ARDOT
WINTER 2021

RESEARCH INFORMER

A Newsletter by the Arkansas Department of Transportation Research Section

Photo by Russell Hubbard

INSIDE THIS ISSUE

Thin Asphalt Layers, Explained

BY JD BORGESON, P.E.

Pavement preservation has become a hot topic, with an increasing number of studies that prove its cost-effectiveness and efficiency. The idea is to use preservation techniques on a pavement before the pavement condition becomes poor in order to maintain a consistently good condition. It has been shown that multiple pavement preservation treatments to a single roadway can still be cheaper in the long run than full rehabilitation when there is not any structural deficiency. Thus, it is key to view pavement preservation as a long-term strategy and not just a 'fix.'

Still, there are several techniques out there that require some disambiguation. This article will discuss thin asphalt treatments, such as thinlays, stone matrix asphalt, open-graded friction courses, and ultra-thin bonded wearing courses. All of these techniques revolve around placing a type of asphalt layer less than 1.5" on a pavement in fair to good condition. While these can restore the pavement to a good surface condition, they do not add structural capacity to the pavement. For example, a thinlay will restore smoothness to a pavement with some minor rutting issues. If the rutting was caused by improper subgrade compaction when the roadway was constructed, the rutting issue will likely reappear. The success of these treatments varies depending on the condition of the pavement to be treated, level of traffic, climate conditions, quality of material, and construction procedure. There are a lot of considerations that go into selecting the appropriate pavement preservation treatment.

Let's start with 'thinlays,' which is short for thin overlay. This asphalt layer is laid via standard paving equipment where the thickness is usually between 0.5" and 1.5". The typical nominal maximum aggregate size (NMAS) for these mixes is 3/8" (9.5mm). However, an NMAS of #4 has been used with success for applications on the thinner side of the spectrum. This thin asphalt layer corrects minor surface

Continued from page 1...

Photo by Russell Hubbard

deficiencies like minor rutting or cracking. It essentially acts to restore the surface qualities of the pavement to like-new condition but does not add any structural capacity.

Next, stone matrix asphalt (SMA) is a tough, gap-graded asphalt mixture that relies on a stable stone-on-stone skeleton offering strength and a rich mixture of asphalt binder. In the gap-graded mix for SMA, most aggregate is near the maximum and minimum sizes. Because this mix relies on the aggregate locking together, it has been shown to be more rut-resistant and durable. This mix design tends to be more expensive, ranging between $6 to $31 more per ton than polymer-modified, dense-graded mixtures. Though this mix is typically thought of as a surface course, studies have shown this mix to be placeable in lifts as small as 1.25" when the NMAS is decreased to 3/8" (9.5mm). This fine SMA has been shown to be a durable pavement preservation method where rutting is an issue.

Open-graded friction courses (OGFC) are similar to SMA mixes. They are gap-graded mixes with high asphalt content and typically laid around 1" thick. The main difference is that OGFC mixes have little to no fines, meaning the aggregate used is typically uniform in size. This creates more air-voids and a popcorn-like texture which results in excellent permeability and high skid resistance. Because of the permeability, this pavement also eliminates tire spray and hydroplaning while increasing surface reflectivity when wet. There is a price disadvantage, though, as OGFC costs 30%-40% more than conventional mixes. The air voids also tend to clog with sand or salt when treated for snow and ice.

To understand our last treatment type, we must step outside the box of conventional asphalt for a moment. Asphalt emulsion is essentially asphalt particles suspended in water with an emulsifying agent that prevents the two liquids from mixing. Asphalt emulsion is sprayed onto the surface of a roadway. Once the water evaporates, all that is left is a layer of asphalt binder, creating a kind of seal. An ultra-thin bonded wearing course (UTBWC) combines some of the concepts discussed earlier with this asphalt emulsion layer. Originally called NovaChip, this technique was a proprietary procedure until the patent ran out in the 2000s. It is now being utilized by many DOTs around the nation, including ARDOT. With UTBWC, you begin with spraying a polymer-modified asphalt emulsion layer followed by an ultra-thin, gap-graded (NMAS of #4 - 1/2") hot mix layer. The total thickness of the UTBWC is typically 1/2"-3/4". This procedure combines the crack sealing benefits of the seal treatments with the durability and hydroplaning resistance of the gap-graded thinlay. The gap-graded nature of the hot mix layer also reduces tire spray and noise. The application is somewhat quick due to the ability to use one machine that sprays the emulsion immediately before the hot mix. This prevents truck tires from tracking through the asphalt emulation. The emulation then wicks up into the asphalt layer creating a membrane sealing the underlying cracks.

