Florida Department of Transportation Research

A Review of Florida's FC-5 Raveling Condition Assessment and Measurement Methods

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Current Situation

Hydroplaning during wet weather is a major risk to motorists that can lead to serious or fatal crashes. FDOT employs several mitigation strategies to reduce hydroplaning potential, including the type of pavements used on high-speed roadways. Currently, FDOT places open-graded friction course (OGFC) asphalt mixtures on multilane roadways with a design speed of 50 mph or greater to reduce hydroplaning potential by increasing pavement friction and draining water from the pavement surface.

However, the OGFC mixture lifespan averages approximately 14 years in Florida conditions compared to a 20-year lifespan for more densely graded pavements. The reduced life is generally due to raveling – progressive disintegration of the road surface through aggregate loss – which causes rapid deterioration of pavement once it begins.

Each year, FDOT surveys the entire state highway system and collects highly detailed pavement condition data and rates the pavement condition of each roadway segment. Raveling is assessed along with cracking based on a visual assessment and summarized in one measure called the crack rating (CR). This makes it difficult to assess raveling alone and trigger the quick repair actions necessary to stop raveling before it becomes severe.

Research Objectives

These three side-by-side images show the progression of raveling per classification from Light (at left), to Moderate (at center), to Severe (at right).

In this study, the research team determined if raveling can be assessed through Florida's existing pavement condition survey or through new 3D pavement surface data collection systems currently being implemented by Florida. Once raveling is accurately accounted for separately, it should then be accounted for in subsequent pavement performance forecasting. The research considered survey approaches and methods to rate and separate raveling from cracking in a way that can proactively target raveling-only treatment needs before the rapid deterioration of OGFC begins.

Project Activities

First, the team conducted a comprehensive literature review to determine state-of-the-art practices; challenges; and critical issues associated with assessing, rating, and forecasting performance of pavements with OGFC. The team also reviewed FDOT's pavement survey and forecasting methods to understand current practices.

A feasibility study was then performed using machine learning models to identify and classify raveling separate from cracking using pavement data that FDOT already collects. To calibrate the algorithms, FDOT engineers provided manual raveling severity ratings as "ground truth". Following calibration, the research team found that one machine learning algorithm, random forest, successfully identified 87% of raveling using the sample data set.

Additionally, in consultation with the FDOT project team, the researchers identified and evaluated a rating system for raveling, methods to predict raveling, and raveling thresholds to trigger rehabilitation.

Project Conclusions and Benefits

The existing pavement condition data, specifically 3D line laser imaging, was found to be sufficient to train a machine learning model to identify and rate raveling severity. New raveling treatment criteria and condition ratings are also recommended.

With automated classification, FDOT will be able to cost-effectively identify and locate raveling with much greater spatial resolution, enabling rehabilitation of only the OGFC where raveling is occurring, resulting in a significant cost-savings.

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