U.S. Department of Transportation
Federal Highway Administration

TOPS
Targeted Overlay Pavement Solutions

CASE STUDY
January 2022

STONE MATRIX ASPHALT GEORGIA DEPARTMENT OF TRANSPORTATION

This is one of five case studies highlighting FHWA's Every Day Counts initiative known as Targeted Overlay Pavement Solutions (TOPS). The purpose of TOPS is to integrate innovative overlay procedures into practices to improve performance, lessen traffic impacts, and reduce the cost of pavement ownership.

SMA Potential Benefits
- **Greater rutting resistance**
- **Longer fatigue life**
- **Longer service life**
- **Lower annualized costs**

Stone matrix asphalt (SMA) has been used in Europe for nearly 60 years due to its rutting resistance and ability to withstand the wearing effect of studded tire use during winter driving conditions.[1] It was first introduced to the United States in 1990. The Georgia Department of Transportation (GDOT) was one of the first agencies to place test sections to evaluate SMA's performance on some of Georgia's heaviest traveled interstate routes. GDOT was interested in SMA based on reports that it had greater rutting resistance, longer fatigue life, longer service life, and lower annualized costs than conventional mixes.[2] However, GDOT had concerns about whether SMA could perform in the southeastern U.S. with its warm climate, and with aggregates that have high abrasion loss as measured using the Los Angeles Abrasion Test (American Association of State Highway and Transportation Officials T 96).[2]

Research

Using two test sections, I-85 in Jackson County and I-75 in Henry County, GDOT verified SMA mixes have greater rutting resistance than conventional mixes, and their higher asphalt content and mineral filler components provide a binder-rich mortar that could improve service life. Based on these research projects, GDOT expanded the use of SMA to other high-volume interstate routes such as I-95 and the I-75/I-85 corridor through Atlanta that carries traffic volume in excess of 300,000 average daily traffic (ADT).[2]

In the 1990s, European agencies required SMA aggregate to have no more than 30 percent Los Angeles abrasion loss and no more than 20 percent flat and elongated particles at a 3:1 ratio. Georgia has sponsored several research studies, including test sections at the National Center for Asphalt Technology (NCAT) test track, to evaluate the effect higher abrasion loss and less restrictive flat and elongated particles might have on SMA performance. The NCAT test sections were loaded to 10 million equivalent single axle loads over a 2-year period. According to GDOT, its research studies showed the aggregate requirements from Europe were excessive for the State since GDOT does not allow the use of studded tires. GDOT also found that it could obtain good performance at a lower cost using conventional aggregate that meets Superpave quality standards.[3]

SMA thin overlay being placed over an intermediate layer.
Source: *NCAT*

[1] American Association of State Highway and Transportation Officials. (1991). Report on the 1990 European Asphalt Study Tour. AASHTO. https://international.fhwa.dot.gov/pdfs/Eurotour.pdf.
[2] Watson, D. (2002). *Summary of Georgia's Experience with Stone Matrix Asphalt Mixes*. Georgia Department of Transportation. http://www.dot.ga.gov/BuildSmart/ResearchDocuments/reports/r-SMA2002.pdf.

Implementation

Following the two test sections on I-85 and I-75, a full-scale widening project on I-95 was contracted to use 195,000 tons of SMA in the dense-graded intermediate and surface layers, topped with an open-graded friction course (OGFC). After the I-95 project, GDOT decided to use SMA for a project with high-occupancy vehicle (HOV) lanes on the I-75/I-85 corridor through Atlanta with more than 300,000 ADT. The $41 million project covered approximately 330 lane miles of milling and inlay resurfacing and included the placement of nearly 200,000 tons of SMA.[2]

Performance

On the I-85 SMA test section constructed in 1991, GDOT found that the improved rutting resistance of SMA compared to conventional dense-graded mix was evident because within four years, the rutting of the conventional mix was more than double the amount for the SMA sections.[2]

GDOT has placed 4.4 million tons of SMA on 133 projects since its first test section in 1991 and has expanded its use to include all interstate resurfacing and heavy traffic projects with greater than 50,000 ADT.

GDOT monitored the friction numbers for 5 years as it had initial concerns that the SMA thick binder film may cause safety issues. GDOT conducted friction tests according to ASTM E274 using a locked-wheel skid trailer with ribbed tires. GDOT found that while friction values were low immediately after construction, the thick film on the surface quickly wore off and friction values after a few months of traffic were higher as compared to immediately following construction.[4]

Potential Benefits

- GDOT typically places an OGFC layer as the final riding surface on interstate projects. On the first full-scale widening project on I-95, the OGFC layer had to be removed and replaced after 15 years, but according to GDOT, the underlying SMA layer, which was left in place, was still performing well after 25 years of service.[5]
- Based upon 2012 bid prices, the cost of SMA in Georgia is about 27 percent higher than a conventional Superpave mix. According to GDOT, the extended service life and environmental benefits from the combination of SMA and OGFC, such as improved visibility, reduced splash and spray, increased friction resistance, and noise reduction justify SMA use in Georgia.[5]

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[3] Barksdale, R. (1995). *Optimum Design of Stone Matrix Asphalt Mixes*. GDOT Research Project 9217: Georgia Department of Transportation.

[4] Jared, D. (1997). GDOT Research Project 9102: *Evaluation of Stone Matrix Asphalt and Porous European Mix*. Georgia Department of Transportation.

[5] Al-Qadi, I., Jayme, A. and Okte, E. (2021). *Georgia Use of SMA, OGFC, and Micro-Milling Results in Improved Sustainable Pavement Performance.* FHWA Report FHWA-HIF-19-084.

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