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National Center for Asphalt Technology
NCAT
at AUBURN UNIVERSITY

Evaluation of a Rubber Modified Mixture Designed Using a Balanced Design in Lake Guntersville State Park and De Soto State Park

Project Update

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1 INTRODUCTION

Asphalt mixtures have been primarily designed using the Superpave mix design method where proportioning of mixture components relies on volumetric requirements. The increased use of recycled asphalt materials and other asphalt modifiers in asphalt mixtures such as recycled tire rubber (RTR), have triggered implementation efforts of a balanced mix design (BMD). BMD is defined as a mix design procedure that uses performance tests to address multiple modes of distress while taking into consideration mix aging, traffic, climate, and location within the pavement structure. A BMD mixture is designed to achieve an optimal balance between rutting resistance and cracking resistance rather than relying on volumetric requirements. Since BMD utilizes testing of the mixture rather than individual components, it motivates innovation for the inclusion of new technologies such as dry RTR products to design quality asphalt mixtures.

Although strong markets have developed for scrap tires in recent years, current estimates still show that millions of scrap tires are left to be placed in landfills. Therefore, there is still a potential to increase the use of RTR in asphalt pavements. The Alabama Department of Environmental Management (ADEM) through their Scrap Tire Program is interested in promoting alternatives use of scrap tires in engineering applications. In 2021, ADEM funded a demonstration project in Lake Guntersville State Park and De Soto State Park that included test sections with RTR.

2 PROJECT OBJECTIVE

The objective of this project is to evaluate the performance of a rubber-modified mixture designed using a balanced mix. To accomplish this objective, the Alabama Department of Conservation and Natural Resources (ADCNR) resurfaced a portion of the road in the Soto State Park and Guntersville State Park using a balanced mix with a recycled tire rubber (RTR) additive.

3 PROJECT TASKS

This project is divided in five tasks. The following paragraphs describe the tasks and the progress at the end of May 2023.

Task 1. Conduct a Balanced Mix Design (BMD) with a RTR additive selected by the ADCNR

A recycled tire rubber (RTR) mix was designed by Wiregrass Construction Company (WCC). The RTR mixture modifier selected was provided by Liberty Tire Recycling at a dosage rate of 12% by weight of the total asphalt binder. The base binder grade was PG 67-22. The mix design information is summarized in Table 1. Samples of this mix were sent to NCAT in September 2021 for BMD evaluation using the IDEAL-CT test and Hot Indirect Tension Test (HT-IDT). The Alabama Department of Transportation (ALDOT) has selected these two tests for evaluation of rutting and cracking resistance of asphalt mixtures. The preliminary BMD criteria required by ALDOT is to

have an IDEAL-CT of at least 50 for A/B traffic roads, and a HT-IDT of at least 20 psi. The results of these two tests are included in Table 2. As presented, the mix design exceeded the minimum preliminary criteria required for both tests.

Table 1. RTR Mix Design

% Passing	RTR Mix
1/2"	100
3/8"	92
# 4	65
# 8	48
# 16	37
# 30	28
# 50	17
#100	9
#200	6.9
Asphalt Content (AC)%, Total	5.7
AC%, Virgin	4.5
AC% from RAP	1.2
Recycled Binder Ratio (RBR)	20.5%
RTR Dosage (by weight of total AC)	12%
Air Voids (Va), %	2.6
Voids in the Mineral Aggregate (VMA), %	16.1
Dust Proportion (DP)	1.16
Maximum Specific Gravity (Gmm)	2.437
Bulk Specific Gravity (Gmb)	2.374

Table 2. RTR Mix Design BMD Results from NCAT

BMD Test	Minimum Target Result	Avg. Test Result	St. Dev. of Test Result
IDEAL-CT	50	71.8	12.0
HT-IDT, psi (at 50°C)	20	33.2	1.4

Task 2. Monitor the Production of The Mixtures, and the Construction of the Section in Guntersville Park.

