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Features

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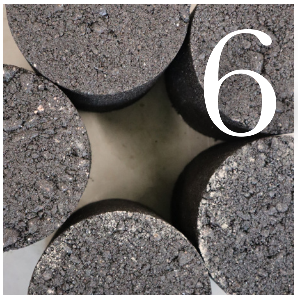
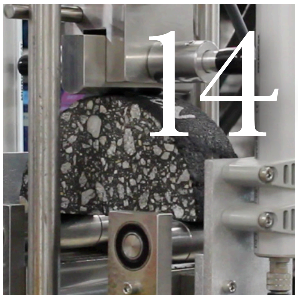
Contents





Message from the Director

Peer Pressure

The term "peer pressure" typically brings to mind a negative connotation, such as the influence of people to do dangerous activities or socially unacceptable behaviors. In my mind, I picture teenagers influenced by friends regarding how they dress, how they communicate, what they do for fun, and even what they believe. Peer pressure can certainly influence more risky behaviors. However, peer pressure can also have positive outcomes – think exercising, work ethic, giving to others. In many ways, we are influenced by our peers and, similarly, we influence them.

For three weeks in March, Fan Yin, Jim Musselman and I presented a roadmap for Balanced Mix Design (BMD) implementation the day before a series of regional BMD peer-exchanges. Peer-exchanges are helpful forums for State DOTs to discuss motivations, challenges, innovations, share goals, and learn and hear from one another. The BMD peer-exchanges are hosted by FHWA and organized by the University of Nevada, Reno (UNR) and Applied Research Associates (ARA) through a cooperative agreement. Typically, these regional peer-exchanges involve technical leaders from six to ten State DOTs. FHWA, UNR, and ARA help to facilitate the conversations. A BMD survey is sent to participants in advance to gather information on where they are on certain decisions and goals. During the peer exchanges, discussions are typically handled round-table style, giving each participant time to provide experiences, questions, and insights to each other.

Feedback from these peer-exchanges has been extremely positive. In each exchange, one or two states are typically much farther along with BMD implementation than the others and one or two states are still in the early planning stage. I've noted in many BMD workshops that implementation of BMD will be a bigger change for the asphalt community than the implementation of Superpave. It's clear from the handful of states that are already well down the path, that the process will probably take seven to ten years. That doesn't mean we should not consider implementation to be urgent. The reality is that there are several tasks that will take years to effectively complete. Just ask or observe agencies that are the early adopters of BMD.

Through the pandemic, we all missed face-to-face professional interactions from meetings and conferences. It is important that we participate in the informal peer-exchanges that occur in state, regional, and national meetings to share experiences about what works and does not work. One of the unfortunate things about some government agencies is their restrictive travel policies that severely limit their staff's opportunities to interact with their peers. To increase the value of the meetings you attend, seek out your peers and ask them about their experiences with implementing BMD or some other hot topics. I'm sure you'll get some good ideas by doing so.

I look forward to seeing you out there and hearing your thoughts.

Randy C. West

Randy C. West, Ph.D., P.E.
NCAT Director and Research Professor

Teaching Pavement Preservation in the Classroom

Conveying the importance and positive impact of proper pavement preservation is vital when teaching students. Both Dr. Adriana Vargas at Auburn University and Dr. Andrew Braham at the University of Arkansas use free, online tools to help students understand the power of pavement preservation.

Since 2017, Dr. Vargas has been teaching the graduate-level Pavement Management and Rehabilitation course. Pavement preservation is one of the course modules, where students are introduced to the different treatments available, from crack sealing to thin overlays, and where they learn how to properly select from various options based on existing pavement condition and cost-effectiveness. For most students, this is an introduction to these treatments, and understanding the processes and impact on a pavement is not always intuitive. Fortunately, NCAT offers a unique opportunity to these graduate students (and anyone else interested in pavement preservation). Only five minutes away from NCAT's main office is a half-mile research study on Lee Road 159 constructed as part of the Pavement Preservation Group (PG) Study, which gives visitors a chance to walk on 25 distinct test sections, see what the treatments look like, and observe the long-term performance and benefits from each.

In addition to the field visit, students have access ten years' worth of performance data for the test sections through an online tool on NCAT's website, developed to provide research results to the public in a user-friendly format. The tool provides pre-treatment, post-construction, and current condition values for three key performance indicators (cracking, rutting, and smoothness), as well as performance curves based on pre-treatment condition, pictures, and treatment details. This information can also be used for the course's final project, where students work in groups to implement a pavement management system using a training database. Part of the assignment consists of developing decision trees to help guide an agency through its project selection process. With the help of Lee Road 159's real world data, students have a better understanding of treatment applicability and expectations under different scenarios. At the end of the semester, students present their work as if they were talking to elected officials. Developing the skills to reach the right audience, while demonstrating a sound technical position, is critical for future professionals.

Dr. Andrew Braham also leverages the observed performance data from NCAT's pavement preservation sections on Lee Road 159, where he uses the data at the end of a semester-long, 3-part class project. The class, CVEG 4423: Transportation Infrastructure, is a required, senior-level undergraduate class. The first and second part of the project uses RoadResource.org. RoadResouce.org has comprehensive information on many types of asphalt emulsion-based pavement maintenance and pavement rehabilitation treatments. In addition, there are four calculators available where data from local agencies can be input in order to explore the behavior of the various treatments. For his class, traffic level, lane miles, existing pavement condition, and budget from the Arkansas Department of Transportation are used as inputs for two of the calculators: life cycle cost and remaining service life. In short, the class is divided into groups, where each group is assigned one maintenance treatment and one rehabilitation treatment. In the first half of the class, students get a sense that, in theory, pavement maintenance treatments may not last as long as rehabilitation treatments, but over the life span of a pavement they actually cost less money. In addition, the students find that all

maintenance treatments increase the overall condition of a pavement network over time, whereas all but two rehabilitation treatments decrease the overall condition of a pavement network over time. In fact, one of the comments from a student after the project was "Pavement preservation has the ability to provide direct, cost saving, and innovative, solutions to the varying issues within the 37,232 lane miles of highway network in Arkansas."

While these first two parts of the class project clearly demonstrate the benefits of proactive maintenance over reactive rehabilitation, they are idealized, as it is never recommended to put one single treatment on an entire network. In addition, the calculators on RoadResource.org use national-level averages for concepts such as price and life extension and assume that the treatments are being put down on a road in the proper condition for the treatment. Therefore, the data from Lee Road 159 provides a perfect platform for the third project. The students already understand the basics of the different types of treatments, and now they can analyze real data, from a real road, with real traffic, where the treatments were put on roads of varying conditions. While in general, treatments performed better when placed on the sections that were in good condition, there are of course exceptions in the "real world". This helps the students understand that while many of the concepts of pavement preservation hold true, there are of course always exceptions. Overall, the best part of this semester-long project is that by the time we get to the end of the semester, and we actually talk about pavement preservation, maintenance, and rehabilitation in class, the students have a working knowledge of these topics, so instead of them simply writing down what is said in class, there is a robust discussion of the concepts.

As pavement preservation becomes a greater priority for agencies looking to maximize cost-effectiveness, educators must adapt to prepare the next generation of pavement engineers. Going beyond traditional academic lectures and examples brings students closer to the real world. Leveraging the results from a long-term research effort to teach these concepts is one of the many contributions of the PG Study to help improve the quality of our pavement networks.

To learn more about the PG study's findings, scan the QR code above.

Contact Andrew Braham at afbraham@uark.edu or Adriana Vargas at vargaad@auburn.edu for more information about this article.

NCAT Completes Second Mixture Performance Test Round Robin

In 2021, NCAT conducted a second Round Robin evaluation to include several mixture performance tests being evaluated for balanced mix design (BMD) implementation and quality assurance (QA) during production. The objective is to help participating labs benchmark their results and generate data to develop within-lab and between-lab variability estimates of the different test procedures. NCAT reached out to State DOTs, contractors, consulting firms, and materials suppliers to learn what tests would be of interest for this second Round Robin evaluation. Participating labs selected the tests they wanted to perform. The most popular tests in the evaluation are:

- Hamburg Wheel Tracking Test [HWTT] (AASHTO T 324-19),
- Asphalt Pavement Analyzer [APA] (AASHTO T 340-10),
- IDEAL Cracking Test or IDEAL-CT (ASTM 8225-19),
- High-temperature Indirect Tensile Strength Test (HT-IDT), and
- Indirect Tensile Asphalt Rutting Test [IDEAL-RT] (ASTM D8360-22).

The HT-IDT and IDEAL-RT are two relatively new rutting tests that are gaining popularity for QA evaluation; because they are simple, quick, repeatable, and correlate well with the traditional wheel-tracking rutting tests (i.e., HWTT and APA). Both tests can be conducted in a Marshall-style press and are similar. The IDEAL-RT uses a shear fixture instead of an indirect tension fixture, as shown in Figure 1. The HWTT, APA, and IDEAL-CT were all previously evaluated in the 2018 NCAT Round Robin.

For the evaluation, a single plant mix produced for an experiment on the 2021 NCAT Test Track is used. This mixture was designed using the BMD process. The mixture is a 12.5 mm NMAS mix containing a PG 64-22 binder and 20% RAP. Participating labs received enough plant mix to fabricate specimens for their selected tests. NCAT provided the participating labs with detailed instructions on specimen fabrication and testing along with data files to report the results.

