2022 • ISSUE 1

RESEARCH INFORMER

A Newsletter by the Arkansas Department of Transportation Research Section

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The Evolution of Highways

BY KIM ROMANO, P.E.

Transportation has been a defining element of civilizations throughout history and an impetus to its advancement. How will future historians view our society and transportation system? The Eisenhower Interstate System transformed the lives of Americans by allowing safe and inexpensive personal travel from coast to coast in a matter of days instead of weeks.

We identify with our vehicles, whether they be cars, trucks, bicycles, or some other mode of transportation. Independent travel in one's own car or truck has been a dominant cultural signature since the 1930s.

How we travel about our day, the goods and services available, and how we get to work, school, and health providers depend on reliable transportation. It is a common element linking activities of daily life. Just as blood carries oxygen and nutrients, transportation systems carry people and goods.

The Evolution of Highways

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Horatio Earle, "Father of Good Roads"

Photo credit: Michigan DOT Photography Unit

Automobile travel and highways, with their current design standards, are recent developments in world history and owe a lot to early bicycle clubs. Horatio Earle, a bicycle industrialist and enthusiast, was instrumental in establishing the first State Highway Commission in Michigan, which was dedicated to funding and building paved roadways with public funds.[1] The first Federal Aid Road Act, passed in 1916, promised to provide federal funds to match state money for highway construction.

After mass production of automobiles made them more affordable, the newly improved roadways became dominated by cars. Eventually, highways themselves became destinations; think of Route 66. Other forms of personal transportation – walking, horseback riding, and bicycling – quickly gave way to the faster and more comfortable automobile.

Suburban life became possible. Coast-to-coast family vacations became popular. Living further away from industrial areas and business centers became the norm. In the USA, land development trends shifted away from central business districts, making mass transit even less feasible for most people.

Research and development were pivotal in every significant transportation mode shift throughout history. People developed new processes and materials to build things better. Today, personal vehicles are safer and more efficient than ever before. Next-generation vehicles will talk to each other and the roadway to further increase safety, efficiency, and transportation network capacity.

Interstates are modern marvels and will likely be viewed by future civilizations as a wonder of the world – or at least a factor that pivoted civilization to a new trajectory – much as we marvel at ancient architecture, roads, and viaducts. Modern highways have changed how people live their lives. The quality of life has dramatically improved over the last 100 years, and modern transportation is a significant contributing factor.

Looking ahead, transportation researchers and planners aim to provide context-sensitive streets that meet the needs of all road users, bring pedestrian and bicycle-friendly roads back into urban areas, and enhance freeways to make them safer and optimize capacity.

[1] https://www.vox.com/2015/3/19/8253035/roads-cyclists-cars-history

SPOTLIGHT ON LTAP:

The Arkansas Local Technical Assistance Program

BY DR. STACY WILLIAMS AND LAURA D. CARTER

Laura Carter presenting at the AAC meeting.

The Arkansas Local Technical Assistance Program (AR-LTAP) hosted a "Low-Cost Maintenance to Save Bridges" webinar for local agencies on February 8, 2022. Participants received knowledge in understanding the importance of bridge preservation and how to identify structures that warrant maintenance. They also received cost guidelines that relate to the appropriate bridge maintenance, for example, the cost difference of properly maintaining a structure when it is in fair to good condition versus when it is in poor condition. Sessions included deck sealing, joint maintenance, concrete deck patching, spot painting, and bridge washing. The AASHTO Bridge Preservation committee sponsored this free webinar, and the instructor was Travis Kinney, PE.

AR-LTAP participated in the Annual Association of Arkansas Counties' Safety Meeting on May 18, 2022, in Little Rock, Arkansas. Approximately 100 county personnel were in attendance, including county judges, safety coordinators, administrative personnel, and members of the sheriff's departments. Laura D. Carter gave a training presentation on safe work zone practices that was based on the Manual on Uniform Traffic Control Devices (MUTCD). This presentation included guidelines for setting up a work zone, the five parts in a work zone area, flagger's responsibilities, and drivers' responsibilities near and in a work zone. Road foremen had an opportunity to share various day-to-day experiences and practices with the audience at the end of the session.

