IMPLEMENTATION PLAN

STUDY AND EVALUATION OF MATERIALS RESPONSE IN HOT MIX ASPHALT BASED ON FIELD INSTRUMENTATION (PHASE I)

Implementation Report: NM11MSC-03

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1.0 Introduction

The purpose of this implementation plan is to provide detailed guidelines and instructions to the project’s technical panel regarding implementation of the research results of the project as described in the final report. The document can thus serve as a simple, concise and straightforward guidebook for the Panel in bringing forth recommendations to senior NMDOT management relating to the material response in pavement under real traffic and climate conditions.

2.0 Target Audience

The implementation plan audience includes the following:

- Asphalt mix plant engineers, pavement construction contractors and laboratory personnel who are responsible for gradation and basic testing of asphalt and soils within construction specification

- State Pavement Material Engineers who are responsible for designing and testing asphalt mixes, soils, and aggregates in New Mexico

- State Pavement Design Engineers who are responsible for pavement design in New Mexico

- Federal agencies, including the Federal Highway Administration (FHWA), who are using state collected material data to study pavement performance with local materials

- Individual citizens and citizen groups with an interest in accessing pavement behavior and testing for New Mexico.

3.0 Implementation Impacts

The Implementation Plan suggested in this document will impact the pavement analysis and design in the following manner:

- Usage of the laboratory determined material properties during the project will help predicting distresses more accurately.

- The traffic related damage prediction will be better using the site specific traffic and load spectra obtained from the study.

- The newly developed Weigh-in-Motion Data Analysis Software (WIMDAS) may help in reducing the WIM data analysis time and producing traffic input data for pavement design.
The design output can be revised for optimum design section considering the fact that the linear elastic analysis produced higher stress compared to the actual field value.

The design input may need to be modified considering the uncertainty of climate data as observed that the predicted moisture content in subgrade is less than the actual field value, generated temperature may not be conservative and so on.

4.0 Current Status of Pavement Response and Climate Data in New Mexico

4.1 Pavement Response Data

Currently, NMDOT relies on the linear elastic analysis by the AASHTOWare Pavement Mechanistic-Empirical (ME) Design Software (or KENLAYER) to determine the materials response in different layers of pavement. The effect of temperature on the asphalt's properties is also determined by the linear elastic analysis. It is not known whether pavement behaves elastically or not, without I-40 instrumented section data.

4.2 Climate Data

NMDOT determines the climate data (air temperature, moisture and rainfall) using the AASHTOWare analysis. No site specific data is still available which can be used to analyze and design pavement.

5.0 Products of the Current Research

5.1 Product One: Material Characterization Data

The materials (AC, asphalt binder, base and subbase) used in I-40 instrumentation section have been characterized in the laboratory. This laboratory data can be used in the pavement design software to analyze the I-40 pavement section. This analysis will be required to calibrate the distresses models used in the AASHTOWare design software. In addition, this laboratory data can be used for other pavement with similar materials used.

5.2 Product Two: Evaluation of Linear Elastic Analysis

From this research, it is found that the linear elastic analysis (for example, Pavement ME) over predicts the vertical stresses in different layers of pavement. Horizontal strain at the bottom of asphalt layer is comparable with the field data. This knowledge can be utilized while analyzing and designing pavement in New Mexico.
5.2 Product Three: Evaluation of Climate Data

The measured climate data (temperature, moisture, and rainfall) were compared with the Level 3 predictions of the pavement design software. The predicted moisture data is comparable with the measured data for base-subbase layers. For subgrade, the predicted moisture data is less than the field measured data. In addition, the predicted temperature data is unsafe and predicted rainfall data is conservative in nature. Based on this knowledge, the climate input can be revised for analyzing and designing pavements in New Mexico.

5.3 Product Four: Field Survey Data

Several field survey data (transverse cracking, longitudinal cracking, rutting, etc.) have been documented during the research. This data can be used to calibrate distresses functions used in the current pavement design guide.

5.4 Product Five: WIM Data

I-40 WIM data has been analyzed in this research; this data can be imported to pavement design software. Pavement Design Engineers can use this software ready data to design pavements of similar traffic of I-40.

5.5 Product Six: WIM Data Analysis Program

A program (Microsoft C#) has been developed during this research to analyze WIM data. This program uses a user friendly interface to analyze the class and weight data collected from the WIM stations. The output from this program can be used in the pavement design software as traffic input data. This program can be used to analyze WIM data collected from any WIM station in New Mexico.

6. Tasks to Complete Implementation

This is phase I of the study; definitely a phase II is needed for full implementation.

6.1 Continue Collecting Stress-Strain Data

Continue collecting the sensor stress-strain data and understand the stress-strain behavior of asphalt pavement under repeated traffic load; stress-strain information is required for efficient pavement design and rehabilitation. The strain level at the bottom of asphalt layer may be way below the threshold value in the first few years of newly constructed pavement; it may exceed the threshold value after 6-8 years. In addition, the measured vertical stresses data are now less than the linear elastic analysis; however, it may converge with time.
6.2 Continue FWD Testing

Continue FWD testing on the section to identify trend/change in materials data with the age of pavement.

6.3 Continue Field Survey

Continue collecting field performance data and use them for calibrating/validating the rutting and alligator cracking models that were calibrated using few inputs values (mostly LTPP pavements in New Mexico) or for recalibration of the pavement design software for New Mexico. Since I-40 section has been constructed/instrumented only 2-3 years at the end of this project, it is imperative that pavement has not shown measurable distress yet.

6.4 Continue Collecting Climate Data

Continue collecting weather and temperature data. These will be useful for developing models of asphalt aging, low temperature cracking and temperature gradient models.

6.5 Training and Technology Transfer

Materials engineer, Laboratory technicians, district laboratory managers, asphalt mix plant QC/QA personnel, pavement design engineers and other relevant members of the pavement materials community should read this report, attend project presentations, and keep pace with instrumentation technologies and applications. The Department should:

- Ensure that selected department staff is able to attend regional and national conferences devoted to pavement instrumentation and calibration of pavement design software.

- Enroll staff in appropriate short courses or webinars devoted to pavement distresses, field survey techniques, pavement instrumentation and calibration of pavement design software.

- NMDOT needs to invest in personnel and resources to deal with pavement instrumentation, data analysis and calibration of pavement distresses models.