ARDOT TRC TRANSPORTATION RESEARCH COMMITTEE

RESEARCH INFORMER

— SPRING 2019 —

A Newsletter by the Arkansas Department of Transportation

2019 Research Peer Exchange

BY JD BORGESON, P.E.

The strength of any state DOT's research, development, and technology (RD&T) program relies on regular self-improvement. The transportation industry has been constantly evolving to meet the needs of a fast growing population and utilize the ceaseless stream of technological advancements in the transportation field; it is the duty of ARDOT's Systems Information and Research Division's Research Section to keep Arkansas moving forward in this industry. RD&T programs across the country, while serving the same general purpose, function in a vast spectrum of different ways. In spite of this, many of the challenges each program faces are extremely similar. Evaluating peer RD&T programs provides valuable insight into the current state of a program, provides new solutions to a program's issues, and provides fresh, innovative ideas to a program seeking to improve. Thus, the conducting of peer exchanges is vital to any RD&T program in order for their department to stay relevant and adapt to the ever-changing transportation industry.

In accordance with 23 CFR 420, ARDOT's Research Section conducted a multistate peer exchange in Hot Springs, AR from March 4th through March 7th, 2019 along with representatives from the RD&T programs of two other state DOTs: Alabama (ALDOT) and Kentucky (KYTC). Peer members from Virginia, Louisiana, and Ohio DOTs also attended the meeting, along with Jason Bittner of Applied Research Associates, Inc. (ARA) who facilitated the peer exchange.

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Spotlight On T²

PAVEMENT MANAGEMENT DECISION TOOL FOR LOCAL AGENCIES

BY STACY WILLIAMS PH.D., P.E.

A pavement management system is a key element in balancing agency priorities and budgets while striving to improve the overall condition of a roadway network. Local agencies have a unique context in dealing with pavement maintenance and preservation and often have an extremely wide variety of pavement types, conditions, and treatment options. It is important to have a systematic method for choosing the right treatment at the right time so that pavement service life can be efficiently extended.

Pavements deteriorate over time, and that length of time depends on a number of factors such as traffic, climate, materials, and subgrade

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TRC1606 – Estimating Bridge Girder Camber and Deflection

BY CHRIS MCKENNEY

Estimating camber is a significant design issue for prestressed concrete girders. According to current research and practice from the Transport Research International Documentation database, it can be difficult to determine a precise estimate of camber, because structural engineers cannot quantify all the factors affecting camber. Camber is defined as the net result of the two opposing quantities that includes the upward deflection due to the eccentricity of prestressing force and the downward deflection due to a dead load.

The objective of the TRC1606 research is to improve the accuracy of estimating long-term camber, deflection, and prestressed losses of precast, prestressed concrete girders. The experimental program consists of concrete materials testing and field measurements for camber, deflection, and prestress losses. Dr. Micah Hale from the University of Arkansas Fayetteville was awarded the project and began work in Fall 2016.

The investigation involved nine full-scale girders from two prestressed concrete plants that regularly supply concrete girders to bridge projects in Arkansas. Coreslab Structures, Inc. in Tulsa, OK cast seven girders and JJ Ferguson Prestress/Precast, Inc. in Greenwood, MS cast two girders. These plants produce the majority of the prestressed concrete bridge girders used in the state of Arkansas.

Different girders with cross-sections at various spans were included to obtain data on a variety of girders used in Arkansas bridges. AASHTO Types II, III, IV, and VI girders

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SPOTLIGHT ON T²

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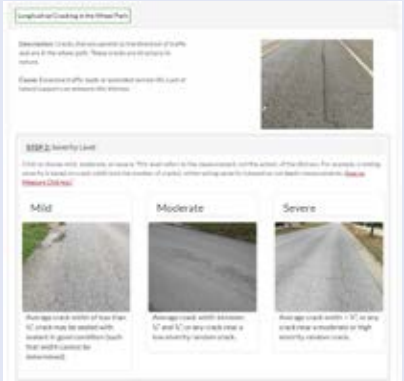
support. Regardless of condition, every pavement loses one year of its life each year unless preservation/maintenance treatments are applied. Often, agencies use a "worst first" approach in selecting projects even though those projects consume a large majority of the available budget. By applying preservation treatments before significant degradation occurs, pavement condition can be maintained at a higher level for a longer time and at a much lower cost. This approach delays major maintenance on roads in good condition freeing up future dollars to be spent repairing roadways in poor condition.