Information regarding upcoming training is available at www.cttp.org/arltap.

PROJECT UPDATES

TRC2301 - Smart Work Zone (SWZ) System Design, Specifications, Estimates, and Implementation Guidelines

BY KIM ROMANO, P.E.

The ability to manage traffic through highway work zones is rapidly improving. Portable Intelligent Transportation System (ITS) devices can detect slowing traffic and push alerts to the contractor, Resident Engineer, Transportation Management Center, and drivers' smartphone apps such as Waze or Google Maps. Smart arrow boards can inform stakeholders of lane closures in real time. Dynamic speed limits based on work zone conditions are being used successfully in many states. Third-party data providers that push data to consumers via smartphone apps can also detect and impute traffic conditions near work zones. This research will inform the development of an SWZ special provision that will replace the automated work zone information system (AWIS) special provision for highway contracts. Specific objectives intend to provide a process that will assist in identifying the need for an SWZ earlier in the project development process, consider when to use specific new technologies, and better design & estimate SWZ costs.

TRC2302 - Development of Pedestrian and Bicyclist Flow Volumes and Risk Factors

BY BETHANY STOVALL

Pedestrian and Bicyclist safety is a growing concern and priority for the U.S. Department of Transportation. Fatalities for non-motorists have increased nationwide since 2009, and this increase has also been observed in Arkansas. The first objective of this project will be to collect data on non-motorized transportation users across the state using count stations and crowdsourced data. Traffic volume data will be overlaid with historical crash data to determine crash risks. Recommended countermeasures will be determined to address high-risk areas and provide resources for future project planning to make Arkansas roads safer for all users.

TRC2303 – Evaluation of Impacts Due to a Bridge Closure: A Case Study of the Mississippi River Bridges in Arkansas

BY SANGHYUN CHUN, PH.D., P.E.

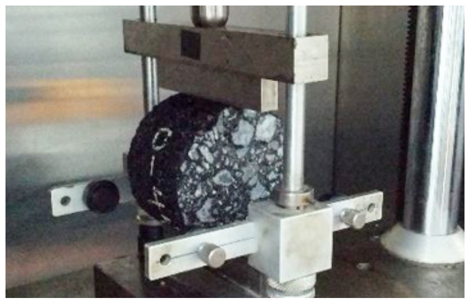
The objective of the proposed research is to quantify the multi-modal impacts due to a Mississippi River bridge closure. This study will consider different scenarios/combinations of bridge closures (i.e., full and partial bridge closures that take into account one/both directions, single/multiple lanes, and day/night closures), including all the Mississippi River bridges in Arkansas (i.e., I-40, I-55, Hwy 49, and Hwy 82 bridges). A comprehensive multi-modal analysis will be performed that considers the number of vehicles, trucks, and marine vessels/barges disrupted due to the bridge closure (with all potential scenarios/combinations) and applies detailed cost conversions to monetize direct (delays) and indirect (safety, infrastructure, operations) impacts. Also, this study will develop an Excel-based tool to conduct "what-if" analyses for decision-making purposes, whether for construction, maintenance, or planning activities.

Indirect Tensile Asphalt Cracking Test (IDEAL-CT): A New Test to Assess Cracking Resistance for Performance-Based Asphalt Mixture Design (PBD)

BY SANGHYUN CHUN, PH.D., P.E.

