Research Project Title: IMPLEMENTATION OF THE AASHTO MECHANISTIC-EMPIRICAL DESIGN GUIDE FOR PAVEMENT REHABILITATION DESIGN

**II. Research Problem Statement:** AASHTO has adopted the pavement rehabilitation design procedures developed under the NCHRP 1-37A project for flexible and rigid pavement structures. These new procedures are based on mechanistic-empirical principles and they replace the earlier empirical procedures. The new procedures are incorporated in the AASHTOWare Pavement ME Design software. A revised version of the procedures, based on the reflection cracking models developed under NCHRP 1-41 project, will be incorporated in the software soon. The asphalt concrete (AC) rrehabilitation procedure consists of AC over PCC overlay, AC over Fractured Slab overlay, and AC over AC overlay. The PCC rehabilitation design consists of overlay analysis and restoration analysis. The overlay analysis is applicable to the flexible/composite and rigid pavements whereas restoration is for rigid pavements only. The most pronounced changes are detailed data required for higher hierarchical levels of overlay design and the life-cycle cost (LCC) analysis. However, the proposed procedures are very sound and flexible and they considerably surpass any currently available pavement rehabilitation analysis tools including the 1993 AASHTO design guide.

It is expected that Kansas DOT and other state agencies will adopt these procedures to replace the methodologies in Chapter 5 of the 1993 AASHTO design guide currently in use. To ensure a more efficient rehabilitation design it is imperative to conduct the local calibration of the design procedures and to determine the material inputs for the rehabilitation materials used in the State.

**III. Research Proposed:** The objective of this research project is to facilitate the implementation of the 2002 AASHTO design guide procedures for rehabilitation design of existing flexible, composite, and rigid pavement structures for the local condition. The project will primarily assist the state DOT pavement design personnel in implementation of the new Guide for the overlay design and LCC analysis. 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 mechanistic design guide rehabilitation procedures, input requirements, SPS-5 and SPS-6 information available in Kansas, etc.

2. Pavement Rehabilitation Strategy Performance – At this stage of the project, a database with the required inputs for all levels of hierarchy will be developed. The task will collect performance information from past typical rehabilitation projects in Kansas for both rehabilitated flexible and rigid pavements. The data will be useful for life-cycle cost analysis of different rehabilitation strategies.

3. Material Input Database – Under this task the material inputs required by the new design procedures will be determined in the laboratory for typical rehabilitation materials used in the State. They will include conventional not-mix asphalt (HMA), WMA and recycled asphalt mixes.

4. Calibration of Distress Models and LCC Analysis- In this task, rehabilitation design runs will be made for overlay design of both flexible and rigid pavements for rehabilitation projects in the State. The comparison between the predicted distresses by the new design procedures and the field measured distresses will be used to calibrate the distress models. Concurrent overlay designs will also be made using the 1993 AASHTO design guide Chapter 5 procedures, and compared with the original design. It is to be noted that the Level I analysis is heavily dependent upon the backcalculated asphalt concrete/PCC moduli from the non-destructive test (FWD for KDOT) data. Thus the backcalculation process and the most suitable software will also be evaluated. LCC analysis for different scenario will also be done.

5. Invesitgation of GPR Usage on Rehabilitation Projects- Ground Penetration Radar (GPR) survey of existing pavement has been highly recommended by the new Guide to identify distressed existing AC layer such as those with stripping. This is especially applicable to Kansas since a large number of projects in Kansas are known to have been built up over the years and known to have stripped or weakened material (e.g. CIPR) layers. Kansas State University (KSU) has an SIR-3000 GPR from Geophysical Survey Systems, Inc. (GSSI). The SIR-3000 is equipped with a display screen and signal processing for real-time imaging and is interchangeable will all GSSI antennas from 16 to 2600 MHz. KSU currently has two antennas with depths of penetration from 0 - 9 m (0 - 30 ft) and 0 - 4 m (0 - 12 ft). The 0 – 4 m antenna (400 MHz) is well suited for imaging rehabilitated pavements. A 900 MHz antenna with penetration to 1 m (3 ft) can be used if more detailed images of the upper layers of the pavements are deemed necessary.

6. Reporting and Training - A final report will be prepared that will give detailed information on methodology and data used for the 2002 AASHTO Guide rehabilitation design implementation. The report will include recommendations on the optimum use of the AASHTO Guide and life cycle cost analysis methodology as well as recommended default input values for the required parameters. Training of the KDOT pavement design personnel will be conducted to ease their work in understanding and using the Guide in an optimal manner.

**IV. Estimate of Funding and Research Period:**

***Estimated project duration: 36 months (start: July 2014)***

***Estimated budget: $198,000***

**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 rehabilitation design of pavement structures in Kansas and other states. This will lead to the optimum utilization of the highway preservation investments in the State, and savings will be very large in the future.

**VI. Implementation Strategy:** Implementation of this study is expected to be carried out by the Bureau of Materials & Research. Results would be used in the implementation of the rehabilitation design and LCC analysis methods for pavement structures.

**VII.** **Project Personnel:** This project will be carried out under the direction of **Mustaque Hossain**, Principal Investigator, **Stacey Tucker**, Co-Principal Investigator and **Stefan R. Romanoschi**, Co-Principal Investigator in close cooperation with the Bureau of Materials & Research. One graduate student and one undergraduate student in civil engineering will also work on this project.

**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).

**Stacey Tucker** is an assistant professor of Civil Engineering at Kansas State University. She is an expert in nondestructive testing methods involving near surface geophysical methods, specifically electrical resistivity imaging, induced polarization, and ground penetrating radar.

**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 Associate Professor of Civil Engineering at the University of Texas at Arlington. Dr. Romanoschi has also extensive experience in field and laboratory testing of soil and highway materials.

**VIII. Submission Information: \**

**February 10, 2014**

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