NCAT screened the data for the Round Robin evaluation for quality prior to incorporation into the database. The database was then used to determine the within-lab and between-lab coefficients of variation (CV) of the tests per ASTM E691-19 "Standard Practice for Conducting an Interlaboratory Study to Determine the Precision of a Test Method". As noted in the 2018 Round Robin evaluation, ASTM E691-19 recommends between three to six materials to be included to develop full precision statements. Although this evaluation only included one mixture, the data is still useful to provide preliminary estimates of test variability.

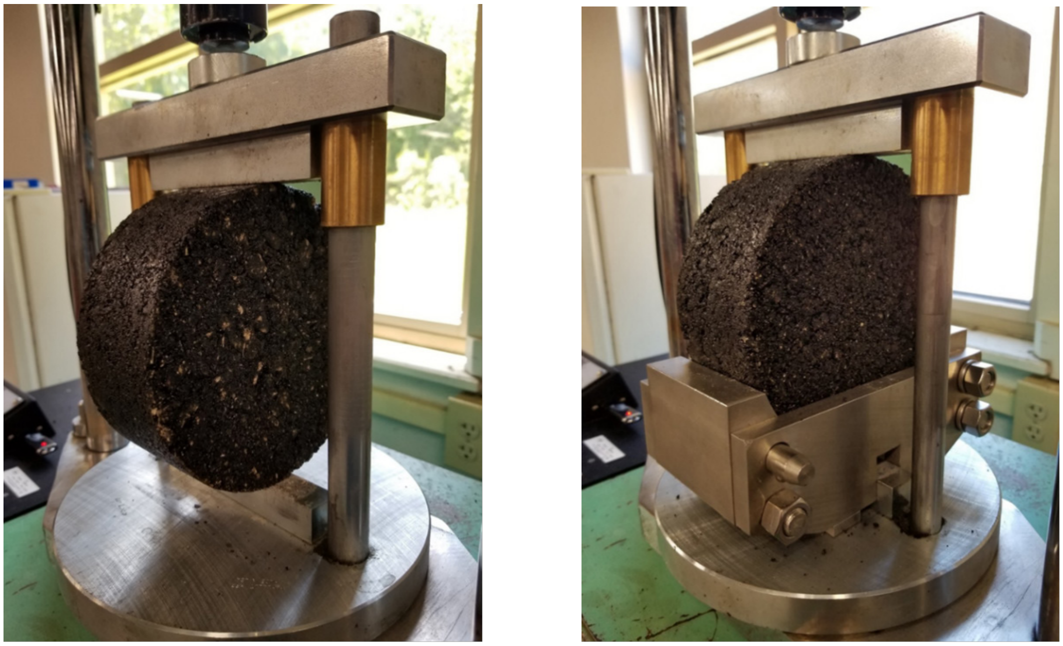


Figure 1. HT-IDT Test Setup (left) and IDEAL-RT Test Setup (right)

The within-lab and between-lab variability estimates for this second Round Robin are summarized in Table 1. The main findings from this evaluation are as follows:

IDEAL-CT was conducted at 25°C. Forty-six (46) labs were included in the evaluation and no labs were identified as outliers. The average CT_{Index} was 106.0, with a within-lab CV of 20.5%, and a between-lab CV of 30.2%. When compared to the results of the 2018 evaluation, the within-lab CV are consistent for both studies at around 20%. The between-lab CV for the 2022 study is 5% lower compared to the 2018 study. This is likely due to triple the number of labs participating in the 2022 study relative to the 2018 study.

HWTT was conducted at 50°C and the variability was assessed for rut depths at 20,000-wheel passes. Forty (40) labs were included in the analysis, with two labs deemed as outliers and removed from the analysis. The average rut depth at 20,000 passes was 3.49 mm, with a within-lab CV of 9.5% and a between-lab CV of 31.1%. When compared to the results of the 2018 study, the within-lab CV was around 10% for both studies. The between-lab CV showed a 5% increase when compared to the 2018 results. Since the mixtures and the participating labs for both studies were different, this may have contributed to the difference in the between-lab variability between the two Round Robin studies.

APA test was conducted at 64°C. The analysis included fifteen (15) labs with no outlier labs removed from the analysis. The average rut depth was 4.5 mm with a within-lab CV, and between-lab CV of 12.0% and 24.5%, respectively. Both the within-lab and between-lab variations obtained for this study were lower than those reported in the 2018 study. This may be attributable to an increase in the number of participating labs in the 2022 study.

IDEAL-RT was conducted at 50°C. Thirteen (13) labs were included in the evaluation with no outlier labs identified. The average RTIndex was 105.9 with a within-lab CV of 7.9% and between-lab CV of 24.3%.

HT-IDT was also conducted at 50°C with eighteen (18) labs included in the evaluation. Two labs were identified as outliers and removed from the analysis. The results yielded an average ITS of 31.4 psi with a within-lab CV of 8.3% and between-lab CV of 14.6%. From all the rutting tests evaluated in the second Round Robin, the HT-IDT yielded the lowest between-lab variability.

NCAT's goal is to conduct similar Round Robin studies every couple of years to support the asphalt industry with their BMD implementation effort, which will result in improved pavement performance.

Table 1. ASTM E 691-19 Precision Estimates-Second NCAT Round Robin Study

Test	Number of Labs (Outliers)	Test Parameter	Average Result	Within-Lab CV (%)	Between-Lab CV (%)
IDEAL-CT	46 (0)	CT_{Index}	106.0	20.5	30.2
HWTT	40 (2)	Rut depth-20,000 passes (mm)	3.49	9.5	31.1
APA	15 (0)	Auto Rut Depth (mm)	4.50	12.0	24.5
IDEAL-RT	13 (0)	RT_{Index}	105.9	7.9	24.3
HT-IDT	16 (2)	Indirect Tensile Strength (ITS)	31.4	8.3	14.6

Contact Carolina Rodezno (left) at mcr0010@auburn.edu, Adam Taylor (middle) at tayloa3@auburn.edu, or Nathan Moore (right) at ndm0005@auburn.edu for more information about this research.

A Roadmap for BMD Implementation

Balanced Mix Design represents a new era in how asphalt mixtures are designed and accepted and is a major first step in the implementation of performance specifications. As such, it continues to be a primary focus among many highway agencies and industry stakeholders. A few states have already implemented specifications using BMD tests and criteria as part of their routine asphalt paving projects, and several others are quickly moving toward that goal. Most states, however, are in the process of gathering test data and trying to figure out how to establish criteria and address other gaps and questions prior to moving forward.

Implementing BMD will be a big change for highway agencies and the asphalt paving industry, and a number of important decisions will need to be made along the way, such as:

- Which BMD tests should we use?
- How do we establish criteria for the new tests?
- Do we add the BMD tests and criteria to existing mix design criteria or replace legacy criteria with BMD criteria?
- Should BMD be used for special applications, specific categories of projects, or all mix types on all projects?
- How should we deal with the effect of mixture aging in a BMD system?
- What approach should an agency use to validate a contractor's BMD test results?
- Should BMD tests be used in quality control and acceptance decisions, and if so, at what frequency and what actions should be taken when a production mix sample fails the criteria?
- What timeline is appropriate for achieving BMD implementation milestones?

NCAT researchers recently completed a guide for BMD Implementation as part of NCHRP project 10-107. The guide presents NCAT's current recommendations based on experiences from Superpave implementation, guidance in existing AASHTO standards and reports, and the evolving body of research on BMD testing. The guide includes eight chapters that coincide with the eight major steps to implementation, as shown in Figure 1.

Chapter One discusses the motivations for implementing BMD. Many highway agencies are motivated to try BMD because they are not satisfied with the field performance of their asphalt pavements built with current specifications. Some people understand the significant weaknesses with current methods on which the legacy criteria are based. Some also believe that we have to change to a system that better evaluates a mixture's resistance to performance so that we will be able to utilize technologies that are longer-lasting and pavement materials that are more sustainable. The chapter references case study reports from seven "early adopter" BMD states that have either begun to implement BMD or have already gone "full Monty" into BMD.

Chapter Two covers key elements in planning the overall implementation process. The guide recommends identifying leaders for change in the agency and the industry, as well as a BMD technical committee to map out goals, identify resources, and address knowledge gaps. Major tasks and subtasks are listed, and an example Gantt chart is provided to aid in planning.

Chapter Three presents guidance on selecting BMD tests and validating their relationships to pavement distresses. A critical step is to identify the jurisdiction's primary modes of distress so that appropriate tests can be selected. The chapter discusses the impact of reheating and mixture aging on test results and acknowledges that decisions need to be made on these procedures that balance timeliness and the importance of providing tests that reasonably represent the field conditions when the distresses develop. One of the most important recommendations of the guide is to validate the relationships between the lab test results and field performance on real projects in each state. Although this can be done in several ways, the best approach is to build test sections for a validation experiment that will become the basis of setting appropriate BMD criteria. NCAT is now developing more detailed guidance specifically for field validation experiments through funding from CAPRI.

Chapter Four covers considerations for acquiring equipment, allocation of laboratory space, staffing needed to work on implementation efforts, and preliminary training. In addition to purchasing new equipment for contractor and agency labs, all organizations need to consider additional human resources needed to gear up for BMD and training new and experienced personnel on the new tests and consistent sample preparation procedures. Participating in a proficiency testing program is recommended as an excellent way to make sure the BMD tests are being conducted properly.