This list is not meant to be exhaustive when it comes to pavement preservation techniques but is meant to clear up some of the differences among the thin asphalt treatments being used. It is important to understand that when used as a long-term strategy, all pavement preservation techniques help maintain the condition of pavements and provide excellent cost savings.

SPOTLIGHT ON LTAP:

The Arkansas Local Technical Assistance Program

BY LAURA D. CARTER

Stacy Williams, Scott Kirby, DeWayne Smith, Joe Walker, Laura D. Carter

The Arkansas Local Technical Assistance Program (AR LTAP) partnered with the Association of Arkansas County Judges to host their biennial Road Maintenance Training Meeting at the DeGray Lake Park Resort, October 5-7, 2021. Dr. Stacy Williams led the training on Design, Plans, Typicals, Specifications for County Roads, and Gravel Road Maintenance. Panelists during these sessions shared day-to-day experiences and practices with the audience. Chris Dailey, Arkansas Department of Transportation's Staff Research Engineer, provided engineering techniques and training on sizing and installing culverts on paved and unpaved roads. Danny Moore, a certified ATSSA and an AR LTAP instructor, led a training session on Temporary Traffic Control and Work Zone Safety based on the Manual on Uniform Traffic Control Devices (MUTCD). This meeting included an opening ceremony dinner that honored the 2021 Road Scholar Graduates: Scott Kirby of Faulkner County, Jason Skelton of Washington County (not in picture), and DeWayne Smith and Joe Walker of Greene County. Information regarding the requirements to become a Road Scholar Graduate is available at www.cttp.org/ardot/t2.

PROJECT UPDATES

TRC1903 - Investigating Concrete Deck Cracking in Continuous Steel Bridges

BY ANAZARIA ORTEGA

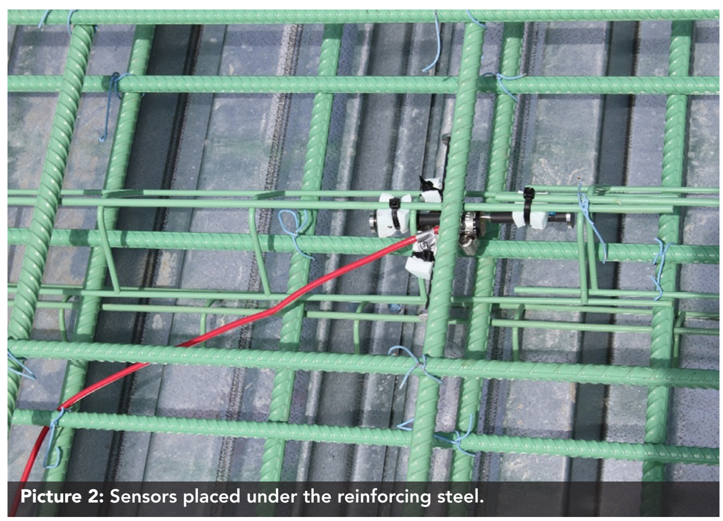
On August 17, Elizabeth Poblete, Behzad Farivar, graduate students from the University of Arkansas, and Dr. Cameron Murray instrumented a bridge using vibrating wire strain gauges (VWSGs) to measure the curing strain and temperature of a concrete deck. Thirty-two (32) strain sensors were placed where cracking was more likely to occur in the concrete deck. These strain sensors were grouped into two stations. Each station consisted of 16 sensors connected to a Geokon data acquisition box (Picture 1). The sensors were placed under the reinforcing steel to reduce the risk of unintentional damage during construction (Picture 2).

