I. Research Project Title: IMPLEMENTATION OF THE 2002 AASHTO DESIGN GUIDE FOR PAVEMENT STRUCTURES

II. Research Problem Statement: There is no doubt that the most serious research effort on mechanistic design and analysis of pavement structures is currently underway. The National Academy of Science through its NCHRP Program (specifically NCHRP Project 1-37A) is dedicating significant resources to develop a user-friendly procedure capable of executing mechanistic-empirical design while accounting for local highway materials and environmental conditions, and actual highway traffic distribution as defined by axle load spectra. Since the resulting procedure is very sound and flexible, and it considerably surpasses any currently available pavement analysis tools, it is expected it will be adopted by AASHTO as the new AASHTO design method for pavement structures, replacing the earlier empirical procedure. It is also expected that all state highway and transportation agencies will eventually adopt the 2002 AASHTO design guide for pavement structures to replace the 1993 AASHTO design guide currently in use.

It should be noted that all mechanistic design approaches produce "*theoretical structural designs"* that should be adjusted or *"calibrated"* to actual conditions by using data from in-service pavement structures. Although calibration should be incorporated in the new 2002 AASHTO design procedure, it is expected that the proposed *"global or national calibration"* will be insufficient to be apply to specific regions. Without region/state specific calibration, the new guide will be of limited use for design purposes. Also, assessment of the design reliability can only be attempted only after the guide has been calibrated.

For successful application of the new 2002 AASHTO design guide to the pavements in this region, this specific calibration strategy should address all main aspects of the pavement performance and economic analysis: (1) characterization of pavement materials and soil, (2) traffic loading, (3) environment conditions, (4) field calibration, (5) design reliability, and (6) life cycle cost (LCC) analysis.

III. Research Proposed: The objective of this research is to develop the calibration procedure for the AASHTO 2002 design guide models for both flexible and rigid pavement structures for this region and to assist the state highway agencies in the region in the implementation of the new Guide for pavement design and surface selection practices. It is envisioned that this study will be accomplished through the following tasks:

1. *Literature Search* - A literature search will be conducted to gather detailed information on the AASHTO 2002 design guide models, and all material and performance prediction models that it contains. Special consideration will be given to the models for characterization of pavement materials and soils and the corresponding material testing procedures. At the end of the literature search, based on the findings, a calibration plan will be developed in consultation with the state-selected Project Monitor (s).

2. *Pavement Performance and Material Database* – At this stage of the project, a database with representative material characterization and pavement condition data for participating states will be built. The process will use data published in various state research reports, construction data

as well as condition data available in the pavement management systems. The database will contain information only for several pavement sections considered representative of the roads in the participating states. The sections will be new as well as rehabilitated flexible and rigid pavements.

3. *Analytical Model Calibration* – In this task, the statistical analysis of the data assembled in the database will be performed. This task will also aim at the calibration factors for the following relationships:

   - layer material parameters used in the design model (e.g. stiffness, resilient modulus) and physical material characteristics (e.g. air voids, binder content, cement content).
   - traffic load spectra analysis and current capability of each agency to generate input for the calibration process.
   - pavement performance parameters (e.g. rutting, cracking, joint faulting) and stresses and strains at the corresponding critical locations in the pavement structures under different environmental conditions.

The analysis will also include the study of the reliability of the new AASHTO design method to be applicable for the road conditions in the participating states when proposed calibration factors and material parameters are used.

4**.** *Sensitivity Toward Surface Types Under Consideration*- In this task, multiple runs of rigid and flexible pavement design methods will be done to determine the sensitivity of the input variables in the design process.

5. *Life Cycle Cost (LCC) Analysis*- The proposed LCC analysis module is quite extensive and needs a large number of inputs. In this task, the input needs and availability will be studied in details. The feasibility of developing default parameters for some inputs will also be investigated.

6. *Reporting and Training* - A final report will be prepared that will give detailed information on methodology and data used for the AASHTO 2002 model calibration. The report will include recommendations on the optimum use of the AASHTO model and life cycle cost analysis methodology as well as recommended default input values for the model parameters. Training of the participating agency pavement design personnel will be conducted to ease their work in understanding and using the model, and to better inform them on the calibration work and the supporting information.

IV. Estimate of Funding and Research Period:
Estimated project duration: 18 months (start: July 2003)
Estimated budget: $62,000 per participating state

V. Urgency and Payoff Potential: The research should have a high priority. The efficient calibration of the new AASHTO design guide will ensure an efficient design of the pavement structures in the participating states. This will lead to the optimum utilization of the highway

construction and repair investments in the participating states, and savings will be very large in the future.

VI. Implementation Strategy: Implementation of this study is expected to be carried out by each participating agency. Results would be used in the implementation of the new design and LCC analysis methods for pavement structures.

VII. Project Personnel: This project will be carried out under the direction of **Mustaque Hossain** and **Stefan R. Romanoschi,** Co-Principal Investigators, in close cooperation with each participating agency. Two graduate students and two undergraduate student in civil engineering will also work on this project. ***The project is very suitable as doctoral dissertation and/or Master's Thesis.***

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

Stefan Romanoschi holds an M.S. degree in Experimental Statistics and a Ph.D. in Civil Engineering from Louisiana State University. Dr. Romanoschi is currently an Assistant Professor of Civil Engineering at KSU. He is highly experienced in the monitoring of pavement condition, pavement instrumentation and Finite Element Analysis (FEA). Dr. Romanoschi has also extensive experience in field and laboratory testing of soil and highway materials

VIII. Equipment and Facilities: Kansas State University has excellent laboratory and computing facilities to conduct this research. An IPC UTM-25 tester is available for conducting Dynamic Modulus and Fatigue Tests on asphalt pavements. An MTS machine with dynamic loading capability to test concrete materials is also available. The UTM-25 unit will be retrofitted with a Triaxial Cell for testing soils and granular materials during this study. KSU also has all other pieces of equipment required for material characterization for this study.

IX. Submission Information:

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