TRACK RESEARCH HISTORY
(Change Necessitates Full Scale Accelerated Performance Testing)

Bates Experimental Road (1922-1923)
Effect of Solid Rubber Tires

WASHO Road Test (1952-1954)
Effect of Post War Truck Loads

AASHO Road Test (1956-1961)
Effect of Varying Loads and Buildups

Mn/ROAD (1994-present)
Effect of Load Limits on Spring Thaw
(& Mechanistic Response)

NCAT Track (2000-present)
Effect of Truck Traffic on Both
Mix & Structural Performance

Effect of Superpave Design
(& Performance Specifications)
• Established by 1986 NAPA-AU Joint Agreement
• Financial Endowment “Seed” from Contractors, Suppliers, & Equipment Manufacturers via NAPA-REF
• Facilities and Faculty from Auburn University
• “Improve the Performance of HMA Pavements via Practical Research, Education, and Information Services”
• Broke Ground at Test Track in September of 1998…
NCAT TRACK

- Materials and Methods (Not Thickness) were 2000 Study Variables
- Materials, Methods and Thickness Studied in 2003 Experiment
- Anticipate Larger Structural Experiment in 2006 Track
2003 MIXED EXPERIMENT

Red – Mill and Inlay New Mix Performance Sections (14)
Blue – Excavate and Install New Structural Sections (8)
Black – Extend Original Rutting Study to 20M ESALs (23)
WHEELPATH DEVELOPMENT
INTERSTATE SIMULATION

Dual Tire Configuration

Axle Rod

Direction of

Measured Offset

Center of Lane

Edge Stripe

Summary Statistics

Average  
Stdev  
N

20.99 in.
8.57 in.
4990

Relative Frequency

Distance from Edge Stripe to Center of Outside Tire, in.
EFFECT OF PAVEMENT TYPE

25 Laps

GPS Velocity as a function of Track Position

Measured Velocity, m/sec vs. GPS Measured Distance Travelled, m

Truck Velocity, m/s vs. Truck 'East' Position
EFFECT OF PAVEMENT TYPE
EFFECT OF PAVEMENT TYPE

- Coarse Superpave Mix
- Stone Matrix Asphalt Mix
- Open Graded Friction Course
EFFECT OF PAVEMENT TYPE

\[ y = -18.70 \ln(x) + 25.57 \]

\[ R^2 = 0.90 \]
Roadway Wavelengths

Wavelengths Less Than 0.5 mm Are Indicative of Aggregate Surface Texture

Wavelengths Between 0.5 and 50 mm Are Indicative of Pavement Surface Texture

Wavelengths Between 50 mm and 60 m Are Indicative of Roadway Surface Roughness
SMA\textsubscript{near} vs OGFC\textsubscript{far} (SAME AGG)
OGFC @ ¼” PER HOUR
RUTTING VIA PROFILES

Average 6-Point Rut Depth via Profiles (mm)

Track Section

E2 E3 E4 E5 E6 E7 E8 E9 E10 E11 E12 E13 E14 E15 E16

N1 N2 N3 N4 N5 N6 N7 N8 N9 N10 N11 N12 N13 N14 N15 N16

W1 W2 W3 W4 W5 W6 W7 W8 W9 W10 W11 W12 W13 W14 W15 W16

S1 S2 S3 S4 S5 S6 S7 S8 S9 S10 S11 S12 S13 S14 S15 S16

E1
RUTTING VIA PROFILES

The diagram illustrates the relationship between ESALs (Equivalent Single Axle Loads) applied and average rut depth (mm) for profiles N11 and N12. The x-axis represents ESALs Applied, ranging from 0 to 20,000,000, while the y-axis shows the Average Rut Depth (mm) from 0 to 12. The data points for N11 and N12 are clearly visible, with N12 showing a slightly steeper increase in rut depth compared to N11.
CHANGING TEXTURE

![Graph showing Mean Texture Depth (mm) vs Traffic Accumulation (ESALs) with data points for N11 and N12]
SURFACE FRICTION

Millions of ESALs

Wet Ribbed Surface Friction

N11

N12

Avg

NCAT Pavement Test Track
LONGITUDINAL JOINTS
TOP-DOWN CRACKS IN OLD MIXES
## STRUCTURAL STUDY

<table>
<thead>
<tr>
<th>N1</th>
<th>N2</th>
<th>N3</th>
<th>N4</th>
<th>N5</th>
<th>N6</th>
<th>N7</th>
<th>N8</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>3</td>
<td>5</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>2</td>
<td>4</td>
<td>4</td>
<td>2</td>
<td>2</td>
<td>4</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>2</td>
<td>4</td>
<td>4</td>
<td>2</td>
<td>2</td>
<td>4</td>
<td>4</td>
<td>4</td>
</tr>
</tbody>
</table>

6” Dense Crushed Aggregate Base

| 4  | 2  | 2  | 4  | 4  | 4  | 6  |

6” Dense Crushed Aggregate Base

200 ft | 200 ft | 200 ft | 200 ft | 200 ft | 200 ft | 200 ft |

- Mix run with modified binder at optimum
- Mix run with unmodified binder at optimum
- Mix run with unmodified binder at cpc + 0.5%

