summary] ***[Read the Final Report]***

- **Enhanced Hydroplaning Prediction Tool**

Applied Research Associates, Inc., enhanced a current hydroplaning prediction (HP) program. The new version of the HP program is able to calculate the hydroplaning potential along lengths of roadway based on either roadway geometry design inputs or automatically collected multipurpose survey vehicle and texture data. It also analyzes multiple proposed lanes (planes)

and multiple storm intensities at one time and integrates the hydroplane potential calculation with a geographic information system (GIS) application for an overall view of hydroplaning risk contour plots.

Project number: BE570
Principal investigator: Hyung Lee, Applied Research Associates, Inc.
Project manager: Charles Holzschuher, FDOT Materials Office

[Read the Project Summary] ***[Read the Final Report]***

- **Development of a Procedure for Evaluating and Approving Liquid Anti-Strip Agents**

Texas A&M Transportation Institute researchers documented the extent to which liquid anti-strip agents can affect asphalt mixture stability during and after construction. They determined effective laboratory methods and procedures to evaluate asphalt mixture stability and developed an approval system for liquid anti-strip agents with respect to mixture stability. This approval system is coupled with FDOT's current system for evaluating the effectiveness of liquid anti-strip agents for moisture susceptibility.

Project number: BE585
Principal investigators: Pravat Karki and Im Soohyok, Texas A&M Transportation Institute
Project manager: Ahmad Chami, FDOT Materials Office

[Read the Project Summary] ***[Read the Final Report]***

- **Accelerated Weathering of Traffic Control Materials by Laboratory Testing**

University of North Florida researchers identified or developed appropriate test protocols for accelerated weathering technology using laboratory instruments to predict acceptable performance of traffic materials such as structural coating and sign sheeting.

Project number: BE717
Principal investigator: Adel Elsafty, University of North Florida
Project manager: Awilda Merced, FDOT Materials Office

[Read the Project Summary] ***[Read the Final Report]***

FDOT Public Transportation Office

- **Incorporating Reliability Measures into the Freight Project Prioritization Decision Support System**

Florida International University researchers developed a methodology to quantify reliability benefits associated with proposed highway and multimodal system improvements. They also developed a data-driven freight project prioritization framework, with considerations of reliability measures and a decision support system with geographic mapping tools to facilitate the freight project prioritization process.

Project number: BDV29-977-42
Principal investigator: Xia Jin, Florida International University
Project manager: Rickey Fitzgerald, FDOT Public Transportation Office

[Read the Project Summary] *[Read the Final Report]*

FDOT Roadway Design Office

- **Measuring the Impact of Florida Scenic Highway Designation**

  University of South Florida researchers developed two survey instruments to collect data to assess and quantify the contribution of Florida Scenic Highways Program efforts to Florida's economy and quality of life of Floridians.

  Project number: BDV25-977-61
  Principal investigator: Sisinnio Concas, University of South Florida
  Project manager: Jeff Caster, FDOT Roadway Design Office

  [Read the Project Summary] *[Read the Final Report]*

- **Optimal Design of Stormwater Basins with Bio-Sorption Activated Media (BAM) in Karst Environments – Phase II: Field Testing of BMPs**

  University of Central Florida researchers used existing Florida Department of Transportation (FDOT) facilities to design two new Bio-Sorption Activated Media-based (BAM-based) treatment alternatives for testing the best management practices, (BMPs) using two stormwater basins under different hydrogeological conditions. They constructed and operated BAM-based treatment systems within the two existing stormwater basins and assessed the cost-effectiveness of different BAM-based treatment systems for removal of nitrogen over a long-term period through a life cycle assessment based on short-term operational data. The researchers also developed removal efficiency curves for BAM-based treatment systems.

  Project number: BDV24-977-20
  Principal investigators: Marty Wanielista, Ni-Bin Chang, and Kelly Kibler, University of Central Florida
  Project manager: Catherine Earp, FDOT Roadway Design Office

  [Read the Project Summary] *[Read the Final Report]*

Traffic Engineering and Operations Office

- **Evaluation of Innovative Alternative Intersection Designs in the Development of Safety Performance Functions and Crash Modification Factors**

  University of Central Florida researchers reviewed best practices for alternative intersection design in the U.S. They developed safety performance functions (SPFs) and crash modification factors (CMFs) for alternative intersection design (i.e., CF, MUT, and jughandle intersections) based on the collected data. A traffic safety diagnosis was conducted for rear-end crashes, and possible countermeasures were suggested. Recommendations were provided for Florida Intersection Control Evaluation as related to the project objectives.

