I. RESEARCH PROJECT TITLE

Structural Characteristics of Aged Hot-Mix Asphalt Pavements

II. RESEARCH PROBLEM STATEMENT

The design and therefore the performance of a hot-mix asphalt (HMA) pavement are based on the initial properties of new aggregates and binder in the HMA mix. However, the traffic loading and the environment cause the pavement to deteriorate, and the initial properties of the HMA mix change. During the life of an HMA pavement, resurfacing and rehabilitation are required to keep the pavement in service. Therefore, the designer is faced with determining the structural characteristics of the aged HMA layers[3]. Generally the HMA layers gain stiffness but may lose other properties such as, fatigue capacity that affect their performance. Currently, for the flexible pavement design using the 1993 AASHTO Design Guide, the year 10 and year 20 overlay thicknesses are determined by KDOT. Using an initial serviceability of 4.2 and a terminal serviceability of 2.5 at year 10, ten years of ESAL's from year 10 to year 20 are used to determine the structural number needed to keep the pavement above a terminal serviceability of 2.5. Then the existing pavement layer coefficient is down graded by 20% and the structural number for the existing pavement from the initial action is calculated. The existing pavement structural number is then subtracted from the structural number needed by the projected traffic from year 10 to year 20 to come up with the structural number needed for the overlay. The same process is used at year 20 and the existing pavement layer coefficients were again decreased by 20%. These coefficients are obtained from NCHRP Report 128. In the newly released Mechanistic–Empirical Pavement Design Guide (M-EPDG), prediction of pavement response and performance must take into account fundamental properties of layer materials. Among these, the most important property of hot-mix asphalt (HMA) is the dynamic modulus of asphalt concrete. In the overlay analysis of existing HMA pavements, the modulus of the existing HMA pavements is characterized by a damaged modulus that represents the condition at the time of overlay placement. However, according to M-EPDG, the laboratory dynamic modulus tests are not needed for measuring the in-place modulus because the test must be performed on intact, but age-hardened specimens. In fact, M-EPDG contends that the resulting modulus values will likely be higher than those for new HMA mixtures. Thus, M-EPDG recommends that the modulus be determined from the deflection basin tests. However, no correlation between the laboratory dynamic modulus of HMA mixture and the backcalculated HMA layer modulus has been established to date. Thus there is a need to understand how the aged HMA properties affect future pavement performance.

III. RESEARCH PROPOSED

The primary objective of this project is to determine how aged HMA layers perform when they are resurfaced or rehabilitation. The following tasks are needed to be accomplished to fulfill the objectives of this research. Unless otherwise mentioned, Kansas State University (KSU) will be responsible for accomplishing all tasks.

[3] Research project statement by Andrew J. Gisi , Geotechnical Engineer, KDOT.

Task 1: Evaluate the current practices for characterizing aged HMA layers and materials.

Task 2: KDOT will help KSU to obtain aged HMA samples (full-depth cores and beams) from in-service pavements. Select at least three pavements that are more than 30 years old and have at least three layers in the structure. Also, conduct in-situ tests such as, Falling Weight Deflectometer and Portable Seismic Pavement Analyzer to determine in-situ properties.

Task 3: Determine the properties of the recovered asphalt to estimate the performance grade.

Task 4: Conduct resilient (dynamic) modulus and fatigue tests on remolded as well as on cores and beam samples. Compare these properties to those of the original materials.

Task 5: Conduct structural analyses using M-E PDG to determine the contribution of new and aged HMA layers to the layered system. Relate the existing pavement performance with the material characteristics determined in the laboratory as well as in-situ.

Task 6: Write the final report.

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: 18 months (start: May 2008)
Estimated budget: $72,000

V. URGENCY AND PAYOFF POTENTIAL

The research should have a high priority. The HMA paving industry is making claims that an initial HMA pavement structure will last 30 or more years without any strengthening. Conventional fatigue analysis will indicate that under repeated loading, elastic materials should have a definite number of repetitions to failure. KDOT needs to be able to defend its position that pavements structurally deteriorate over time or change its strategy of resurfacing and rehabilitation. If the results support the current design and selection process, the current expenditures on resurfacing and rehabilitation program can be justified. If the results even support a reduction of one inch in overlays, the cost savings would amount to $250,000 per year.

VI. IMPLEMENTATION STRATEGY

Implementation of this study is expected to be carried out by the Bureau of Materials & Research. The results can be implemented immediately in the pavement design and selection process.

VII. PROJECT PERSONNEL

This project will be carried out under the direction of **Mustaque Hossain**, Principal Investigator, and **Paul Lewis**, Co-Investigator, in close cooperation with the Bureau of Materials & Research. One graduate students 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 materials, pavement design, performance, management and non-destructive evaluation using Falling Weight Deflectometer (FWD).

Paul Lewis is the Operations Manager of the Civil Infrastructure Systems Laboratory (CISL) at Kansas State University. He has extensive experience in fatigue testing of HMA mixes.

VIII. SUBMISSION INFORMATION

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