AASHTO

RESEARCH

Cost-Saving Techniques for Pavements

SCOR RAC

State departments of transportation are committed to using research and innovation to meet the challenge of delivering more efficient and safer transportation systems. The projects on these pages, funded primarily through national programs, are a few among many that exemplify the high return on transportation research investments. The State Planning and Research (SPR) Program, as the nation's cornerstone state transportation research program, provides federal aid funding to the states to address top concerns and identify solutions at the state level.

The pavement projects highlighted here are examples of state DOTs providing "Transportation Excellence through Research." The projects were compiled from the 2015 High Value Research solicitation carried out by the Value of Research Task Force, part of the American Association of State Highway and Transportation Officials Research Advisory Committee.

Weblink: Research Impacts 2015

Hydraulic Fracture Test to Determine Aggregate Freeze-Thaw Durability

Indiana

Hydraulic fracture test equipment.

Indiana Department of Transportation (INDOT) refined the Hydraulic Fracture Test (HFT), using the existing MnDOT HFT equipment and the newly developed INDOT HFT equipment allowing researchers to accurately predict the freeze-thaw performance of carbonate aggregates quarried in Indiana in 8 days instead of 90 days. Quicker results expedite the material selection process and ensure a quality aggregate is selected. Using the HFT to analyze recycled concrete as aggregate (RCA) showed potential promise as an in-place pavement aggregate for new concrete placement.

HFT sample prep and analyses procedures produced a model that correctly predicted the freeze-thaw durability of 14 out of 18 aggregate sources using INDOT's acceptance criterion of <0.060 percent dilation. If the acceptable HFT predicted dilation of <0.050 percent is used, then 17 of the 18 sources were properly identified. The research results led to the development of a new HFT standard, more efficient testing, and future project cost savings.

More information can be found at http://dx.doi.org/10.5703/1288284315515.

Deployment Support and Caltrans' Implementation of the Sealzall Machine

California

The Advanced Highway Maintenance and Construction Technology (AHMCT) Research Center and the California Department of Transportation (Caltrans) developed the Sealzall prototype high-production, crack-sealing machine. Corroborated by a one-year field trial by Caltrans' maintenance crew, the machine was shown to increase highway sealing production as well as improve worker safety.

The Sealzall sealant kettle heat-up and sealing systems are fully automated and can be monitored and controlled from inside the truck's cab. A single worker controls the entire longitudinal sealing operation while driving the truck at a continuous 2-5 mph speed in a moving-lane closure. Workers are not on foot or exposed to direct highway traffic. The Sealzall, which sealed nearly 8 linear miles of edge joints a day, saves the department 4 million dollars annually. The Sealzall machine can also be used to seal in-lane and random pavement cracks with a traditional manual sealing operation in a stationary lane closure.

More information can be found at http://ahmct.ucdavis.edu/pdf/UCD-ARR-13-06-30-03.pdf.

The Sealzall machine platform.

Mechanistic-Empirical Design, Implementation and Monitoring for Flexible Pavements

Illinois

Illinois Department of Transportation (IDOT) conducted a series of research projects aimed at updating their mechanistic-empirical (M-E) full-depth hot mix asphalt (HMA) pavement design procedures to reflect contemporary materials and mixture practices that support related activities. The research was achieved through lab testing and construction simulation and supported new asphalt fatigue algorithms for both full-depth HMA and rubblizing design procedures, which reduced pavement thickness approximately 1.5 to 2.5 inches for the average pavement design. In addition, investigators reviewed HMA modulus-temperature relationships, a revised HMA fatigue algorithm, design reliability/traffic multiplier factors, and maximum HMA thickness as part of the revision of the Bureau of Local Roads and Streets (BLRS) pavement design manual.

The change in pavement thickness has been estimated to save 63,180 tons of HMA binder annually, valued at $5.1 million. The environmental benefits resulted in the reduction of CO_2 emissions estimated to be approximately 2,529 tons annually, with a value of approximately $96,000. Together, the total benefit realized from the HMA pavement design procedure refinement efforts totaled $5.2M/year. The updated pavement design policy and guidance provides longer lasting, cost-effective, and sustainable pavements for the people of Illinois.

