Research Summary

South Carolina Department of Transportation | Office of Materials and Research

Evaluation of Open Graded Friction Courses: Construction, Maintenance, and Performance Phase II

Project Information
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Open graded friction course (OGFC) is a special asphalt mixture having high permeability that allows water to more quickly be removed from the surface of the road. OGFC has been used on interstate routes in South Carolina for decades to minimize hydroplaning and increase roadway safety. While OGFC has been shown to increase safety in wet weather, there has also been a history of durability issues with the mix in South Carolina, specifically related to raveling. This research included a comprehensive study on the factors influencing the performance of OGFC mixtures.

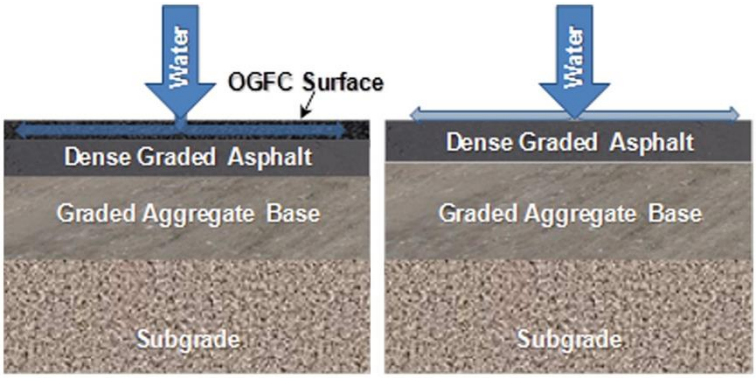

Illustration of water flow for a pavement with an OGFC layer (left) and without OGFC (right)

Problem

Open graded friction course (OGFC) mixtures have shown to be an effective treatment to reduce hydroplaning and increase the safety of high-speed roadways such as interstate routes. However, due to the porous nature of these mixtures, they are also more susceptible to raveling, which can result a reduced service life. OGFC raveling has been attributed to the following:

1. Mix materials and composition
2. Layer thickness
3. Bonding with the underlying layer
4. Field compaction

Research

This research included a comprehensive study to identify ways to improve the performance of OGFC mixtures in South Carolina, specifically with respect to durability, while also maintaining the safety benefits. The research included both lab and field studies that focused on:

Lab test methods to assess the durability of OGFC mixtures. Lab test procedures were evaluated to assess the durability performance of OGFC. These procedures included standard procedures as well as a new surface abrasion method.

Example of OGFC raveling at a bridge joint

Mixture materials composition. The influence of aggregate Los Angeles (LA) Abrasion and gradation on OGFC mixtures was evaluated in the lab. The effects of asphalt binder content were also studied.

OGFC layer thickness and bonding. Bond performance between OGFC and a standard asphalt layer was evaluated to determine the influence of tack coat material, tack coat application rate, OGFC gradation, and OGFC compaction effort on the bond strength.

Long-term field performance of OGFC. Select OGFC pavements were analyzed to assess the in-situ performance.

Results

The results of this study summarized in for each general area of research include:

Materials

- Mixes made with higher LA Abrasion aggregate generally outperformed those made with lower LA aggregates. This unexpected result was linked to aggregate breakdown during mixing and compacting that altered the gradation to allow for greater packing density and reduced the porosity. The degree of aggregate breakdown, however, must be monitored to maintain adequate mixture permeability.
- The results of this study supported the specification revisions that the SCDOT made to the OGFC gradation by increasing the allowable percent passing the No. 4 sieve from 15-25% to 15-30%. Additionally, increasing the filler content of OGFC mixes, within reason, has the potential to result in positive effects on the durability while still maintaining adequate permeability for drainage performance.
- Increasing the binder content of the OGFC mix from 5-6%, and then from 6-7% increased the performance in all test procedures evaluated in this study, however, it also resulted in a porosity reduction, which needs to be monitored to ensure sufficient permeability. When the OGFC specimens were subjected to aging at 60^{o}C, the stiffness of the binder increased due to oxidation which was reflected in the durability performance tests.

Tack Coat and Bonding

- Non-tracking tack coat products yielded the highest bond strength results compared to the other traditional tack coat materials. The bond strength increased with the increase in percent passing No. 4 sieve for the composite specimens with a nominal maximum aggregate size (NMAS) of 12.5 mm.

Field Performance

- The results of this portion of the study confirmed findings from previous studies including that the infiltration of OGFC layers is typically higher closer to a transverse joint, then decreases until leveling out approximately 100 ft beyond the joint.
- The majority of localized areas of raveling occur at either transverse joints or bridge departures. Warm mix asphalt (WMA) OGFC mixes generally exhibited better field performance (i.e., durability) than hot mix asphalt (HMA) OGFC mixes, but data was limited.

Research team members measuring the field infiltration rate of OGFC

Value & Benefit

The results of this comprehensive study informed a series of recommendations to be considered for implementation by the SCDOT that could potentially enhance the safety, durability, and life-cycle costs of OGFC pavements, , thus supporting the SCDOT's Strategic Plan—specifically Goals 1 and 2.

> ***Goal 1:*** *Improve safety programs and outcomes in our high-risk areas.*
>
> ***Goal 2:*** *Maintain and preserve our existing transportation infrastructure*.

These recommendations include specification revisions, construction best practices, and materials selection and mix design.

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