On August 27, the day before the concrete pour, Dr. Ernie Heymsfield from the University of Arkansas checked that the sensors had not been moved and that data acquisition boxes were working properly. Because these sensors were going to be embedded in concrete, any readjustment to the system needed to be done before the concrete pour.

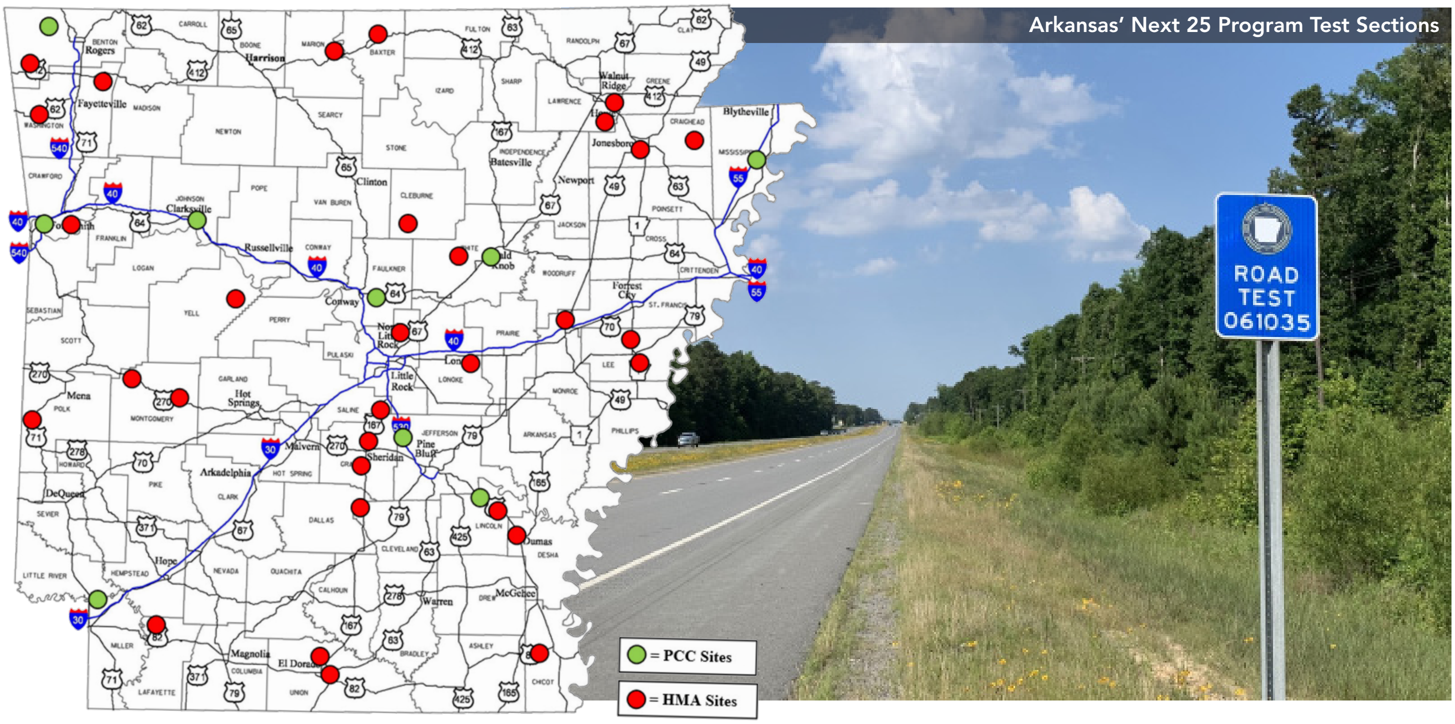
This bridge instrumentation is part of the ongoing research project *TRC1903 -Investigating Concrete Deck Cracking in Continuous Steel Bridges*. This project aims to reduce continuous steel bridge cracking by providing recommendations regarding bridge design and construction methods. As part of this project, a numerical model will be developed to predict the concrete deck behavior during pouring and the initial hardening stage of concrete. The information gathered from the sensors will be used to calibrate this numerical model.

