RESEARCH PROJECT SUMMARY

February 2016

NAPA
NATIONAL ASPHALT PAVEMENT ASSOCIATION

ASPHALT. AMERICA RIDES ON US.

Why Research?

Dear NAPA Member,

Driving Competitive Advantages: Growth. Productivity. Success., the theme of the NAPA 61st Annual Meeting, reflects the engineering research, legislative efforts, marketing initiatives, and deployment activities undertaken over the past three years on behalf of the asphalt pavement industry. Under the leadership of NAPA members, programs have been conceived, built, and launched to convey asphalt's competitive advantages to our customers and the driving public. We have created credible, compelling programs based in engineering science and research, guided by persuasive market surveys, and channeled into an effective deployment strategy to authoritatively and convincingly sell our product.

The Pavement Economics Committee (PEC), comprised of the Best Quality and Competitiveness, Environmental Sustainability, Legislative, Pavement Design, Pavement Preservation, and Pavement Type Selection task groups, strives to develop science-based research projects that examine, calibrate, and ease implementation of the core needs of road owners and road users. Since its inception in 2013, the industry has approved 23 unique research projects and two legislative programs with a total investment of more than $2 million.

The Go-To-Market Task Group aims to preserve market share through a comprehensive communications and marketing program aimed at influencing the asphalt industry's primary customers: DOT officials, design-build firms, public works agencies, toll authorities, and consulting engineers. The program packages the scientific research conducted through the Pavement Economic Committee in a way that is authentic, persuasive, and dynamic. In addition, the program seeks to engage industry customers and the driving public with an energetic, educational campaign that highlights the positive attributes of asphalt roadways.

Strategic grassroots and grasstops activities help inform our customers, lawmakers, and the driving public about the technical benefits of using asphalt in roadway construction. At the same time, the Deployment Task Group works with the State Asphalt Pavement Associations to sell our product directly to our customers. By connecting with customers at tradeshows, through webinars, and local in-person meetings, we are able to highlight lessons learned, while underscoring the industry's collaborative approach in working with its customers.

All these efforts together — research, marketing, deployment — combine to create a better product for our customers and the driving public. For the public and for the industry, we will continue to lead with integrity, intelligence, and dependability.

John J. Keating
Chairman of the Marketing Council

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The National Center for Asphalt Technology

The asphalt industry's premiere research facility

The National Center for Asphalt Technology (NCAT) is a cooperative venture between NAPA and Auburn University. Founded in 1986, NCAT was created to ensure the asphalt paving industry is able to adapt to the changing needs of America's highway infrastructure. Working with stakeholders from highway agencies and the construction industry, NCAT evaluates new products, design technologies, and construction methods that lead to cost-effective pavement improvements.

NCAT's main 40,000-square-foot facility is designed for complete testing of asphalt binders and mixtures with state-of-the-art equipment. Its training space with hands-on laboratories accommodates classes for up to 40 people. NCAT conducts trainings for more than 800 asphalt technicians each year and reaches thousands more industry professionals through workshops, webinars, and conference presentations.

The NCAT Test Track is located on a 309-acre site where research is conducted on experimental asphalt pavements. This 1.7-mile oval track is comprised of 46 test sections sponsored on three-year cycles. The test track is a unique real-world laboratory allowing for cutting-edge pavement experimentation while avoiding the risk of failure on actual roadways.

The sixth cycle of accelerated performance testing has just begun and features an experiment to validate laboratory top-down cracking tests and determine an appropriate test and criteria that can be implemented as part of mix design and QA testing during project construction. In 2015, NCAT expanded its work on assessing the benefits of pavement preservation treatments by adding an experiment with 40 test sections to a nearby U.S. highway, complimenting previously built treatment sections on the track and a local county road. NCAT is partnering with the Minnesota DOT to conduct full-scale pavement testing at its MnROAD facility near Albertville, Minn., to meet national pavement research needs in hot and cold climates.

NCAT's focus is on practical research and the application of findings that lead to specification improvements that agencies can put into contracts. Its research center and test track make it one of the world's leading institutions for asphalt pavement research and an important source of information for those tasked with maintaining our nation's infrastructure.

Over the past 25 years, NCAT researchers have:

- advanced aggregate testing methods,
- developed mix design procedures for stone-matrix asphalt,
- evaluated modified asphalt mixtures,
- improved mix design and test procedures to minimize rutting,

- developed a Perpetual Pavement design method,
- recommended revisions to AASHTO standards mixes containing high RAP contents,
- prepared guidelines for management of RAP and RAS,
- provided guidelines on life-cycle cost analysis for pavement type selection, and
- developed the ignition method to measure asphalt content without solvents.

The textbook "Hot Mix Asphalt Materials, Mixture Design and Construction," currently in its third edition, has helped ensure engineers and technicians have the training needed to formulate and lay cost-effective asphalt pavements. The NCAT newsletter, Asphalt Technology News, is published biannually and has a worldwide circulation of more than 7,000. It has been well received by practicing engineers in both the public and private sectors.

NCAT is guided by a Board of Directors and an Applications Steering Committee. The 14-member Board guides strategic plans and policies. It includes four members from the NAPA Research and Education Foundation, four from Auburn University, and five at-large members. In addition, there are two emeritus members and five ex-officio members representing the industry. The Applications Steering Committee meets twice a year to review the scientific and technical quality of NCAT's programs and reports its findings to the Board. This group consists of 12 regular members and eight ex-officio members.

NCAT's dedicated staff of 35 full-time employees includes 10 lead researchers. The center also employs about eight graduate students and five undergraduate co-op engineering students who are destined for careers throughout the pavement industry.

Current project sponsors include the National Cooperative Highway Research Program, numerous individual state departments of transportation, the Federal Highway Administration, various corporations, and the NAPA Research and Education Foundation. NCAT's annual budget is typically about $5 million.

Newsletters, training information, technical reports, and research synopses can be accessed at *ncat.us*. Pavement Test Track research and performance data can be found at *pavetrack.com*.