Chapter Five provides recommendations for establishing baseline data. The first part of the chapter discusses developing and analyzing benchmarking databases of existing mixtures. It is vital that benchmarking databases include detailed information and results for lab-prepared mixtures and plant-produced mixtures representing a wide range of materials used in the state. The second part of the chapter discusses shadow projects which involve sampling and BMD testing of numerous plant-produced mixtures at the same frequency currently used for acceptance testing. The results of the BMD tests are for informational purposes only. The primary goal of shadow project testing is to gather production variability data for the new tests. The "within-lot" standard deviation or coefficient of variation are the key production variability statistics of interest, which contractors need to set production targets to avoid results that fail to meet the agency's BMD criteria.

Chapter Six presents considerations needed to develop BMD specifications and possible adjustments to a state's Quality Assurance Program. This chapter assumes that BMD testing will eventually become part of routine testing for QC and acceptance of plant-produced mixtures. For that to happen, agencies may need to consider revisions to their sampling and testing plans, reevaluate their acceptance quality characteristics (i.e., pay factor items), and incentive and disincentive provisions. Much of the data gathered in Chapter 5 will be needed to make appropriate decisions for pilot specifications. Pilot projects are recommended for the first few years of implementation to gain familiarity with the tests and specifications and allow for adjustments in the system.

Chapter Seven discusses possible modifications for an agency's asphalt technician training and qualification and laboratory accreditation programs. Ongoing research indicates that most BMD tests are more sensitive to sample handling and specimen preparation than volumetric properties. Agency and contractor testing personnel will need training on the new methods to ensure accurate and meaningful results. New checks will also be needed for laboratory accreditations.

And finally, Chapter Eight presents basic guidance on transitioning to the new methods, specifications, and QA program to full implementation. The key point in this chapter is that the early stages of implementation should include a process for feedback and possible adjustments to test methods, criteria, sample frequencies and handling protocols, training efforts, etc., through agency and industry collaboration. The BMD technical committee suggested in Chapter 2 should provide a forum for discussion of issues and collaborative solutions throughout the process of BMD implementation.

For a copy of the draft final BMD implementation guide, click this link or visit the NCAT website, www.ncat.us.

Contact
Randy West at
westran@auburn.edu
for more information
about this research.

Validation of Rapid Rutting Test Procedures Using Plant Mixtures from the 2021 NCAT Test Track

Many State Departments of Transportation (DOTs) use either the Asphalt Pavement Analyzer (APA) or the Hamburg Wheel-Track Test (HWTT) during the mix design process to evaluate rutting resistance. Currently, eleven (11) State DOTs specify the APA during mix design and sixteen (16) State DOTs specify the HWTT during mix design.1 While these two tests are well-regarded and widely used for mix design, they are not considered optimal for use during routine quality control/quality assurance (QC/QA) testing. This is due to the longer conditioning and testing time required (i.e., 7 to 9 hours total) and the lack of equipment availability among industry contractors. There is a research need to select appropriate rapid rutting tests (RRT) for routine QC/QA testing during plant production.

Two promising RRT have been proposed for a production setting, which include the indirect tension test at high temperatures (HT-IDT) and the indirect tensile asphalt rutting test (IDEAL-RT). The indirect tensile strength (ITS) and rutting test index (RTIndex) are the rutting test parameters determined from HT-IDT and IDEAL-RT, respectively. Both HT-IDT and IDEAL-RT are rapid strength tests, which use an IDT fixture or a shearing fixture, respectively. These tests require only a short conditioning time (around 1 hour in a water bath) prior to the quick strength test (around 5 minutes for 3 replicates). Some preliminary studies indicated that both RRT showed good correlations with the two wheel-tracking tests (i.e., APA and HWTT) or limited field rutting performance.

During construction of the 2021 NCAT Test Track, NCAT further validated the two RRT using (14) fourteen unique Test Track surface mixtures with a wide spectrum of mixture components including different additives, binder types, binder contents, RAP contents, aggregate types, and aggregate gradations. The plant-mixed lab-compacted (PMLC) specimens for all mixtures were tested using the two RRT (i.e., HT-IDT and IDEAL-RT) and two wheel-tracking tests (i.e., APA and HWTT) to evaluate the mixture rutting resistance. Two aging conditions were evaluated – Production PMLC and Re-heated (RH) PMLC. Production PMLC specimens were compacted the same day as paving, while the re-heated PMLC mix was allowed to cool prior to being re-heated and tested later. APA testing was only conducted on RH PMLC specimens. The rutting test results were collected and analyzed to:

- evaluate the correlations among four rutting test parameters, and
- determine the preliminary threshold values of the rapid rutting parameters (i.e., ITS and RTIndex).

Pearson correlation analysis is used to investigate the relationship among the four rutting test parameters. Pearson correlation measures the strength of the relationship between two variables. The correlations indicated that there was a very strong linear correlation between HT-IDT ITS and IDEAL-RTIndex at both aging conditions, and HWTT rut depth had strong power correlations with two rapid rutting parameters (i.e., ITS

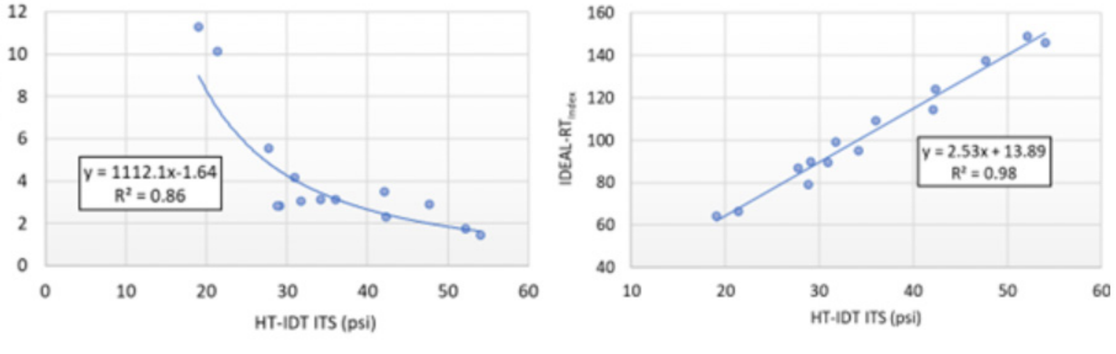


Figure 1. Examples of Correlations among Different Rutting Test Parameters; (a) Reheated HT-IDT ITS Vs. HWTT Rut Depth; (b) Reheated HT-IDT ITS Vs. IDEAL-RTIndex

and RTIndex), as shown in Figure 1. However, no strong correlation existed between APA rut depth and the other three rutting test parameters for the materials used in this study.

Based on the strong power correlations between HWTT rut depth and two RRT parameters, the preliminary threshold values of two RRT parameters corresponding to the HWTT rut depth criteria of 12.5 mm at 20,000 passes were determined at both aging conditions. As presented in Table 1, the preliminary threshold values of ITS for reheated and production PMLC are 18.5 psi and 22.2 psi, respectively. The preliminary threshold values for RTIndex are 60.2 and 74.8 for reheated and production PMLC mixtures, respectively. The existing threshold values of ITS and RTIndex parameters from the literature are generally consistent with the values obtained in this study. In the future, these test results can be compared against the eventual field rutting of these sections on the 2021 NCAT Test Track.

Table 1. Preliminary Threshold Values of ITS and RTIndex

Rapid Rutting Parameters	Reheated PMLC	Production PMLC	Threshold Values from Literature[5-6]
ITS (psi)	18.5	22.2	20 (ALDOT BMD Special Provision)
RT_{Index}	60.2	74.8	60 – 75 depending on the binder type

References

National Asphalt Pavement Association 2022, National Asphalt Pavement Association website, accessed July, 2022, https://www.asphaltpavement.org/expertise/engineering/resources/bmd-resource-guide.

Bennert, T., Haas, E., & Wass, E. (2018). Indirect Tensile Test (IDT) to Determine Asphalt Mixture Performance Indicators during Quality Control Testing in New Jersey. Transportation Research Record Vol. 2672(28), 394-403.

Zhou, F., Crockford, B., Zhang, J., Sheng, H., Epps, J., & Sun, L. (2019). Development and Validation of an Ideal Shear Rutting Test for Asphalt Mix Design QC/QA. Journal of the Association of Asphalt Paving Technologists, 719-750.

Yin, F., Taylor, A. J., & Tran, N. (2020). Performance Testing for Quality Control and Acceptance of Balanced Mix Design. Auburn, AL: NCAT Report 20-02.

Yin, F., & West, R. C. (2021). Balanced mix design resource guide (No. IS-143).

Zhou, F., Steger, R., & Mogawer, W. (2021). Development of a coherent framework for balanced mix design and production quality control and quality acceptance. Construction and Building Materials, 287, 1230.

Contact Chen Chen (left) at czc0105@auburn.edu, Adam Taylor (middle) at tayloa3@auburn.edu, or Nathan Moore (right) at ndm0005@auburn.edu for more information about this research.

Searching for a Test to Evaluate Low Temperature Cracking Potential

Most state agencies are embracing the idea of specifying asphalt mixtures using a balanced mix design (BMD) approach. A key decision in the process of implementing BMD is selecting appropriate tests to assess resistance to the primary asphalt distresses encountered by a particular highway agency. Low-temperature thermal cracking is a common distress in regions that experience rapid drops in temperature.

