NATIONAL COOPERATIVE HIGHWAY RESEARCH PROGRAM
PROBLEM STATEMENT

I. PROBLEM NUMBER

To be assigned by NCHRP

II. PROBLEM TITLE

Effect of Geosynthetics on Structural Pavement Design

III. RESEARCH PROBLEM STATEMENT

Properly installed geosynthetics have been proven to generate cost savings and improved performance of aggregate base courses used in highway pavement construction. Other advantages include the ability to extend pavement service life without increasing pavement thickness and without sacrificing performance. While many agencies are currently using geosynthetics, there is a significant lack of understanding of the fundamental properties of these materials; thus, designers are often forced to rely on conservative estimates when considering the contribution of geosynthetics in the performance of the pavement structure. A deeper understanding of the interactions between geosynthetics and aggregate base courses is needed, as well as a more fundamental method for incorporating the properties of geosynthetics into existing pavement design practices. To this end, the effects of geosynthetics should be quantified with respect to 1) the improvement of subgrade and/or base stiffness (i.e., resilient modulus) and 2) the improvement in tensile capacity of unbound materials.

IV. LITERATURE SEARCH SUMMARY

Several ongoing studies are currently in progress to establish the material properties of geosynthetic materials. A number of readily available test methods exist for the purpose of characterizing geosynthetics and their interactions with aggregate base materials. Geosynthetic-aggregate interface properties are most often measured using pullout methods or direct shear tests which focus on the conditions at failure. However, such properties have not been adequately characterized for typical service conditions, resulting in relatively conservative empirical relationships. While a national guide of practice has not yet been established for geosynthetics, a number of AASHTO and ASTM methods exist and are generally used for this purpose; although the current AASHTO guidelines acknowledge that insufficient information is available at this time for a complete characterization. A 2007 FHWA publication includes guidance for the use of geosynthetics in roadways and pavements, and includes recommended minimum standards for the properties of ultimate multi-rib tensile strength and ultraviolet (UV) stability. While junction strength is also acknowledged as an important property, sufficient data was not available to recommend firm specifications. Additionally, minimum tensile modulus values were not included.

V. RESEARCH OBJECTIVE

The objective of this research is to develop a design methodology with guidelines to specify when, where, and how to use geosynthetic materials within a pavement structure. The guidelines will target design engineers and practitioners in the pavements and materials engineering community, with a focus on the most basic engineering properties of geosynthetics as they relate to structural pavement design. It is anticipated that the design principles contained in the guidelines could be readily incorporated into the Mechanistic-Empirical Pavement Design Guide (MEPDG).

The initial task of this research effort would include a thorough review of available literature regarding geosynthetics, their laboratory-measured properties, and documented field performance. Because many 'best practices' for the use of geosynthetics have been documented in previous research, the lessons learned from these efforts should be considered prior to developing the detailed laboratory work plan for characterizing geosynthetics. Additionally, a number of studies have demonstrated the field performance of geosynthetics; these findings should be incorporated into the scope of the work as appropriate, with additional field trials performed to validate the initial conclusions developed.

A large portion of the work will revolve around the development of specific techniques for considering the effects of geosynthetics on the pavement performance prediction models contained in the MEPDG. The results of this research will provide a solid engineering basis for estimating the structural effects (benefits) of geosynthetics when properly placed within a pavement structure, effectively replacing the "rule of thumb" design procedures currently used. By more accurately characterizing the effects of geosynthetics, pavement structures may be constructed more efficiently while also providing a greater degree of design reliability.

VI. ESTIMATE OF PROBLEM FUNDING AND RESEARCH PERIOD

The estimated funding for the project is $300,000. The estimated time to conduct the research is 18 months.

VII. URGENCY, PAYOFF POTENTIAL AND IMPLEMENTATION

This activity has significant payoff potential in terms of providing a solid engineering basis for achieving cost-effective pavement designs featuring the use of geosynthetics. In order to effectively implement the results of this research project, recommendations should also be made regarding the specific test methods that should be used to adequately characterize various types of geosynthetics. These guidelines can then be used by agencies to perform product evaluations and/or for product qualification. Providing relatively generic, fundamental qualification procedures will ensure a sustainable mechanism for the incorporation of new geosynthetic materials that may be developed in the years to come. Finally, the logical conclusion to this effort should include regional and/or national training on the design guidelines for practicing engineers.