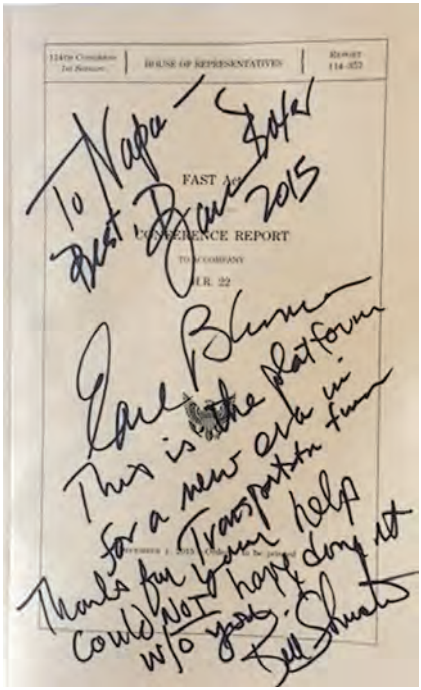
National Center for Asphalt Technology
NCAT
AUBURN UNIVERSITY

Legislative

Summary

The Accelerated Implementation & Deployment of Pavement Technologies (AID-PT) program supports the implementation and deployment of cost-saving and useful technologies that are proven to extend the life of pavements. This program, first established in the Moving Ahead for Progress in the 21st Century (MAP-21) Act, directs funding for continuing advancement of pavement technologies through partnerships between the Federal Highway Administrations and the asphalt industry. The NAPA–FHWA cooperative agreement is funded under AID-PT and has assisted in the advancement of groundbreaking technologies that improve and preserve pavements. The opportunities presented through this agreement allow NAPA and FHWA to simultaneously facilitate the design and construction of pavements using innovations, such as Thinlay™ thin asphalt overlays for pavement preservation, warm-mix asphalt, and pavements that incorporate higher levels of recycled materials, including RAP and RAS.

Through NAPA's work with FHWA to successfully implement and administer the program, lawmakers have endorsed and reauthorized the AID-PT program in 2015 as part of the Fixing America's Surface Transportation (FAST) Act. The FAST Act, a five-year highway bill that includes a host of policy reforms and that provides long-term funding to sustain America's infrastructure, allocates $12 million annually to the AID-PT program, half of which is appropriated to asphalt-focused efforts.



SAVE THE DATE

2016 World of Asphalt Show & Conference

MUSIC CITY CENTER, NASHVILLE, TN

www.WorldofAsphalt.org

March 22-24

World of Asphalt Show & Conference is the leading exposition and education resource for the asphalt industry. The event features in-depth educational programming and comprehensive exhibits that showcase the latest technologies and innovations in asphalt-related equipment, products and services.

2016 Transportation Construction Coalition Fly-In

HYATT REGENCY HOTEL, WASHINGTON, DC

www.AsphaltPavement.org/tccflyin

May 10-11

The annual TCC Fly-In is where hundreds of transportation construction industry executives from the across the nation meet in the nation's Capital to hear from top federal policymakers and meet with their congressional delegation to discuss pending transportation issues.

2016 Midyear Meeting

RENAISSANCE SEATTLE HOTEL
SEATTLE, WA

www.AsphaltPavement.org/Midyear

July 18-20

The NAPA Midyear Meeting is designed to benefit all industry senior and middle management personnel from asphalt pavement companies. Networking opportunities are interspersed with general sessions and committee/board meetings for a dynamic experience.

NAPA
NATIONAL ASPHALT PAVEMENT ASSOCIATION

2016 Young Leaders Conference

theWIT HOTEL, CHICAGO, IL

www.AsphaltPavement.org/YoungLeaders

Sept. 22-24

The Young Leaders Conference is filled with leadership development, updates on new and innovative paving technologies, and great networking events that will help young leaders build alliances and connections with peers throughout the asphalt industry.

2017 Annual Meeting

HILTON BONNET CREEK
ORLANDO, FL

www.AsphaltPavement.org/AnnualMeeting

Jan.29-Feb.1

The NAPA Annual Meeting provides practical knowledge useful for members involved in the strategic management of their companies; engineers responsible for asphalt production, road construction, and sustainability; estimators who bid on asphalt construction projects; and marketers who create communications and sales materials.

Advancement of Innovative Asphalt Technology

PURPOSE: This cooperative agreement is a joint effort between FHWA and NAPA for the advancement of new and innovative technologies to design, specify, construct, and preserve asphalt pavements.

Background

FHWA and the asphalt pavement industry represented by NAPA have developed a positive system for advancing and implementing asphalt technologies and materials. This includes technology identification through research studies and demonstrations and international and domestic scanning tours. Crucial to the implementation are FHWA's Mobile Asphalt Laboratory, government and industry ETGs, TWGs, and industry committees, such as NAPA committees and TRB. Standards and specifications are refined and implemented through AASHTO subcommittees and American Society of Testing and Materials (ASTM) committees.

The cooperative agreement is led and managed by Dr. Audrey Copeland and assisted by NAPA staff. NAPA has established an innovation team of recognized experts in asphalt technologies including NCAT, Texas A&M Transportation Institute, Advanced Asphalt Technologies Inc., other industry consultants, and the State Asphalt Pavement Associations.

Study or Project Focus

The objectives of this cooperative agreement are: to 1) Promote the deployment and adoption of state-of-the-art innovative materials, design procedures, specifications, practices, and construction methods to improve asphalt pavement performance and extend the pavement life of our transportation facilities, and to 2) Replace or update multiple documents developed in previous years to reflect today's technology and to improve the performance of asphalt pavements. The audience for this effort is the asphalt material community, consisting of state and local agencies, industry, manufacturers, suppliers, producers, field construction, and researchers/academia.

Outcome/Benefits

This cooperative agreement presents a unique opportunity for mutual FHWA–NAPA technology activities to be managed under one "umbrella," which will facilitate simultaneous activities and allow for longer term planning for the most cost-effective and successful pavement technology program.

Committee for Asphalt Research and Technology, Engineering Advisory Committee

Funding Level: Up to $2.5 million
Research Lead: NAPA
Project Dates: October 2013–September 2018

The deliverables of the cooperative agreement will include conferences and workshops, presentations at government and industry events, webinars, publications, surveys for benchmarking, and multimedia tools

Progress Report

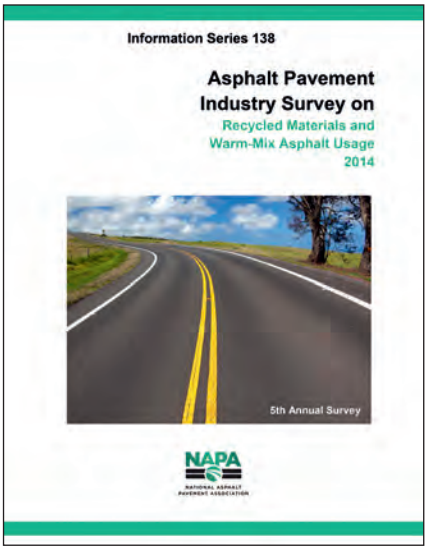
Several deliverables were completed in 2015, including:

- Asphalt Pavement Industry Survey on Recycled Materials and Warm-Mix Asphalt Usage: 2014 (IS 138, fifth edition)
- Best Practices for RAP and RAS Management (QIP 129)
- High RAP Asphalt Pavements: Japan Practice — Lessons Learned (IS 139)
- FHWA Tech Brief: Porous Asphalt Pavements With Stone Reservoirs (FHWA-HIF-15-009)
- 2015 Asphalt Pavement Sustainability Conference in Portland, Ore.
- Basic Principles of Asphalt Mix Durability webinar
- Asphalt ETGs website (www.AsphaltETGs.org)
- Education Tools for Asphalt Innovations pilot course

Annual Asphalt Pavement Industry Survey on Recycled Materials and Warm-Mix Asphalt Usage: 2014 (IS-138)

Background/Need

The FHWA/NAPA survey was first conducted in 2010, focusing on the use of RAP, RAS, and WMA technologies in the 2009 and 2010 construction seasons. This initial survey served as a benchmark for the asphalt pavement industry's use of these sustainable technologies and complimented state DOT surveys conducted by AASHTO/FHWA. Since the initial benchmarking, FHWA has successfully partnered with NAPA to conduct similar surveys annually. Starting with the 2013 construction season, the survey has been conducted under the NAPA/FHWA Cooperative Agreement.



Study or Project Focus

The survey focuses on the quantities of RAP and RAS being used in asphalt mixtures, as well as the total amount of WMA produced nationally. Estimates are also made for the total asphalt mixture market in each state or territory. Information on other recycled materials, such as rubber and slag, are also collected.

Outcome/Benefits

The survey results have shown significant growth in the use of RAP, RAS, and WMA technologies over the past few years. These results show that the asphalt industry remains the country's most diligent recycler, recycling asphalt pavements at an average rate of greater than 99 percent. The amount of RAP used in asphalt mixtures has increased by 28 percent, from 56 million tons in 2009

FHWA/NAPA Cooperative Agreement

Funding Level: $40,000
Research Lead: Kent Hansen, Audrey Copeland
Project Dates: Annual

PURPOSE: The purpose is to quantify the use of recycled materials, including RAP and RAS, and warm-mix asphalt (WMA) production by the asphalt pavement industry to help support and promote sustainable practices. The survey tracks reported use of other commonly used recycled materials, such as ground tire rubber and slags, in asphalt pavement mixtures.

to 71.9 million tons in 2014. Use of RAS increased 179 percent from 702,000 tons in 2009 to 1.96 million tons 2014. In 2014, WMA production was estimated at 113.8 million tons, about one-third of the total asphalt mixture market for 2014, and WMA use has increased more than 577 percent since 2009. This data has been widely used in the trade and popular press that documents sustainable infrastructure practices.

Progress Report:

The survey report is complete and available on the NAPA website www.asphaltpavement.org/recycling.

Marketing:

In addition to press releases distributed to trade and general press, an infographic was developed to highlight the impact of asphalt sustainability, leveraging data collected through the survey. The infographic also can be viewed at www.asphaltpavement.org/recycle.

Optimized Flexible Pavement Design and Material Selection

PURPOSE: Synthesize best practices regarding optimized flexible pavement design and materials utilization, develop supporting data, and make recommendations that further refine current and new design practices for cost-effectiveness and performance.

Background

Current flexible pavement design methods may result in overdesigned asphalt pavement thicknesses and unnecessary higher initial costs. In the years since the AASHO Road Test, pavement materials and construction technologies have advanced significantly. However, these advances have not been adequately incorporated into pavement design methods. Capitalizing on known and proven technological advances in will reduce the cost of the pavement structure while providing quality long-term performance.

Study or Project Focus

Synthesize current best practices regarding optimized flexible pavement design and pavement materials utilization and develop new supporting data/best practices that further refine current practices focused on the design of cost-effective, well-performing pavements.

Outcome/Benefits

The final report will illustrate the potential for long-lasting asphalt pavements to be designed in a more economical fashion through 1) the use of proper MEPDG calibration and implementation,2) appropriate pavement performance reliability and criteria for evaluating pavement designs, 3) the use of limiting strain criteria (with appropriate strain levels), and 4) optimized materials utilization.

Progress Report

The following reports are complete:

A synthesis and research synopsis for "Refining Limiting Strain Criteria and Approximate ranges of Maximum Thicknesses for Designing Long-life Asphalt Pavements," NCAT Report 15-05 and NCAT Research Synopsis 15-05, both available through the NCAT website, http://ncat.us/files/reports/2015/15-05.pdf

A report and research synopsis for "Flexible Pavement Design: State of the Practice," NCAT Report 14-04 and NCAT Research Synopsis 14-04,

Joint Pavement Type Selection/ Pavement Design Task Group

Funding Level: $190,000
Research Lead: NCAT
Project Dates: August 2013–April 2015; No Cost Extension until December 2015

provide an overview of current flexible pavement design practices in the United States.

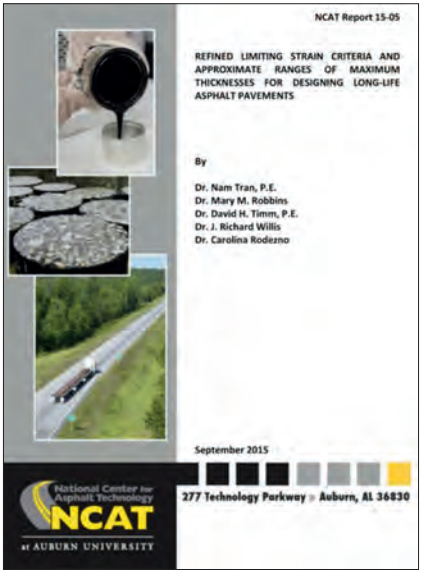
The report "Recalibration Procedures for the Structural Asphalt Layer Coefficient in the 1993 AASHTO Pavement Design Guide," NCAT Report 14-08, outlines methods for localizing and calibrating the structural number for pavement designs using deflection data, historical performance data, or matching mechanistic-empirical design thicknesses.

All reports are available through the NCAT website, www.ncat.us

Deployment

The authors have spoken at SAPA conferences on the project and research papers have been submitted to journals.

With the help of the APA, a pavement design workshop is being developed and deployed through ASCE.



Simplified Pavement Design Tool — PaveXpress

PURPOSE: Develop a web-enabled computer application and a corresponding mobile application capable of providing structural designs for concrete and asphalt roadways and parking facilities.

Background

To better educate and assist pavement decision makers, a simplified pavement design tool is desired. The expectations are that the simplified pavement design tool, PaveXpress, will be easy to use and understand while providing technically sound pavement structural designs and analyses that illustrate the benefits of using asphalt pavement structures.

Study or Project Focus

The primary software functionality will involve roadway structural pavement design (asphalt and concrete), pavement structural analysis (asphalt), and an interactive help tool covering program operation and pavement engineering references. Additional modules were developed in Phase II to handle asphalt overlays in addition to other design and tool improvements.