In 2014-2015, MnROAD and NCAT developed an experiment to validate laboratory asphalt mixture cracking tests known as the Cracking Group Experiment. Two complimentary experiments were conducted: an experiment to validate tests for top-down cracking and an experiment to validate tests for low-temperature thermal cracking (LTC) of asphalt mixtures. The experiment to validate top-down cracking was built on the NCAT Test Track in 2015, and the experiment for LTC was built at MnROAD in 2016. The top-down cracking experiment results were published in NCAT Report 21-03 and summarized in the fall 2021 NCAT newsletter.

The MnROAD Cracking Group experiment was sponsored by DOTs in Illinois, Michigan, Minnesota, New York, and Wisconsin. The experiment included eight test sections (cells) constructed on MnROAD cells 16-23. Each cell included two 12-foot travel lanes with a 10-foot outside shoulder and a 4-foot inside. Figure 1 shows the cell locations on the MnROAD mainline and their structural layout. Each cell had the same pavement structure but different surface mixtures designed with various recycled materials contents and binder grades to provide a wide range of expected thermal cracking performance. Field performance of the cells was monitored for 5 ½ years.

Eight cracking tests were evaluated in the testing plan as shown in Table 1. Five of the tests are conducted at low temperatures and are considered to be thermal cracking tests, and three of the tests are conducted at intermediate temperatures as general cracking tests, but were included in the experiment to determine if meaningful correlations exist with the field performance of the cells.

The cracking tests were conducted on plant mixes sampled during construction. For each mix, two sets of plant-mixed, laboratory-compacted samples were prepared. The first set was compacted after samples were reheated to the compaction temperature. The second set of samples were prepared using reheated mix that was then critically aged for six hours at 135°C prior to compaction. The term "critical aging" was introduced by NCAT to simulate four to five years of in-service aging of surface asphalt layers. For the UTSST, the second set of samples were prepared with reheated mix then the compacted samples were long-term oven aged at 85°C for five days per AASHTO R30. Low-temperature SCB tests were only conducted on reheated samples. Correlations were made using distress survey results from 2020, 2021, and 2022 (3 ½, 4 ½, and 5 ½ years of service) to the eight lab test results for both aging conditions.

Based on the results of the MnROAD low-temperature cracking study, the following findings are provided:

Although the experiment was intended to yield a wide range of thermal cracking performance, the actual range was tighter than expected due to the properties of the asphalt mixture components. For example, the RAP and RAS used in the mixtures were relatively soft so the range of recovered binder grades from the experimental mixtures was narrow. Overall, the narrow range of material properties caused many of the mixtures to have similar thermal cracking field results, which diminished the reliability of the lab to field relationships.

Disk-shaped Compact Tension Test (DCT): The fracture energy results generally had good repeatability with

Figure 1. Figure 1. (a) Aerial view of MnROAD Cracking Sections on MnROAD Mainline, and (b) Section Pavement System Structural Designs

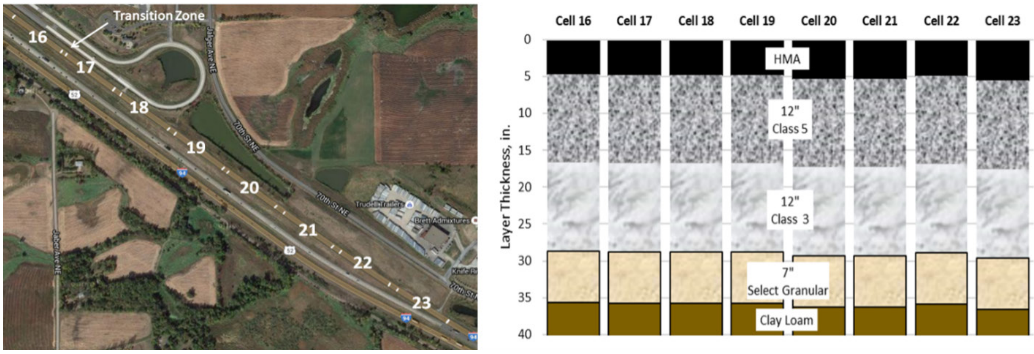
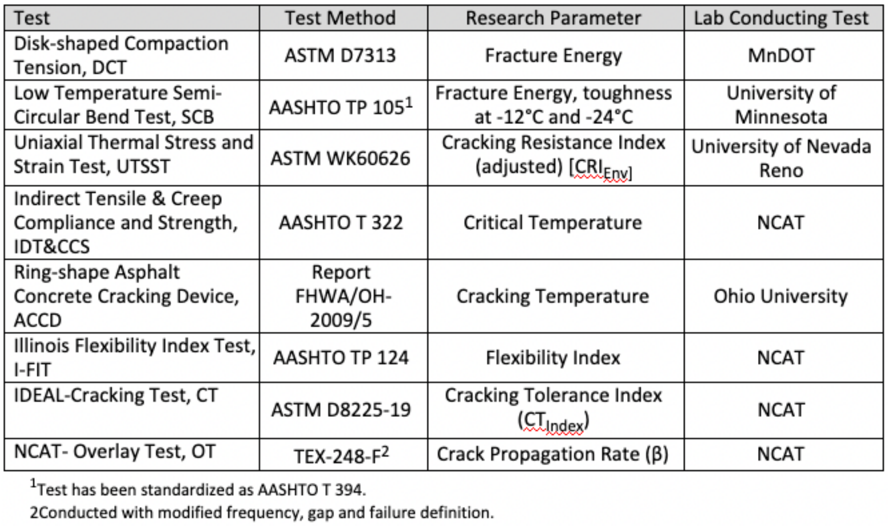


Table 1. MnROAD Cracking Group Test Evaluated.



Test	Test Method	Research Parameter	Lab Conducting Test
Disk-shaped Compaction Tension, DCT	ASTM D7313	Fracture Energy	MnDOT
Low Temperature Semi-Circular Bend Test, SCB	AASHTO TP 105[1]	Fracture Energy, toughness at -12°C and -24°C	University of Minnesota
Uniaxial Thermal Stress and Strain Test, UTSST	ASTM WK60626	Cracking Resistance Index (adjusted) [CRI_{Env}]	University of Nevada Reno
Indirect Tensile & Creep Compliance and Strength, IDT&CCS	AASHTO T 322	Critical Temperature	NCAT
Ring-shape Asphalt Concrete Cracking Device, ACCD	Report FHWA/OH-2009/5	Cracking Temperature	Ohio University
Illinois Flexibility Index Test, I-FIT	AASHTO TP 124	Flexibility Index	NCAT
IDEAL-Cracking Test, CT	ASTM D8225-19	Cracking Tolerance Index (CT_{Index})	NCAT
NCAT- Overlay Test, OT	TEX-248-F[2]	Crack Propagation Rate (β)	NCAT

[1] Test has been standardized as AASHTO T 394.

2Conducted with modified frequency, gap and failure definition.

within-lab coefficients of variation (COVs) between 10 to 16%. The correlation between the lab results and field performance appeared to improve with mixture aging. Moderate to strong correlations with thermal cracking were found with the critically aged results, with DCT showing the strongest correlation with thermal cracking after 5 ½ years of service (R^2=0.85).

Low-Temperature Semi-Circular Bend Test (SCB): The fracture energy results had within-lab COVs between 7 and 37%; fracture toughness results had COVs of 5 to 17%. For tests conducted at -24°C, fracture energy and toughness results had strong correlations to field performance with R^2 values of 0.79 and 0.89, respectively.

Uniaxial Thermal Stress and Strain Test (UTSST): The CRIEnv parameter had low correlations to field performance with R^2 values of 0.33 and 0.20 for the results of reheated and aged samples, respectively.

Indirect Tensile Creep Compliance and Strength Test (IDT-CC&S): For tests conducted on reheated mixtures, the critical temperature did not correlate to field performance, while the correlation for test results using critically aged mixtures had a fair correlation (R^2=0.60).

Asphalt Concrete Cracking Device (ACCD): Results from this test did not correlate well with the field performance of the sections. The critical low temperature results indicated poor correlations to the field performance with R^2 values of 0.28 and 0.21 for results of reheated and critically aged samples, respectively.

IDEAL Cracking Test (IDEAL-CT): The within-lab COVs of CT_{Index} ranged from 5 to 28%. The IDEAL-CT results for reheated mixtures had a poor to moderate correlation with field performance. For critically aged mixtures, CT_{Index} had moderate correlations with thermal cracking at 3 ½ and 4 ½ years of service, but the correlation was much stronger at 5 ½ years (R^2=0.84).

Illinois Flexibility Index Test (I-FIT): Within-lab COVs of the Flexibility Index (FI) ranged from 16 to 63%. For reheated mixtures, FI had a poor correlation to field performance. For critically aged mixtures, FI had weak correlations with thermal cracking at 3 ½ and 4 ½ years of service, but the correlation improved (R^2=0.70) for the 5 ½ year field performance data.

NCAT Overlay Test (OT): The within-lab COVs of the β parameter ranged from 7 to 73%. For reheated mixtures, the β parameter had a strong correlation to low temperature cracking, with the highest correlation at 3 ½ years of services (R^2=0.96). For critically aged mixtures, the strength of the correlations between the β parameter and field data was lower but still moderate to strong with the highest correlations with field performance at 5 ½ years of service (R^2=0.85).

Overall, the DCT and SCB tests had the best correlations with field performance. The IDEAL-CT test also had good correlations to thermal cracking for critically aged mixtures. Although the OT test results had the highest R^2, its high variability diminishes its utility as an indicator of thermal cracking.

