



PAVEMENT & MATERIALS

ID	TITLE	SUBMITTED BY	AFFILIATION
PV-01	Tensile Strength – A Design & Evaluation Tool for Superpave Mixtures	Chris Bacchi	Materials & Tests Unit
PV-01	Development of APA Design Criteria for Surface Mixes	Chris Bacchi	Materials & Tests Unit
PV-03	Performance Based Analysis of Polymer Modified Emulsions in Bituminous Surface Treatments	Emily McGraw	State Road Maintenance Unit
PV-04	Performance Assessment of PADL & HB or B25.0B Under Jointed Concrete Pavement	Clark Morrison	Pavement Management Unit
PV-05	Crack Sealing and Resurfacing Performance	Judith Corley-Lay	Pavement Management Unit
PV-06	Performance of Surface Treatments in North Carolina	Judith Corley-Lay	Pavement Management Unit
PV-07	Updating and Automating Construction Aggregate Testing Process	Mehdi Haeri & C.K. Su	Materials & Tests Unit
PV-08	Use of Recycled Glass Aggregates in Concrete	Brian Ketchem & Azam Azimi	Design Services Unit

CALL FOR NEW RESEARCH IDEA

Your Name: Chris Bacchi DATE: August 8, 2003Organization / Branch / Unit: Materials and Test**TITLE of the Research Idea:** Tensile Strength – A Design and Evaluation Tool for Superpave Mixtures

Background: The Superpave mix design process evaluates only the volumetric properties. There is no strength test currently being used in the mix design methodology. Tensile strength, which is used in evaluation of moisture sensitivity in AASHTO T-283, can also be used as a very effective and dependable tool in the mix design process. In addition, tensile strength has a direct correlation with performance of asphalt mixtures, e.g. fatigue and rutting. Thus, tensile strength, a simple test already used for moisture sensitivity, could be explored for use as an additional tool for design and evaluation of Superpave mixes.

What is the Specific Problem or Issue? Superpave does not currently use a performance test to evaluate mix designs, and there is much debate over what type of performance test to use. Perhaps a current test, the TSR, may be a useful tool for evaluating performance without the need for new expensive equipment such as rut testers or dynamic modulus devices.

List Research Objectives and Tasks: The primary objectives of this study will be to:

1. Evaluate tensile strength as a mix design parameter and develop design criteria for Superpave mixtures containing different aggregates and gradations.
2. Investigate and develop correlations of tensile strength and fatigue and rutting characteristics of the mixtures in (1) above.
3. Evaluate TSRs for mixtures in (1) above and their effect on performance and service life of pavement structures.

What Would be the Product[s] of the Research? The proposed study will provide a simple, reasonable and dependable method for mix design and performance evaluation of Superpave mixtures.

How Will You or Others Use the Product[s]? The recommended methodology and design criteria could be immediately implemented into the current mix design specifications.

How Will the Product Benefit the Department? (e.g., increase operational efficiency, decrease costs, enhance safety, etc. Indicate short term and/or long term benefit)

If the results show this method is reliable and is effective in determining the quality of mixes, the benefits for the DOT would be better, longer lasting HMA roadways.

Indicate Urgency of Having the Product: Moderate Immediate Strategic

Other Comments:

Suggest Names of Prospective Researcher[s] and Respective Institution[s]

(1)Paul Khosla NCSU

Approval (Division official or Unit Head)

Cecil Jones
Print Name

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State Materials Engineer
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NORTH CAROLINA DEPARTMENT OF TRANSPORTATION
CALL FOR NEW RESEARCH IDEA

PV-02

Your Name: Chris Bacchi DATE: August 15, 2003

Organization / Branch / Unit:

TITLE of the Research Idea: Development of APA Design Criteria for Surface mixes.

Background: Rutting potential of asphalt mixtures can be evaluated using several different procedures. The commonly used procedures include Triaxial tests, Shear tests and Simulative tests, such as APA, NCSU-WTD etc. In a recent research study completed at NCSU, it was concluded that APA could clearly detect poorly performing mixtures. The APA test is simple, inexpensive and requires less expertise than the fundamental tests such as Shear tests. The Department will acquire a new and improved version of APA in M&T unit. It becomes imperative to employ this equipment to develop APA criteria for evaluating rutting potential of all of our surface course mixtures.