More information can be found at http://ict.illinois.edu/2015/04/14/improvements-to-idots-mechanistic-hot-mix-asphalt-pavement-design-saves-dollars-and-environment/.

HMA pavement thickness reduction based upon former HMA thickness design.

Quality Control/Quality Assurance Testing for Joint Density and Segregation of Asphalt Mixtures

Iowa

Longitudinal joint with coarse segregation.

Longitudinal joint with fine segregation.

Longitudinal joint quality control/assurance is essential to the successful performance of asphalt pavements and it has received considerable amount of attention in recent years. A longitudinal joint is the interface between two adjacent and parallel hot-mix asphalt mats. Inadequate joint construction can lead to a location where water can penetrate the pavement layers and reduce the structural support of the underlying base and sub-base layers.

This study evaluated the level of compaction at the longitudinal joint and determined the effect of segregation on the longitudinal joint performance.

Five paving projects with the use of traditional butt joint, infrared joint heater, edge restraint by milling and modified butt joint with the hot pinch longitudinal joint construction techniques were selected for the study. In general, researchers concluded that the minimum required joint density should be around 90 percent of the theoretical maximum density based on the AASHTO T166 method.

The restrained-edge by milling and butt joint with the infrared heat treatment construction methods both create a joint density higher than this 90 percent limit. A traditional butt joint exhibits lower density and higher permeability than the criterion. In addition, all of the projects appeared to have segregation at the longitudinal joint except for the edge-restraint by milling method.

More information can be found at http://publications.iowa.gov/14933/.

Acknowledgment of Sponsorship & Disclaimer

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Disclaimer: The opinions and conclusions expressed or implied in the reports are those of the research agencies. They are not necessarily those of the AASHTO or the program sponsors.

Rightsizing Concrete Pavement Design Saves Millions

Minnesota

Until recently, mechanistic-empirical pavement design software was only available for asphalt pavements in Minnesota. Local and state engineers did not have a similar tool for concrete pavements and relied on a program called RigidPave that used AASHTO's outdated 1993 design procedures.

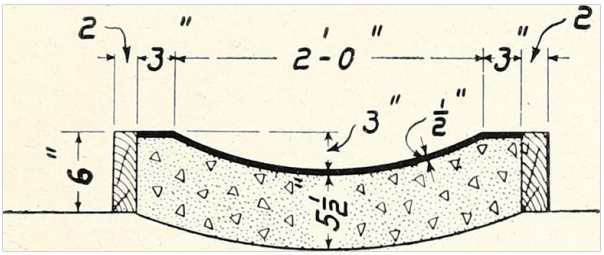
In this project, researchers developed MnPAVE Rigid, a mechanistic-empirical concrete pavement design software to replace RigidPave. It enables engineers to design the right concrete pavement for the conditions, allowing for thinner pavements that save on costs without compromising performance.

To create MnPAVE Rigid, researchers adapted AASHTO's Mechanistic-Empirical Pavement Design Guide (MEPDG) to Minnesota conditions, creating software that is portable and produces instantaneous results. An updated edition of MnDOT's Pavement Design Manual makes MnPAVE Rigid its primary design program for concrete pavements.

