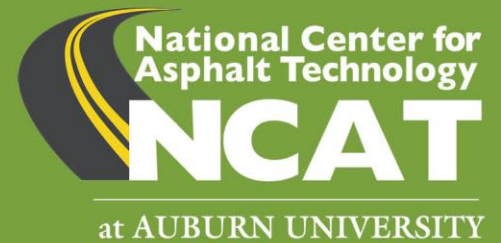


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Evaluation of a Rubber Modified Mixture Designed Using a Balanced Design -Annie Lee Road in St. Clair County, Alabama

Construction and Year 1 Field Evaluation

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1. INTRODUCTION

Asphalt mixtures have traditionally been designed using the Superpave mix design methodology, in which mixture component proportions are established primarily on the basis of volumetric property requirements. However, the increasing use of recycled asphalt materials and asphalt modifiers, such as ground tire rubber (GTR), has accelerated the implementation of Balanced Mix Design (BMD) approaches.

Balanced Mix Design is a mix design methodology that incorporates performance testing to evaluate multiple pavement distress mechanisms while considering factors such as mixture aging, traffic loading, climate, and pavement layer location. Unlike conventional Superpave design, which relies heavily on volumetric criteria, BMD aims to optimize the balance between rutting resistance and cracking resistance through direct evaluation of mixture performance. By focusing on the overall performance of the asphalt mixture rather than on individual material properties, BMD provides greater flexibility to incorporate innovative materials and technologies, including GTR products, while ensuring the production of durable, high-quality asphalt mixtures.

Although significant progress has been made in developing beneficial end-use markets for scrap tires, millions of tires are still disposed of in landfills or stockpiles each year. This presents an opportunity to further expand the use of GTR in asphalt pavements as a beneficial reuse strategy for scrap tires. Recognizing this potential, the Alabama Department of Environmental Management (ADEM), through its Scrap Tire Program, has expressed interest in promoting alternative engineering applications for recycled tire materials.

In support of this initiative, ADEM provided funding assistance in 2024 for a demonstration project on Annie Lee Road in St. Clair County, Alabama, which included the construction of a GTR-modified asphalt pavement section. This project provides an opportunity to evaluate the performance of GTR mixtures designed using BMD principles and to demonstrate a practical, beneficial application of recycled scrap tires in roadway construction.

2. OBJECTIVE

The objective of this project is to evaluate the performance of a ground tire rubber (GTR)-modified asphalt mixture designed using a Balanced Mix Design (BMD) approach and compare it with that of a conventional Superpave mixture. To achieve this objective, the Alabama Department of Conservation and Natural Resources (ADCNR) resurfaced sections of Annie Lee Road in St. Clair County, Alabama, using two different asphalt mixtures: a BMD mixture incorporating a recycled GTR additive and a conventional Superpave mixture. The side-by-side comparison will provide an opportunity to assess the effect of GTR and the BMD approach on mixture performance under field conditions.

3. PROJECT TASKS

Project Tasks

This project is divided into six tasks. The following paragraphs describe the tasks and progress as of the end of August 2026.

Task 1. Conduct a verification of the balanced mix design (BMD) with a GTR additive designed by the selected contractor.

ADCNR helped coordinate with the selected contractor the delivery of materials for the verification at NCAT. The contractor selected for this project was APAC-AL from Birmingham, Alabama. APAC-AL provided the aggregates for the GTR mix design verification, and the GTR was provided by Lehigh Technologies. APAC-AL also provided an ALDOT-approved 424 1/2" mix design to use for the project.

The preliminary BMD criteria required by ALDOT are an IDEAL-CT of at least 50 for A/B traffic roads and a Hot-IDT of at least 20 psi.

NCAT conducted a GTR BMD verification using materials provided by APAC-AL, with 12% GTR added by binder weight. Table 1 summarizes the mix design. After the verification, IDEAL-CT and Hot-IDT samples were prepared and tested. The GTR IDEAL-CT samples provided a CT_{index} of 51.4, and the Hot-IDT provided a strength of 42.6 psi. The results of these tests met the requirements for the ALDOT BMD criteria. Table 2 summarizes these results.

Table1. GTR Mix Design

Sieve	Design GTR Mix
P _{1/2} , %	99
P _{3/8} , %	96
P _{#4} , %	71
P _{#8} , %	42
P _{#16} , %	29
P _{#30} , %	20
P _{#50} , %	12
P _{#100} , %	7
P _{#200} , %	5.0
Total Binder Content (P _b), %	5.80
Eff. Binder Content (P _{be}), %	5.74
Dust/Binder Ratio	0.87
Air Voids, %	3.5

Table 2. GTR BMD Verification Results

Avg. CT _{Index}	51.4
St. Dev. CT _{Index}	19.9
Avg. HT-IDT	42.6
St. Dev. HT-IDT	10.8

Task 2. Monitor the production of the rubber modified mixture, and the construction of the test section.

The GTR sections were constructed on October 1, 2024. The construction activities were monitored by NCAT staff, and the plant mix was sampled for further testing. For this project, GTR was placed on all roads, and a control section was paved with a dense-graded mixture. Figures 1, 2, 3, and 4 show the GTR rubber feeder and placement and compaction activities taken during construction. A close-up of the RTR section after placement and compaction is presented in Figure 5.



