



at AUBURN UNIVERSITY

277 Technology Parkway
Auburn, Alabama 36830

September 1, 2017

Mr. George Conner, P.E.
Deputy Director of Operations
Alabama Dept. of Transportation
1409 Coliseum Boulevard
Montgomery, AL 36110

Re: 2018 NCAT Pavement Test Track

Dear Mr. Conner,

As you know, we are currently preparing for the next research cycle on the NCAT Pavement Test Track in the spring/summer of 2018. Preliminary plans are being developed based on discussions with prospective research sponsors. Based on our current understanding of the scope of work, we respectfully request that the Department consider the following two items to facilitate the 2018 research plan:

1. Establishment of a formal multistate pooled fund of at least **\$6,240,000** (noting the actual amount will vary based on the final number of research sponsors and resulting scope of work) that will provide funding for construction (zero to \$6 million) and operations/research (\$6 to \$10 million) in the 2018 research cycle. Please note that funding for this project will come from numerous sources (with most sponsors being state DOTs), and that all construction activities will be competitively procured and administered by Auburn University (as in the 2006, 2009, 2012, and 2015 research cycles); and
2. Allocation of ALDOT funds in the amount of **\$1,830,000** for the following high value research options:
 - a. \$150k for continuation of the Preservation Group (PG) study to quantify the life extending benefit of numerous treatments/combinations, which is foundational for a data driven selection process, with implementation support for innovative treatments/combinations;
 - b. \$300k for continuation of the Cracking Group (CG) study to identify and validate a laboratory cracking test(s) with practical methodology and pass/fail criteria that can be used for both mix design approval and construction quality testing;
 - c. \$480k for traffic continuation of sections E9 and E10 for long term open graded friction course durability improvement. These sections will be 6 years old in 2018, which has in the past been a critical age for differentiating between good and bad performance for these mixes;
 - d. \$450k for a mill/inlay section in which a new and practical dense graded asphalt thinlay surface ($\frac{1}{2}$ to $\frac{3}{4}$ inches in thickness) will be developed and placed at a rate of between 50 and 60 pounds per square yard in order to minimize the cost of overlays/inlays while at the same time optimizing cracking performance, with a specification for ALDOT implementation as a deliverable; and
 - e. \$450k for a mill/inlay section in which a new and practical stone matrix asphalt thinlay surface (1 inch or less in thickness) will be developed and placed with a 3/8" MAS gradation utilizing aggregates that are commercially available in the Alabama market, with a specification for ALDOT implementation as a deliverable.

We are optimistic that all current DOT sponsors will continue to participate in the 2018 research cycle, with the confirmed addition of one new state. The MnROAD partnership, which drew 7 new northern states into the 2015 Track pooled fund, will continue to be a focus of the research program on the 2018 NCAT Pavement Test Track. If additional information is required to facilitate the Department's consideration of these requests, please advise.

Sincerely,

Dr. R. Buzz Powell, PE
NCAT Assistant Director and Test Track Manager

Cc: File

**A project of the NAPA Research and Education Foundation and Auburn University
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at AUBURN UNIVERSITY

POOLED FUND ANNOUNCEMENT

Project Title

Accelerated Performance Testing on the 2018 NCAT Pavement Test Track with MnROAD Research Partnership

Principal Investigators

Dr. Raymond "Buzz" Powell, P.E.
Dr. David Timm, P.E.
Dr. Randy West, P.E.

Contact Information

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Financial Partners

Numerous state DOTs and FHWA

Commitment Start Year

2018

Commitment End Year

2021

Duration of Work

42 months

Commitments Required

\$6,240,000

Commitments Received

Pending

Background

The NCAT Pavement Test Track was originally constructed as a result of interest and support from state Departments of Transportation (DOTs) who shared a concern for building and maintaining safe and cost effective pavement infrastructure. Track research operations began in the summer of 2000. Forty-six 200-ft test sections were subjected to 10 million equivalent

single axle loadings (ESALs) of heavy truck traffic through December of 2002. Test sections were rebuilt in 2003, 2006, 2009, 2012, and 2015 with 10 million ESALs applied within each 3-year research cycle. Positive experiences with implementable findings that reduce the life cycle costs of flexible pavements and facilitate rapid deployment of sustainable technologies have made Track research an outstanding investment for numerous state DOTs, who pool their resources to share the cost of construction, operations, and research in a cooperative manner. The summer 2018 rebuild is the starting point for the seventh research cycle, with many high reward research options available for potential sponsors. NCAT is again partnering with MnROAD in the 2018 research cycle to execute a pavement performance experiment with a nationwide implementation impact. Background information on the scope of the NCAT/MnROAD partnership is provided as an attachment.