WCC placed this mix in Guntersville State Park in November 2021. An NCAT representative was onsite on November 11, 2021 to observe operations and to sample the mix for further testing at NCAT. Figures 1-2 contain pictures of the plant and the paving site. The existing surface mix was

in poor condition and was milled. The existing surface is shown in the lane adjacent to the paving lane in Figure 2.

Figure 1. WCC Plant near Guntersville, AL

Figure 2. Paving Site in Guntersville State Park

Task 3. Conduct Performance Tests (Rutting and Cracking) Using Plant Mix Sampled During Construction (Control and Rubber Mix) to Determine its Compliance with the Performance Requirements.

The sampled mix was taken back to the NCAT lab and tested. IDEAL-CT and HT-IDT specimens were compacted and tested to compare against the results from the mix design phase in Table 2. The BMD results are provided in Table 3. The plant-produced mix was stiffer than the mix tested during mix design. The rutting resistance results increased, and the cracking resistance results decreased. However, the 49.7 CT-Index was right at the target mix design target of 50 and easily surpassed the minimum rutting criteria of 20 psi.

Table 3. BMD Results on Sampled Mix Specimens

BMD Test	Avg. Test Result	St. Dev. of Test Result
IDEAL-CT-CT Index	49.7	8.7
HT-IDT, psi (at 50°C)	36.8	2.1

Task 4. Evaluate Field Performance of the Test Sections Every Year for Six Years.

This evaluation will be conducted using an automated pavement condition survey vehicle. The data collection vehicle used by NCAT is a fully automated PathRunner vehicle. The van is a class

1 inertial profiler with 3D automated crack and rutting detection system. The van includes an on-board laser package which measure smoothness, rutting, and macrotexture, in addition to front-facing super HD cameras, GPS, and 3D automated crack detection software providing a comprehensive pavement evaluation. The first field evaluation was conducted in February 2023. The results of this evaluation are summarized in the next section.

Task 5. Prepare Final Report with Findings.

A draft final report will be submitted to the ADCNR at the conclusion of the project (6 years after construction) documenting field performance of the RTR test sections.

4 YEAR 1 PROJECT EVALUATION

4.1 Condition Survey for Lake Guntersville State Park

A recycled tire rubber (RTR) asphalt mixture was placed in Lake Guntersville State Park in the Fall of 2021. The mix was placed in both lanes for approximately 11 total lane-miles of pavement (Figure 3). A one-year survey of the site was conducted on February 24, 2023 using NCAT's high-speed data collection vehicle, shown in Figure 4. The purpose of these surveys was to assess the current pavement condition in terms of IRI, rutting, texture, and cracking. Three data collection runs were made in each lane.

Figure 3 Survey Location for Guntersville Site

Figure 4. Data Collection Vehicle

The pavement surface appeared to be performing well, with no distresses visible to the survey vehicle. There was also no measured rutting. The average performance data for IRI and texture are shown in Figures 5 and 6. Figures 7 and 8 show examples of the pavement at the time of the one-year visit.

