

# Mack-Blackwell Transportation Center

October 2018 - September 2019

[mackblackwell.uark.edu](http://mackblackwell.uark.edu)



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Cover photo courtesy of ARDOT

## MESSAGE FROM MBTC EXECUTIVE DIRECTOR



As we get closer to 2020, there has been significant discussion concerning “the future”. What does the 21<sup>st</sup> century’s next 20 years hold? What transportation challenges will we face? What opportunities do we have? How do we educate and train our workforce for these challenges and opportunities? As various groups have grappled with these questions, it seems that a number of common themes continue to surface: *innovation; critical thinking; systems thinking; people/professional skills; diversity, inclusion, and equity*; and many others. It is clear that technology continues to evolve more rapidly than we can prepare, educate, and train people to fully harness it – and importantly, to fully understand its impact from social and cultural perspectives. The faculty, staff, and partners of the Mack-Blackwell Transportation Center are committed to proactively explore not only boundary-redefining innovative technologies, but also innovations in how we think, how we prepare engineers and others working in the transportation community, and how we can implement innovative technology in a socially, economically, and environmentally responsible manner. It is truly a joy and a privilege to work alongside the many dedicated folks associated with MBTC. We certainly look forward to the ‘next’ 20 years of the 21<sup>st</sup> century.

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# HISTORY OF MACK-BLACKWELL

The Mack-Blackwell Transportation Center (MBTC) has served the state of Arkansas and the nation for over 25 years by providing state-of-the-art research, high quality transportation education, and technology transfer.

In 1987, Congress authorized the U.S. Department of Transportation (USDOT) University Transportation Center (UTC) program, which led to the establishment of ten regional UTCs, one in each of the ten federal regions. The UTC program was designed to improve transportation research and education in the United States by advancing technology and expertise across multiple modes of transportation and addressing vital workforce needs for the next generation of transportation leaders. The center was named in the Intermodal Surface Transportation Efficiency Act of 1991, which was signed into law by President George H. W. Bush. Dr. Bob Elliott coined the center name cited in the bill – the National Rural Transportation Study Center.

In 2007, MBTC was designated as one of seven members of the U.S. Department of Homeland Security National Transportation Security Center of Excellence, in accordance with HR1, implementing the recommendations of the 9/11 Commission Act of 2007. The center fulfilled transportation security research needs for six years under this designation.

In 2013, MBTC partnered with Jackson State University, Louisiana State University and the University of New Orleans to form the Maritime Transportation Research and Education Center (MarTREC), which was competitively selected as a USDOT Tier 1 University Transportation Center under the MAP-21 transportation bill. With continued funding in 2016, the MarTREC consortium added Texas A&M University and Vanderbilt University and, through the FAST Act, and is working to preserve the Nation's transportation system through efficient, resilient, and sustainable maritime and multimodal logistics and infrastructure.

Mack-Blackwell has been fortunate to be led by four outstanding directors over the past twenty seven years.

- Dr. Walt LeFevre, Civil Engineering, 1992-1996
- Rear Admiral Jack Buffington, Civil Engineering, 1996-1999
- Dr. Melissa, Tooley, Civil Engineering, 1999-2006
- Dr. Heather Nachtmann, Industrial Engineering, 2007-present

## Spotlight on Jack E. Buffington

Admiral Jack E. Buffington served thirty-four years in the Navy Civil Engineer Corps, wherein he rose to the position of Chief of Engineers and Commander of the Naval Facilities Engineering Command in charge of navy contracting and public works worldwide. He was in charge of an annual workload of \$7 billion dollars with over 22,000 employees. In addition, he represented the 24,000 active and reserve Seabees and Civil Engineer Corps officers throughout in the Navy.



For thirteen years Buffington managed the University of Arkansas, Mack-Blackwell Transportation Center (MBTC), either as Director or Associate Director. The Mack-Blackwell Transportation Center is dedicated to improving the quality of life in America through our transportation research, education, and workforce development programs.

An expert in public works and transportation engineering, Admiral Buffington is a member of several professional societies including the National Society of Professional Engineers, the Arkansas Academy of Civil Engineers, which he helped to found, and the Society of American Military Engineers.

