ARDOT TRC TRANSPORTATION RESEARCH COMMITTEE

RESEARCH INFORMER

— FALL 2019 —

A Newsletter by the Arkansas Department of Transportation

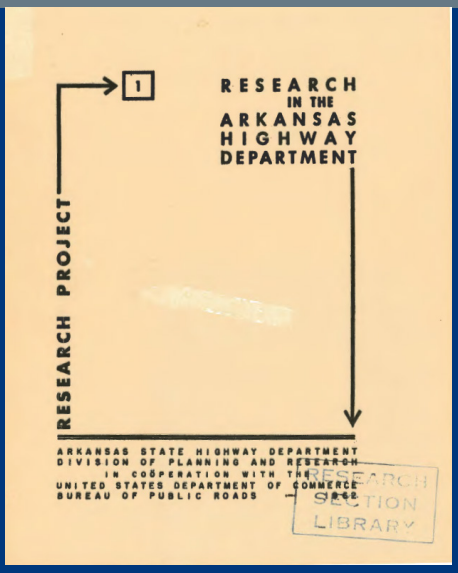
The Research Section through the Years

BY ROBIN RUSSELL & KAREN MCDANIELS

Many changes have taken place throughout the Arkansas Department of Transportation (ARDOT) over the years. Recent changes include renaming the Department, refining job classifications, and implementing a performance management system. One goal of the Research Section is to implement newly developed equipment and technologies that continually creates change. While the Research Section is responsible for many of the changes around the Department, the Section itself has also been through multiple changes over the years.

As early as 1953, documents show that research was conducted by the Joint Highway Research Program (a cooperative project between the State Highway Department and the Engineering Experiment Section of the University of Arkansas) under a basic joint agreement.

In December 1961, the Highway Commission authorized the Director to enter into an agreement on behalf of the



Department to participate in the cost of a proposed Long-Range Cooperative Highway Research Program with the member states of the American Association of State Highway Officials (AASHO).

In March 1962, the critical need for a comprehensive research program in the Department was recognized, and this resulted in Administrative Order 62-5. With the order, a Departmental Research Program and Highway Research Committee (HRC) was authorized and established. The HRC was composed of three types of members: full members (seven to twelve), ex-officio members (not more than six), and administrative members that included

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Spotlight On T²

NEW T² CLASS!

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

The Technology Transfer (T²) program has a new course available – Hot Mix Asphalt Paving Basics. This class reviews best practices for asphalt paving and how those best practices can affect the long-term performance of the pavement. Specific topics covered in this course include materials and mixes, production, preparation and delivery, the paver, compaction and longitudinal joints, calculation of quantities and rates, inspection and quality control, warm mix asphalt, and recycled materials.

Perhaps the most important message in the class is the concept of consistency. Because all of the steps in designing a pavement include a component of variability, one of the most

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ARDOT Research Project Receives Award

BY CHRIS DAILEY, P.E.

Each year, in its effort to demonstrate the value of research conducted by state DOTs the American Association of State Highway Transportation Officials' (AASHTO) Research Advisory Committee (RAC) compiles a document titled "Research Impacts: Better – Faster – Cheaper." The Value of Research Task Force of RAC selects 16 "high-value" research projects to receive the Sweet Sixteen award. Four projects are chosen from each of the four RAC regions.

This year, ARDOT's project TRC1803 – Mapping Subsurface Conditions for Transportation Applications was selected for a Sweet Sixteen award. Understanding subsurface conditions—and whether any hazardous slope or bedrock issues exist—leads to safer roads and helps state DOTs avoid unexpected expenses related to slope remediation and bedrock removal. As part of TRC1803, ARDOT is exploring geophysical methods, which create two- and three-dimensional subsurface maps, as a way to locate such hazards along its highways. Researchers field-tested these methods at four sites that have shallow bedrock and weak slope stability, analyzing the advantages, benefits, costs, limitations, and accuracy of each.

The project has provided ARDOT with best practices, equipment recommendations, and training materials for select geophysical methods, as well as slope stability data sets and analyses. Geophysical methods have already proven to be cost-effective, saving ARDOT $750,000 on three construction projects. Once fully implemented, the project could save ARDOT millions of dollars in its first year.