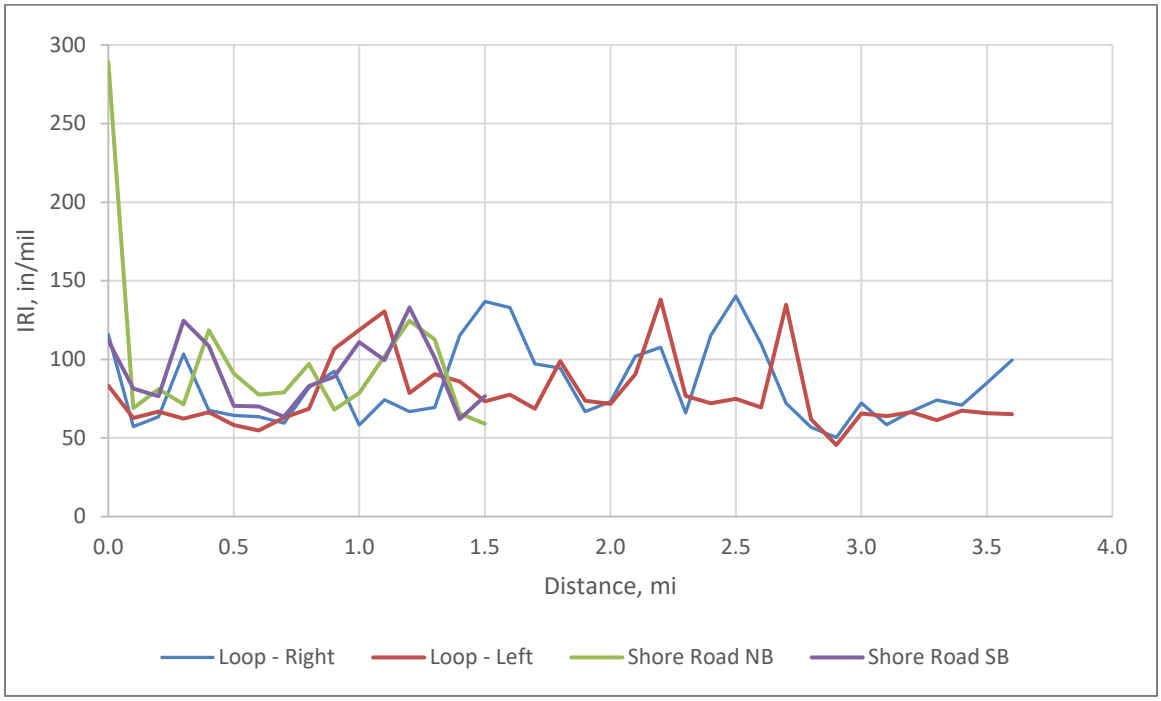

Figure 5. IRI Results for Guntersville Site

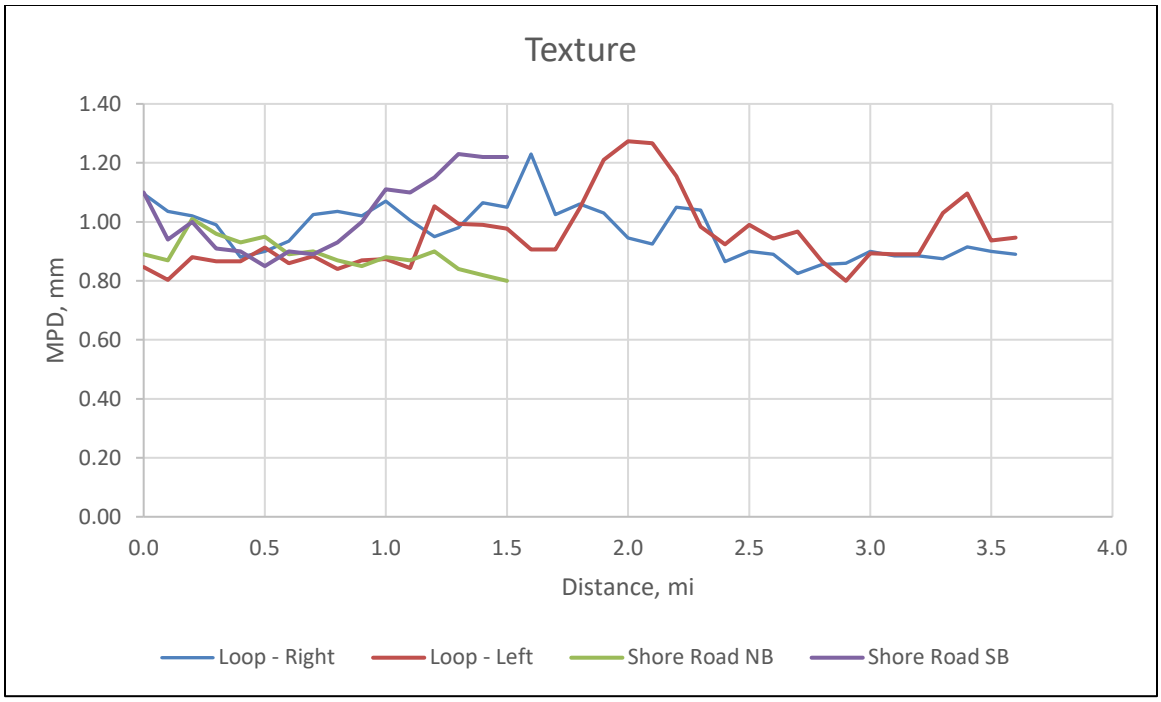

Figure 6 Texture Results for Guntersville Site

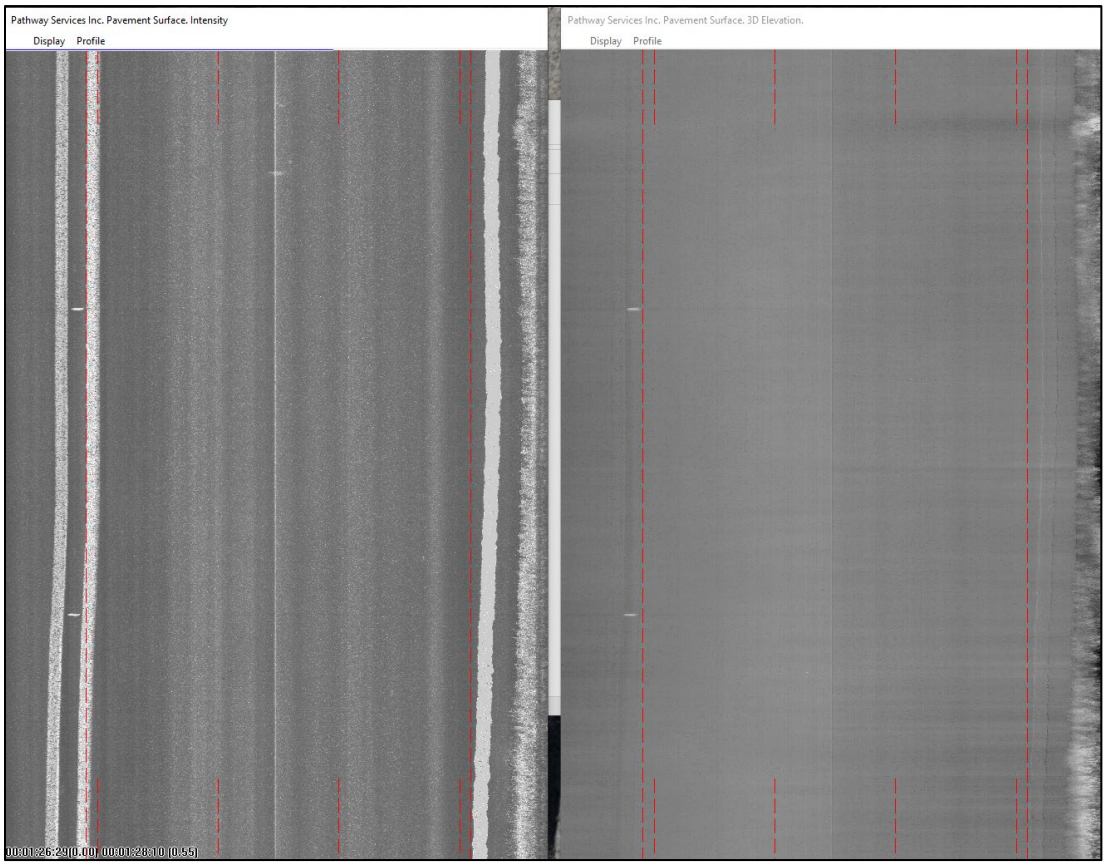

Figure 7 Pavement Surface from Survey Vehicle at Guntersville Site

Figure 8 Pavement Overview from Survey Vehicle at Guntersville Site

4.2 Condition Survey for Desoto State Park