What is the Specific Problem or Issue? Right now, there are specifications that address limits on materials in specific mix designs, like natural sand and limestone. These limits could be eliminated if a reliable and useful rut test specification could be implemented. The DOT already owns an APA rut tester, as mentioned above, but up to now, it has been used sparingly.

List Research Objectives and Tasks: The primary objectives of this study will be to:

1. Conduct APA and Shear tests on all of our currently used surface course mixtures.
2. Develop correlations of Shear tests and APA test data.
3. Develop and recommend the APA criteria for evaluation of rutting potential of the mixtures as a part of our mix design procedure.

What Would be the Product[s] of the Research? The proposed study will provide a simple and effective methodology and design criteria for using APA for our Superpave surface mixtures.

How Will You or Others Use the Product[s]? The Materials and Tests Asphalt lab along with the Pavement Construction section would implement rut depth criteria for all new surface mix designs and test contractor submitted specimens for compliance.

How Will the Product Benefit the Department? (e.g., increase operational efficiency, decrease costs, enhance safety, etc. Indicate short term and/or long term benefit)

Reduction of somewhat trivial material restrictive specifications, better overall pavement performance and possibly less rutting in HMA pavements in NC.

Indicate Urgency of Having the Product: Moderate Immediate Strategic

Other Comments:

Suggest Names of Prospective Researcher[s] and Respective Institution[s]

(1) Paul Khosla NCSU

Approval (Division official or Unit Head)

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CALL FOR NEW RESEARCH IDEA

Your Name: Emily McGraw DATE: August 8, 2003
 Organization / Branch / Unit: State Road Maintenance Unit

TITLE of the Research Idea: Performance Based Analysis of Polymer Modified Emulsions in Bituminous Surface Treatments

Background: In 2002, NCDOT treated over 2,500 miles of roads using Bituminous Surface Treatments (chip seals). These chip seals are an important method in pavement preservation. Typically chip seals are used on lower volume facilities. Recently, Division Bituminous Units have expressed an interest in trying polymer modified emulsions in their surface treatments. The retention of aggregate chips in the emulsion is an issue of concern for NCDOT. One of the problems associated with chip seals is the loss of stone that results in broken windshields and tort claims. Only limited data is available in quantifying the overall performance of chip seals with regard to raveling, cracking, rutting, bleeding, and stone retention. This project will test the improvement in chip seal performance resulting from modifying the emulsion with polymers. In addition, it will provide baseline performance information about standard chip seals, which will be most valuable in planning maintenance activities.

What is the Specific Problem or Issue? Is the performance of a chip seal improved by the use of a polymer-modified emulsion with regard to stone retention, raveling, cracking, rutting, and bleeding? Is the amount or increased performance enough to justify for the increased cost associated with the polymer-modified emulsion? Can a polymer-modified emulsion be used on a higher volume facility?

List Research Objectives and Tasks: 1. Conduct a literature study of chip seal performance, with polymer-modified emulsions as well as unmodified emulsion.
 2. Conduct baseline performance tests for unmodified NC chip seals (Straight, Split, and Triple Seals).
 3. Conduct performance tests for polymer modified chip seals to those in task 2 (Straight, Split, & Triple).
 4. Evaluate performance including recommendations of conditions under which polymer modified and unmodified emulsions should be used in chip seals.

What Would be the Product[s] of the Research? Guidelines for the use of chip seals, both with polymer modified and unmodified emulsions. Another product would be performance data for polymer modified and unmodified chip seals.

How Will You or Others Use the Product[s]? The products of this research will be useful for Division Bituminous Supervisors, County Maintenance Engineers, as well as Division Maintenance and Operations Engineers in planning and specifying chip seal treatments.

How Will the Product Benefit the Department? (e.g., increase operational efficiency, decrease costs, enhance safety, etc. Indicate short term and/or long term benefit) If the polymer modified emulsions significantly improves the performance of a chip seal as well as improves stone retention, NCDOT may realize a longer service life as well as decreased tort claims for windshield damage. Also having performance data will improve the efficiency of timing preventive maintenance activities.

Indicate Urgency of Having the Product: Moderate Immediate Strategic

Other Comments: This project would build on the research project "Optimizing Gradations for Surface Treatments" which was funded July 1, 2003 (Project 2004-04). It should be noted that Judith Corley-Lay with Pavement Management also worked on this research topic.