Sponsorship Options

The 2018 NCAT Pavement Test Track is expected to consist of an even larger structural experiment as well as more mill/inlay surface mixes, with continued formal research sponsorship by private sector partners. Track research sponsors have always been encouraged to choose experiments that meet their specific research needs. Individualized test sections will again be optional on the 2018 Track; however, NCAT is also encouraging sponsors to consider partnering with others in two different group experiments that have been designed to meet the most pressing needs of the industry. The NCAT/MnROAD partnership team works with sponsors to develop and execute group experiments that address common needs that include test sections at NCAT, MnROAD, and on public roadways both in Alabama and Minnesota.

Cracking Group (CG)

The first focus area in the 2018 research cycle is referred to as the Cracking Group (CG) experiment. The CG study consists of instrumented structural sections built in the 2015 research cycle at both NCAT and MnROAD. Mix designs, materials, and methods were selected for both locations to create a broad range of expected cracking performance using mixes produced with varying levels of reclaimed and recycled materials. A battery of laboratory tests is being run on included mixes in an effort to identify testing protocols that predict cracking, regardless of the binder replacement level in the mix designs, in order to make it as practical as possible for state DOT implementation. All structural sections are instrumented for high speed response and monitored weekly in order to carefully define the changing relationship between temperature, time, stiffness, strain, and pressure as a function of the accumulation of traffic damage. Funding in the 2018 research cycle is needed for traffic continuation on sections that have already supported 10 million ESALs in the 2015 research cycle (at the NCAT Pavement Test Track), noting that the middle of the 2018 research cycle is the expected age at which significant differences will be observed.

The lack of a cracking test that is proven to work with both virgin and ever higher binder replacement mix designs represents a critical need for state agencies. A test must be identified that can be used to approve mix designs as well as spot check plant produced mix in order to ensure good life cycle performance. The following list of testing protocols is included in the CG study in the 2015 and 2018 partnership between NCAT and MnROAD, as determined by consensus within sponsoring agencies, noting that testing on plant mixed material is being run with and without long term aging and testing on lab mixed material is being run with both short and long term aging:

- Illinois Flexibility Index Test
- Semicircular Bend Test using LTRC parameters
- Overlay Tester using Texas parameters
- Overlay Tester using NCAT parameters
- Energy Ratio
- Indirect Tensile Strength using Nflex parameters
- Indirect Tensile Strength using IDEAL parameters

Additionally, the Asphalt Mixture Performance Tester is being used to run Dynamic Modulus and Simplified Viscoelastic Continuum Damage testing on unaged plant mix material. Disk-Shaped Compact Tension Testing is also being run on unaged plant mix material from the MnROAD sections.

Innovation Group (IG)

The second focus area in the 2018 research cycle is referred to as the Innovation Group (IG) experiment. The IG study will consist of instrumented structural sections built to meet the high value research needs of state DOT participants. Some examples of IG sections may include consideration of lime and cement treatment of subgrades and bases in mechanistic pavement design, rapid pavement reconstruction with full depth asphalt placed in a single thick lift, and inverted pavements. The 2018 IG experiment is designed to assist states with implementation of high risk, high reward technologies that have the potential to reduce materials costs, pavement thickness, and sustainability, while at the same time avoiding costly mistakes on actual roadways. All structural sections on the NCAT Pavement Test Track are instrumented for high speed response and monitored weekly in order to carefully define the changing relationship between temperature, time, stiffness, strain, and pressure as a function of the accumulation of traffic damage. Results from this comprehensive effort on the track, in concert with results from a battery of performance tests on actual plant material in the laboratory, will equip state DOTs to implement innovative technologies and construction practices.