SPOTLIGHT ON T²

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important things we can do during the construction process is to limit that variability. By purposely balancing the paver speed, plant production rate, number of delivery trucks, and rolling patterns, a more consistent paving event, and better product can be achieved. Another key factor is to never stop the paver. Each time the paver stops, the screed must rise over the uncompacted asphalt mixture, resulting in a bump in the road. While it is unlikely that all paver stops can be avoided, careful planning can reduce these issues, leading to a smoother pavement. A smoother pavement provides more evenly distributed support to heavy traffic loads and avoids concentrated stress points that are more susceptible to cracking. This means that the pavement will have a longer service life, and allows for a more efficient use of tax dollars.

The pilot offering of this class was held in December 2018, and subsequent classes have been offered in northwest and northeast Arkansas. Although the class is aimed at crew leaders and crew members who perform in-house paving projects, it also provides valuable information for decision-makers, consultants, and those inspecting paving work done on a separate contract. It is appropriate for new employees who need a "crash course" in paving, while also beneficial for experienced employees reviewing best practices. Each participant receives a course workbook, which includes the classroom presentation and calculation worksheets. This half-day class provides 4 hours of ROADS Scholar credit in the infrastructure and maintenance category and can be requested by any local agency. This course is typically delivered in a "live" classroom setting but is also available in webinar format. To find out more, or to request this class for your agency, visit www.cttp.org/ardot/t2.

THE RESEARCH SECTION THROUGH THE YEARS

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a secretary and other necessary administrative personnel.

In April 1962, Arkansas Highways Magazine wrote, "The Research Section is now a reality. It was authorized over a year ago and is now an operating unit under the directions of Robbie Parker. Space for the office was obtained when the Traffic Services office moved to a building on West Capitol." The space was on the third floor of the Game and Fish Commission Building.

Later in 1962, the first report was issued under the newly formed Highway Research Committee. The stated purpose of HRC1 – Research in the Arkansas Highway Department was to "enable the Highway Department to have a clearer understanding of the nature and methods of highway research and especially to develop a definition of highway research that would apply specifically to the Arkansas State Highway Department."

In December 1964, the first version of the Procedural Manual for Highway Research Projects was compiled from instructions previously sent out over a period of several years.

In June 1977, the Highway Research Committee was reorganized. Research projects to be considered for funding are to this day selected by the Transportation Research Committee (TRC). The TRC was composed of Division Heads, District Engineers, and other Department personnel. The committee received information and advice from the Advisory Council for Transportation Research, now just called the Advisory Council, which was composed of representatives from academic institutions, industry, contractors, transportation organizations, and AHTD coordinators. The Council members were also asked to serve on project subcommittees and provide technical assisstance to the TRC during the project selection process.

Two years later, TRC57 Effects of Interstate 630 and East Belt Freeway Right-of-Way Acquisitions on Pulaski County, Arkansas Relocatees was completed. This was the first project completed under the new committee.

In March 1981, The Research Section of the Planning and Research Division was combined with the Materials Divisions to form the Division of Materials and Research. Earl Kirkpatrick assumed responsibilities of Research Engineer.

In June 1992, the Research Section was transferred back to the Planning Division forming a new Planning and Research Division. Meadors was the Staff Research Engineer.

In October 2013, the Planning & Research Division was divided into two new divisions: Transportation Planning & Policy (TP&P) and System Information & Research (SIR). Elisha Wright-Kehner was the Staff Research Engineer.

To date, 209 projects have been completed. The research procedure manual has been updated 10 times since the first version of the Procedural Manual for Highway Research Projects, with the latest version approved at the beginning of 2019. The TRC members are: the Deputy Director; the Chief Engineer; the Assistant Chief Engineers for Planning, Design, and Operations; the State Maintenance Engineer; the State Construction Engineer; Engineers from Bridge, Materials, Roadway Design, SIR, and TP&P; the Division Heads from Information Technology, Environmental, and Surveys; and two District Engineers. The Staff Research Engineer serves as secretary and is a non-voting member along with the Advisory Council Chairperson and an FHWA Representative.

Membership on the Advisory Council is by invitation of the Director and consists of representatives from educational institutions, private industry, and other transportation-related agencies and associations. Seven standing subcommittees that specialize in specific areas conduct the initial review and ranking of Problem Statements within their area of expertise.

With so many changes to highway and transportation over the years, the Department strives to preserve and improve Arkansas's transportation system. The Research Section works to provide the Department with current information concerning the use and availability of newly developed equipment, modern upgrades to current equipment, and innovative materials, techniques, and practices. The Research Section works to implement these changes to support ARDOT's Mission Statement: "Continue to provide safe and efficient transportation solutions to support Arkansas' economy and enhance the quality of life for generations to come."

