TECHSUMMARY *March 2024*

State Project No. DOTLT1000328 | LTRC Project No. 20-1B

Evaluation of Performance and Life Cycle Cost of Asphalt (8/18 Specifications)

INTRODUCTION

In the past, roadways constructed with hot mix asphalt (HMA) for the state of Louisiana have relied on control of the volumetric properties of voids filled with asphalt (VFA), air void content (AV), voids in the mineral aggregate (VMA), and density to ensure pavement performance. Sole reliance upon these volumetric properties for quality, as well as increased traffic volume, has led to roadways failing prematurely at an increased frequency. The Louisiana Department of Transportation and Development (DOTD) implemented changes to its asphalt pavement specifications based on research conducted at the Louisiana Transportation Research Center (LTRC) to improve the performance and value of its asphalt roadways. These changes include the introduction of performance-based specifications (PBS), which required the use of loaded wheel tracking (LWT) and semi-circular bending (SCB) tests for rutting and cracking characterization, respectively, as well as a revision to the volumetric and compaction criteria during the design process. Figure 1 shows the Louisiana DOTD performance-based specification framework.

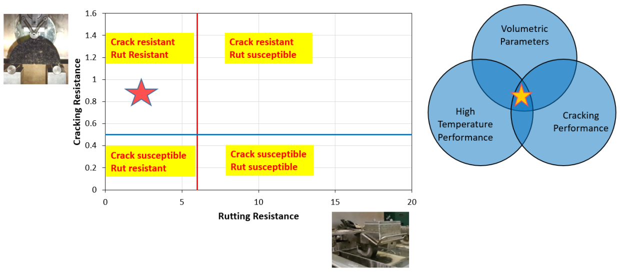

Figure 1. Louisiana DOTD Performance-Based Specification

Following the implementation of the new specification in the 2016 DOTD Standard Specifications for Roads and Bridges (SSRB) and revisions made in Special Provision 8/18, this study was conducted to measure and evaluate the performance and life-cycle costs of asphalt pavements. Additionally, a balanced evaluation of the effects of the specification changes on various mixture types was conducted to ensure that the changes made to the specifications are resulting in overall improvements.

OBJECTIVE

The objective of this research was to analyze and compare the performance of asphalt pavements constructed using specifications from the 2006 SSRB to pavements built under the 2016 SSRB and its accompanying special provision 8/18.

SCOPE

This study evaluated the density, volumetric, and performance data for various pavement sections. A life-cycle cost analysis was also performed to determine if the specification changes had increased the service life of asphalt pavements in Louisiana. To sufficiently analyze the various aspects of the project, several different resources were employed. The volumetric data for asphalt pavements that utilized the 2006 specifications for construction was obtained from DOTD laboratory engineers throughout the state. The online pavement management system known as LaPave was used to gather volumetric data for the roadways constructed per the 2016 specification and special provision 8/18. The long-term performance and life-cycle costs of the pavement sections were determined by using the pavement mechanistic empirical design (i.e., Pavement ME) software to ascertain the effects of the current specifications on field performance compared to the previous specifications. Additionally, asphalt samples were collected from various contractors to conduct volumetric and performance testing in a laboratory setting.

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PRINCIPAL INVESTIGATOR:
Corey R. Mayeux, P.E.

LTRC CONTACT:
Samuel B. Cooper, III, Ph.D., P.E.
(225) 767-9164

FUNDING:
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Louisiana Transportation Research Center

4101 Gourrier Ave
Baton Rouge, LA 70808-4443

www.ltrc.lsu.edu

METHODOLOGY

When this project started, there were still projects being constructed with the 2006 asphalt specifications. It was determined that all projects after November 14, 2018, would utilize the 2016 asphalt specifications. Fourteen projects were identified as candidates for analysis. The information for the mixtures used in these projects is shown in Table 1. The job-mix formulas (JMFs) for each project were compiled, as were the plant reports, the roadway reports, the pay reports, and the project design proposals. The asphalt samples were obtained at the asphalt plant on the day they were produced before being brought back to LTRC for testing. Volumetric testing was conducted to determine the air void content (AV), voids in mineral aggregate (VMA), and voids filled with asphalt (VFA). Additionally, the asphalt content was found using the ignition method in accordance with AASTHO T 308, as well as the mixture gradation. Finally, samples were prepared and subjected to the laboratory performance testing summarized in Table 2.

Table 1. Asphalt Mixture Information

Project Location	Project No.	Type of Construction	Mix ID[1]	Design Level	Binder Grade	NMAS (in.)
LA 16	H.010124	Roundabout and Asphalt Roadway	124B	1	70-22	3/4
LA 16	H.010124	Roundabout and Asphalt Roadway	124W	1	70-22	1/2
US 190	H.013262	Patch, Mill and Overlay	262B	1	70-22	3/4
LA 26	H.009615	Patch, Mill and Overlay	615B	1	76-22	3/4
LA 26	H.009615	Patch, Mill and Overlay	615W	1F	70-22	1/2
LA 3235	H.010688	Asphalt Concrete and Overlay	688B	1	70-22	3/4
LA 3235	H.010688	Asphalt Concrete and Overlay	688W	1F	70-22	1/2
LA 63	H.013739	Mill and Overlay	739B	1	70-22	3/4
LA 63	H.013739	Mill and Overlay	739W	1	70-22	1/2
I-12	H.011152	Patch, Mill, Asphalt Concrete	152B	2	76-22	3/4
US 61	H.013209	Patch, Mill and Overlay	209W	2F	76-22	1/2
US 61	H.000320	Mill and Overlay	320W	2F	76-22	1/2
US 167	H.010353	Patch, Mill, Widening	353W	2F	76-22	1/2
I-10	H.010601	Micro-Milling, Asphalt Concrete	601B	2	76-22	1

B: Binder course, W: Wearing course; NMAS: Nominal maximum aggregate size.

Table 2. Laboratory Performance Test Parameters and Protocols

Test Method	Performance Indicator	Test Temperature (C)	Test Procedure
SCB	J_c (kJ/m^2)	25°	DOTD TR 330
LWT	Rut Depth (mm)	50°	AASHTO T 324
|E*|	Dynamic Modulus	-4.4° to 54°	AASHTO T 342

CONCLUSIONS

The following conclusions were made from the study:

- Most of the mixtures exhibited SCB Jc values that met the Louisiana DOTD recommended minimum values for levels 1 and 2 mixtures. However, noticeable differences were observed between laboratory-measured values and those reported on the JMF.
- All the mixtures evaluated exhibited LWT rut depth values that met the Louisiana DOTD recommended maximum thresholds for level 1 and 2 mixtures.
- Most of the mixtures showed volumetric properties that met the Louisiana DOTD recommended mixture volumetric criteria, with minimal differences in laboratory-measured values and those reported on the JMF.
- The Pavement ME analysis showed that adoption of the BMD approach has the potential to improve field rutting and cracking performance.
- The BMD approach resulted in improved service life values ranging from 0.1 to 3 years, which can substantially influence the maintenance and operation costs of asphalt pavements in Louisiana
- The Pavement ME analysis showed the average service life improvement for all sections evaluated is 9.2%, which can substantially influence the maintenance and operation costs of asphalt pavements in Louisiana.

RECOMMENDATIONS

Based on the outcome of this study, the authors do not recommend any changes to the performance-based specifications. Furthermore, it is recommended that the pavement sections be continuously monitored to validate the results of the Pavement ME analysis.