Suggest Names of Prospective Researcher[s] and Respective Institution[s]

(1) Y Richard Kim NCSU

(2) A Tayebali NCSU

Approval (Division official or Unit Head)

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CALL FOR NEW RESEARCH IDEA

Your Name: Clark MorrisonDATE: August 11, 2003**Organization / Branch / Unit:** Pavement Management Unit**TITLE of the Research Idea:** Performance Assessment of PADL & HB or B25.0B under Jointed Concrete Pavement

Background: For many years, NC constructed jointed concrete pavement on a 4 inch layer of dense graded aggregate base. In order to provide a positive drainage system, use of a Permeable Asphalt Drainage Layer (PADL) in conjunction with an edge drain system was specified beginning in the mid 1990's. Stability of the PADL layer and questions regarding the degree of drainage that is needed led to use of black base (HB in Marshall mix design and B25.0B in Superpave).

What is the Specific Problem or Issue? As NC looks toward reconstruction or widening of its interstate pavements, we need to assess which base material will provide both construction time and in-service performance.

List Research Objectives and Tasks: The objective of the research is to determine the most beneficial base material under jointed concrete pavement in NC. The tasks might include the following:

1. Literature review of issues and comparative studies done by others.
2. Define performance measures during construction and during life of pavement. Determine how much drainage and rate of drainage that is required.
3. Select projects for comparison. Also evaluate special sections in NC's LTPP SPS-2 site in Lexington, NC and other LTPP sites that will address the issue.
4. Report findings and make recommendations regarding base type.

What Would be the Product[s] of the Research? Recommendations for base material to be used under jointed concrete pavement in NC.

How Will You or Others Use the Product[s]? If a significant difference in performance is determined to exist, the pavement design and analysis group will change our standard section for jointed concrete pavement.

How Will the Product Benefit the Department? (e.g., increase operational efficiency, decrease costs, enhance safety, etc. Indicate short term and/or long term benefit) Results could improve both short term construction of concrete pavement and long term performance which would result in decreased life cycle cost.

Indicate Urgency of Having the Product: Moderate Immediate Strategic

Other Comments:

Suggest Names of Prospective Researcher[s] and Respective Institution[s]

(1)

Approval (Division official or Unit Head)

Judith Corley-Lay

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CALL FOR NEW RESEARCH IDEA

Your Name: Judith Corley-Lay DATE: August 15,2003Organization / Branch / Unit: Pavement Management Unit**TITLE of the Research Idea:** Crack Sealing and Resurfacing Performance

Background: Crack sealing of flexible pavements is a common pavement preservation activity conducted by maintenance workers and contractors. It may be followed in some cases by resurfacing with a 1 to 1.5 inch lift of hot mix asphalt within a period of 1 or 2 years. When this timing scenario occurs, cracking of the resurfacing has been observed within 24 hours of paving.

What is the Specific Problem or Issue? This project will evaluate the causes of the early cracking of resurfacing in the presence of joint sealant and make recommendations to avoid the problem. These recommendations could be aimed at the crack sealant operations, crack sealant materials, or resurfacing activities.

List Research Objectives and Tasks: Determine causes of early age cracking of resurfacing in the presence of crack sealant and make recommendations to reduce this distress.

1. Literature review for reports of similar distress, causes, and recommendations by others. Collect NCDOT specifications and information on crack sealing and resurfacing processes.
2. Select several hypotheses on the causes of the early age cracking. Attempt to replicate them in a controlled environment to establish the conditions under which they occur.
3. For the most likely cause(s), alter the methods or materials to reduce or eliminate the early age cracking.
4. Make recommendations regarding changes to DOT processes or specifications to avoid this distress.

What Would be the Product[s] of the Research? Recommendations for changes to DOT specifications or processes. These changes could involve either materials or methods or timing (coordination).

How Will You or Others Use the Product[s]? Findings will be used by maintenance planners including those assigning work in local maintenance yards and by those planning and carrying out resurfacing of roadways to assure that our efforts minimize the occurrence of early age cracking.

How Will the Product Benefit the Department? (e.g., increase operational efficiency, decrease costs, enhance safety, etc. Indicate short term and/or long term benefit) Early age cracking is costly to the department because it allows water to enter the pavement, causing deterioration of both the asphalt and the subgrade. If sealing cracks is causing other damage, we need to coordinate our efforts to avoid the problem. This will improve efficiency, decrease maintenance costs and improve public perception.