Outcome/Benefits

PaveXpress provides a user-friendly, visually appealing, pavement design tool accessible to users on a variety of devices that provides pavement decision makers technically sound pavement designs, demonstrates the benefits of using asphalt pavement structures, and provides a free alternative to other pavement design software.

The Roadway Pavement Design module compares pavement designs for up to three alternatives: Long-Life Asphalt Pavements per elastic layer theory/fatigue & rutting criteria, Asphalt Pavements per AASHTO 93 methodology, and Concrete Pavements per AASHTO 93 methodology and the 1998 AASHTO Supplement.

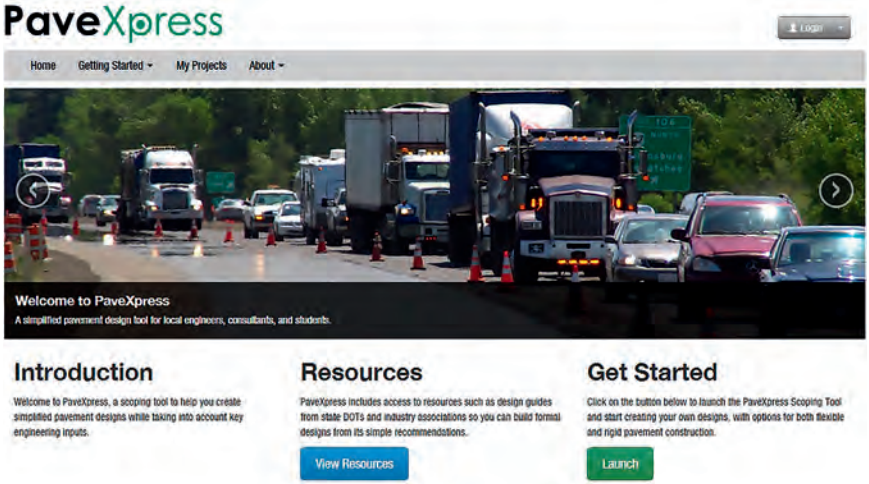
Progress Report

PaveXpress has been completed and is available at www.pavexpressdesign.com.

In 2015, a thin asphalt overlay tool was added, as well as additional user features and guidance.

Pavement Design Task Group

Funding Level: $180,000
Research Lead: Pavia Systems
Project Dates: October 2013–July 2015



Marketing

- Advertisements in industry trade press (print and electronic), including *Civil Engineering*, *Roads & Bridges*, and *Public Works* magazines.
- PowerPoint training presentation developed for use by SAPAs and others to introduce PaveXpress to potential users

Deployment:

- Knowledge transfer to about 1,650 people through workshops, conferences, and webinars.
- Over 3,000 sessions and 2,000 unique users.

Perpetual Pavement Design — PerRoad Updates

Background/Need

PerRoad software was developed for the Asphalt Pavement Alliance to facilitate Perpetual Pavement analysis and design of flexible pavements. The current version of the software (3.5) relies primarily on user-entered threshold strain levels (i.e., endurance limits) and corresponding transfer functions to compute the amount of time before cumulative damage reaches 0.1. While this approach to Perpetual Pavement design has proven effective, it is greatly limited by requiring the designer to enter a transfer function, which is often seen as a weak point of any M-E procedure. Recent research has demonstrated the effectiveness of using cumulative strain distributions as a basis for design. Enabling PerRoad users to work with strain distributions, rather than endurance limits and transfer functions, is seen as a much-needed upgrade for the software. Also, PerRoad 3.5 does not facilitate a comparison between Perpetual Pavement and non-Perpetual Pavement designs. There is a need to allow PerRoad users to evaluate both design options within a single program using the same basic set of inputs.

Study or Project Focus

The project focuses on two objectives:

1. Implement strain distribution design criteria within PerRoad.
2. Implement non-Perpetual Pavement design criteria within PerRoad.

Outcome/Benefits/ Deliverables

Redesigned PerRoad software, along with a research synopsis that describes the newly revised program and contains the sensitivity analysis, will be delivered. In addition, a webinar will be developed that presents the new design philosophy, features of the program, and demonstrates the software.

Pavement Type Selection and Pavement Design

Funding Level: $25,500
Research Lead: NCAT, Auburn University (D.H. Timm, M.M. Robbins, and X. Guo)
Project Dates: August 2015–June 2016

PURPOSE: This project will upgrade PerRoad mechanistic-empirical design software so that pavement designer can work with strain distributions rather than endurance limits and transfer functions. This will allow users to evaluate and compare non-Perpetual Pavement designs to Perpetual Pavement designs.

Progress Report

PerRoad has been modified to include a conventional mechanistic design. This new feature runs simultaneously with the pre-existing Perpetual Pavement design option, allowing designers to easily assess the difference between a Perpetual and conventional design. Work has begun on incorporating the strain distribution concept in the program.

Determining Service Life Based on Comparable International Roughness Index Values

Background

Technical advancements have improved the performance of asphalt pavements and, as a result, have increased the lifespan of asphalt pavement. However, these technology advances have not been adequately incorporated into the analysis and prediction of pavement service life, which is an input for pavement type selection tools, such as LCCA. A method is needed to accurately determine performance life and eliminate errors introduced from inappropriately applied maintenance cycles.

Study or Project Focus

This study focuses on pavement ride quality (smoothness), how it changes over time, and how it can be used in

Pavement Type Selection Task Group

Funding Level: $65,000
Research Lead: NCAT
Project Dates: October 2013–March 2015

PURPOSE: Analyze and determine how pavement ride quality (i.e., smoothness) can be used to determine service live in a life-cycle cost analysis (LCCA) and quantify the cost of different pavement options in order to validate LCCA input assumptions such as the period of performance for initial construction and maintenance.

best practices to determine service/performance lives for various cycles (i.e., initial construction, maintenance, rehabilitation, etc.) in an LCCA.

Outcome/Benefits/Deliverables

This project will assess the state of practice for determining pavement service life and provide recommendations for determining service life, which is used in life cycle cost analyses, based on maintaining ride quality. Ride quality is a function of pavement smoothness and building and maintaining smooth pavements improves performance and fuel economy for vehicles.

Progress Report

A synthesis report and literature review has been completed. NCAT Report 15-02, "Literature Review: The Impact of Pavement Roughness on Vehicle Operating Costs," is available on the NCAT website, http://www.ncat.us/files/reports/2015/15-02.pdf

A survey and summary report of agency practices on determining service life and a report of best practices and establishing service life cycles for maintenance and rehabilitation was completed in 2015 and will be published on NCAT website.