  Project number: BDV24-977-27
  Principal investigator: Mohamed Abdel, University of Central Florida

Project manager: Alan El-Urfali, FDOT Traffic Engineering and Operations Office

[Read the Project Summary] ***[Read the Final Report]***

- **Using Smartphone as On-Board Unit (OBU) Emulator Implementation Study**

  University of Central Florida researchers explored using smartphones as on-board unit (OBU) emulators for in-vehicle communication. The researchers validated the feasibility of using smartphones as OBU emulators and the accuracy of smartphone data related to transportation. They developed a smartphone application to emulate OBUs and evaluated the application based on field tests.

  Project number: BDV24-977-30
  Principal investigator: Mohamed Abdel-Aty, University of Central Florida
  Project manager: Raj Ponnaluri, FDOT Traffic Engineering and Operations Office

  [Read the Project Summary] ***[Read the Final Report]***

- **Developing Florida-Specific Mobility Enhancement Factors (MEFs) and Crash Modification Factors (CMFs) for TSM&O Strategies**

  Researchers from Florida International University and the University of North Florida developed resources to assist agencies in evaluating the effectiveness of strategies identified in the newly developed state TSM&O Strategic Plan.

  Project number: BDV29-977-46
  Principal investigators: Priyanka Alluri, Florida International University, and Thobias Sando, Univerrsity of North Florida, Florida International University
  Project managers: Raj Ponnaluri and Yujing "Tracey" Xie, Traffic Engineering and Operations Office

  [Read the Project Summary] ***[Read the Final Report]***

- **Traffic-Event Unification System Highlighting Arterial Roads**

  University of Florida researchers developed machine learning techniques that use historical and real-time data to fuse information and detect incidents and accidents on arterial networks. This research seeks to apply machine learning to data relevance amplification and incident detection, explore potential challenges, and propose innovative solutions. If machine learning can be successfully integrated with existing systems, it would potentially open an array of future applications and benefits not only in operations aspects but also in safety, reliability, and planning. With automated vehicular technology around the corner, the integration of machine learning with signal systems would provide additional capabilities, especially in the transition phase when there will be a mix of automated vehicles (AV), connected vehicles (CV), and manual vehicles, creating a complex heterogeneous environment.

  Project number: BDV31-977-97
  Principal investigators: Sanjay Ranka, Anand Rangarajan, and Siva Srinivasan, University of Florida
  Project managers: Jeremy Dilmore and Raj Ponnaluri, FDOT Traffic Engineering and Operations Office

[Read the Project Summary] *[Read the Final Report]*

- **Impact of Heavy Trucks and Permitted Overweight Loads on Highways and Bridges Now and in the Future versus Permit Fees, Truck Registration Fees, and Fuel Taxes**

  Florida International University researchers developed guidance for legislators and FDOT officials that can be used to plan for infrastructure maintenance budgets, as justifications for modifications to the current fee structure of permits and licenses for overweight transports, and to assign fair costs to the vehicle types used in this study.

  Project number: BE695
  Principal investigator: Hesham Ali, Florida International University
  Project manager: Thomas Beitelman, FDOT Traffic Engineering and Operations Office

  [Read the Project Summary] *[Read the Final Report]*

Newly Funded FDOT Research, July 2020 – September 2020

FDOT Materials Office

- **Testing Methods for the Next Generation of Concrete**

  University of Florida researchers will determine if existing test methods can quantify concrete's performance with respect to cracking, durability, and heat generation at the mix design phase. A literature review will be conducted to identify these methods, with preference given to methods based on these criteria: (1) testing is conducted on conventional portland cement concrete containing coarse aggregate – not mixture components, derivatives, or specialty mixes (e.g., paste, mortar, grout, UHPC, RCC); (2) time for test completion does not exceed 30 days; (3) testing does not utilize hazardous materials; (4) tests are relatively simple, within the scope of a high-school education; and (5) cost of testing equipment does not exceed $30,000. Tests will be assessed for their ability to determine potential for excessive shrinkage, potential to experience excessive temperature rise, and chloride and sulfate durability. The research team will categorize test methods meeting the criteria: Category I – Test meets current needs of FDOT without any modifications; Category II – Test can be modified to successfully meet FDOT needs; and Category III – Test shows some potential to meet FDOT needs, but does not meet one of the five criteria. Methods in these categories will be used to make recommendations to the Standards Specification for Road and Bridge Construction to be used in the concrete mixture approval process specified in section 346.

  Project number: BDV31-977-136
  Principal investigator: Christopher Ferraro, University of Florida
  Project manager: Tim Ruelke, FDOT Materials Office

  [TRB Research in Progress entry] (not available at times of publication)

- **Performance Evaluation of SP-9.5 and SP-12.5 Superpave Mixtures**

  Texas A&M Transportation Institute researchers will compare the performance of the Superpave asphalt mixtures SP-9.5/FC-9.5 and SP-12.5/FC-12.5. The objective is to determine if SP-9.5/FC-9.5 mixtures are at least equivalent to SP-12.5/FC-12.5 mixtures in terms of cracking and rutting resistance. The outcome of this research is needed to determine the best use of our aggregate resources.