Indicate Urgency of Having the Product: Moderate Immediate Strategic

Other Comments:

Suggest Names of Prospective Researcher[s] and Respective Institution[s]

- (1) Richard Kim NCSU
- (2) Akhtar Tayebali NCSU

Approval (Division official or Unit Head)

Judith Corley-Lay

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CALL FOR NEW RESEARCH IDEA

Your Name: Judith Corley-LayDATE: August 15, 2003Organization / Branch / Unit: Pavement ManagementTITLE of the Research Idea: Performance of Surface Treatments in North Carolina

Background: North Carolina has a significant program of surface treatment application in every division to maintain and preserve our secondary road system. With initiatives like "North Carolina Moving Ahead" these efforts will combine with overlays to raise the condition level of a significant number of roadways. Planning of future treatments, and selection of the best treatment for a particular road requires that we look at roadways we have treated in the past, consider the condition of the road at the time of the treatment, and develop a performance curve for particular surface treatments.

What is the Specific Problem or Issue? What is the typical performance for surface treatments in North Carolina and how is the performance affected by condition of the roadway at the time of treatment? What guidelines can be given to assist counties and districts in placing treatments when they are most likely to be successful?

List Research Objectives and Tasks: Survey the literature and make inquiries within Southeastern states about performance of surface treatments in their state.

Select two or three commonly used surface treatments in North Carolina and obtain locations and dates when they were placed. Representation of the three regions (coastal plain, piedmont and mountains) should be obtained. Evaluate condition prior to treatment and performance since treatment as well as factors that may effect the performance.

Develop performance curves and guidelines for selection of treatments.

What Would be the Product[s] of the Research? Performance curves for each of the studied surface treatments for each of the regions. Guidelines to assist county and district engineers in selecting treatments.

How Will You or Others Use the Product[s]? Used in planning future maintenance needs. Also useful in selection of treatments.

How Will the Product Benefit the Department? (e.g., increase operational efficiency, decrease costs, enhance safety, etc. Indicate short term and/or long term benefit) Will improve treatment selection by reducing treatment of roads that are not suitable for a particular treatment. This will improve efficiency and reduce waste.

Indicate Urgency of Having the Product: Moderate Immediate Strategic

Other Comments:

Suggest Names of Prospective Researcher[s] and Respective Institution[s]

- (1) Richard Kim NCSU
- (2) Akhtar Tayebali NCSU

Approval (Division official or Unit Head)

Judith Corley-Lay

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CALL FOR NEW RESEARCH IDEAYour Name: Mehdi Haeri, C. K. Su DATE: August 22, 2003Organization / Branch / Unit: Materials & Tests Unit**TITLE of the Research Idea:** Updating and Automating Construction Aggregate Testing Process

Background: Most aggregate testing procedures are original and have not been updated with current advanced technologies for years. Aggregate testing generates excessive noise and airborne crystalline silica particles in a confined workplace, which, unless levels are monitored and controlled, can increase health hazards for employees. Additionally, the production process is repetitious, labor-intensive, and requires heavy lifting. These factors not only create an unsafe work environment, but also provide ideal conditions for human errors to occur. Finally, obtaining and retaining good quality employees for the aggregate testing is extremely difficult due to the harsh working conditions.

What is the Specific Problem or Issue? With the new Mechanistic-Empirical pavement design method and new specification for asphalt and cement concrete, the existing test methods can't accurately and effectively determine aggregate characteristics of size, shape, texture, and angularity, which have significant effects on the materials performance of hot-mix asphalt, hydraulic cement concrete mixture and unbound base materials used in highway pavement. The parallel NCHRP Project 4-30 is a good reference. The testing equipment needs to be updated according to updated test procedures.

List Research Objectives and Tasks:

- Determine appropriate testing procedures for measuring characteristics of aggregates.
- Adopt and modify the latest test equipment to meet the NCDOT needs.
- Develop automated aggregate processing system, including loading, splitting, weighing, sieving, and various measurements.
- Develop data acquisition system, which will acquire and process data and make results available to the HiCAMS and other databases.

What Would be the Product[s] of the Research? Practical and suitable test procedures, latest test equipment, and optimized testing setup for both central and/or regional laboratories of NCDOT.

How Will You or Others Use the Product[s]? Through the training of the manufacturers and researchers who conduct the project, the laboratory personnel will utilize the final product on the routine basis.

