Project Summary

Texas Department of Transportation

0-6992: Develop Practical Field Guidelines for the Compaction of HMA or WMA

Background

Compaction is a key component in constructing asphalt pavements with good performance. Insufficient compaction can result in premature permanent deformation or rutting, excessive aging, and moisture damage even if all desirable mixture design characteristics are met. The TxDOT project 0-6992 aimed to develop practical procedures for monitoring field compaction of hot and warm asphalt mixes in order to improve the performance of Texas pavements and extend their service life. A comprehensive evaluation of compaction of asphalt pavements was conducted to evaluate the factors that affect the compactability of asphalt mixtures in the field. In addition, an automated system was developed to monitor the uniformity of the compaction in real time during construction. The study quantified the effect of density on mechanical properties of asphalt mixtures in dry and wet conditions using various testing methods.

What the Researchers Did

In the first phase of this study, the researchers constructed several test sections at the Riverside Campus of Texas A&M University. These test sections were constructed using different asphalt mixtures and were compacted using different compaction methods. The researchers studied the density uniformity of extracted cores across the mat and evaluated the use of ground-penetrating radar (GPR) to determine its ability to provide full coverage of the in-place air voids. In the second phase, the researchers developed a new system called compaction monitoring system (CMS) for monitoring the compaction effort and temperature uniformity of asphalt pavements in real time. This system uses the latest GPS technologies and various sensors to provide full coverage of the newly constructed mat. The software produces color coded maps in real time for the number of passes, surface temperature of the mat, and compaction index.

What They Found

The findings of this study can be summarized as follows:

- The efficiency of the compactive effort across the steel rollers was found to be non-uniform. A point on the mat closer to the center of the roller was subjected to more compaction than a point closer to the edge of the roller.
- The compaction temperature had a great effect on compaction irrespective of mixture type.

Research Performed by:

Texas Transportation Institute (TTI),
The Texas A&M University System

The University of Texas at San Antonio (UTSA)

Research Supervisor:
Tom Scullion, TTI

Researchers:
Arif Chowdhury, TTI
Cindy Estakhri, TTI
Emad Kassem, TTI
Wenting Liu, TTI
Eyad Masad, TTI
Samer Dessouky, UTSA

Project Completed: 8-31-11

- The WMA was relatively easier to compact compared to the HMA in spite of the fact that WMA was laid and compacted at lower temperatures than the HMA.
- The GPR was found to be an effective tool for assessing the in-place air voids after compaction of asphalt pavements. There was an excellent correlation between the predicted GPR air void distribution maps and the air void maps generated from core measurements.
- The compaction level highly affected the performance of asphalt mixtures. Specimens that had less percent air voids performed better in both wet and dry conditions.
- The CMS was found to be simple and easy to install and use. The CMS shows maps of coverage, compaction index, and temperature in real time. The CMS was able to capture some inconsistencies in the compaction process in the field.
- The CMS system was field tested on a number of TxDOT overlay projects. It did identify some areas of unequal coverage. It did also document rapid cooling problems on the new 1 inch thick overlays being used widely around Texas. Based on these results it was proposed to modify specifications to require two breakdown rollers working in parallel with these thin lifts.
- A method was developed for predicting the density of asphalt pavement compacted using static and vibratory rollers. This method utilizes the location of the roller on the mat and the compaction curves for each roller to predict the final density. The predicted density was found to be close to the measured one.

What This Means

The researchers developed a system for monitoring the compaction during construction. The CMS consists of a GPR, two infrared sensors, an accelerometer, data acquisition and display system. The CMS is mounted on any steel wheel roller and it produces color coded maps for coverage, temperature, and compaction index for the new mat. This system supplies real time coverage maps to the roller operator to ensure equal and uniform coverage across the mat. The system was successfully field tested on a number of new overlay projects in Texas. The researchers also proposed a practical method for predicting the density of asphalt pavements during field compaction. The researchers verified the developed methodology in several field test sections. The predicted densities using the proposed method correlated well with the measured ones. This method can be integrated into the CMS software to predict the field density in real time. Such further development will produce an effective tool to assess the density level in real time during construction. Further implementation of this device will require a commercial outfit to develop a commercially available unit so contractors can purchase the device. It is recommended that an implementation project is created to help with this development

For More Information:
Research Engineer - German Claros, TxDOT, 512-416-4730
Project Director - Jeremy Dearing, TxDOT, 806-748-4564
Research Supervisor - Tom Scullion, TTI, 979-845-9910

Technical reports when published are available at:
http://library.ctr.utexas.edu/index.html

www.txdot.gov
keyword: research

Texas Department of Transportation
Research and Technology Implementation Office
P.O. Box 5080
Austin, Texas 78763-5080
512-416-4730