Dr. Heymsfield carefully observed the construction process to analyze the means and methods used during this deck pour. Construction intervals, pour lengths, and sustained construction loads are examples of factors that could contribute to cracking in continuous deck pour. The information gathered from field observation, in addition to the strain and temperature data, will allow a broader understanding of continuous deck pours.

Picture 1: Vibrating Wire Strain Gauges (VWSGs) connected to the Geokon Data Acquisition Box.



Picture 2: Sensors placed under the reinforcing steel.



Next 25: Long-Term Pavement Performance Evaluation Program in Arkansas

BY DAVIN WEBB AND SANGHYUN CHUN

Next 25 refers to a long-term pavement performance evaluation program developed in Arkansas. Under this program, 40 test sections (30 asphalt concrete hot-mix (ACHM) sites and 10 jointed plain concrete pavement (JPCP sites) were set up around the state that represent materials used in all 10 Districts. The primary objectives of this program are as follows: **1.** To develop and maintain the comprehensive database that will provide information for future calibrations and further enhancement of performance prediction models included in the AASHTOWare Pavement ME Design Guide. **2.** Continue to update the database for use in evaluating the long-term pavement performance in the state of Arkansas that will support the Department's Pavement Management System (PMS). In particular, the ability to identify the performance characteristics of pavements (timeline, type of distresses, etc.) will provide the information to apply proper pavement preservation, maintenance, or rehabilitation strategies that will lower the cost of maintaining our pavement system across the state.

The ACHM sites consist of 500-foot long test sections, and the data collected includes a manual distress survey (distress mapping and rut measurements) and permeability. The materials tests include binder content, gradation, volumetric properties, mechanical properties, and performance-related properties using field cores obtained from test sections at the early period of service life. In addition, the Asset Management Section collects the falling weight deflectometer (FWD) data for each site every year. The JPCP sites contain 1000-foot long test sections, and the data collected includes a manual distress survey (distress mapping and fault measurements). The majority of the test sections have comprehensive design, production, and construction data and have been closely tracked for their long-term pavement performance through distress surveys and changes in structural integrity since construction. The data collection efforts will continue in order to carefully monitor the project sections. The Next 25 program will provide ArDOT with the information that will allow it to effectively maintain and reduce long-term costs for the pavement network in Arkansas.

The Transportation Pooled Fund Program: Collaboration That Works

BY BETHANY STOVALL

The Transportation Pooled Fund (TPF) Program is a popular way for State DOTs and the Federal Highway Administration (FHWA) to combine resources and achieve common research goals. This program has existed for over 30 years in some capacity, with the program in its current form being developed in 1999 by FHWA. A TPF study should advance a particular topic or address a new subject related to research, planning, or technology transfer. They will not exceed five years and must be sponsored by either a State DOT or FHWA. These studies are typically funded using State Planning and Research (SPR) Part B Research, Development, and Technology (RD&T) funds, although some of the studies utilize Part A Planning funds instead, depending on the subject of the project. TPF studies are also unique because they can qualify for a funding match waiver. For projects that apply and are approved for this waiver, the typical match requirement for SPR funds (20% match of State funds to the 80% Federal funding) is waived, allowing states to use 100% Federal SPR funds to participate in the project.

ArDOT is the Lead Agency for a Planning TPF study titled *EconWorks – Improved Economic Insight*. There are currently 18 partner states for this project. This five-year study seeks to provide transportation planners with a better understanding of the economic impact of transportation projects by continuing the delivery and improvement to the SHRP2 *EconWorks* product and adding additional case studies to provide a more robust economic analysis.

The TPF program has a track record of being an excellent way to leverage funds. Pooling resources reduces marginal costs and provides efficient use of taxpayer dollars. The ArDOT Research Section is committed to four studies this fiscal year and has participated in numerous projects over the years. Recent studies we have participated in are Performance Engineered Concrete Paving Mixtures, led by Iowa DOT, and a joint study between Minnesota DOT Road Research Project (MnROAD) and the National Center for Asphalt Technology (NCAT) titled National Partnership to Determine the Life Extending Benefit Curves of Pavement Preservation Techniques. We look forward to the opportunities the TPF program will continue to provide for our state in the future.