## DAN FLOWERS DISTINGUISHED LECTURE SERIES



November 15, 2018

**Dr. Tianjia Tang**

Chief of Travel Monitoring and Surveys  
Division, Federal Highway Administration  
U.S. Department of Transportation

U of A Ph.D., Agronomy '92

*Lecture: Challenges & Opportunities in  
Surface Transportation*



April 15, 2019

**Eric C. Shen**

Director of the Mid-Pacific Gateway Office in the Maritime  
Administration of the U.S. Department of Transportation

*Lecture: Marine Transport and Goods Movement: Why  
Should You Know and Why Should you Care*



Mr. Eric Shen and Dr. Sarah Hernandez

## COMPLETED MBTC RESEARCH PROJECTS

### **Development of the MASW Method for Pavement Evaluation**

Clinton Wood, Ph.D., P.E.  
University of Arkansas  
October 2013-July 2016

Infrastructure deterioration is a major issue for transportation infrastructure. This project explored the use of the Multi-Channel Analysis of Surface Waves (MASW) as a NDT method for characterization of pavements. Tests were conducted on concrete samples and full size pavement sections affected by alkali-silica reaction (ASR) to determine the relationship between shear wave velocity developed using the MASW method and strain increases due to ASR expansion of the concrete. Results indicate that the MASW method is capable of detecting the damage due to ASR for low to moderate damage levels.

### **Evaluation and Repair of Existing Bridges in Extreme Environments**

Royce Floyd, Ph.D., P.E.  
University of Oklahoma  
Gary Prinz, Ph.D., P.E.  
University of Arkansas  
October 2013-July 2016

The goal of this project was to increase the longevity of existing structures through development of comprehensive strategies for evaluation and resilient repair of pre-stressed concrete and steel bridge girders subjected to extreme environments. Detailed finite element simulations indicate that the partial-depth cross-frame-to-girder attachments within these multi-girder systems are the most fatigue critical regions. Laboratory tests equipped with the prototype retrofits were successful in shifting the mean stress in an instrumented steel beam. The result is a cost-effective and corrosion resistant “bridge band-aid” that can be applied to mitigate fatigue cracks.

### **Dependence of Infrastructure Restoration on Transportation Networks**

Sarah Nurre, Ph.D.  
University of Arkansas  
May 2016-October 2017

The restoration of critical infrastructure systems after extreme events is vital. We developed an optimization model which decides on the restoration of tasks in interdependent infrastructure networks, such as power, based on the availability and restoration of transportation over time. We found favorable configurations of work crew skills and preplacement within an impacted area.

### **Effects of Weather Events on Truck Traffic Using Fixed and Mobile Traffic Sensors**

Sarah Hernandez, Ph.D.  
University of Arkansas  
March 2016-January 2018

Severe weather conditions can effect traffic volumes. Unlike passenger vehicles, which may choose not to travel, freight trucks adhere to delivery schedules requiring them to alter their route. This study applied spatial panel regression techniques to develop a predictive model that relates variations in truck traffic patterns to weather conditions. The model developed can assist state and regional transportation agencies in developing freight-oriented programs for road and winter maintenance, structural and geometric pavement design, highway life cycle analysis, and long range transportation planning.

### **Rapid and Continuous Assessment of Soil Conditions along Highway Alignments**

Clint Wood, Ph.D., P.E.  
University of Arkansas  
April 2016-July 2018

The purpose of this research was to explore the applicability of Capacitively-Coupled Resistivity (CCR) as an improvement on traditional drilling and sampling methods for subsurface soil investigations. The CCR method could be used to identify critical locations for drilling and sampling such as expansive clay lay-

**Final project reports available @  
[www.sptc.org/projects/](http://www.sptc.org/projects/)**

ers, rather than uniformly sampling across a site. The resulting resistivity plots revealed continuous subsurface soil information and the impact of water level when interpreting the resistivity results.

### **Evaluation of Surface Treatments to Mitigate Alkali-Silica Reaction**

Micah Hale, Ph.D., P.E.  
University of Arkansas  
October 2013-October 2019

Alkali-silica reaction (ASR) is the most common form of alkali-aggregate reaction and has become a problem in concrete structures throughout the world. This research focused on mitigating ASR once it has occurred. The project examined using silane and other sealers to mitigate ASR in concrete structures. Due to the limited amount of time that this test has been ongoing, the conclusions here for 1 year and 3 months may not be applicable for a longer amount of time. It is recommended that the blocks be measured for at least 7 years to come to an accurate conclusion of how each sealer performs over time. Expansion readings along with recording winter temperatures should continue to determine the freeze-thaw and ASR damage.