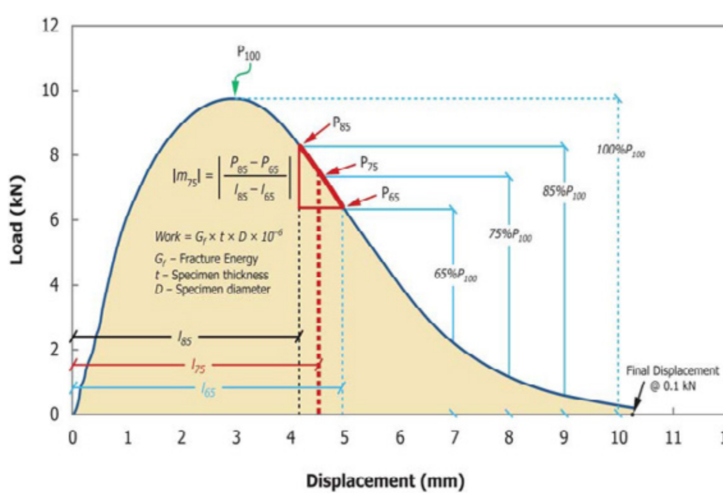
The Performance-Based Asphalt Mixture Design (PBD) procedure includes performance tests to evaluate rutting and cracking potentials during the asphalt mixture design phase. Arkansas's initial implementation plan of the PBD requires a volumetric design with performance verification to produce the mixtures that effectively achieve the anticipated performance. In this system, it is necessary for agencies to check the performance-related properties or index of the final mixture for acceptance. TRC1802 recommended that the Indirect Tensile Asphalt Cracking Test at Intermediate Temperature (IDEAL-CT) and the Cracking Tolerance Index (CTindex) be used to assess the cracking resistance of asphalt mixtures during the mix design phase.

The IDEAL-CT is similar to the traditional indirect tensile strength test. However, there are various advantages that include: (1) the ability to discriminate between asphalt mixtures exhibiting a variation in performance; (2) the relative ease of specimen preparation and testing as compared to other cracking-related tests; and (3) it does not require specialized testing equipment, outside of an appropriate data collection system. The test is conducted at room temperature using cylindrical specimens at a loading rate of 50 mm/min in terms of cross-head displacement. The result of the IDEAL-CT is the CTindex, a performance-related cracking parameter that can be determined from the measured load vs. displacement curve. The primary recommendations from TRC1802 include test specimen preparation protocols, laboratory testing protocols, and initial mixture acceptance criteria based on laboratory testing as follows:



TEST SPECIMEN PREPARATION

- Cracking test specimens should be compacted in the Superpave Gyratory Compactor (SGC).
- The final height of the test specimen should be 62±1 mm.
- The air void content of the test specimen should be 7±0.5 %.
- Laboratory test specimens shall be aged in loose condition at 135 °C for 4 hours. The mix should be stirred every 60 minutes during that period. The thickness of the loose mixture layer should be between 25 and 50 mm. This protocol is in general accordance with the loose mix pre-conditioning procedure in AASHTO R30, long-term aging for mechanical testing. After the 4-hour aging procedure, the mix should be brought to the specified compaction temperature prior to compaction.



LABORATORY TESTING PROTOCOLS

- The laboratory test to assess cracking resistance is the IDEAL-CT. The IDEAL-CT test method is detailed in ASTM D8225-19.
- Compacted test specimens should be pre-conditioned in a temperature chamber or water bath at a temperature of 25±1 °C for a period of 2 hr±10 min.
- The loading rate for the test should be 50±2 mm/min.
- The data sampling rate (applied load and load-line displacement) should be 40 data points per second (minimum).
- The test should be performed until the load drops below 100 N after reaching a peak load.

MIXTURE ACCEPTANCE CRITERIA

- The result of the IDEAL-CT is the CTindex, and ASTM D8225-19 describes the calculation of CTindex.
- The value of CTindex for mixture acceptance is CTindex ≥ 50.
- The recommended acceptance value should represent the average of 3 physical tests (replicates).