Effect of Pavement Types on Building Energy Efficiency: Phase II

PURPOSE: The main project outcome is to understand the effect of different pavement types on building energy efficiency, radiative forcing, and human thermal comfort by creating a numerical model of the thermal interactions between buildings and their environment.

Background/Need

State legislation, as well as federal legislation and green building codes, are increasingly penalizing dark-colored pavements in efforts to mitigate the urban heat island effect (UHI). Unfortunately, the laws have moved faster than the science; as demonstrated in the PEC Project "Phase I: Unintended Consequences of Reflective Pavements." Current modeling efforts can demonstrate energy savings from reflective materials; however, these models oversimplify thermal interactions by neglecting the physical interactions between buildings and the surrounding urban environment.

Study or Project Focus

This study will build a numerical model that includes building-environment thermal interactions.

The model will be validated from field experiments and used to evaluate the effect of different pavement characteristics (including, but not limited to, thermal conductivity, heat capacity, and albedo) on energy consumption, radiative forcing, and the noted unintended consequence of human thermal discomfort.

Outcome/Benefits

The model is available for use by other researchers. Among studied thermal properties, it was found that modifying ground pavement reflectivity has negligible effects on building energy consumption. However, increased pavement reflectivity did significantly degrade human thermal comfort. The project team concluded that modifying pavement albedo may not be the best parameter for mitigating urban heat island (UHI) and reducing building cooling loads.

Progress Report

The project team has developed an urban canopy model that enables modeling of building environment interactions with climatic conditions for Phoenix, Ariz. Field measurements were used to validate the model for a variety of urban land cover types. Using the developed model, the project team studied the effect of different pavement types on

PEC Environmental Sustainability Task Group

Funding Level: $75,100
Research Lead: Zhihua Wang, ASU
Project Dates: July 2014–December 2015

buildings energy loads and outdoor human comfort. The model was also used to assess the pavement surface impacts on radiative forcing. Results from the study will be presented at a conference and published in an academic journal.

Develop an Industry Average Environmental Product Declaration

PURPOSE: To create a tool to calculate asphalt mixtures environmental impacts communicated through Environmental Product Declarations.

Background

Environmental Product Declarations (EPDs) are being incorporated into green rating systems, such as LEED, Greenroads, and the International Green Construction Code (IgCC), replacing material credits for best practices such as recycling and materials reuse. An EPD is a certified document that reports fair, verified, and comparable information on the potential environmental impacts of a product. Information used in an EPD is based on life-cycle assessment (LCA) methodology following certain product-specific requirements and boundaries called product category rules (PCRs).

Study or Project Focus

An LCA study will be conducted and product category rules developed for asphalt mixtures. In addition, a software tool will be created to aid asphalt mix producers in declaring the environmental impacts of their asphalt mixes through a certified NAPA Environmental Product Declaration.

PEC Environmental Sustainability Task Group

Funding Level: $129,500
Research Lead: Amlan Mukherjee/Heather Dylla
Project Dates: August 2014–August 2016

Outcome/Benefits/ Deliverables

The real-time EPD software program created will allow asphalt mix producers to develop NAPA-certified EPDs for their various mixes in a fast, simple, and affordable manner. EPDs certified under the NAPA EPD program will aid producers in demonstrating their commitment to sustainability, showcase their environmental improvements over time in a common in a credible reporting format, and enable them to meet the new material requirements in green rating systems. Material suppliers with EPDs will gain a competitive advantage over those without EPDs.

Progress Report

A PCR Development Working Group of various stakeholders has created a draft PCR for asphalt mixes. In support of the PCR being developed, an LCA was conducted to identify the availability of primary data and validate the feasibility of the PCRs. Both the underlying LCA and the initial PCR draft will undergo a series of technical and public review before they are published.

Deployment

Presentations were given on the program's unique approach at Greenbuild 2015, LCA XV, 2015 NAPA Asphalt Sustainability Conference, and various SAPA annual conferences.

Environmental Life Cycle Assessment (LCA) Use-Phase Emissions Due to Pavement Roughness

Background

Life-cycle assessments (LCA) are used to quantify the environmental impacts associated with a product spanning all phases of its life. While most pavement LCA tools are "cradle to grave," focusing on the material extraction, manufacturing, and construction phases, research has shown that this accounts for only 10%–12% of the total greenhouse-gas (GHG) emissions associated with a pavement life cycle. A very large portion of the emissions come from the pavement use phase.

Study or Project Focus

Previous studies have shown that pavement roughness directly impacts rolling resistance, which in turn impacts vehicle fuel efficiency. This study developed an analysis method to mine IRI data from the FHWA Long-Term Pavement Performance (LTPP) database, in order to identify significant statistical trends in IRI degradation over time. These trends are directly applied to estimating pavement use-phase GHG emissions.

Outcome/Benefits/ Deliverables

The study showed that asphalt pavements tend to have a lower initial IRI and are overall smoother than concrete pavements; however, they tend to grow rougher at a faster rate than concrete pavements. A critical insight from the study is that context-specific approaches must be used to identify the best pavement type and maintenance schedules. IRI Explorer, an easy-to-use interface for analyzing IRI data in the FHWA LTPP database and modeling use-phase GHG emissions, was developed to aid decision-makers in conducting context-specific comparisons of their own, including support for additional data not included in the LTPP.

PEC Environmental Sustainability Task Group

Funding Level: $72,000
Research Lead: Michigan Technological University
Project Dates: Project Completed December 2014, In Deployment

PURPOSE: Identify how pavement roughness directly impacts use-phase greenhouse-gas emissions for asphalt and concrete pavement types.

Progress Report

Two conference papers resulted from this study and were presented at the 2014 International Symposium on Pavement LCA in Davis, Calif., and at the 2015 TRB Annual Meeting. "Assessing the role of pavement roughness in estimating use-phase emissions" at the International Symposium on Pavement LCA 2014. California, Davis., Oct. 2014., and "Empirical assessment of Pavement Roughness to Estimate pavement life cycle Use-Phase Emissions" at the Transportation Research Board. Washington, D.C. Jan. 13, 2015.

Deployment

Project findings were presented by Dr. Amlan Mukherjee at the 2014 Asphalt Sustainability Conference and FHWA Sustainable Pavement Technical Working Group. The project team has developed training materials to aid the IRI Explorer deployment efforts. This includes a teacher's manual including a PowerPoint presentation and script, case studies, and quizzes, as well as a user's manual. Using these materials, two webinars were held to teach both the SAPAs and DOTs how to use IRI Explorer.

Marketing

A logo and branding have been developed for IRI Explorer and a white paper is under development by NAPA staff to highlight the differences in pavement smoothness identified through IRI Explorer's pavement comparison tool.