TPF TRANSPORTATION POOLED FUND

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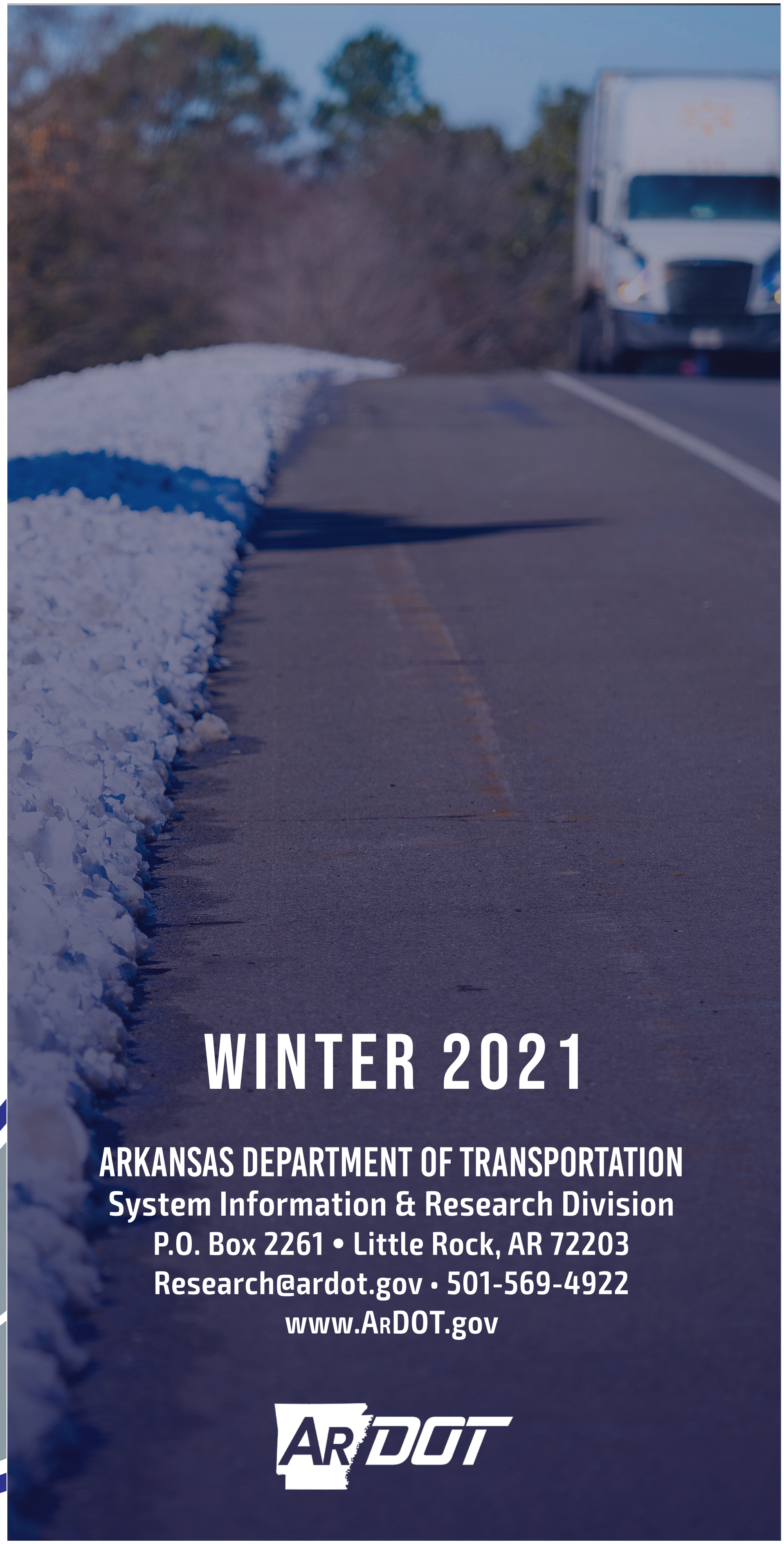

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