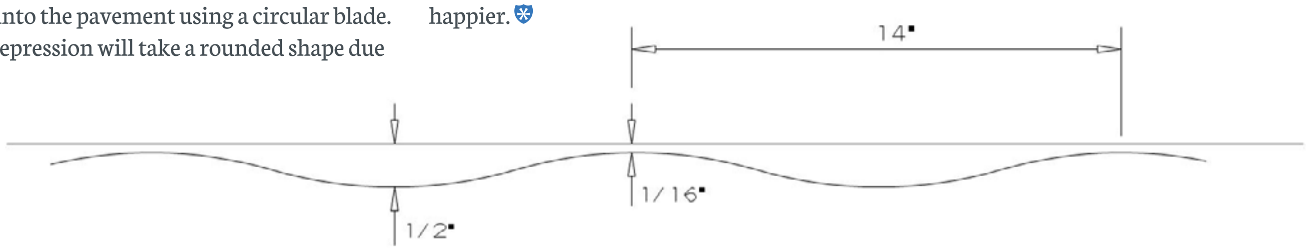
Mumble Strip - A New Type of Rumble Strip

BY MARK SIMECEK, P.E.

Most of us know what a rumble strip is - that area on the side or center of the road that has been ground into the pavement that makes a noise and vibration loud enough to wake you up from a nap or alert you that you have wandered from your lane for whatever reason. Residents along our roadways are not always pleased with the presence of rumble strips because they increase the ambient noise from traffic. This led to the development of a new type of rumble strip called a mumble strip. That sounds very similar to a rumble strip for a reason; it is a modified rumble strip designed to be quieter.

The main differences between the types of rumbles strips are the width, depth, and whether gaps are included to allow bicycles to navigate across the strip. To create a traditional rumble strip, a contractor grinds a divot into the pavement using a circular blade. This depression will take a rounded shape due to the circular blade. The depth of the divot is relatively shallow compared to the size of the blade. Usually, the divot will be approximately three-eighths inch to a half inch deep for a rumble strip. Between each divot, there will be a flat area that is undisturbed, followed by another divot. This pattern repeats to form the rumble strip.

The mumble strip differs from the rumble strip in a side profile view, taking on the shape of the sinusoidal wave. This sinusoidal wave (shown in the graphic) is a continuous wave shape with no flat undisturbed areas between divots. The depth of the mumble strip is seven-sixteenths of an inch from the top of the sinusoidal wave. The continuous wave reduces the exterior noise produced while allowing enough internal noise and vibration to remain effective. The result? The neighbors will be happier.



2022 Transportation Conference & Equipment Expo

BY GLORIA HAGINS

Research has done it again! The 2022 Transportation Conference & Equipment Expo, live and in-person, was a huge success, with approximately 320 attendees and 37 vendors. The conference was held in Hot Springs, Arkansas, on May 24-26, 2022, at the Hot Springs Convention Center. The conference not only provided a variety of workshops and sessions with knowledgeable presenters with engaging content but also provided great networking opportunities.

Sessions included Pavement Innovations, Construction, Bridge, Geotechnical + Construction, Complete Streets, Current Research, and ARDOT Employees 101. The General Session provided a variety of informative content. ARDOT Director Lorie Tudor kicked off the conference with a State of the Department address. There was also an update from FHWA on the new Infrastructure Investment and Jobs Act (IIJA or BIL), a look into how the Public Information Office works to keep the public informed while building and maintaining a loyal and trusting relationship with them, an overview of the Department's Sign Inventory Project, a glimpse into the newest version of the MMHIS application that has since been released for installation, and Alternative Project Delivery Methods being utilized at ARDOT.

If you missed a presentation that interests you, you can view all available presentations on the Research Section's website: https://www.ardot.gov/divisions/system-information-research/research/trc-conference/2022-trc-conference-presentations/.

With the close of each Transportation Conference & Equipment Expo, preparation for the next year's event begins. We look forward to improving the annual Transportation Conference & Equipment Expo and being able to provide intriguing content each year. If you attended this year, we would love to receive your feedback so we can improve next year.

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