Contact Carolina Rodezno at mcr0010@auburn.edu for more information about this research.

Assessing the Sensitivity of the IDEAL-CT and the I-FIT to Polymer Modification

As the asphalt pavement industry moves toward the implementation of balanced mix design (BMD), asphalt practitioners have been exploring innovative approaches to design asphalt mixtures with balanced rutting and cracking resistance. One potential approach is polymer modification to improve the quality of the asphalt binder. However, several existing studies found that using polymer modified asphalt (PMA) did not improve the cracking resistance of the mixture measured in the Indirect Tensile Asphalt Cracking Test (IDEAL-CT) and the Illinois Flexibility Index Test (I-FIT). This finding contradicts the superior cracking performance of many field projects using PMA versus unmodified asphalt mixtures, highlighting a potential limitation of the IDEAL-CT and the I-FIT as not being sensitive to polymer modification.

In a recently completed National Road Research Alliance (NRRA) study, researchers at NCAT and Mathy Technology and Engineering Services, Inc. (MTE) assessed two hypotheses for the lack of sensitivity of the IDEAL-CT and the I-FIT to polymer modification:

Hypothesis 1 is "Testing the IDEAL-CT and I-FIT at the volumetric optimum binder content (OBC) of the mixture is not sufficient to capture of the benefits of polymer modification." Many Superpave asphalt mixtures are lacking asphalt binder and thus have inadequate cracking resistance. Using PMA in these mixtures will improve the overall quality of the asphalt binder, but this improvement is not sufficient to affect the cracking resistance of the mixture. In other words, polymer modification alone cannot fix a "dry mix" issue. In this case, more asphalt binder would be needed to capture the benefits of polymer modification on improving the IDEAL-CT and the I-FIT results.

Hypothesis 2 is "The IDEAL-CT and I-FIT must be conducted at an equal stiffness condition to properly assess the cracking resistance of PMA versus unmodified asphalt mixtures." Currently, both tests are conducted at 25°C with a constant loading rate of 50 mm/min, and the final cracking index parameters [cracking tolerance index (CT_{Index}) for the IDEAL-CT and flexibility index (FI) for the I-FIT] are calculated based on the fracture energy (Gf) and the post-peak slope of the load-displacement curve. A high Gf and a moderate post-peak curve are desired for good cracking resistance. Polymer modification tends to stiffen the asphalt binder but while making it more ductile at the same time. As a result, the PMA mixture will have a higher Gf but a steeper post-peak curve, which could yield a similar or lower CT_{Index} and FI value than the unmodified mixture. This limitation could be addressed by running the test at an equal stiffness condition to better characterize the impact of the binder's elasticity and relaxation property on the cracking resistance of the mixture.

The study includes two mix designs (one from Alabama and one from Wisconsin) and four sets of virgin binders. As shown in Table 1, each set of virgin binders included an unmodified binder, a styrene-butadiene-styrene (SBS) modified binder, and a reactive ethylene terpolymer (RET) modified binder, where the two modified binders were formulated with the same unmodified binder to avoid the confounding impact of different base binders. The Alabama mix design was a 9.5 mm NMAS Superpave mixture with 20% RAP, and the Wisconsin mix design was a 12.5mm NMAS Superpave mixture with 23% RAP. The volumetric OBC of the two mix designs were 5.5% and 5.1%, respectively.

To assess the first hypothesis of the study, each mixture was tested with the IDEAL-CT and the I-FIT at three binder contents: volumetric OBC, + 0.3%, and + 0.6%. Both tests were conducted at 25°C following the current ASTM and AASHTO procedures. Test results were compared across the three virgin binders at each binder content to determine if increasing the binder content beyond the volumetric OBC could better capture the

Table 1. Mix Design and Virgin Binder Summary

Mix Design	Virgin Binder	
Alabama	Set 1 (PG xx-22)	PG 64-22, PG 76-22 RET, PG 76-22 SBS
	Set 2 (PG xx-28)	PG 58-28, PG 64-28 RET, PG 64-28 SBS
Wisconsin	Set 3 (PG xx-28)	PG 58S-28, PG 58V-28 RET, PG 58V-28 SBS
	Set 4 (PG xx-34)	PG 52S-34, PG 58V-34 RET, PG 58V-34 SBS

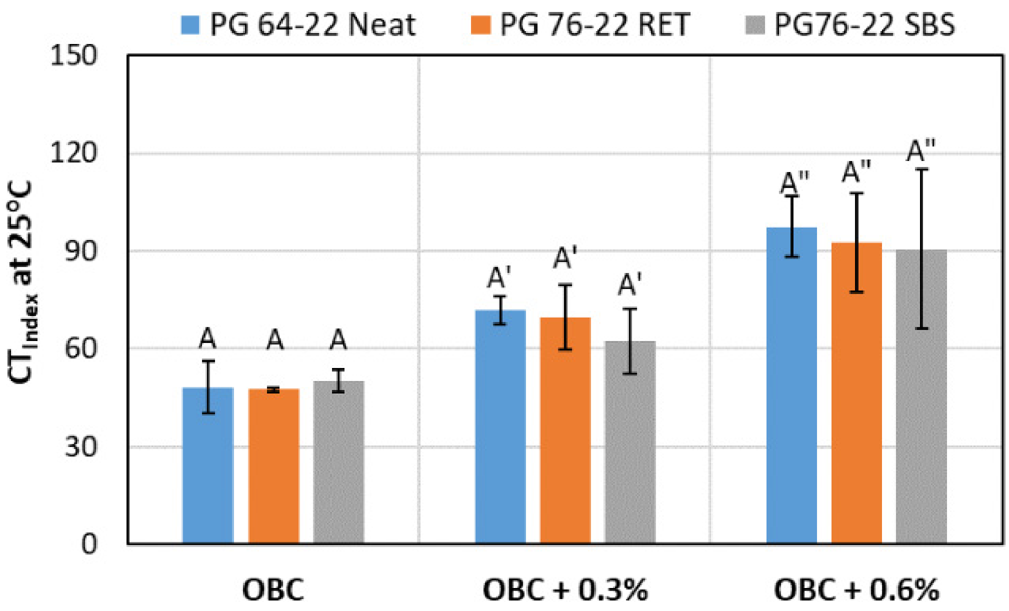


Figure 1. IDEAL-CT Results of Alabama Mixtures with PG xx-22 Binders at 25°C

improved cracking resistance of the mixture due to polymer modification. Figure 1 presents the IDEAL-CT results of the Alabama mixtures with PG xx-22 binders for illustration purposes. Increasing the binder content consistently increased the CT_{Index} of all the mixtures, indicating improved cracking resistance. However, at all binder contents, the two PMA mixtures had statistically equivalent CT_{Index} results as the unmodified mix, which indicated that the CT_{Index} was not sensitive to polymer modification regardless of the binder content. The IDEAL-CT and the I-FIT results for the other combinations of mix designs and virgin binders showed similar trends. Therefore, Hypothesis 1 of the study was rejected.

To assess the second hypothesis of the study, additional IDEAL-CT and I-FIT testing at the volumetric OBC was conducted at an equal stiffness temperature (T=G*) in addition to 25°C. The T=G* was determined based on the Torsion Bar Modulus test, which varied from 22 to 25°C among the Alabama mixtures and 19 to 28°C

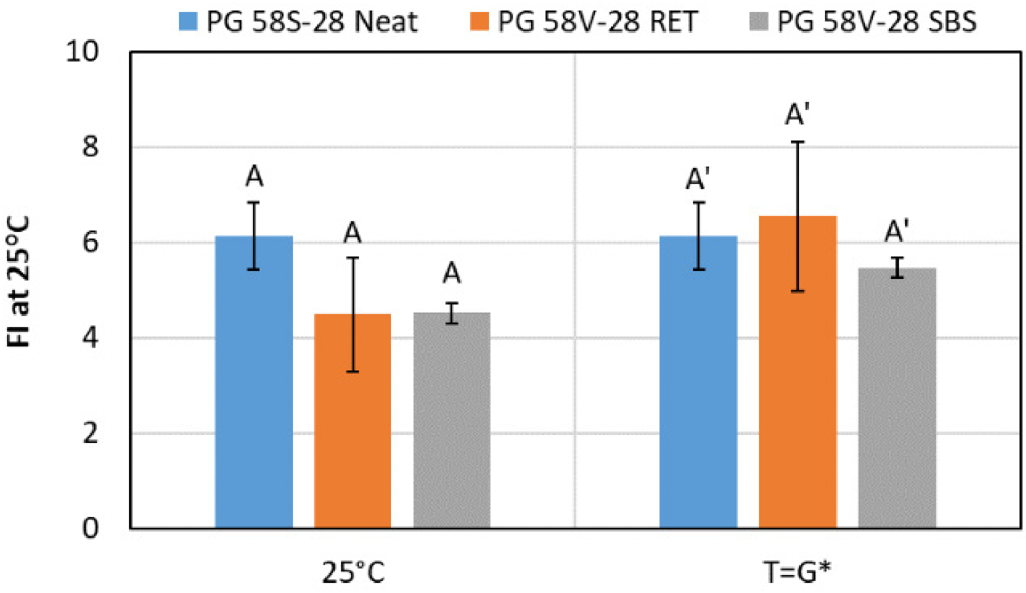


*Figure 2. I-FIT Results of Wisconsin Mixtures with PG xx-28 Binders at 25°C versus T=G**