By monitoring response instrumentation (i.e., pressure plates and strain gauges) installed in each of these sections at the time they were constructed and by documenting changing surface conditions (rutting, roughness, cracking, etc.) under heavy truck traffic, it is possible to compare both surface and structural performance. This information provides for the optimization of specifications regarding the deployment of these technologies on the pavement infrastructure with a high level of confidence.

Objectives

The primary objectives of the pooled fund project described herein will be:

1. Constructing 200 ft test sections on the existing 1.7 mile NCAT test oval that are representative of in-service roadways on the open transportation infrastructure;
2. Applying accelerated performance truck traffic in the 2 years following construction, and extending traffic on sections built in previous research cycles both on the NCAT test oval and at MnROAD for the duration of the 3-year research cycle;
3. Assessing/comparing the functional and structural field performance of trafficked sections on a regular basis via surface and subsurface measures;

4. Validating/calibrating new and existing M-E approaches to pavement analysis and design using pavement surface condition, pavement load response, precise traffic and environmental logging, and cumulative damage;
5. Correlating field results with laboratory data for both mechanistic and preservation applications. Laboratory performance data that can predict preservation outcomes would provide DOTs with an additional mechanism for making rational selection decisions; and
6. Answering practical questions posed by research sponsors through formal (i.e., reports and technical papers) and informal (e.g., one-on-one responses to sponsor inquiries) technology transfer. For example, can the same laboratory tests be used to screen both virgin and high binder replacement (i.e., higher RAP and RAS) mixes for cracking susceptibility for both mix design approval and quality control test applications?

Scope of Work

The scope of work for the pooled fund project will include:

1. Hauling materials to the project from offsite locations. Material donations are typically secured by state sponsors, while reasonable hauling expenses are handled by the pooled fund;
2. Rebuilding sections in accordance with sponsors' directives via competitively bid subcontracts administered by NCAT. It is anticipated that aggregate hauling, liquid asphalt supply and delivery, rental of select construction equipment, plant production, and mix placement may all be procured via competitively bid subcontracts;
3. Installing both environmental (i.e., multi-depth pavement temperature probes) and response instrumentation (i.e., high speed stress and strain gages) in new experimental sections;
4. Operating a 5-truck heavy triple-trailer fleet in order to apply accelerated truck traffic on the NCAT test oval following the completion of construction. Human drivers operate NCAT vehicles in order to best induce representative vehicle wander, but it is expected that autonomous vehicles will be implemented in the future. Interstate traffic is used to load test sections at MnROAD;
5. Measuring field performance each week when the fleet is parked to fully document the changes in surface condition as a function of traffic and temperature. High-speed pavement response will also be measured on a weekly basis. Pavement deflection and surface friction will be measured on a monthly basis;
6. Conducting laboratory testing to quantify basic material and mix performance properties, which will serve as the basis of performance model development; and
7. Comparing predicted and measured pavement response as well as predicted and measured cumulative pavement damage in order to validate then calibrate prevailing M-E methodologies.

Comments

This project is expected to be eligible for 100% SP&R funding. Each sponsor participating in the study is asked to contribute funding as a function of the scope of their selected research. The cost to participate varies as follows according to the amount of effort required:

- Continue traffic on existing mill/inlay section – \$80k / year (\$240k / section)
- Surface treatment on existing mill/inlay section - \$80k / year (\$240k / section)

- Intended to provide access to project for private sector partners
- Does not include the cost of materials, construction or mitigation
- Commitment to rapid mitigation of failed experiments is required
- Continue traffic on existing structural section – \$100k / year (\$300k / section)
 - This option also applies to participation in the cracking group (CG) study
- Mill/inlay surface performance section – \$150k / year (\$450k / section)
- Mill/inlay structural performance section - \$180k / year (\$540k / section)
- Structural performance section – \$210k / year (\$630k / section)
 - This option also applies to participation in the innovation group (IG) study

Funding requirements are based on reasonable assumptions; however, if project costs increase significantly (e.g., fuel) either a proportionate amount of additional funding or a modified scope of work may be required. All items purchased through the pooled fund for the execution of this study (regardless of whether it can be categorized as “equipment” or “supplies” by research sponsors) will be retained by Auburn University. Please visit the project webs at www.pavetrack.com and <http://www.dot.state.mn.us/mnroad/> for additional information.