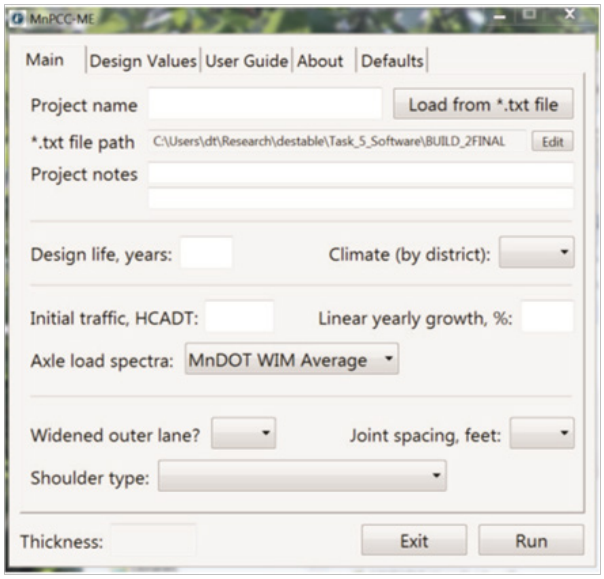
The software is a standalone Microsoft Windows executable program that can be dragged to any desktop. It is portable and requires no installation. Because MnPAVE Rigid includes a database of Minnesota concrete pavement projects, the software requires that users modify only critical input parameters and produces immediate results. It also incorporates previous MEPDG calibrations for Minnesota pavements, local climate and weigh-in-motion traffic data, and the advanced analysis features of its counterpart for asphalt pavements, MnPAVE Flexible.

MnPAVE Rigid can also be easily modified if necessary by Minnesota Department of Transportation (MnDOT) research engineers to provide new default values for advanced inputs or to modify the database using other MEPDG methods. Researchers also created a user's guide to accompany the software.

More information can be found at http://dotapp7.dot.state.mn.us/projectPages/pages/projectDetails.jsf?id=8626&type=CONTRACT.



Use of mechanistic-empirical design will allow for thinner pavements that save on costs without compromising performance.



MnPAVE Rigid allows users to modify a manageable number of inputs, while defaults for advanced parameters are preset using a database of thousands of MnDOT pavement projects.

Lessons Learned from a Pavement Marking Warranty Contract

Utah

Pavement markings at I-15 project site.

In 2012, the Utah Department of Transportation (UDOT) required for the first time a performance-based warranty on a portion of an interstate pavement marking project near Salt Lake City. The awarded contract requested a six year contractor warranty. The estimated cost was comparable to past material-and-workmanship warranty contracts but the performance specifications were much higher in the past. Life cycle analyzing models determined that the marking will need to be reapplied during the third year of warranty to meet the performance specifications. UDOT personnel involved in all phases of construction were surveyed to help researchers understand the warranty's impacts. Results of the surveys showed a consensus that the warranty contract was a more effective option than traditional, non-warranty contracts.

Expected benefits from the warranty contract include increased safety due to predicted accident reduction, a result of stricter pavement marking retroreflectivity requirements. However, the benefit-cost analysis could not be performed due to the lack of data. Once sufficient crash data is available, a safety evaluation of the new pavement markings may be performed. Nevertheless, because personnel survey feedback was positive, UDOT is considering warranty contracts for similar projects.

More information can be found at http://ntl.bts.gov/lib/51000/51100/51140/UT-13_16.pdf.

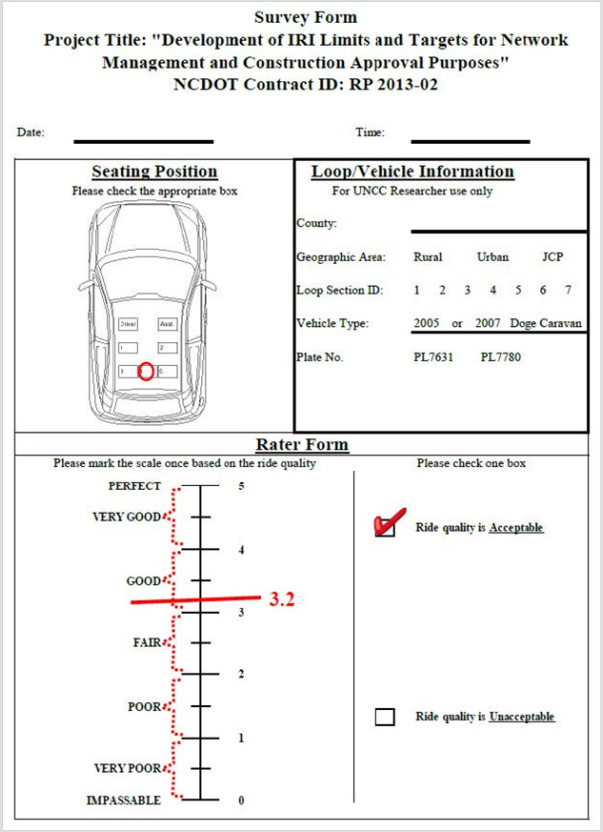
Development of IRI Limits and Targets for Network Management and Construction Approval Purposes