Modeling of Pavement Characteristics on Vehicle Rolling Resistance: A Critical Analysis

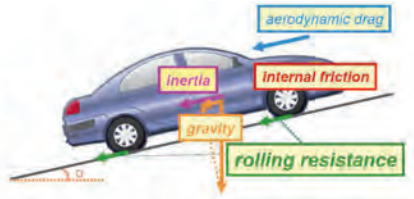
PURPOSE: Conduct an investigation concerning pavement properties that affect rolling resistance and vehicle fuel economy.

Background/Need

Concern over transportation-related greenhouse gas emissions has encouraged research to identify the impact of pavement characteristics on a vehicle's rolling resistance and fuel consumption. The Concrete Sustainability Hub (CSHub) has released a modeling effort that identifies a substantial impact from pavement viscoelasticity or deflection on rolling resistance and vehicle fuel consumption, indicating that driving on asphalt roads is akin to continuously driving uphill. However, before local and national decisions are made based upon this research, the assumptions and limitations of this model need to be understood.

Study or Project Focus

This analysis includes a review of existing literature on the effect of viscoelasticity of asphalt pavement on vehicle fuel consumption and will take an in-depth look at the methodology behind the pavement-vehicle interaction (PVI) model developed by CSHub.



Various forces must be overcome for a vehicle to sustain movement. (ISO 28580:2009)

Outcome/Benefits

The survey of recent literature illustrates that smooth roads decrease vehicle fuel consumption while no real consensus has been determined as to the effect of pavement stiffness. Identified concerns with the CSHub PVI deflection model include: little transparency in data used for model validation and calibration, ignores conventional flexible pavement design philosophies and understood physical properties of asphalt pavements, and how the tire load is modelled

PEC Environmental Sustainability Task Group

Funding Level: $25,000
Research Lead: Richard Willis, NCAT
Project Dates: Project Completed September 2014, Updated June 2015

Progress Report

"Effects of Pavement Properties on Vehicular Rolling Resistance: A Literature Review" (NCAT Report 14-07), originally published in July 2014, was updated June 2015 to include a review of the CSHub modelling effort

Deployment

Results from the study were presented by Dr. Richard Willis at NAPA's 2014 Asphalt Sustainability Conference and in a webinar, "Where the Rubber Hits the Road: Pavement Vehicle Interaction Re-examined". Key findings from the model review were published as "Special Report 208: Modelling Pavement's Effect on Fuel Economy: A Brief Review of Concerns Identified in the CSHub 2012 Simulation Model." In addition, several fact sheets on PVI have been created for various audiences, including engineers, industry, and lawmakers.

Development of Thin Asphalt Overlay Mixes with High Recycle Content

PURPOSE: Develop high binder replacement (HBR) surface mixes that have equivalent or better performance to the standard mixes used in several states by conducting performance testing and analysis on laboratory prepared asphalt mixture specimens for the purpose of gathering data.

Background/Need

Thin-lift overlays, or Thinlays™, with a high level of binder replacement using reclaimed asphalt pavement (RAP) or reclaimed asphalt shingles (RAS) can be an economical and environmentally sound pavement preservation treatment. Increasing the level of binder replacement in any asphalt mix design improves cost effectiveness by putting waste material to practical use and reducing the need for virgin materials.

Study or Project Focus

The results of the testing and analysis will help provide guidelines to other states for developing crack-resistant HBR surface mixes. Mixtures received from four participating states — Oregon, North Carolina, Ohio, and Maryland — will go through rigorous testing processes. The cracking modes of interest are thermal and fatigue cracking.

THINLAY
SAFE. SMOOTH. DURABLE.

Outcome/Benefits/ Deliverables

A report will be produced comparing the control and high binder replacement (HBR) mixes for each state, including documentation of the testing results, performance comparisons, and discussion of critical factors that may improve performance of future HBR mixtures.

Progress Report

Reports are complete for all states and show that using softer binder in combination with recycled materials results in equal or better laboratory performance compared to standard mixes used in these states. A forthcoming PEC project, "Consolidated Report of Increasing Recycle Content of Thinlays" will consolidate these reports and provide guidance to others wishing to increase the recycle content of Thinlay™ mixes.

Pavement Preservation

Funding Level: $70,000
Research Lead: NCAT
Project Dates: July 2013–October 2015

Comprehensive Synthesis on High Binder Replacement Effects and Practices

PURPOSE: Develop a synthesis of current and past research on asphalt mixes with 20 percent or greater binder replacement using reclaimed asphalt pavement (RAP) and/or reclaimed asphalt shingles (RAS), and develop articles and presentations from the research to facilitate knowledge transfer.

Background/Need

While the asphalt pavement industry has been using RAP and RAS for many years, opportunities remain for the use of these materials in combination and at greater levels with the potential for significant economic and environmental benefits. When RAP and RAS are used at higher percentages, there is a chance the asphalt binder replacement (ABR) will vary considerably due to fractionation or combining the materials. With a number of states moving to specifying the amount of RAP and RAS that may be used in a mix in terms of ABR, rather than as a percent of the aggregate or total mix, it is important to synthesis existing research regarding ABR.

Study or Project Focus

The project will focus on the benefits of using RAP and/or RAS based on ABR in asphalt pavement construction operations, including the economics of using the recycled/reclaimed materials, as well as the conservation of natural resources, reduction in energy consumption, and reduction in emissions.

Outcome/Benefits/ Deliverables

This synthesis will document laboratory and field performance testing and use of high-ABR mixes to develop several types of materials for various audiences (contractors, public, owner, consultants, legislators, etc.), advancing knowledge on the benefits of using of RAP and/or RAS, and encouraging best practices for its use that ensure product quality. A Tech Brief based on this work will be developed for FHWA under the NAPA/ FHWA Cooperative Agreement.

Progress Report

The final report will be available in February 2016. Articles/white papers and PowerPoint presentations are being developed. A webinar, "Improved Sustainability and Performance with High RAP and RAS Usage," based on this synthesis was presented on September 25, 2014, and an FHWA Tech Brief will be available in February 2016 under the FHWA Cooperative Agreement.

PEC Best Quality and Competitiveness Task Group

Funding Level: $30,000
Research Lead: Dr. David Newcomb (PI), Dr. Jon Epps, and Dr. Fujie Zhou, Independent Contractors
Project Dates: August 2013–February 2015

Considerations and Case Studies in Rapid Highway Construction Using Asphalt Pavement

Background/Need

One of the most recognized benefits of asphalt pavements is their speed of construction. The construction zone is the primary visible factor that stands between the driving public and the delivery of a roadway for public use. Drivers are very aware of and sensitive to the time they spend in work zone delays. From the driver's point of view, any amount of time lost to roadway activities is excessive and inconvenient. Significant public support and financial savings result

PEC Best Quality and Competitiveness Task Group

Funding Level: $50,000
Research Lead: Texas A&M Transportation Institute (TTI)
Project Dates: January 2014–January 2016

PURPOSE: Determine the effect of rapid highway construction on the total costs — construction and user delay — associated with maintenance, rehabilitation, and reconstruction of pavements.

when project delivery is accelerated and construction on roadways is unnoticeable to the driving public.