### **Impact of Extreme Summer Temperatures on Bridge Structures**

Micah Hale, Ph.D., P.E.  
University of Arkansas  
Royce W. Floyd, Ph.D., P.E.  
University of Oklahoma  
October 2013-October 2019

This research investigated temperature gradients in AASHTO I-girders without wide top flanges to determine the environmental conditions that produce these gradients. This research also sought to understand the global response of concrete bridge girders to thermal gradients through three-dimensional finite element modeling. Large daily temperature variation is the most important contributing factor. Low wind speeds and no precipitation also contribute. Proper lateral bracing at all points during construction should negate the effects of transverse thermal gradients enough to keep tensile stresses below the cracking limit. During modeling, measured temperature gradients decreased camber. However, design gradients increased camber. Based on the results of this research, the vertical thermal gradient is recommended for AASHTO Type I, Type II, Type III, and Type IV girders in the pre-deck placement condition.

## **ONGOING MBTC RESEARCH PROJECTS**

### **Data Simulation to Support Interdependence Modeling in Emergency Response and Multimodal Transportation Networks**

Haitao Liao, Ph.D.  
Heather Nachtmann, Ph.D.  
University of Arkansas  
September 2017-August 2020

Access to data on the design and operation of interdependent critical infrastructures (ICIs) is now recognized as essential for developing new data analytics, design and decision-support tools. This project will create and make available synthetic and simulated data on ICIs by developing new data creation techniques and model-based approaches to simulating data on ICIs and human cognition and/or behavior with ICIs. It will provide research communities a free tool for modeling and collecting data on complex ICIs

involving human activities and decisions. The research investigates a methodology for developing hybrid data-driven statistical models and simulation tools that help decision-makers, researchers and other stakeholders have a good understanding of multimodal freight movement processes based on different data sources. So far, a spatiotemporal statistical model has been developed to capture extreme natural events causing disruptions in inland waterways and to predict such events in the future to facilitate commodity flow planning. Moreover, a simulation tool has been built to capture the effect of inland waterways disruptions on the commodity flow through other ICIs. A case study based on the Mississippi River and the McClellan-Kerr Arkansas River Navigation System (MKARNS) has been used to validate the hybrid model.

## WORKFORCE DEVELOPMENT



Stacy Goad Williams, research associate professor and director of the Center for Training Transportation Professionals, was named Professional of the Year by the Arkansas Chapter of the association.

The focus of the award is to inspire dedication and excellence in public service by recognizing individuals who have demonstrated those qualities in their career service to the public works profession.

Williams was recognized for her role as an expert in the field of public works, and for the guidance she has provided to infrastructure professionals in the public and private sectors. She has contributed to the Arkansas Technology Transfer Program to develop and teach courses that aid local agencies in understanding and implementing new technologies and best practices to improve the work quality throughout Arkansas.



The Arkansas Department of Transportation made a \$1 million investment in a Civil Engineering Research and Education Center at the University of Arkansas to support the creation of a facility that will benefit students, researchers and companies across Arkansas. Students will use the center's design and construction process to explore topics in construction techniques and management; computer-aided design and drafting; plan development; construction materials; soil mechanics and foundation design; structural steel design and reinforced concrete design.



MarTREC hosted a Regional Resiliency Assessment Program (RRAP) of the McClellan-Kerr Arkansas River Navigation System. Chad Johnston, Protective Security Advisor, Region VI Cyber Security and Infrastructure Security Agency directed the meeting.

The goal of the RRAP was to generate greater understanding and action among public and private sector partners to improve the resilience of a region's critical infrastructure. *Photo courtesy of USACE*



## CENTER FOR TRAINING TRANSPORTATION PROFESSIONALS



**Frances Griffith, Stacy Williams, Roselie Conley, Mary Fleck,  
Talley Faulkner, Katie Juniel, Austin Williams.**

2019 has proven to be another busy year at CTTT, with many new contractors and active highway construction projects in the state of Arkansas. The National Pollutant Discharge Elimination System (NPDES) course continues to see increased enrollment following a 2018 requirement for contractors to be certified in this topic. Materials testing certifications have also been in high demand, resulting in a total of 34 courses held since the beginning of the year. The most popular courses have been Soils Testing and Basic Aggregates, followed by Concrete Field Testing, Hot Mix Asphalt, and Concrete Strength Testing. Laboratory certifications have followed suit, with 6 new laboratory enrollments this year, and 3 re-locations, making a total of 103 laboratories currently participating in the program.