Subjects

Accelerated Pavement Testing, Pavement, M-E Design and Validation

Minnesota Department of Transportation's Road Research Facility (MnROAD)
National Center for Asphalt Technologies (NCAT)

Quantifying the Benefits of Pavement Preservation and Development of Asphalt Cracking Performance Tests

Partnership Vision

This partnership between MnROAD and NCAT facilitates high-value pavement research that addresses national needs using full-scale pavement testing facilities in both warm and cold climates on flexible, rigid, and composite pavement structures.

How to Become an Equal Partner

We invite your agency to join us in developing cost-effective solutions to those issues public agencies are facing in both northern and southern climates. Sharing our resources and expertise will improve the coordination of experiments focused on pavement preservation and developing asphalt cracking performance tests. Your involvement is essential to execute experiments that address agencies' specific needs and to help insure the research is done so it can be implemented into each agency as easy as possible. Bi-annual (face-to-face) sponsor meetings are utilized to keep agencies directly involved with the research direction and current findings.



How Do We Join?

To get involved, simply join the pooled funds or provide a commitment letter. The Alabama DOT is leading the asphalt cracking test partnership through a pooled fund effort in which MnDOT (MnROAD) is the subcontractor, and MnDOT is leading the pavement preservation partnership through a pooled fund effort in which NCAT is the subcontractor. Agencies can focus their funding toward either facility.

Pooled Fund (MnROAD/NCAT joint efforts) – Advertisement Pending

- Pavement Preservation @ 50K/yr (3 years)
- National HMA Cracking Performance Test @ 100K/yr (3 years)

Agencies can become an equal partner by joining either of the pooled funds referenced above. If your agency wishes to participate, but cannot provide funding at this time, you can still be involved in the planning of the study and provide funds later by submitting a commitment letter now documenting your intent to financially support the study at the rate described above.



Pavement Preservation

Our goal is to quantify the life-extending benefits of different pavement preservation treatments for roadways in different stages of life and decay. Our facilities have a history of evaluating the performance of pavement preservation treatments, including chip sealing, micro-surfacing, crack sealing and thin overlays. Accelerated testing will provide unique opportunities to determine the field performance of breakthrough materials and pavement preservation concepts without the risk of failure that local and state agencies are unwilling to accept. To address the needs of northern and southern climates, similar test sections are built in both Alabama and Minnesota on both low and high volume roadways. Off-site concrete test sections in Minnesota may also be incorporated.

Asphalt Cracking Performance Testing

Through this partnership, future asphalt technologies will be developed more efficiently over a wide range of climate and traffic factors. While many tests have been developed to predict the cracking potential of asphalt mixtures before they are placed in the field, a national effort is needed to verify those that are the most useful for each type of cracking. Types of cracking that are being investigated include top-down, reflection, and low-temperature cracking for new roadways and overlays of asphalt and concrete. Test sections will be developed with a range of crack-susceptible mixes over asphalt and concrete and then these mixes will be subjected to a battery of laboratory tests.

The goals are to evaluate various tests based on:

- Criteria related to field performance.
- Practicality of the tests for mix design verification and quality control testing.
- The ability to accommodate recycled materials, new and future additives, and mix combinations.
- Cost-effectiveness.

Timeline

A series of planning meetings will set the stage for the next three years. Each participating agency will help direct the research effort and aid in the technology transfer with the goal of implementation of research findings in each agency.

- **Planning Meetings**
 - Fall 2017: One-on-one support for research plans and financial commitments
 - Winter 2018: Planning for new section construction (stockpiles, mix designs, etc.)
 - Spring 2018: Finalize plans and initiate construction
- **Construction**
 - NCAT Track – Summer 2018
 - MnROAD Track – Summer 2018
- **Sponsor Study Meetings** (2X/Year face-to-face meetings)
 - Starting fall 2018

Other Opportunities

- NCAT will conduct research on topics outside of the studies presented herein at the Pavement Test Track under this same pooled fund.
- MnDOT will conduct other at the MnROAD facility through the National Road Research Alliance (NRRRA). You can learn more at <http://dot.state.mn.us/mnroad/nrra/index.html>

Questions?