How Rice Hull Ash Could Modernize Roman Concrete for the 21st Century

BY CHRISTOPHER MCKENNEY

Arkansas may be known for some of its unique features, and when it comes to rice production, Arkansas is the US's largest producer of rice. According to the University of Arkansas, Division of Agriculture, Research and Extension offices, approximately 1.1 million acres were harvested. This equates to approximately 4.04 million tons of rice. A part of the rice plant is the rice hull, which has many uses such as fertilizer, insulation material, or fuel. Another potential use is in building materials, as a natural pozzolan, meeting ASTM C 618 Class N requirements. An added benefit is that it is readily available in Arkansas. Although a portion of rice hull has found uses, a great deal more finds its way into landfills every day as Rice Hull Ash (RHA).

RHA is a highly reactive pozzolanic material, produced by burning rice hull, that could provide improved concrete strength and durability properties compared with Class C and Class F fly ash, reduce materials cost due to cement utilization, and environmental benefits by keeping RHA out of landfills. Reactivity of RHA is attributed to its high content of non-crystalline silica, and its very large surface area governed by the cellular structure of the particles. It has shown preliminary positive results as a supplementary cementitious material that could be incorporated into minor concrete construction projects, such as sidewalks, easements, and curb and gutter.

So how does someone start an investigation into RHA? It was through another research opportunity to examine how to modernize Roman concrete. Through archaeological investigations, it was discovered that pozzolans were incorporated in Roman concrete construction. This discovery revealed Romans used volcanic ash as a binder by mixing it with hydrated lime. Research has discovered RHA as a potential source of amorphous reactive silica when rice hulls are incinerated.

Implementing verified RHA percentages could furnish sustainable material suitable for all types

of construction, including transportation. The U.S. Green Building Council (USGBC) through Leadership in Energy and Environmental Design (LEED) currently awards Innovation in Design credit for recycled mineral admixtures utilized for roadways, sidewalks, and curbs. The echoing conclusion is RHA could be a suitable natural pozzolan for concrete production; a transformation which could provide a cost-benefit for concrete construction without sacrificing structural integrity.

Through this special research opportunity project, one of ArDOT's Research Study Analysts, Christopher McKenney, initiated a work plan to test RHA in minor concrete mix designs where the required PSI is less than other ArDOT classes of concrete. The research studied the effects of substituting current fly ash with prescribed RHA percentages in concrete mixture designs for Class A and Class M mix designs in accordance with ArDOT specifications. Variable tests included RHA effectiveness by utilizing material passing #80 sieve (180 microns), as well as 100% unprocessed RHA (URHA).

Christopher's research paper submission, "Integrating Rice Hull Ash in Minor Concrete Construction," was reviewed by the Concrete Materials and Placement Techniques Committee and accepted for presentation during the Advances in Science and Engineering of Concrete in Transportation session at the 2018 Transportation Research Board's Annual Meeting in Washington, D.C.

Comparing Testing Results between Control Groups and Classes A and M

Mix Design Comparisons							
Test	Class	15% Class C Fly Ash* (WR Amount)	15% RHA (No Ad.)	15% RHA (7 oz.)	15% RHA (8 oz.)	15% RHA (10 oz.)	15% URHA (10 oz.)
Unit Weight	A	149.36	142.86	148.86	147.26	NT	145.5
	M	149.36	142.26	NT	148.06	149.26	146.3
% Air	A	1.30%	5.00%	1.60%	0.70%	NT	2.70%
	M	1.20%	5.60%	NT	2.70%	1.50%	3.80%
7 Day psi	A	4215	2299	2559	2526	NT	2861
	M	3965	2321	NT	2469	2979	3117
28 Day psi	A	NR	3268	3805	3632	NT	3743
	M	5385	3130	NT	3600	4026	3879
Slump	A	4″	2″	3″	2″	NT	1″
	M	3.5″	1″	NT	2″	5″	1″

WR – Water Retardant; NR – Not Reported; NT – Not Tested; * - Control Group; Unprocessed RHA (URHA)

NEW RESEARCH HIGHLIGHTS

TRC2001

Many vehicles with overloaded axles do not exceed the legal gross weight limit but are over the axle or axle group weight limits. Preliminary studies show a tandem axle group with one axle weighing 4 tons over the weight limit has a 31% higher relative damage factor than a tandem axle group with legal axle weights. TRC2001 will focus on these types of overloaded axles and axle groups and the damage they cause to Arkansas roadways.