VIII. PERSON(S) DEVELOPING THE PROBLEM

AASHTO Joint Technical Committee on Pavements

IX. PROBLEM MONITORING

To be determined by AASHTO/NCHRP

X. DATE AND SUMITTED BY

June 30, 2009
AASHTO Joint Technical Committee on Pavements

AASHTO STANDING COMMITTEE ON RESEARCH (SCOR)
NCHRP Problem Statement Outline

I. PROBLEM NUMBER

To be determined

II. PROBLEM TITLE

Using Pavement Management Systems to Improve Decision Making

III. RESEARCH PROBLEM STATEMENT

Pavement Management Systems (PMS) have been developed by most highway agencies to track the characteristics and performance of their road networks. However, these systems are not always used to their full potential to improve decision making. Additionally, the AASHTO Pavement Management Guide only provides general information and philosophy about PMS and does not contain detailed information on how to perform various, necessary analyses. This problem statement seeks to develop a "how-to" guide for key uses of PMS data for commonly used software packages. It is expected this guide will be very useful to those agencies that experience frequent turnover in Pavement Management staff, as well as existing agency pavement managers.

The key uses and implementation strategies to be described include:

- Development of programs for pavement preservation, maintenance, rehabilitation and reconstruction
- Prioritizing projects within a program
- Determining funding requirements to meet performance targets
- Determining the impacts of different funding scenarios on the pavement system
- Dealing with changes in technology that result in discontinuity in data sets
- Integration of information from different databases such as materials, maintenance and construction to use with the PMS to make better decisions.
- Identify strategies that make PMS more effective including methods to establish organizational trust in PMS recommendations
- For each key use, clearly indicate what data is used and how it is used in the analysis.

IV. LITERATURE SEARCH SUMMARY

A TRIS search revealed numerous studies related to pavement management. However, it appears none of the studies performed approaches the identified problem in a manner consistent with the desired user's "how-to" guide for performing the various analyses using common software packages.

There is also a separate NCHRP project that was recently funded to update the Pavement Management Guide. However, the scope of this project is to provide editorial updates including more recent examples, revised national statistics, and references to technology, such as Superpave. The scope of the recently approved project will not address the issues identified within this problem statement.

V. RESEARCH OBJECTIVE

The anticipated deliverable from this research is a document for pavement management practitioners that describes methods for using a pavement management system to its full potential as indicated in the Research Problem Statement. It is expected this information will ultimately be incorporated in the "Pavements Manual" being developed under a separate NCHRP study.

The research shall consist of the following tasks:

- Literature review on specific PMS applications. At least three commonly used software packages should be researched. A survey of highway agencies may be required to determine which software packages to further investigate.
- Develop instructions or best methodologies to accomplish the desired outputs as described in the Research Problem Statement, including the required data. Common elements between the software systems, as well as specific uses that the software is unable to address, should be clarified,

- Identify implementation strategies to maximize buy-in and trust of PMS recommendations.
- Recommend a frequency for each use described under the Research Problem Statement.
- Develop a "start-up" procedure for new users of PMS to assist them in learning how to accomplish the major uses of the PMS.

VI. ESTIMATE OF PROBLEM FUNDING AND RESEARCH PERIOD

Recommended Funding:

NCHRP Request: $150,000
FHWA Contribution: $ 50,000**

Total: $200,000
**FHWA has indicated funding support for this project in the amount shown.

Research Period:
2 Years

VII. URGENCY, PAYOFF POTENTIAL, AND IMPLEMENTATION

It is critically important that highway agencies make decisions on how to use their limited resources in a cost effective manner. Pavement Management Systems can provide very valuable tools to aid decision making, provided agencies know what data is needed to perform the desired analysis and they know how to perform the analysis using their existing system.