The Pavement Management Decision Tool for Local Agencies is an online tool that specifically targets local agency needs and lower volume roadways. It provides photos of various types of distresses and generates a selection of appropriate treatments based on the type, severity, and extent of the distress. Information about various treatment options is provided with general descriptions, construction considerations, cost, and life extension information. This tool can be accessed at www.cttp.org/ARDOT/t2. To use the tool, simply select the 1) type of distress, 2) severity, and 3) extent, then click to reveal treatment options. Then use the Budget Worksheet to set multi-year budget plans.

For more information, contact CTTP at cttp@uark.edu.



2019 RESEARCH PEER EXCHANGE

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The objective of this peer exchange was to examine specific functions and processes of each of the participating DOT's RD&T programs and to evaluate these functions and processes based on the practices of the other participating DOTs, along with the expertise of the other invited participants. The processes and functions of interest for this peer exchange were broken down into four topics: Finances of Research Program/CFR 200/Alternative Funding for Research, Return on Investment for Research Projects, Tracking Research Implementation, and Research Program Performance Measures. From March 4th through March 6th, each state DOT was provided an opportunity to present their current states of practice regarding each topic. After each state DOT presented their state of practice, each state was provided a round-table brainstorming session to determine what lessons they had learned, their strengths and weaknesses regarding each topic, and the opportunities each DOT had for improvement in these areas. Jason Bittner, acting as facilitator of the discussion, emphasized the importance of story-telling to help participants internalize the massive amount of information being shared. The afternoon of March 6th was used to wrap-up any topic discussions and provide a summary of the critical items and takeaways. Summaries for what was discussed in each session were created and included in this report which was finalized and approved by the participants on March 7th.

While the research team from ARDOT was able to glean an enormous amount of useful information during this exchange, there were three key takeaways identified for ARDOT's research program: the need to develop a streamlined research project tracking system, the need to develop better strategies for marketing research projects and processes, and the need to consider methods aimed at increasing training for university and research staff in order to emphasize responsibilities and expectations regarding research projects. The other participants in the exchange were able to provide methods at achieving these goals as well as examples of their successes and failures at doing so; ARDOT was also able to provide valuable insights and solutions to the issues that the other participants were having with respect to their research programs. Thus the overall attitude at the exchange was one of excitement at the prospect of growth and having the methods and resources to achieve it. Each participant stated they were walking away with information that will aid in improving their respective programs which displays the relevance of this peer exchange and proves that the main goal of the exchange was achieved.

Because state DOTs rely on their research programs to keep their departments up to date with the transportation industry, it is crucial for the research programs to constantly seek improvement themselves. ARDOT, in conjunction with ALDOT and KYTC, were provided many new ideas, methods, and solutions from this peer exchange that their respective research programs plan to examine in order to do just that: improve. More information about this peer exchange, and others, can be found on the RAC webpage dedicated to peer exchanges (https://research.transportation.org/peer-exchange-program/).

TRC1606 – ESTIMATING BRIDGE GIRDER CAMBER AND DEFLECTION

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with different lengths and cross-sections were examined in this project during a two-year period taking measurements from the time of casting to the completion of the bridge.

Several Departments of Transportation have developed camber prediction methods due to girders having camber that is less than expected. With the conclusion of TRC1606, preliminary findings in the implementation report outline the research that confirms an update or modifications to the current prediction method of long-term camber and deflection in prestressed concrete bridge girders are recommended.

Mapping Bedrock Conditions for Highway Project in Arkansas

BY TYMLI FRIERSON

Past highway projects in the State of Arkansas have encountered unexpected and problematic subsurface conditions that have led to change orders, project delays, or both. These problematic conditions often take the form of rapidly changing bedrock conditions that do not follow the ground surface. In extreme cases, these changes are not observed in the boring logs available for the project. Researchers at the University of Arkansas at Fayetteville recently conducted non-invasive seismic testing to characterize the subsurface conditions for the Highway 10 Single Point Urban Interchange project and the Hot Springs Highway 70 East – Highway 7 North project. This testing included surface wave testing and horizontal to vertical spectral ratio (HVSR) testing across the project sites where significant excavation is expected.

These non-invasive seismic methods image the subsurface by inducing stress waves into the subsurface and measuring their response at the surface similar to how ultrasounds image the human body in the medical industry. These methods can be utilized over a much larger area of the proposed cuts than traditional borings, which allows a more complete picture of the subsurface to be developed leaving fewer blind spots between boring locations. In addition, the testing provides insight into the rippability of various formations across the project site. Ultimately, this testing is expected to reduce the likelihood of encountering unexpected subsurface condition during project construction, provide designers with more information to use in their designs and reduce the risk assumed by contractors on the project.