  Project number: BE928
  Principal investigator: Sheng Hu, Texas A&M Transportation Institute
  Project manager: Wayne Rilko, FDOT Materials Office

  [TRB Research in Progress entry]

- **Green Bike Lane Evaluation for Florida Pavements**

  Texas A&M Transportation Institute researchers will conduct a comprehensive review of nationwide and Florida's green bike lane (GBL) experience. They will identify and document best practices (good performing GBL projects) as well as the causes of premature pavement failures on poorly performing GBL projects. They will identify alternative GBL materials or construction methods that may reduce the application costs and increase the pavement

performance while being effective in delineating GBLs. They will conduct laboratory and field testing for evaluation of GBL products and develop Florida guidelines for GBL application and update the existing GBL specification.

Project number: BE965
Principal investigator: Tito Nyamuhokya, Texas A&M Transportation Institute
Project manager: Charles Holzschuher, FDOT Materials Office

[TRB Research in Progress entry]

- **Effects of Composition and Temperature Control Measures on Mass Concrete Durability**

Construction Technology Laboratories, Inc., researchers will work to improve the FDOT mass concrete specifications to ensure the long-term durability of mass concrete structures.

Project number: BEA04
Principal investigator: Jan Vosahlik, Construction Technology Laboratories, Inc.
Project manager: Jose Armenteros, FDOT Materials Office

[TRB Research in Progress entry]

FDOT Planning Office

- **Microsimulation: Department Assessment and Guidance**

Florida International University researchers will provide guidance and directions to improve FDOT's microsimulation modeling practice. The specific objectives of this project are to identify current and potential FDOT applications of transportation system simulation and associated needs; to assess existing simulation manuals and guidance in Florida and produce a new, comprehensive simulation guidance document that will support standardized practice for FDOT; assess the ability of available microsimulation platforms and applications to meet simulation needs in Florida; provide direction for the application of multiresolution as part of the modeling practice in Florida; explore development of simulation modeling clearinghouse practices; and identify department training needs in relation to the use of transportation system simulation.

Project number: BDV29-977-61
Principal investigator: Mohammed Hadi, Florida International University
Project manager: Thomas Hill, FDOT Planning Office

[TRB Research in Progress entry]

FDOT Safety Office

- **Characterizing Curve Crashes in Florida**

University of Florida researchers will characterize curve crashes in Florida and provide the FDOT Safety Office with an overview of curve safety performance statewide. Based on the current curve safety performance in Florida, the research will propose systemic safety analysis of characterizing curve crashes for all roads, identifying contributing factors for curve crashes

and developing safety performance functions (SPFs) for curves, which can be used as a guide to prioritize the most high-risk locations for curve improvements. The application of the research will contribute to a better understanding of curve safety issues in Florida and inform transportation engineers and planners to select proper countermeasures and target resources more effectively.

Project number: BDV31-977-135
Principal investigator: Ilir Bejleri, University of Florida
Project manager: Rupert Giroux, FDOT Safety Office

[TRB Research in Progress entry]

FDOT Traffic Engineering and Operations Office

- **Development of Crash Modification Factors for Speed Management of Traffic Signal Progression**

  University of South Florida researchers will investigate the function and impacts of traffic signal progression on pedestrian crash frequencies and severities on Florida urban arterials. They will develop crash modification factors and functions (CMFs) for speed management via traffic signal progression and provide guidelines on implementation of effective and adequate traffic signal progression strategies to manage vehicle speeds to reduce pedestrian crashes. Research objectives include (1) addressing traffic signal progression-related factors contributing to or alleviating pedestrian crashes and injuries, such as signal timing parameters (cycle length, phases, offset, etc.), (2) roadway characteristics (type, lane configuration, speed limit, etc.), and others, (3) investigation of the influence of traffic signal progression on vehicle speed, which is a surrogate safety measure related to pedestrian crash and injuries, on urban arterials, (4) develop CMFs to quantify the impacts of traffic signal progression on pedestrian crash frequency by injury severity, and (5) develop guidelines and recommendations to apply traffic signal control strategies on urban arterials for improving pedestrian safety and keeping vehicle mobility. The research will investigate the influence of traffic signal progression on vehicle speed and develop CMFs to quantify impacts of traffic signal progression on pedestrian injuries and fatalities on Florida urban arterials. The guideline developed under this research can provide FDOT and local transportation agencies the tool to effectively and adequately implement traffic signal progression strategies to reduce pedestrian crashes and injuries and also maintain vehicle mobility.

  Project number: BDV25-977-73
  Principal investigator: Pei-Sung Lin, University of South Florida
  Project manager: Alan El-Urfali, FDOT Traffic Engineering and Operations Office

  [TRB Research in Progress entry] (not available at times of publication)