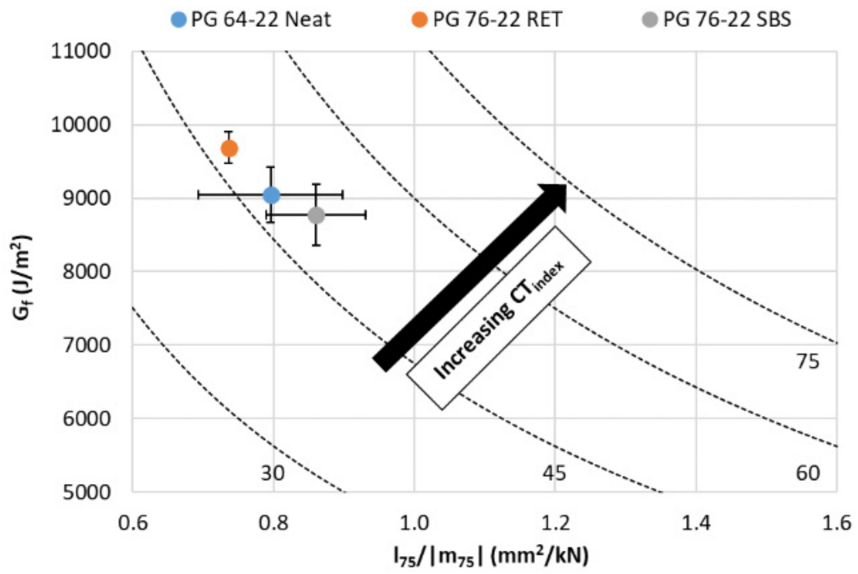
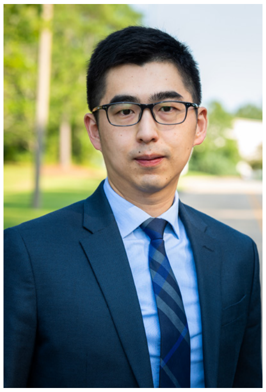


Figure 3. IDEAL-CT Interaction Diagram of Alabama Mixtures with PG xx-22 Binders at 25°C

among the Wisconsin mixtures. Figure 2 presents the I-FIT results of the Wisconsin mixtures with PG xx-28 binders at 25°C and T=G*. At both test temperatures, the two PMA mixtures had statistically equivalent FI results as the unmodified mixture when the test variability was considered. Similar findings were observed in the IDEAL-CT results, which indicated that adjusting the test temperature to T=G* did not help discriminate the cracking resistance of PMA versus unmodified mixtures. Therefore, Hypothesis 2 of the study was also rejected.

In addition to assessing the two hypotheses discussed previously, the IDEAL-CT and the I-FIT results were also evaluated using the interaction diagram analysis developed in Yin et al. (2023). The analysis showed that in most cases, polymer modification had a notable impact on the load-displacement curve, but its impacts on the fracture energy (Gf) and the post-peak parameters tended to offset each other on the CT_{Index} and the FI value. As shown in Figure 3, the direction of change in the IDEAL-CT and the I-FIT results due to polymer modification on the interaction diagram was almost perpendicular to the direction of increasing CT_{Index} or FI. As a result, the PMA and unmodified mixtures fell on similar CT_{Index} and FI contour curves despite having different Gf and post-peak parameters.

In summary, the study concluded that the current IDEAL-CT and I-FIT procedures and parameters are not sensitive to polymer modification. Future research was suggested to explore alternative parameters from the interaction diagram analysis that could discriminate PMA versus unmodified mixtures. In the meantime, SHAs were suggested to use the same IDEAL-CT and I-FIT criteria for asphalt mixtures containing PMA and unmodified binders with the same base binder grade. More detailed results and findings of the study can be found on the NRRA website.



Contact Fan Yin at f-yin@auburn.edu for more information about this research.

Cold Recycling Finally Has a Construction Guide Specification!

For years, readers of this newsletter have found interesting information and updates on Cold Recycling (CR) processes, such as Cold Central Plant Recycling (CCPR) and Cold In-place Recycling (CIR). With all the talk of great performance even on high-traffic volume roads (and the famed NCAT Test Track) there has been a deluge of State Departments of Transportation (DOTs) personnel, Federal Agencies, and even industry members looking to NCAT experts to provide insight into how to craft a specification to deliver a high-quality, reliable CR pavement. This has been especially important considering NAPA's The Road Forward plan, the industry's drive to net-zero emissions, and U.S. DOT grant opportunities (such as FHWA's Climate Challenge projects), which focuses on lowering greenhouse gas (GHG) emissions and energy associated with producing and constructing pavements.

In 2020, a team from NCAT led by Principal Investigator (PI) Dr. Benjamin Bowers, PE (that's me!) was awarded National Cooperative Highway Research Program (NCHRP) Project 14-43, Construction Guide Specifications for Cold Central Plant Recycling and Cold In-Place Recycling. Team members included Co-PI Dr. Brian Diefenderfer, P.E. at the Virginia Transportation Research Council (VTRC), Auburn/NCAT alumnus, Asphalt Recycling and Reclaiming Association (ARRA) technical director Dr. Stephen A. Cross of S. Cross & Associates, LLC, NCAT Associate Research Professor Dr. Adriana Vargas, and former Assistant Research Professor Dr. Fan Gu, PE. The objectives of this research project are to develop and produce a proposed AASHTO Construction Guide Specification, and develop a Best Practices Guide and training materials for the construction of CIR and CCPR.

You might ask: how do you go about putting together an AASHTO Construction Guide Specification? The first step was to assemble the right team: Our team consists of implementation-minded academics (Bowers, Vargas, Gu), agency representation (Diefenderfer), and industry representation (Cross) – the latter two who just happen to also be implementation-minded academics. Then, we gained insights from our NCHRP panel, findings from the literature review, and from feedback to a survey that went out to DOTs, counties, and municipalities. The information from these sources helped us gain an understanding of what was working and what wasn't in their CR specifications. Independent interviews were also conducted with DOT personnel identified in the survey, as well as experienced contractors who could speak to the construction process. This was critical because the team wanted to make a flexible specification that would suit the needs of the agency, as well as see these techniques grow in use, while not discouraging bids and competition due to a limiting specification.

The team then set out to draft the first specification. All five key elements of an AASHTO Construction Guide Specification were outlined and approved by the panel. Using experience from the team, input from DOT and industry experts, and drawing on some of the "top" specifications, the team drafted a CR specification. This iterative process included multiple panel reviews and a round of reviews from the team's Industry Technical Support Team – a team of industry experts who could provide insight into the challenges induced by the proposed specification language – we finally had a final draft. The draft specification was then submitted to AASHTO to begin committee reviews.

The final report contains a Best Practice Guide and training materials that will be useful for agencies and contractors interested in using CR. These guides will draw attention to many common questions, concerns, and will help troubleshoot challenges in the field. These guides are also an excellent complement to the commentary provided in the draft AASHTO specification. The training materials are intended to be complimentary materials that can be used in preparation for a project or for Just in Time Training right before construction commences. Publication of the final report is forthcoming, and the draft AASHTO Guide Specifications are in review. Keep an eye on TR News and NCAT social media for announcements of final publication, or simply search "NCHRP 14-43" in your favorite web search engine.

Contact Ben Bowers at bfbowers@auburn.edu for more information about this research.

Hong Kong Airport

Built on reclaimed land on the island of Chek Lap Kok, the Hong Kong International Airport (HKIA) serves as a gateway for destinations in greater China, Asia, and the world. The airport is the world's busiest cargo gateway and one of the world's busiest passenger airports. More than 100 airlines operate flights from HKG to over 1800 cities across the globe. To accommodate long-term air traffic growth, HKIA is expanding to a three-runway system. The mega-project, one of the largest infrastructure projects in the history of Hong Kong, began with the reclamation of 650 hectares (approximately 2.5 square miles) of land from the sea north of the existing airport.

Over the past few years, NCAT has played a role in the design and performance testing of the airport's new airfield pavements. In late 2020, NCAT began a relationship with Hong Kong-based construction company SPR JV to provide asphalt mix designs and performance testing for the addition of the new 3,800-meter runway, supporting taxiways and aprons.

SPR JV asked NCAT to perform aggregate and binder testing on the materials sent from Hong Kong and to develop mix designs for the surface and base layers. After the two mix designs were developed, SPR JV asked NCAT for performance testing on the two mix designs. Tensile strength ratio, Hamburg wheel track, beam fatigue, dynamic modulus, and flow number were all performed on the mix designs. Both of the designs passed the performance test criteria in all cases and the mixtures were used for the new runway, taxiway, and aprons. The new runway began aircraft operations in June 2022.

Another phase of the project then began to reconfigure the middle runway. In December 2022, SPR JV again contacted NCAT to provide mix design verifications for three additional 75-blow Marshall mix design verifications, along with aggregate gradations and binder properties. NCAT's test results were approved and accepted by SPR JV, and used to ensure the asphalt mixtures are suitable for the high demands of the HKIA airfield pavements.

The connection with HKIA was made possible with the help of Ken Kandhal. Ken was an assistant director for NCAT for twenty years from 1988 until his retirement in 2008. Ken is well respected throughout the asphalt world and is well known as an expert on asphalt materials. Ken still works as a consultant. SPR JV reached out to Ken for help with their airport asphalt mix designs. Ken asked NCAT to help SPR JV with the Hong Kong International Airport mix designs.