How Will the Product Benefit the Department? (e.g., increase operational efficiency, decrease costs, enhance safety, etc. Indicate short term and/or long term benefit)

Provide meaningful test data to conform to the advanced design criteria and mix specification. Minimize employee's exposure to a potentially harmful working environment, plus decreasing human errors and increasing accuracy and repeatability of test results. Through HiCAMS and other databases, data can be obtained in a more timely manner. There are general discussions in the NCHRP Report 427 (1999) about possible benefits, outcomes and cost evaluation regarding automating highway materials testing. This proposed research is intended to be a practical investigation to identify needs and implement automation specifically for North Carolina DOT.

Indicate Urgency of Having the Product: Moderate Immediate Strategic

Other Comments:

The objectives and tasks can be refined and developed in multiple phases.

Suggest Names of Prospective Researcher[s] and Respective Institution[s]

(1)

Approval (Division official or Unit Head)

Cecil Jones
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State Materials Engineer
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NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

CALL FOR NEW RESEARCH IDEA**Your Name:** Brian Ketchem, EI and Azam Azimi, PhD, PE**DATE:** August 29, 2003**Organization / Branch / Unit:** Value Management Section of Design Services Unit**TITLE of the Research Idea:** **Use of Recycled Glass Aggregates in Concrete**

Background: NCDOT has in the past shown its commitment to incorporating recycled materials such as plastic, concrete, and tires in its construction projects. Significant volumes of waste glass is generated and collected in all regions of North Carolina. Recently, a consistent decline in the markets for recycling much of this waste glass has led to more and more of this material ultimately being landfilled. In attempt to continue diverting this waste from the solid waste stream and avoiding the resultant consumption of landfill space, past attempts at using recycled glass in concrete have encountered problems with Alkali-Silica Reaction (ASR), particularly with soda-lime glass. However, new developments with recycled E-glass has shown great promise for controlling this reaction when using recycled glass in concrete applications. The potential pay-off of using recycled glass as aggregates in concrete may include significant cost-savings for the state, while helping North Carolina industries. NCDOT could possibly use recycled glass in both structural and non-structural concrete applications that may offer equal or possibly greater possibilities than traditional concrete aggregates. For example, a recycled mirror glass product would be possible for uses such as traffic barriers, where reflectivity of the glass may provide an additional deterrence against nighttime collisions.

What is the Specific Problem or Issue? Use of recycled glass aggregates in concrete requires a thorough understanding of the issues related to its durability and mechanical characteristics. Clearly, the issue of ASR and its control are major concerns. Additional durability issues of glass aggregate concrete are also of importance. Furthermore, mechanical properties of glass aggregate concrete need to be determined before NCDOT could identify potential applications for this type of concrete.

List Research Objectives and Tasks: The primary objective of this research is to identify the implications of using recycled glass aggregates in concrete. More specifically, the research needs to (a) evaluate workability and performance of the glass aggregate concrete, (b) determine its fundamental mechanical characteristics, and (c) assess potential durability issues. The proposed research will include: (1) review of published literature on glass aggregate concrete, (2) mixing glass aggregate concrete and assessing its workability and placement, (3) mechanical properties testing of glass aggregate concrete to determine its compressive strength, tensile strength, modulus of rupture, and creep and shrinkage properties, (4) durability tests including ASTM C1260, C 1293 and C227 for potential alkali reactivity of aggregates and cement-aggregate combinations, (5) developing materials specifications for glass aggregate concrete, and (6) dissemination and technology transfer, and in particular, recommendations on potential applications of glass aggregate concrete.

What Would be the Product[s] of the Research? The product of the research will be the materials specifications for glass aggregate concrete in different applications for NCDOT.

How Will You or Others Use the Product[s]? The results of this study will be implemented as part of the materials specifications of glass aggregate concrete for NCDOT.

How Will the Product Benefit the Department? (e.g., increase operational efficiency, decrease costs, enhance safety, etc. Indicate short term and/or long term benefit) Benefits to NCDOT include cost-savings and efficiency. Applications in traffic barriers may provide additional safety against nighttime collisions. Moreover, the State as a whole will benefit from reduced burden on its landfills.

Indicate Urgency of Having the Product: Moderate Immediate Strategic

Other Comments: The project is very timely for cost saving in any future concrete construction.

Suggest Names of Prospective Researcher[s] and Respective Institution[s]

NC State University

Approval (Division official or Unit Head)

Name: Victor Barbour, PE

Signature: Verified

Title: State Design Services Engineer