Ben Worel (MnROAD) – (651) 366-5522, ben.worel@state.mn.us

Buzz Powell (NCAT) – (334) 750-6293, buzz@auburn.edu

2018 NCAT Pavement Test Track
Funding Commitment Letter

Based on our understanding of research needs within the _____, an estimate has been prepared by _____ on _____ that describes one possible sponsorship scenario on the 2018 NCAT Pavement Test Track. Assuming all options are selected, a multi-year total of \$_____ in funding would need to be programmed in order to support the following proposed research:

<u>Section(s)</u>	<u>Description of Research Option</u>
_____	Sponsors Utilizing “Preservation Group (PG) Study” Option \$50,000 per sponsor per year for three years (FY 2018 – FY 2020) for a total of \$150,000
_____	Sections Utilizing “Surface Performance Traffic Continuation” Option \$80,000 per mill/inlay section per year for three years (FY 2018 – FY 2020) for a total of \$240,000
_____	Sections Utilizing “Surface Treatment on Existing Surface Performance Section” Option \$80,000 per surface treatment section per year for three years (FY 2018 – FY 2020) for a total of \$240,000
_____	Sections Utilizing “Structural Performance Traffic Continuation” Option (also applies to the “Cracking Group (CG) Study” continuation at both NCAT and MnROAD) \$100,000 per structural section per year for three years (FY 2018 – FY 2020) for a total of \$300,000
_____	Sections Utilizing “Mill and Inlay for Surface Performance” Option \$150,000 per new mill/inlay section per year for three years (FY 2018 – FY 2020) for a total of \$450,000
_____	Sections Utilizing “Mill and Inlay in Structural Sections” Option \$180,000 per structural section per year for three years (FY 2018 – FY 2020) for a total of \$540,000
_____	Sections Utilizing “Structural Performance” Option (also applies to Innovation Group (IG) Study) \$210,000 per new section per year for three years (FY 2018 – FY 2020) for a total of \$630,000

It is understood that these costs are estimates generated for planning and programming purposes. The actual cost of sponsorship at the time contract documents are finalized may be slightly more or less depending on changes in the cost of diesel fuel, construction materials, etc. between now and then.

It is further understood that construction will begin in the spring of 2018, meaning the first payments will be needed in FY 2018. The project will end in FY 2021; however, funds must be provided in annual payments within FY 2018, 2019, and 2020. The first annual payment must be paid no later than March of 2018 in order to facilitate construction activities. The second annual payment is due in October of 2018 (the first month of the next fiscal year). The final annual payment is due in October of 2019. Advance payments (e.g., paying for the next fiscal year as a means of annual research appropriations) are possible and encouraged.

The 2018 preservation group (**PG**) experiment will extend traffic on all 2012 preservation group (**PG**) sections until all life extending benefit curve data has been collected, or until the end of the research cycle (whichever comes first). This includes any surviving sections on the Track, Lee Road 159, and US-280 in Alabama as well as at MnROAD, Mille Lacs County Road 8, and US-169 in Minnesota. As sections become unserviceable, they will be rehabilitated or rebuilt to support continued traffic. Additional sections will be considered as a function of available funding.

The cracking group (**CG**) study will consist of traffic continuation on structural sections with a range of expected cracking susceptibilities at both NCAT (in a southern climate) and MnROAD (in a northern climate) as a means to identify practical laboratory cracking tests that can predict cracking performance in both climate extremes.

The innovation group (**IG**) study will consist of building new structural sections with innovative materials that are optimally sustainable and cost effective. The actual experiment design will be developed to meet the needs of sponsoring agencies, but it is expected that the focus of the experiment will be cold recycle mixes, porous layers, soft subgrades, geotextiles, etc.

Space can be reserved on the 2018 NCAT Pavement Test Track by returning a signed copy of this Commitment Letter. In consideration of any additions, changes, or deletions noted above, a multi-year total of \$_____ in funding will be programmed in order to support planned research

Signed for the Sponsoring Agency by: _____
Printed name of authorized agent: _____
Date of commitment execution: _____