LOUISIANA TRANSPORTATION RESEARCH CENTER

Technical Summary

LTRC Report 709

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Improving Maintenance of Open-Graded Friction Course in Louisiana

Introduction

Open-Graded Friction Course (OGFC) mixtures, sometimes referred to as Permeable Friction Course (PFC) mixtures, are porous, gap-graded asphaltic concrete mixtures. These mixtures, which are primarily used as thin-wearing course layers, provide safety, economic, and environmental benefits. OGFC mixtures contain a high percentage of interconnected air voids, which aids in the drainage of water and the preservation of surface friction. This improved drainage and friction reduces hydroplaning and splash-and-spray while enhancing roadway visibility and skid resistance in wet conditions. OGFC also provides improved pavement smoothness and reduced tire noise.

The experimental application of permeable thin asphalt overlays on dense-graded mixtures began in the 1940s. The first applications aimed to offer a superior alternative to chip seals. In the U.S., California pioneered the construction of OGFC pavements. Plant seal mixes, typically used in California, were applied in a thin layer with a smaller nominal aggregate size and additional binder content compared to the conventional dense-graded mixtures. This approach offered benefits similar to chip seals, along with reduced road noise, increased durability, and improved ride quality. In the 1970s, the Federal Highway Administration (FHWA) initiated the Skid Accident Reduction Program, which resulted in the increased use of OGFC pavements. However, during the 1980s, many states discontinued OGFC usage due to performance issues. The most critical shortcomings of OGFC mixtures included durability problems (e.g., raveling and stripping due to aging) and maintenance challenges (e.g., clogging of voids by dirt), resulting in a shorter service life and higher maintenance costs. To address these issues, agencies in Georgia, Texas, and Oregon experimented with modifications such as adding polymers and fibers, increasing binder content and air voids, and using more durable aggregates.

The Louisiana Department of Transportation and Development (DOTD) began developing Open-Graded Friction Course (OGFC) mixtures in the late 1960s and 1970s. However, a moratorium was imposed in the 1980s due to early failures primarily caused by moisture and temperature issues, leading to premature raveling and stripping, as well as construction difficulties. In the 1990s, the National Center for Asphalt Technology (NCAT) proposed a new generation of OGFC mixtures, renewing interest in its use. With this renewed interest, DOTD conducted a comprehensive evaluation of Louisiana OGFC mixtures in the 2000s. This research, which evaluated several OGFC pavements based on their laboratory and field performance, concluded that the selected OGFC mixtures had the potential to meet current DOTD specifications, along with the various performance standards established by previous studies.

Objective

The goal of this research was to review current practices for constructing and maintaining OGFC pavements.

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Methodology

To fulfill the objectives of the study, a comprehensive review of published literature focusing on current and proposed maintenance methods for Open-Graded Friction Course (OGFC) mixtures was conducted. Additionally, a multi-state survey was administered to gather information about OGFC construction and maintenance practices, as well as the durability issues most frequently encountered by state agencies. The survey was distributed to DOTs from all 50 U.S. states and five additional districts and territories.

Conclusions

Based on the literature review and survey responses, the following key observations were made:

- The most commonly used asphalt binder for OGFC mixtures is PG 76-22, followed by unconventional binders like HiMA asphalt and crumb rubber.
- SB, SBS, and ground tire rubber (GTR) are the most common additives used in OGFC mixtures.
- Granite is the most widely used aggregate, followed by limestone and quartzite. Other unconventional aggregates, such as slag, are also used in some states.
- Various aggregate tests are performed on OGFC-mixture aggregates, including elongated particles, coarse aggregate angularity, fine aggregate angularity, and other physical and durability properties. The specific tests and criteria for each aggregate property vary by state.
- The dimensional ratio specified for flat and elongated particles is typically 5:1, with a maximum allowable percentage of elongated particles ranging from 10% to 20%. A high percentage of fractured faces (85 to 100%) is generally required for coarse aggregate angularity, while fine aggregate angularity is often specified with a minimum percentage of 45%.
- The nominal maximum aggregate size (NMAS) for OGFC mixtures typically ranges from 9.5 to 12.5 mm.
- Only one respondent reported using epoxy asphalt in OGFC mixtures, and most respondents do not conduct mechanical tests on OGFC mixtures. The Cantabro test is the most common mechanical test used.
- The most common maintenance issue for OGFC pavements is raveling or delamination, followed by clogging or unclogging.
- Field tests are not conducted regularly to determine the need for maintenance, with only 9% of respondents using roughness measurements.
- Patching is a common maintenance activity, with dense-graded mixtures used most frequently. Maintenance costs for OGFC vary, with some states reporting higher costs compared to other pavement types.
- Rehabilitation is often triggered by raveling, potholes, delamination, or safety concerns. Mill and overlay is the most common rehabilitation technique. Micromilling is also used, sometimes in combination with full-depth milling or other treatments.
- Challenges faced by states in OGFC pavement rehabilitation include limited space, poor workmanship, and difficulties in assessing pavement conditions.
- Tack coat application is a widely adopted practice in OGFC rehabilitation, with various types of tack coats used.
- The minimum temperature requirements for laying OGFC pavement range from 40°F to 85°F, with most states requiring a minimum of 55°F to 65°F.

Recommendations

Based on the findings of the study, the following recommendations are made for Louisiana DOTD:

- Continue to conduct routine inspections of existing OGFC pavements to identify potential maintenance issues early.
- Prioritize preventive maintenance, such as cleaning voids and patching localized defects, to extend the service life of OGFC pavements.
- Explore and implement innovative maintenance techniques, such as specialized cleaning equipment or surface treatments, to improve efficiency and effectiveness.
- Provide comprehensive training and education programs for engineers, contractors, and maintenance personnel to enhance their knowledge and skills in OGFC pavement management.