I. RESEARCH PROJECT TITLE:

Review of Data in CMS and QC/QA Data Bases to Improve Current Specifications for Superpave and Concrete Pavements in Kansas

II. RESEARCH PROBLEM STATEMENT

KDOT has built an impressive database of as-constructed properties of materials for Superpave and PCC pavements. For Superpave pavements, the CMS and QC/QA databases have information on gradation, asphalt content, theoretical maximum specific gravity, bulk specific gravity, air voids, VMA, VFA, dust-to-binder ratio, flat or elongated particles, sand equivalent, CAA, FAA, percent moisture, tensile strength ratio and surface smoothness. For concrete pavements, these databases have information on aggregate gradation, slump air content, unit weight/yield, compressive strength, flexural strength, material passing No. 200 sieve, % moisture in aggregate, temperature and density of fresh concrete, flexural strength, compressive strength, PCC slab thickness and smoothness. Currently KDOT uses Percent Within Limits (PWL) specifications for both Superpave and PCC pavements. A survey by NCHRP in 2005 found that 27 out of 45 agencies (responding) employed PWL specifications. Clearly this QA specification is the most widely used among the highway agencies. However, PWL has its limitations. The use of PWL imposes uncertainties on all project parties that would not have occurred had the project been evaluated for compliance (e.g., average quality characteristics) without using the PWL approach. PWL can be misleading because it rewards uniformity. The method does not distinguish between uniformity around a desirable target and uniformity around the threshold of unacceptable properties. One other problem of PWL is that the number of samples can be infinite, which will lead to a value for the percentage within limits and consequently, the percent defective. In this case, it is not clear what is the defect and what are the consequences from this defect. For example, in the case of asphalt content, the percent defective does not show whether it is higher or lower asphalt content, although each case will result in a different pavement performance because too much asphalt content leads to bleeding and loss of skid resistance and too little asphalt content leads to early deterioration. Again, PWL is good as a statistical method, but it does not correlate strongly with performance. This causes problems for highway agencies that seek to have a pay factor related to quality represented in the expected pavement performance. Again any specification, particularly a QA specification, must be an evolutionary process. Since new information is constantly becoming available in the form of additional test results, and as new construction or testing processes are employed, the specification must be continually monitored to see if modifications are needed. Thus this project seeks to review the current PWL specifications in Kansas to find the opportunities for improvement.

III. RESEARCH PROPOSED OR RESEARCH OBJECTIVES

The primary objective of this research project is to review the PWL specifications in Kansas to improve the specifications for Superpave and PCC pavements. The secondary

objective is to develop the framework for the performance-related specifications for Superpave and PCC pavements in Kansas based on available PWL data.

The first part of the study will involve review of the current specification limits on the parameters used in the Quality Level Analysis for the Superpave and PCC pavements. The study also will evaluate whether the contractor's risk should be measured using alpha and beta as required by FHWA.

The second part of the study will attempt to develop performance relationship of the form advocated by Burati et al. (2004) in the FHWA report No. HRT-04-046 for the Superpave and PCC:

$$EXPLIF = A\, e^{-(B1PD1 + B2PD2 + \ldots\ldots\ldots + BkPDk)}$$

Where *EXPLIF* = expected life, in years;
A = constant (to be determined);
B_k = coefficients to be determined for each of the k quality characteristics;
PD_j= percent defective of individual quality characteristic;
k = number of quality characteristics; and
e = base of natural logarithm.

The detailed tasks of this project will be developed in consultation with the KDOT project monitor if this idea is selected for funding in FY 09 K-TRAN program.

IV. ESTIMATE OF FUNDING AND RESEARCH PERIOD

Estimated project duration: 24 months (start: June 2008)
Estimated budget: $52,000

V. URGENCY AND PAYOFF POTENTIAL

The research should have a high priority. Improved specifications always result in savings in terms of better quality products.

VI. IMPLEMENTATION STRATEGY

Implementation of this study is expected to be carried out by the Bureau of Construction and Maintenance.

VII. PROJECT PERSONNEL

This project will be carried out under the direction of Mustaque Hossain, Principle Investigator, in close cooperation with KDOT. Mr. Lon Ingram will work as a consultant to this project. One graduate student will also work on this project.

Mustaque Hossain is a professor of Civil Engineering at Kansas State University. His areas of expertise are pavement materials, pavement design, performance, management and non-destructive evaluation using Falling Weight Deflectometer (FWD).

VIII. SUBMISSION INFORMATION

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