NCAT provides mix design verifications for airports in the US and other countries. For help with airport mix designs or testing for airport mixes, please contact Jason Moore.

Contact Jason Moore at moore02@auburn.edu for more information about this research.

Benchmarking Cracking Resistance of Alabama Mixtures

In Alabama, Superpave asphalt mixtures are designed and accepted for payment based on volumetric properties and tensile strength ratio (TSR) conducted periodically during production. While these specifications have largely eliminated rutting in the state, there are concerns that they are not adequate for assessing the cracking susceptibility of asphalt mixtures that contain reclaimed asphalt pavement (RAP) and recycled asphalt shingles (RAS).

To address these concerns, the Alabama Department of Transportation (ALDOT) plans to implement the Indirect Tensile Asphalt Cracking Test (IDEAL-CT) described in ALDOT Test Procedure 459 (ALDOT-459), which is very similar to the method in ASTM D8225-19. Several studies have reported that the CT_{Index} parameter correlates well with cracking data from test sections (Zhou et al. 2017, West et al. 2019). A higher CT_{Index} indicates better resistance to cracking.

To assist ALDOT in implementing the cracking test, a benchmarking study was completed on asphalt mixtures currently used in Alabama. The CT_{Index} results of the Alabama mixtures were assessed against the CT_{Index} threshold recommended from the NCAT Test Track Cracking Group experiment (West et al. 2019).

Experimental Plan

The benchmarking effort was conducted on both laboratory-prepared and plant-produced mixtures. The laboratory mixtures were tested by the ALDOT Bureau of Materials and Test during mix design approval from 2020 to 2022. In addition, plant-produced mixtures were sampled throughout the state during the 2019 to 2022 construction seasons and tested by NCAT.

A total of 456 laboratory mixtures were tested, representing a wide range of mixture types and components (i.e., binder content, binder type, recycled materials content, aggregate type, maximum aggregate size (MAS), and additives). Binder contents ranged from 4.2% to 6.8%, and RAP contents were up to 35%. All laboratory mixes were prepared by the contactor submitting the mix design for approval. Each contractor was responsible for short-term conditioning the mix at 135° for four hours per AASHTO R30-2002 before compacting to a target height of 62 ± 1 mm with 7 ± 0.5 percent air voids for the cracking test.

In addition to lab mixtures, 38 plant mixtures were tested. As with the lab mixtures, the plant mixtures included a wide range of mixture components and mix types. Testing was conducted on mixtures subjected to two aging conditions: (1) reheated (RH) plant mix for all mixtures and (2) critically aging (CA) to simulate the impact of aging of surface mixes. Critical aging was conducted on 17 SMA and Superpave surface mixtures. The CA protocol involves conditioning the loose mix sample for 8 hours at 135°C before compaction, simulating approximately 4 to 5 years of field aging in Alabama (Chen et al. 2018).

Benchmarking Cracking Resistance

Figure 1 compares the average CT_{Index} of the lab and RH plant mixtures, with error bars indicating one standard deviation (s) above and below the mean (±1s

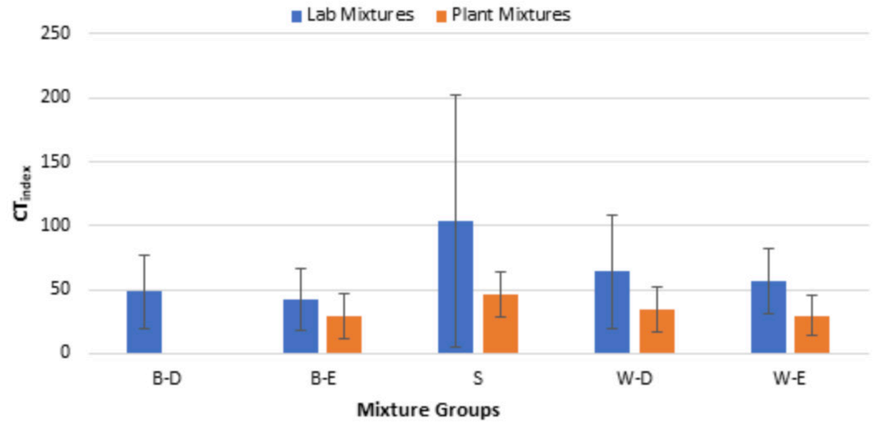


Figure 1: Comparison of Average CT_{Index} Between Lab and RH Plant Mixtures

encompasses 68% of the data distribution). The results are grouped by: (indent bullets)

- Mix type: Base/Binder(B), SMA (S), and Wearing Surface (W)
- Traffic level: up to 10M ESALs (D) and up to 30M ESALs (E).

The CT_{Index} values were highest for the SMA mixtures, followed by the Wearing Surface and Binder/Base mixtures. CT_{Index} values generally increased with total asphalt content (AC) but decreased with increasing MAS and RAP content. Notably, Figure 1 illustrates a large range in the cracking resistance of the mixtures within each grouping, as indicated by the size of the error bars compared to the respective average values. These results suggest that relying solely on volumetric properties in the current mix design and acceptance fail to capture the large differences in the cracking resistance of these mixtures.

Another observation from Figure 1 is that the average CT_{Index} results of short-term aged, lab mixtures were about twice as high as the CT_{Index} of the RH plant mixtures. The largest difference between the lab and plant mixtures was for the SMA mixtures. The differences in CT_{Index} between lab and plant mixtures may be attributed to variations in:

- differences in component materials (e.g. binder source) between the design and production mixtures,
- aging levels between lab mixing and plant production, or
- the reheating process for the plant mixtures.

These results suggest that relying solely on lab mixtures during mix design approval is inadequate, as they do not accurately reflect the cracking resistance of plant mixtures in this study. Therefore, it is essential to test the plant mixtures, which are more representative of the compacted pavement, to ensure optimal performance.

Comparing with Thresholds Observed in Test Track Cracking Group Experiment

Results from the NCAT Test Track Cracking Group (CG) experiment showed that short-term aged mixtures with CT_{Index} above 30 and critically-aged mixtures with CT_{Index} above 15 had no cracking. (West et al. 2019). These values were used in this study as CT_{Index} thresholds to assess the benchmarking databases of plant mixtures.

As shown in Figure 2, approximately half of the plant mixtures collected from Alabama contractors did not meet the reheated CT_{Index} threshold of 30. Only one of the seven RH SMA mixtures did not meet this threshold, but more than half of the RH Wearing Surface and Binder/Base mixtures had CT_{Index} values below the threshold.

After critical aging, half of the SMA and half of the Wearing Surface mixtures did not meet the CT_{Index}

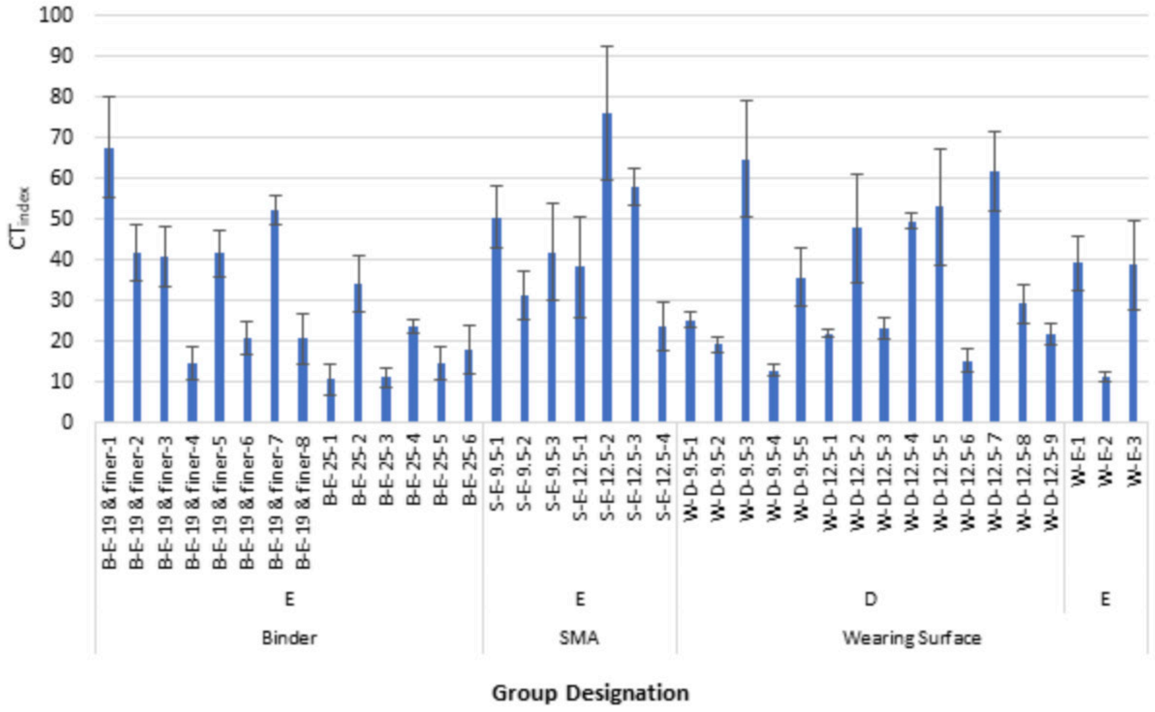


Figure 2: Comparing CT_{Index} of Reheated Plant Mixes with the CG Experiment CT_{Index} Threshold

threshold of 15, as shown in Figure 3. These results suggest a need to improve the mix designs and production processes for these mixtures. Further analysis is examining mix factors with mixtures in the database to determine the impacts of binder grade, effective asphalt content, aggregate types, and recycled materials contents.