TRC2002

Calcium Sulfoaluminate (CSA) Cement is a rapid setting hydraulic cement similar to Portland cement with a very fast strength gain. If a typical Portland cement concrete mixture can reach 4,500 psi in 28 days, the complementary CSA cement mixture would reach 4,500 psi in 4 hours. Because of this extremely fast strength gain, CSA cement is an ideal material for repairs. ArDOT currently utilizes CSA cement for bridge deck repair, but corrosion issues tend to arise in the patched area due to several factors. This project will evaluate the effectiveness of using CSA for full-depth repairs on roadways as well as methods aimed at increasing the life of CSA repairs on bridge decks.

TRC2003

The highway network faces risks from natural and human-made disasters and events that can leave it vulnerable. It is imperative to plan and prepare so that our transportation system can recover and adapt when these situations arise. TRC2003 seeks to develop and implement a framework to measure the resilience of Arkansas' state highway system. The study will define resiliency assessment methods and indices, as well as evaluate current state of practice within ArDOT. The most relevant methodology will then be applied to perform a resiliency assessment of the Arkansas state highway network. Finally, recommendations for improving system resiliency will be implemented.

TRC1804 – Annual Average Daily Traffic Estimation for Local Roads

BY KIM ROMANO, P.E.

Annual Average Daily Traffic (AADT) is the total volume of vehicle traffic on a highway or road for a year divided by 365 days. AADT is a measure primarily used by transportation planners and safety engineers, providing critical roadway information to estimate performance. It is an important metric for highway planning and funding decisions.

Although reporting AADT records is standard for major roads, they have not been routinely reported or updated for local roads. Traffic counts are expensive, and a new FHWA requirement to report every paved roadway across the state is a monumental task, both logistically and financially.

TRC1804 developed a low-cost methodology for estimating traffic on local roadways. It is similar to a previously developed method as it utilizes known features along routes to estimate traffic. However, the new process incorporates new data sources, specifically, spatially enhanced datasets such as 911 address locations, county assessor parcel information, and census demographic data. It also utilizes trip generation estimates based on land use type from the Institute of Transportation Engineers (ITE) and other sources.

The new methodology assigns trip estimates based on ITE guidance for each address point location based on land use type (i.e., residential, commercial, agricultural, etc.) and the property value derived from county assessor parcel data. After estimating trips at each address, the trips are combined for census blocks and factored based on demographic variables, such as citizens of driving age, workforce participation, and vehicle ownership. The final step is to run a spatially automated process that associates each address to a roadway, estimates trip totals that originate on each route and assigns traffic along Arkansas' All Roads Network of Linear Referenced Data (ARNOLD) network. The local road AADT estimates are carried over into the ArDOT Road Inventory Database for roads where counts are not collected. The estimated AADT plays a vital role in the summary report tables that contain daily vehicle miles traveled by various roadway categories.

The next step will be placing traffic counters strategically at selected locations to validate and calibrate AADT estimates. The trip generation and AADT estimate methodology may be adjusted based on the results of the validation efforts. TRC1804 research will conclude in 2020.

Reclaimed Glass Aggregate

BY JD BORGESON, P.E.

Recycling glass, which is an indefinitely recyclable material, has many benefits to the citizens of Arkansas as well as the environment. Unfortunately, due to several factors, it is becoming less feasible for many Arkansas cities and counties to continue to collect it. This has led to some of Arkansas's largest cities (e.g., Little Rock and Ft. Smith) to discontinue glass collection as part of their recycling programs. Forcing citizens and businesses to rely on separate, private entities to collect recycled glass, along with having to pay extraneous fees, will undoubtedly lead to a reduction in glass recycling and an increase of glass in Arkansas landfills (which is known to take millions of years to decompose naturally).

One partial solution to this problem could be allowing reclaimed glass to be used as aggregate in roadway construction. Crushed reclaimed glass has been shown to be incorporable into aggregate mixes at rates of 10%-20% without reductions in quality of the roadway and can be competitive in price compared to conventional aggregates. With Arkansas's natural beauty being, arguably, the main draw of tourism to the state, policies aimed at maintaining this natural beauty are bound to increase, or at least maintain, the current revenue generated from tourism. For these reasons, project RSCH1520 is slated to determine the feasibility of using reclaimed glass in aggregate mixes in Arkansas.

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