Study or Project Focus

This study provides a foundation for defining the social cost savings associated with accelerated or rapid pavement construction. These cost savings are substantial from a user and non-user standpoint and are a major factor associated with justifying the use of rapid construction operations for public agencies. Information was obtained on actual field projects, as well as typical types of rehabilitation and maintenance operations.

Outcome/Benefits/ Deliverables

Report quantifying the benefits of rapid highway construction techniques that allow contractors to innovate with more leeway given in construction and work zone scheduling. Case histories will be included in report.

Progress Report

The final report is complete and under final editorial review. NAPA is working with TTI to publish this as a TTI report.

Other relevant information

This project was partially funded by TTI.

Targeted Education, Promotion, and Training Program

PURPOSE: Develop training curriculum to help educate city and county public works officials, consulting engineers, and engineering firms on proper engineering methods required to design and deliver a high-quality asphalt pavement.

Background/Need

Insufficient knowledge of asphalt pavements and its benefits can lead to limited confidence in designing asphalt pavements and applying emerging technology. Pavement type selection decision-makers and consultants want to be educated on asphalt pavement products. An adaptable training program that can be used by SAPAs or others to train and educate persons responsible for specifying and designing pavement is needed.

Study or Project Focus

Develop an adaptable education program that includes Life-Cycle Cost Analysis, and asphalt innovations including: RAP/RAS, Thinlays, Perpetual Pavements, OGFC, and WMA.

PEC Best Quality and Competitiveness Task Group

Funding Level: $100,000
Research Lead: NCAT
Project Dates: October 2014 – June 2016

Outcome/Benefits/ Deliverables

Educate city, county, and state officials, as well as consulting engineers, on best practices and benefits of asphalt pavements. With training, well-informed customers will be more confident to consider and use asphalt for their pavement needs.

Progress Report

The project was awarded to NCAT in October 2014 with the addition of adult education experts to the team. A pilot training was held in November 2015 to obtain feedback from the participants and task group. A no-cost extension was approved to allow time to make changes to the program. It is anticipated the final training program will be available in June 2016.

Webinars

PURPOSE: The NAPA Talks Webinar series provides the industry easy access to leading educators on timely topics in research, engineering, health and safety, environmental sustainability, legislation, business management and marketing. Webinars are free to NAPA members, agency personnel and educators, and their students.

Benefits

With access to premier experts on numerous topics of concern to the industry, NAPA's goal is to be the best educational resource and provider for the entire asphalt pavement industry, our partners, and our clients. Participants can attend a pre-scheduled, live webinar or download an archived webinar at a time convenient to them. This easy access offers relevant educational opportunities that meet users' needs and schedules.

Since 2009, NAPA-hosted webinars have attracted more than 3,000 industry and agency participants. Surveys of webinar participants have found that 95% of respondents either agree or strongly agree that information provided was clear and concise; 98% agree or strongly agree that the information provided was helpful; and 92% of respondents feel that the webinar lived up to their expectations.

List of Webinars available on website

- Greenhouse Gas Calculator Webinar
- Developing an SPCC Plan
- Social Media for Asphalt Producers
- Using LCA Software
- Election Implications for Asphalt Contractors
- Upping the RAP
- Keeping the Work Zone Safe
- Thinlays for Pavement Preservation
- Rethinking Asphalt Recycling
- EPCRA Reporting Requirements for Asphalt Plants
- Night-time Work Zone Safety
- Porous Asphalt Pavements Part 1 and Part 2
- The What, Why, and How of Environmental Product Declarations

- Introducing Pave Xpress
- Sustainability 101
- Improved Sustainability and Performance with High RAP/RAS
- Mix Design for Managers
- Aggregate Management for Asphalt Plants
- Financial Management for Non-Financial Managers
- The New Workforce
- Cold Central Plant Recycling and Full-depth Reclamation
- Rethinking Asphalt Recycling
- Inspecting Asphalt Tanks for SPCC Compliance
- Best Practices in Tack Coat Application
- Best Practices in Pavement Repair
- Thin Asphalt Overlays for Pavement Preservation
- IRI Explorer
- Asphalt Durability
- Ethics in Construction

Announced 2016 Webinars

- Best Practices Series for Paving
  - Leadership, Communication & Planning in Paver Operations
  - Best Practices in Milling and Profiling
  - Best Practices in Paver Operations
  - Best Practices for Compaction
  - Best Practices in Work Zone Safety
  - Best Practices in Positioning Technology in Asphalt Paving
  - Best Practices for Residential and Commercial Paving
- Best Practices Series for Sustainability

Marketing/Communications

GOAL: Serve as the marketing and communications avenue of the industry, responding to threats and optimizing opportunities that impact the asphalt pavement industry's competitive position. Manage a market research program that examines and understands the opinions of pavement specifiers, elite users, and the public.

Making the Case for Drivability

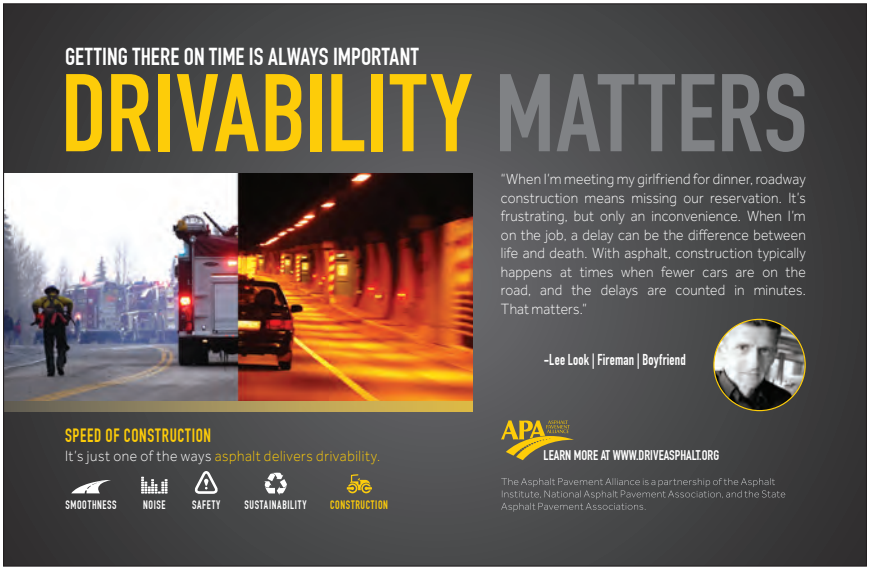
Drivability 2.0 — Currently underway is a second wave of advertising and marketing materials built around the concept of "Drivability." Surveys of road owners and drivers in 2013 and 2014 helped delineate the positive attributes of asphalt pavements, what each audience wants from a pavement, and how asphalt is the best material for delivering performance and drivability. The Drivability 2.0 campaign builds on this foundation to look at what elite drivers — from motorsports to emergency services — demand from pavements when they are on the job and when they go about their lives. Elite drivers include people who drive for a living and they can talk about the benefits of asphalt when there's more than a trophy on the line.