The same RTR asphalt mix was placed in Desoto State Park in 2021. This site is a parking lot/circular drive for Desoto Falls as shown in Figures 9 and 10. A one-year survey of the site was conducted on March 10, 2023. NCAT's high-speed data collection vehicle was unable to travel at speed due to the geometry of the parking lot. Therefore, IRI could not be accurately measured.

A manual survey was conducted, and there was no cracking or rutting visible. The pavement was performing well. Figure 11 show examples of the pavement. There were some roller marks noted coming up the hill as shown in Figure 12. The texture results are shown in Figure 13.
The second-year visit will be conducted early in 2024.

Figure 9. Survey Location for Desoto Site

Figure 10. Site Overview at Desoto Falls Site

Figure 11. Pavement Example at Desoto Falls Site

Figure 12. Roller Marks Observed at Desoto Falls Site

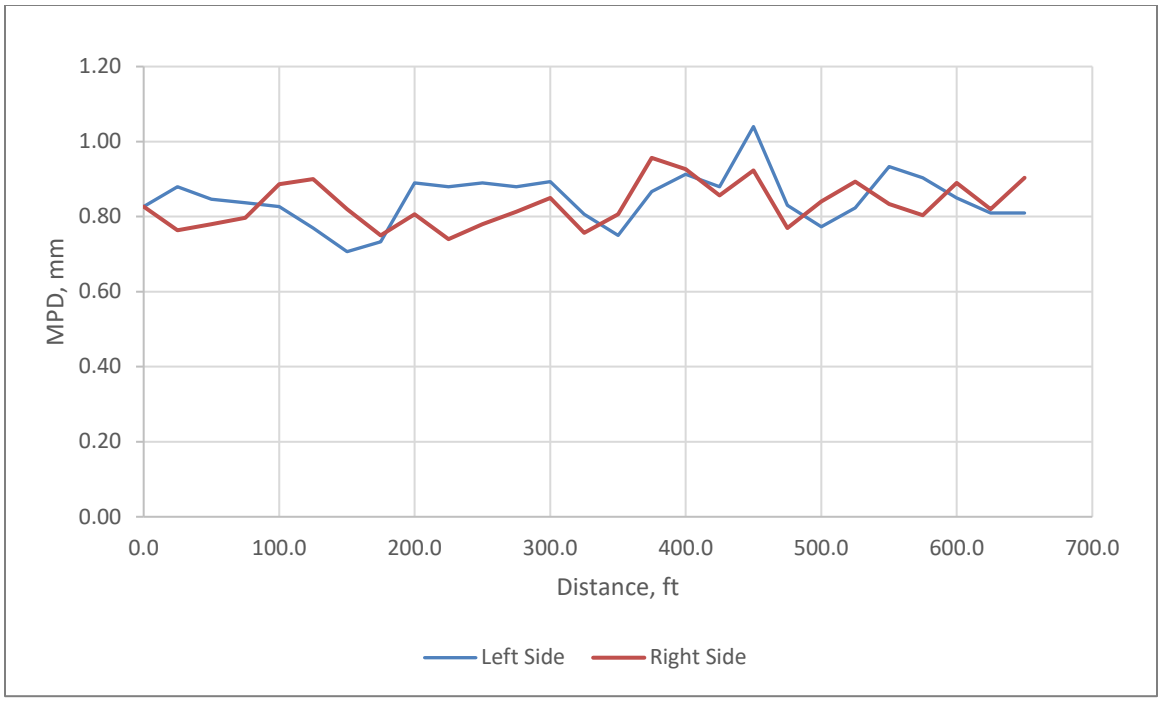

Figure 13. Texture Results for Desoto Falls Site