- Mixes 1 & 3: 3/8” ARZ Superpave in 1” Lifts
- Mixes 2, 4 & 6: 3/4” ARZ Superpave in 2” Lifts
- Mix 6: 3/8” SMA in 1” Lifts
STRUCTURAL STUDY OBJECTIVES

• Determine Actual Layer Coefficients for ’93 AASHTO Design Describing New Mixes, Materials and Methods
• Provide an Initial Validation of the Upcoming Mechanistic Design Guide (Mechanistic and Performance Models)
• Prepare for Comprehensive Validation Experiment on the 2006 Track (3RD Cycle of Testing)
STRUCTURAL SECTION RUTTING

![Graph showing rut depth (mm) vs. ESALs for N1, N4, and N5 sections.](image-url)
RESPONSE INSTRUMENTATION
FIELD PERFORMANCE TESTING

200 ft Total Constructed Section Length

Random Test Location

Random Test Location

Random Test Location

Instrumentation Array

Wheelpath Densities & Transverse Profiles

Wheelpath Densities & Transverse Profiles

Wheelpath Densities & Transverse Profiles

25 ft Buffer

50 ft Replicate

50 ft Replicate

50 ft Replicate

25 ft Buffer

Random Test Location

Random Test Location

Random Test Location

Wheelpath Densities & Transverse Profiles

Wheelpath Densities & Transverse Profiles

Wheelpath Densities & Transverse Profiles
STRAIN SIGNAL PROCESSING

W1: cut(w2)

W3: movavg(W 1, 20)

W4: inflect(W 3.60, 350, 4.5)

W6: xy(col(W 4, 1), col(W 4, 2)); overplot(xy(col(W 5, 1), col(W 5, 2))); setsymbol(1, 1); setplotstyle(1, 1)

Inflection Point
MEASURED PAVEMENT RESPONSE
Measured Strain vs. Mid-Depth Temperature

N1
\[ y = 0.097x^{1.9608} \]
\[ R^2 = 0.9302 \]

N2
\[ y = 0.0216x^{2.2302} \]
\[ R^2 = 0.7846 \]

N3
\[ y = 0.1036x^{1.7561} \]
\[ R^2 = 0.9115 \]

N4
\[ y = 0.0282x^{2.0339} \]
\[ R^2 = 0.9425 \]

N5
\[ y = 0.0336x^{2.0924} \]
\[ R^2 = 0.9055 \]

N6
\[ y = 0.0404x^{2.0551} \]
\[ R^2 = 0.9424 \]

N7
\[ y = 0.0146x^{2.2812} \]
\[ R^2 = 0.9055 \]

N8
\[ y = 4.7572x^{0.8333} \]
\[ R^2 = 0.8671 \]
Measured vs. Theoretical Strain (excluding coordinates (0,0))

\[ y = 0.9345x \quad R^2 = 0.9158 \]
\[ y = 0.9912x \quad R^2 = 0.9033 \]
FATIGUE CRACK DEVELOPMENT
HISTORY OF N2
N2 CRACK MAP – 10/21/03 (0.0M)
N2 CRACK MAP – 6/28/04 (2.7M)
N2 FATIGUE CRACKING
PRELIMINARY FINDINGS

• No Difference in Stiffness Between Modified and Unmodified Mixes, But More Elastic Recovery in Modifieds
• Strong Relationship Between Temperature, Thickness and Strain Accommodates Blending Temperature and Traffic Record into Cumulative, Comprehensive Damage Model
• Higher Longitudinal Strains Induce Transverse Cracking
• Thin Sections Failed, Lasted Longer than Predicted
2006 TRACK RESEARCH OPTIONS

- **Structural** Deep Remove/Replace Sections in a Comprehensive Validation Experiment for Mechanistic-Empirical Thickness Design ($150k per Section per Year for 3 Years)
- **Mill and Inlay** New Mix Performance Sections ($100k per Section per Year for 3 Years)
- **Continue Traffic** on Existing Sections and Apply Another Design Lifetime of Trucking ($50k per Section per Year for 3 Years)
STRUCTURAL MILLING
APT COOPERATIVE EFFORTS

• Purdue Rutting Study on 2000 Track
• Florida Rutting Study on 2003 Track
• Purdue Structural Study on 2003 Track
• New TRB Alliance Subcommittee
• Structural Sections on 2006 Track
Welcome to the home page for the NCAT Pavement Test Track. The primary objective of this site is to successfully communicate our experiences to the world as we strive to assist governmental agencies nationwide in streamlining the practical application of research designed to extend the life of flexible pavements. We appreciate your feedback.

Sponsor Meeting Information - This cooperatively funded research project provides for 2 onsite meetings each year as a benefit of sponsorship. The purpose of these meetings is to ensure that research efforts are meeting sponsors' expectations. During the last onsite meeting (June 11th and 12th), sponsor representatives decided to next meet some time in November or December. This timeframe is intended to...