North Carolina

The International Roughness Index (IRI) is an important indicator of pavement condition. Since 1998, the North Carolina Department of Transportation (NCDOT) has collected IRI data but the thresholds recommended by the Federal Highway Administration (FHWA) did not reflect the ride smoothness perceived by the state's traveling public. Research was conducted by the University of North Carolina-Charlotte to better understand the relationship between ride comfort and measured IRI by selecting candidate roadway sections, recruiting research participants, collecting in-vehicle and pavement condition data, and developing an ordinal categorical model.

Researchers determined that smooth pavements (smaller initial IRI values) deteriorated at a slower rate and therefore had longer service lives. Other factors such as traffic volume and environmental conditions worked jointly to impact how the network performance IRI values change over time. The research results will help agencies understand the public's perception of unacceptable pavement conditions as it relates to IRI and will contribute to specifications and treatments. The research defines a relationship between initial construction IRI and network performance IRI, will help approve levels of construction smoothness, and set design values for Pavement-ME programs.

More information can be found at https://connect.ncdot.gov/projects/planning/RNAProjDocs/2013-02FinalReport.pdf.


Survey Form
Project Title: "Development of IRI Limits and Targets for Network Management and Construction Approval Purposes"
NCDOT Contract ID: RP 2013-02

Date: _____ Time: _____

Seating Position
Please check the appropriate box

Loop/Vehicle Information
For UNCC Researcher use only

County: _____

Geographic Area: Rural Urban JCP

Loop Section ID: 1 2 3 4 5 6 7

Vehicle Type: 2005 or 2007 Doge Caravan

Plate No. PL7631 PL7780

Rater Form

Please mark the scale once based on the ride quality

PERFECT 5
VERY GOOD 4
GOOD 3
FAIR 2
POOR 1
VERY POOR
IMPASSABLE 0
3.2

Please check one box

☑ Ride quality is Acceptable

☐ Ride quality is Unacceptable

Rater form for pavement condition survey.

Nominal Maximum Aggregate Size for WisDOT Specification

Wisconsin

National research in Superpave mix design has resulted in expansion of the nominal maximum aggregate size (NMAS) mix designs available and has established the relationship between NMAS and pavement performance. The objective of this study was to apply the findings related to NMAS and mixture performance in order to support revisions to specifications and development of application guidelines for different NMAS mixes. A revision of current standards to allow a wider range of NMAS and lift thicknesses would improve the cost effectiveness of hot mix asphalt (HMA) pavement construction.

Potential Alternative Specifications for HMA Layer Thickness

NMAS (mm)	Minimum Layer Thickness (in)		Max Layer Thickness (in)
	Fine Mixes	Coarse Mixes	
25	3	4	5
19	2.25	3	4
12.5	1.75	2	2.5
9.5	1.5	1.5	2

Research efforts consisted of laboratory testing and various simulations. The predictive models were used to analyze the relationship between NMAS and different performance-related properties such as modulus, permeability, layer coefficient, and predicted thermal cracking temperature. Based upon the research findings, Wisconsin Department of Transportation (WisDOT) changed their intermediate, case, and leveling course specifications. Revised specifications allow for the use of 9.5 mm in the surface and suggest that either a 9.5 mm or 12.5 mm surface could be used over a 19 mm lower layer. Also, HMA specifications are being updated to a combined bid item so that the binder and mix are paid as one.

More information can be found at http://wisconsindot.gov/documents2/research/final-reports-proj-briefs/WisDOT-WHRP-project-0092-12-01-final-report.pdf (final report) and http://www1.wisconsindot.gov/documents2/research/final-reports-proj-briefs/WisDOT-WHRP-project-0092-12-01-brief.pdf (research brief).