Florida Department of Transportation Research

Evaluation of Asphalt Pavement Interface Conditions for Enhanced Bond Performance

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Project Manager
Greg Sholar
FDOT Materials Office

Principal Investigator
Reynaldo Roque
University of Florida

Current Situation

A road is composed of layers, which give it its structural strength. The layers are "glued" together with a tack coat, which in Florida is typically an asphalt emulsion. The tack coat is applied to an existing layer right before paving the next layer. Bonded layers have much greater strength compared to being unbonded (similar to a glued laminated beam). If the layers are not properly bonded together, then under certain circumstances, such as with heavy vehicle loading or extreme thermal weather cycling, the top layer can separate – called interface debonding – resulting in a layer that is cracked or has areas of lost material due to slippage or debonding. Cracking may also occur in the layer, or layers, below the surface course. Cracking may precede debonding, or both mechanisms may occur at the same time.

An even layer of tack coat is essential for ensuring good bonding between layers of asphalt.

Research Objectives

In this project, University of Florida researchers conducted a comprehensive program of modeling to understand interface debonding and near-surface longitudinal cracking in the wheel path of asphalt pavements.

Project Activities

To understand the interaction of debonding and cracking, the researchers set two goals. First, they wished to model asphalt pavements to find where stresses caused by vehicle loads might make debonding possible. Second, once debonding occurred, they wanted to know how stresses were distributed in the separated layers and how that contributes to near-surface longitudinal cracking.

The primary method for modeling the pavement-vehicle system was finite element analysis of a four-layer pavement model. To properly frame this work, the researchers evaluated various parameters and modeling scales to determine the appropriate level of complexity needed to provide meaningful results.

Once a suitable modeling method was established, the fully-bonded four-layer pavement model was studied. The researchers conducted a parametric study of their model, meaning they looked at how varying the parameters that defined the model could make regions in the pavement vulnerable to debonding. These would be areas where shear stress was high but direct pressure from the vehicle wheel was low (areas of low confinement). Generally, these areas are just in front of, and to the sides of, the vehicle wheel. Concurrently, the researchers conducted a second parametric study to look at deformation of the model pavement in terms of its Von Mises stress, which can predict the tendency of materials like asphalt to distort under stress. The study suggested that more care should be taken in the choice of application methods and products to ensure good bonding. The methods employed in the study might provide a means of testing materials for their debonding potential that improves on the current reliance on simple shear testing to measure bond strength between layers.

Project Benefits

Understanding the precise mechanisms of pavement failures can lead to improved materials and procedures that reduce maintenance and increase durability of Florida roadways.

For more information, please see www.fdot.gov/research/.