The non-invasive methods used for these projects are being evaluated as part of the ongoing TRC1803 research project on Mapping Subsurface Conditions for Transportation Applications. For more information on the project, please contact Research or visit the PI's website at https://sites.google.com/site/clintonmwood/home.

This research would not have been possible without the hard work of graduate students Salman Rahimi, Michael Deschenes, Ashraf Himel, and Landon Woodfield. A special thanks also goes out to Paul Tinsley, Paul Campbell, Matt Green, and many others at ArDOT. Their advice and assistance are instrumental in the success of the work.

CURRENT RESEARCH HIGHLIGHTS

TRC1903

TRC1903 is a project to investigate concrete deck cracking in continuous steel bridges. Concrete bridge decks crack due to stresses and strains in construction and after construction when traffic travels on the bridge. Through this project, we expect to determine the types of cracks we have occurring most frequently in our newly constructed bridges, then test bridges under construction to better understand how to eliminate cracking in continuous steel bridges.

TRC1904

This research project will develop a framework for understanding the economic, social, and environmental impacts of transportation improvement projects. TRC1904's purpose is to provide evidence-based guidance in order to improve the understanding of certain construction jobs. This will be accomplished by developing and implementing a methodology to determine the economic impact of bypasses. The measurement of these impacts will focus on the conditions before and after the decision to construct a bypass, improve or widen the existing alignment, or make no changes. This methodology will assist in the decision-making process of stakeholders within Arkansas.

TRC1905

This research project will develop routine procedures for interpreting and analyzing a large quantity of high-quality Cone Penetrometer Test (CPT) data for most ArDOT geotechnical transportation applications. Since CPT is a more refined in situ test, the project will provide the basis for ArDOT engineers to use CPT results directly for the assessment of site conditions and the design of future geotechnical projects. At the end of this project, using CPT and shear wave velocity from Seismic CPT for bridge projects can achieve more accurate and continuous estimates of liquefaction resistance. Obtaining accurate estimates of liquefaction resistances can lead to significant cost savings for the Department.

Planning for Work Zones

Measuring Work Zone Impacts

BY KIM ROMANO, P.E.

Arkansas Department of Transportation (ARDOT) is continually trying to find ways to minimize unplanned delays. It starts by observing traffic patterns. The traveling public does this while driving to work, listening to radio or TV traffic broadcasts, or planning the day outside the home. ARDOT observes traffic patterns by counting vehicles classified by type, such as passenger cars, buses, delivery trucks, and tractor-trailers.

A few years ago, traditional highway construction and maintenance activities were usually performed on weekdays. In recent years, construction windows have shifted to off-peak times (nights or weekends) on busy highways to better accommodate traffic flows. Traffic flow rates and highway capacity thresholds are crucial elements to consider when deciding the best times to close a lane.

Determining optimum lane closure times requires careful data analysis. Routine traffic data is collected for 'average day' conditions. Collecting traffic count and speed data during construction presents many challenges, including where to place traffic counters and when to collect counts. Traffic measuring devices can get in the way of construction operations. Timing the data collection efforts so that capacity is being measured can be tricky since work activities are planned for times to minimize congestion. Research project TRC1306 examined several sites to compare traffic counts before and during construction. After examining collected traffic counts, three sites were identified where capacity was reached at the time the data was collected.

Counts were parsed into fifteen minute and hourly time bins, charted by the time of day, and analyzed. Traffic was studied to determine if a queue was present and the flow rate of vehicles before and during queued conditions. The traffic capacity data collected through TRC1306 will be used to determine times a lane can be closed with minimum traffic impacts, and times when traffic impacts are anticipated.

When determining lane closure times, traffic impacts are weighed against available work windows and lane width requirements to create an optimum balance of traffic flow for motorists and workflow highway maintenance or construction crews. The daily activities of the traveling public are considered – the time that work and schools start, holidays, and special events – and work times and days are assigned.

Innovative construction and contracting methods are being tested to improve project delivery while minimizing traffic impacts. For example, Broadway Bridge was entirely closed for six months. This closure allowed the contractor to get in, get the work done, and get out. The 30 Crossing is using Design-Build contracting – a new method for Arkansas – to optimize construction and minimize total traffic impacts. New technology offers exciting opportunities to collect and analyze data collected in construction work zones. Leveraging new information and construction innovations results in better work zone management and reduced driver delays.

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