As technology becomes a more natural part of our daily lives, it also becomes a more integral feature of CTTT training courses. CTTT currently maintains 41 online training modules, and has recently launched a series of 40 training videos to assist with technician training. More modules and videos will be added in the coming months. Classroom information has also been added to the website, allowing a technician to more thoroughly prepare before attending a class, or to refresh in specific test methods after attending a class. In some cases, the online training materials may be completed in lieu of attending the full class, allowing technicians to simply attend a 1-day testing session. This reduces travel costs, as well as time away from the job.

The Technology Transfer (T2) program has continued to be a significant part of the CTTT program, with CTTT instructors presenting popular courses such as Unpaved Roads and Erosion Mitigation, Asphalt Pavement Maintenance, Stormwater Management, and Guide for Traffic Signs, Markings, and Signals. Newly developed courses, including Asphalt Paving Basics and Concrete Construction Basics, have also gained considerable attention, and have garnered favorable feedback as practical introductory training for new local agency employees and valuable refresher training for seasoned veterans. Pavement management and pavement preservation have continued to be popular topics of discussion at state and local conferences, and CTTT personnel have worked individually with local agencies to launch pavement management programs, explore alternative paving options, and assist in problem solving sessions. For information about CTTT and Technology Transfer, please visit [www.cttp.org](http://www.cttp.org) and [www.cttp.org/ardot/t2](http://www.cttp.org/ardot/t2).

## 2018 JACK BUFFINGTON OUTSTANDING STUDENT POSTER



The Jack Buffington Outstanding Student Poster was awarded to Eddie Gallarno and Ashley Johnson for their poster on "Trade-Off Analytics for Infrastructure Preservation". Gallarno and Johnson are Industrial Engineering students under the supervision of Dr. Greg Parnell and Dr. Ed Pohl. Pictured: Eddie Gallarno, Ashley Johnson, and Dr. Kevin Hall.