It is anticipated this research will provide a "how to" guide for agency practitioners to perform common PMS analysis functions as described in the Research Problem Statement. It is expected that the products from this research will ultimately be incorporated into the Pavement Manual being developed under a separate NCHRP study.

VIII. PERSON(S) DEVELOPING THE PROBLEM

On behalf of the AASHTO Joint Technical Committee on Pavements (JTCP):

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IX. PROBLEM MONITOR

To be determined by AASHTO/NCHRP

X. DATE AND SUBMITTED BY

AASHTO Joint Technical Committee on Pavements
June 11, 2009

AASHTO STANDING COMMITTEE ON RESEARCH
AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS

NCHRP Problem Statement Outline

I. PROBLEM NUMBER

To be assigned by NCHRP staff.

II. PROBLEM TITLE

Review of the basis for rehabilitation design using the MEPDG.

III. RESEARCH PROBLEM STATEMENT

While the Mechanistic Empirical Pavement Design Guide (MEPDG) is a considerable improvement over earlier methods for rehabilitation design, an independent review of the MEPDG conducted as NCHRP Project 1-40A noted a number of issues with the methodology employed for rehabilitation. These issues included inconsistent characterization of HMA stiffness when dealing with HMA overlays and PCC overlays; a reliance on characterizing "as new" pavement properties for existing pavements that results from using the same approach for new and rehabilitated pavements; simplistic approaches to converting FWD-derived field moduli for unbound material to equivalent laboratory results; simplistic approaches to characterizing chemically stabilized bases that may not apply after the bases have deteriorated; the use of a simple empirical model to predict reflective cracking; unsupported assumptions regarding HMA thickness reduction when using a crack-retarding geosynthetic; questionable handling of the effects of aggregate interlock and LTE; faulting predictions that are insensitive to the subgrade fines content and number of wet days per year; and apparently poor predictions of transverse cracking of JPCP.

IV. LITERATURE SEARCH SUMMARY

In addition to NCHRP 1-40A, research work has been conducted on most of the issues identified with the rehabilitation module of the MEPDG over the last decade.

V. RESEARCH OBJECTIVE

The basis of the rehabilitation module of the MEPDG would be reviewed to further clarify the shortcomings identified in NCHRP 1-40A. Since the developers of the MEPDG were limited to the models available at the outset of the development, research conducted in the interim would be reviewed for its applicability to the rehabilitation module of the MEPDG. The final objective of the research would be to identify a new framework for rehabilitation analysis in the MEPDG and provide a "roadmap" of necessary development to achieve more accurate and comprehensive rehabilitation analysis results.

VI. ESTIMATE OF PROBLEM FUNDING AND RESEARCH PERIOD

Recommended Funding:
$300,000
(Note: This estimate may be changed by the AASHTO Standing Committee on Research.)

Research Period:
18 months
(Note: This estimate may be changed by the AASHTO Standing Committee on Research.)

VII. URGENCY, PAYOFF POTENTIAL, AND IMPLEMENTATION

As the highway system in the United States matures, pavement design and analysis needs for state transportation agencies have shifted from new pavement to rehabilitation of the existing system. It is imperative that investment decisions made for pavement rehabilitation are as efficient as possible given the perennial shortfall in funding for maintenance and rehabilitation. Consequently, continuous improvement in the ability of designers to accurately assess and treat existing pavement is necessary. Even incremental improvements in the efficiency of pavement rehabilitation designs have a payoff potential measured in billions of dollars. This research would ultimately be implemented in future versions of the MEPDG.

VIII. PERSON(S) DEVELOPING THE PROBLEM

Andrew Johnson, South Carolina DOT
Paul Looney, Kentucky Transportation Cabinet
Peter Stephanos, Federal Highway Administration

IX. PROBLEM MONITOR

AASHTO Subcommittee on Design, Joint Technical Committee on Pavements

X. DATE AND SUBMITTED BY

Judith Corley-Lay for the Joint Technical Committee on Pavements
June 8, 2009