Figure 1. GTR Feeder



Figure 2. GTR Mix Placement



Figure 3. GTR Mix Compaction



Figure 4. GTR Mix Compaction



Figure 5. Close-up of GTR Section after Placement and Compaction

Task 3. Conduct performance tests (rutting and cracking) using plant mix sampled during construction to determine its compliance with the performance requirements.

The plant mix sampled during construction was brought to NCAT for performance tests to determine whether the plant-produced mix met the cracking and rutting performance requirements. Table 3 and Table 4 summarize the results of the IDEAL-CT and Hot-IDT tests. As can be seen from the test results, the plant-produced GTR mix did not meet the performance requirement of 50 for IDEAL-CT. The GTR mix had a CT_{index} of 37.6. The GTR mix had a higher CT_{index} than the Control mix (11.9). The GTR mix had a Hot-IDT of 48.9 psi, which exceeded the performance requirement of 20 psi. The GTR mix Hot-IDT was lower than the Control Hot-IDT of 56.2 psi.

Table 3. IDEAL-CT Results from Plant Produced Mix for Control and GTR Sections

Mix ID	Average	St. Dev	Replicates	COV, %
Control	11.9	3.8	3	31.7
GTR	37.6	10.7	3	28.4

Table 4. Hot-IDT Results from Plant Produced Mix for Control and GTR Sections

Mix ID	Average	St. Dev	Replicates	COV, %
Control	56.2	1.0	3	1.8
GTR	48.9	2.7	3	5.5

Task 4. Evaluate the field performance of the test sections every year for six years.

A 2.6-mile segment of Annie Lee Road in St. Clair County, Alabama, was constructed in October 2024 with a GTR modifier. A 2,500-foot Control section was also placed using a conventional mix. The Control mix was placed in the westbound lane beginning at the intersection with Acmar Road, and the GTR was placed in both lanes for the remainder of the 2.6 miles. Figure 6 shows the location of these test sections.

The first field performance evaluation was conducted in October 2025. These sections were evaluated using NCAT's automated pavement condition survey vehicle, as shown in Figure 7. The purpose of this survey was to assess and compare the current pavement condition of the test sections in terms of IRI, rutting, texture, and cracking. Three data collection runs were made in each lane.

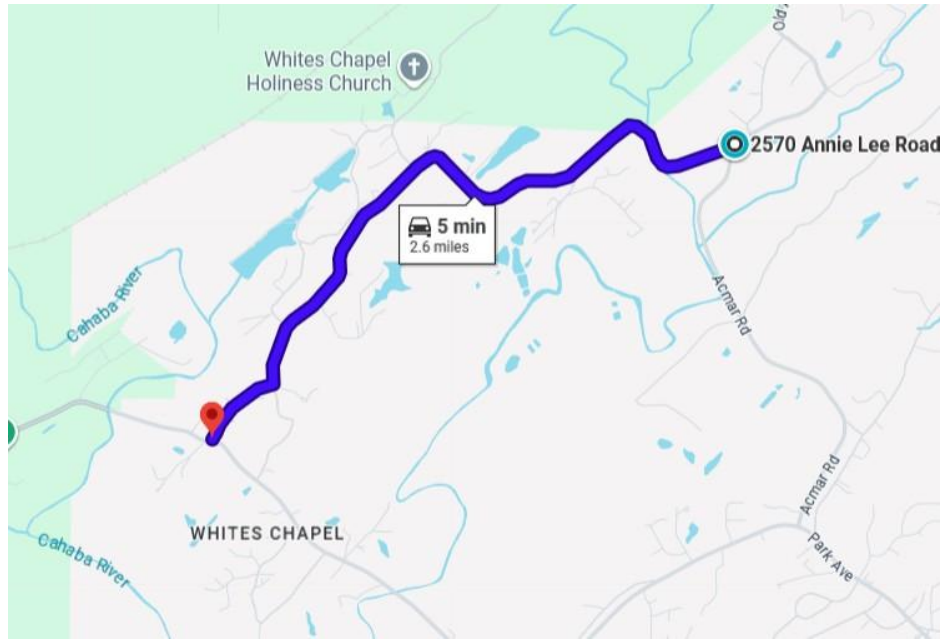


Figure 6. Test Section Location



Figure 7. NCAT's Automated Pavement Condition Survey Vehicle

The average performance data for IRI, rutting, and texture are shown in **Error! Reference source not found. 5**. The two mixes had similar IRI, rutting, and macrotexture values.

Table 5. Ride Quality, Rutting, and Texture Results at One-Year Inspection

Mix	Lane	IRI, in/mil	Rutting, in	Macrotexture, mm
Control	WB	125	0.11	0.45
GTR	EB	133	0.10	0.44
	WB	135	0.10	0.42

At the time of the one-year inspection, the Pathway system did not detect any discernible cracking in the mix sections. Figure 8 shows an example of the surface texture of the mixes. Both mixes were found to be performing well at the time of the one-year inspection.



Figure 8. Example of Both Mixes at One-Year Inspection (Rubber on Left, Control on Right)

Task 5. Prepare Final Report with Findings

After six years of field monitoring, a final report will be submitted documenting the findings and recommendations.