Based on the results of the benchmarking experiment, ALDOT also plans to validate the CT_{Index} thresholds using field test sections on open access roadways with additional research to identify mix design strategies and additives that can help improve the cracking resistance of asphalt mixtures in Alabama.

References

Chen, C., Yin, F., Turner, P., West, R. C., & Tran, N. (2018). Selecting a laboratory loose mix aging protocol for the NCAT top-down cracking experiment. Transportation Research Record, 2672(28), 359-371.

West, R., Timm, D., Powell, B., Heitzman, M., Tran, N., Rodezno, C., ... & Vargas, A. (2019). Phase VI (2015–2017) NCAT test track findings (No. NCAT Report 18-04). Auburn University. National Center for Asphalt Technology.

Zhou, F., Im, S., Sun, L., & Scullion, T. (2017). Development of an IDEAL cracking test for asphalt mix design and QC/QA. Road Materials and Pavement Design, 18(sup4), 405-427.

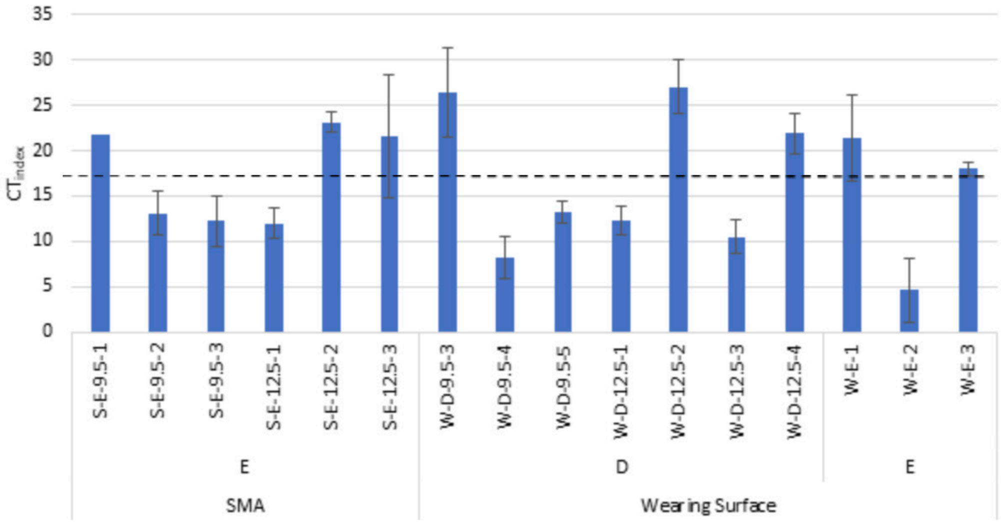


Figure 3: Comparing CT_{Index} of Critically Aged Plant Mixes with the CG Experiment CT_{Index} Threshold

Contact
Nam Tran at
nht0002@auburn.edu or
Zane Hartzog at hartzogz@
dot.state.al.us for more
information about this
research.

Specification Corner

Florida DOT

We will allow 9.5 mm NMAS mixtures to be used in FDOT's highest traffic loading roadways, provided the layer is a minimum of 1.5" thick. This is based on sponsored research.

Indiana DOT

Indiana is planning to make significant changes to binder specs by 2025. We are currently a PG 64-22 base grade state, and specify AASHTO M 320. We are concurrently moving towards being a PG 58-28 base grade state, and implementing AASHTO M 332 specs for projects starting in 2025. This change was due to a number of factors, including a recently completed research project, recommendations of an outside expert hired by APAI, and observations on performance on pilot projects using -28 grade binder.

Minnesota DOT

We are requesting for each of our districts to build 2 Superpave5 projects, or approximately 10 total projects for 2023.

Mississippi DOT

Last year we switched from external angle calibration requirements of the gyratory compactor to internal angle. We saw that only two or three mix designs needed to be redesigned because of the change in angle. We allow contractors to pick which brand gyratory they would like to use. Some choose to use Troxler. The older Model 4140 is getting phased out for the Model 5850 which cannot be externally calibrated. This is the major reason we decided to change our specification.

Montana DOT

We are implementing one grade of MSCR binder this season. Montana is a 58-34 PG state from LTPPBind data but we've been paving with -28 grades for some time so we're bumping down to -34 along with implementing MSCR. We found that 58V matches our current PG 64 binders so we're going with 58V-34 as a replacement for 64-28. That may be overkill, with a 58H being more appropriate for our traffic level, but that's what we need to investigate. We're also going to test our mixtures in the Hamburg at two temperatures, 44 C and 50 C, as part of our efforts to tier our Hamburg criteria in relation to traffic level. We varied test temperature based on PG temp before, but now that our PG temp will stay constant, we must determine the appropriate test temp so we can focus on varying number of passes in the Hamburg for different traffic levels.

North Carolina DOT

We are in the final stages of revising and updating our Standards and Specifications Book for 2024. We are also conducting research in friction and macrotexture to evaluate any current issues related to friction and texture.

Virginia DOT

Planned changes to our specifications for 2024 include 92.5% min. density for ALL asphalt layers, allowing lift thicknesses up to 5x NMAS. In the balanced mix design area: All SM-9.5 and 12.5 A and D mixes on maintenance schedules will be designed using our BMD criteria. D mixes will be performance tested during production to meet required thresholds.

Asphalt Forum

NCAT invites comments and questions submitted to Kyle Lubinsky at kal0105@auburn.edu.

Which state DOTs pay for binder as a separate binder vs. which consider it incidental to the pant mix payment? Wyoming pays for it separately but I've heard that the majority of states don't.

-Greg Milburn, Wyoming DOT

Has anyone experience significant issues achieving compaction in the field with some of the "extreme" MSCR grades, i.e., 58V-34? or 58E-34? Any other issues when moving to MSCR from the field? Our switch from -28 to -34 has everyone nervous.

-Oak Metcalfe, Montana DOT

What type of mix design program do you use or allow? (Web based, spreadsheet, or other, and why)?

-Tony Collins, North Carolina DOT

I would like to share a positive experience on improving density. Indiana DOT has fully implemented Superpave5, which is a tweak to the Superpave method that targets 5% air voids in mix design and 5% in-place air voids (95% density) in the field. INDOT implemented Superpave5 as a contractor option in 2019, with full implementation in 2020. We have seen approximately 1.3% increase in in-place density, with no increase in cost of the mixture. We have implemented on all categories and traffic levels, and have not experienced rutting or other adverse issues. The statewide average density results per year are shown below. 2017 S4 = 93.19% 2018 S4 = 93.05% 2019 S4 = 93.16% 2019 S5 = 94.41% 2020 S5 = 94.46% 2021 S5 = 94.41% 2022 S5 = 94.47%

-Matt Beeson, Indiana DOT

Are there any states who are using bag house fines as "mineral filler" in SMA mixes? Are you experiencing any issues with using them?

-Susan Dukes, South Carolina DOT

The following responses were received to questions shared in the previous issue.

We continue to adapt to dwindling gravel sources, as permitting and volume are causing us to explore new options. As such, we're seeking guidance on quarry/ledge rock and how to specify/accept it. In one situation, a contractor with a quality (anecdotally) limestone source did not bid a job because they claimed to meet all specifications except a 75 gyration mix design. In another situation, we had a contractor use a limestone source that met all durability requirements, as well as a 75 gyration design, but it performed poorly in the field. What we found was the aggregate didn't completely degrade, but "resized" in the plant so the 3/4" NMAS design ended up being a 1/2" NMAS (more or less). Any information or insight on how to guard against that phenomenon would be helpful.

-Oak Metcalfe, Montana DOT

Zane Hertzog, Alabama DOT

Alabama DOT uses L.A. Abrasion AASHTO T96 as a measure of an aggregates resistance to breaking down during mixing processes. For bituminous work the general requirement is less than 48% loss. More details can be found in our standard specifications section 801.03(b) on PDF page 713, linked here : https://www.dot.state.al.us/publications/Construction/pdf/Specifications/2022/SpecBookComplete.pdf

Greg Sholar, Florida DOT

We use limestone in Florida, with some of it being softer than others. If during production, the gradation of a sample after burning in the ignition oven changes NMAS (say from 12.5 to 9.5) we ignore this. We still expect the mixtures to meet all the pay properties (Roadway density, Air voids, AC content, % passing #8, % passing -200).

John Garrity, Minnesota DOT

LAR requirements for the aggregate from the quarry might help. Also, the use of a Vertical Shaft Impact crusher will remove the unsound portion of the aggregate during crushing operations.

Charlie Pan, Nevada DOT

I assume the "degradation" happened during the heating and mixing process in the barrel. Before paving. A "hot drop" can be produced at the plant to verify the aggregate gradation after mixing. a gradation sample can also be obtained at cold feed belt to evaluate the gradation before heating and mixing.

AUBURN UNIVERSITY
Samuel Ginn College of Engineering

1161 W. Samford Ave., Building 8
Auburn, AL 36849

National Center for Asphalt Technology
277 Technology Parkway
Auburn, AL 36830-5354
eng.auburn.edu/NCAT

Randy West Director
Kyle Lubinsky Editor, Graphic Design

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