Building upon the science and user surveys, the creative content — videos, infographics, and advertising — offers another way to share with road owners key research findings in an entertaining and visual manner. Videos and infographics are available, covering topics ranging from drivability attributes from the public and elite users' perspectives to Perpetual Pavement designs. The creative materials content — advertising, infographics, and video — are backed by an October 2015 survey of 1,500 elite users, in addition to data from our 2013 and 2014 surveys. There are also other videos celebrating the joy of driving on asphalt and the inspiring work road builders perform every day.

All these materials are publically available through the industry's DriveAsphalt.org website. The site is rigorously sourced and has a vast library of videos, illustrations, and technical papers. The videos and infographics are for the industry to use and share, amplifying positive messages about our product to pavement type selection decision makers and the driving public. The library is easily searchable and includes research emerging from the Pavement Economics Committee (PEC) and its six NAPA–SAPA Task Groups, as well as third-party research papers and reports.

Go-To-Market Task Group

Research Lead: Golin
Project Dates: Ongoing



Looking Forward

In 2016, as additional PEC projects reach completion, the program will include an emphasis on creating trade articles, SAPA guidance memos, legislative and industry factsheets, videos, infographics, and social media updates that help the industry, specifiers, and our partners put research into practice. These new materials, combined with a continuation of our broader marketing efforts, will convey to all interested parties the asphalt advantage.

APA Deployment Activities

Market Integration

In 2015, the Asphalt Pavement Alliance (APA) focused on realigning its plan for deploying Pavement Economics Committee scientific research and Go-To-Market program materials to our industry customers. Working with the State Asphalt Pavement Associations and other industry representatives, the deployment efforts are centered on two primary audiences: pavement specifiers and regulators.

The tradeshow program provides an opportunity to meet directly with the industry's primary audiences discussing scientific facts and technological innovations. With a presence at nearly one trade show a month, the deployment program was able to get the latest industry information in front of key stakeholders in the pavement, architectural, green construction, and parking industries as well as other industries of interest during 2015.

Key to advancing the adoption of long-life asphalt pavement designs, the Perpetual Pavement Awards program recognizes asphalt pavements that are at least 35 years old, have never had a structural failure, and receive periodic resurfacing no more than every 13 years on average. These awards help departments of transportation convey to lawmakers, taxpayers, and drivers the value of constructing long-life asphalt Perpetual Pavement. To date, 100 pavements have been recognized with a Perpetual Pavement Award.

All these efforts are undertaken with the support of the State Asphalt Pavement Associations, a constituent part of the APA and the industry's frontline for both deploying messages and materials, as well as responding to local competitive, legislative, or regulatory threats.

Looking Forward

To broaden the impact of the APA, the Deployment Task Group is increasing the APA's personnel resources so that industry tools and products can be deployed in a targeted, regional manner to ensure the greatest impact. Regional deployment will also focus on national accounts to represent asphalt's interests in proper design and construction for the commercial sector.

Deployment Task Group

Research Lead: Amy Miller, P.E.
Project Dates: Ongoing

GOAL: To utilize products and resources developed through the scientific and engineering research community, including the Pavement Economic Committee (PEC) Task Groups, and through the industry's communications and marketing Go-To-Market program distribute industry messages before decision-makers with the aim of making asphalt the pavement of choice.

Throughout 2016, the deployment program will continue to amplify the latest news and messages from the industry nationally as it begins development of a network of strong, regional marketing councils. United with the support of the Asphalt Institute, the National Asphalt Pavement Association, and the State Asphalt Pavement Associations —the APA will increase the success of the asphalt industry locally and nationally.

NAPA gratefully acknowledges the generous support of the State Asphalt Pavement Associations for the programs of the Pavement Economics Committee.

Alabama Asphalt Pavement Association

Arkansas Asphalt Pavement Association

California Asphalt Pavement Association

Colorado Asphalt Pavement Association

Connecticut Asphalt & Aggregate Producers Association

Delaware Asphalt Pavement Association

Asphalt Contractors Association of Florida

Georgia Asphalt Pavement Association

Hawaii Asphalt Paving Industry

Illinois Asphalt Pavement Association

Asphalt Pavement Association of Indiana

Asphalt Paving Association of Iowa

Kansas Asphalt Pavement Association

The Plantmix Asphalt Industry of Kentucky

Louisiana Asphalt Pavement Association

Maine Asphalt Pavement Association

The Maryland Asphalt Association

Massachusetts Aggregate & Asphalt Pavement Association

Asphalt Pavement Association of Michigan

Minnesota Asphalt Pavement Association

Mississippi Asphalt Pavement Association

Missouri Asphalt Pavement Association

New Jersey Asphalt Pavement Association

Asphalt Pavement Association of New Mexico

New York Construction Materials Association

Carolina Asphalt Pavement Association

Dakota Asphalt Pavement Association Inc.

Flexible Pavements of Ohio

Oklahoma Asphalt Pavement Association

Asphalt Pavement Association of Oregon

Pennsylvania Asphalt Pavement Association

South Carolina Asphalt Pavement Association

Tennessee Road Builders Association

Texas Asphalt Pavement Association

Utah Asphalt Pavement Association

Virginia Asphalt Association

Washington Asphalt Pavement Association

Asphalt Pavement Association of West Virginia

Wisconsin Asphalt Pavement Association

SAPA

State Asphalt Pavement Associations

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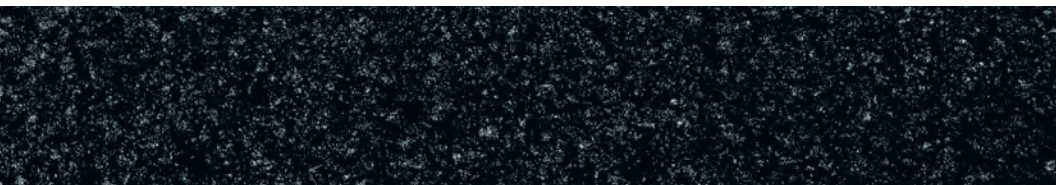

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