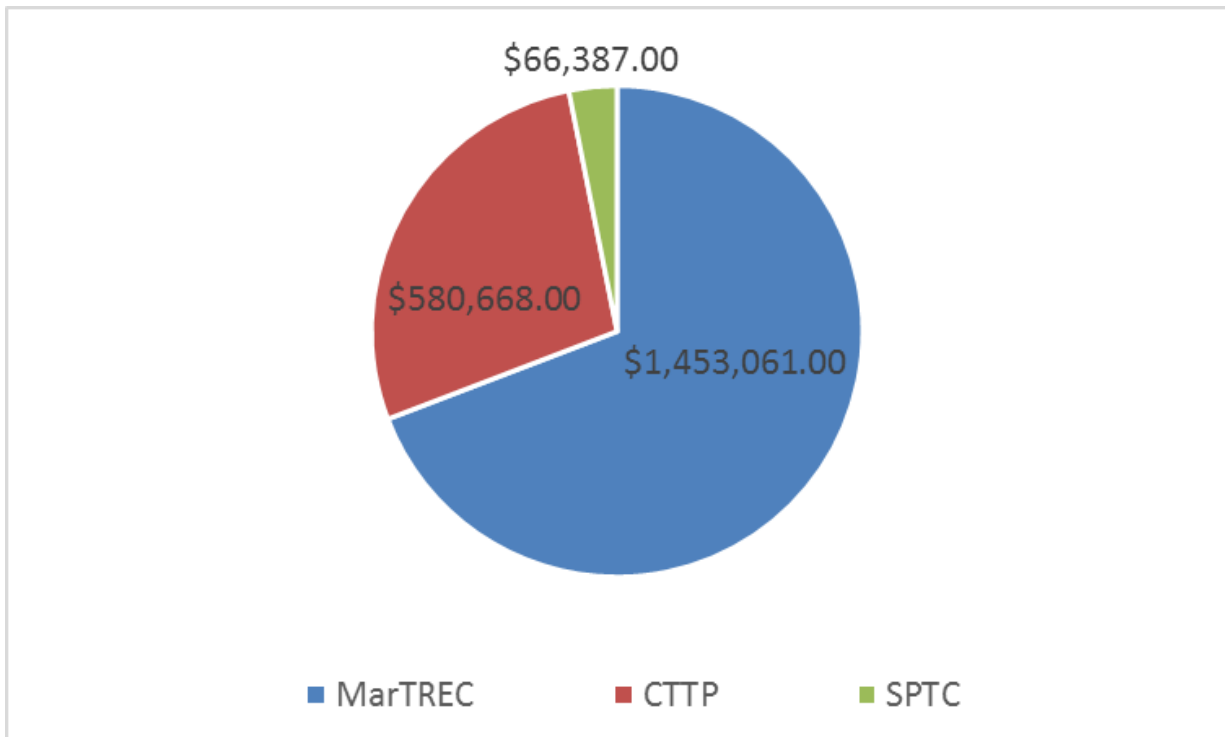
## 2019 ARKANSAS GOOD ROADS SCHOLARS



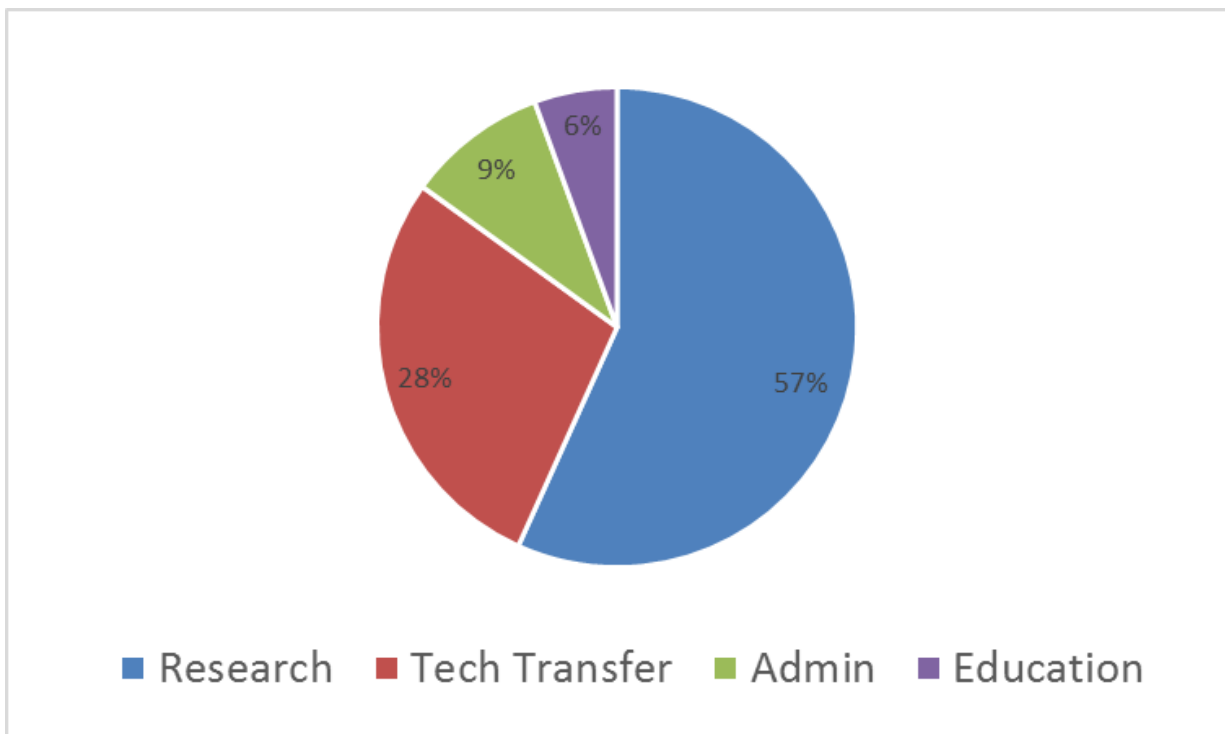
Emily Sherrill , Mariah Crews, Madeline Giebler, Justin Edwards, Brady Patrick, and Jocie Baker (not pictured) were selected as the 2019 Arkansas Good Roads scholarship recipients. The organization grants scholarships to outstanding civil engineering students in their junior or senior year. Recipients of the scholarship commit to work in the transportation field in Arkansas for a minimum of one year after graduation.

# MBTC FINANCIALS

## Center Expenditure Breakdown FY19 Expenditures = \$2,100,116



## Expenditure Activity Distribution FY19 Expenditures = \$2,100,116



# MarTREC OUTREACH

## 3rd Annual GirlTREC Summer Camp

July 8-12, 2019, MarTREC hosted 24 fifth and sixth grade girls at our GirlTREC summer camp on the University of Arkansas campus. The camp focused on hands-on activities related to transportation engineering from roads to rail to waterways and was designed to build courage and interest towards studying STEM fields and considering a career in the transportation industry. Our interactive programs were taught by faculty at the University of Arkansas' civil and industrial engineering departments and included activities in bridge construction, social media data during disaster response, traffic control systems, and train operations. A special thanks to Caren Kraska (pictured below), Arkansas & Missouri Railroad president and chairman, and crew, for scheduling a train ride and giving us a tour of the depot.

