Benchmarking Cracking Resistance of Asphalt Mixtures in Alabama

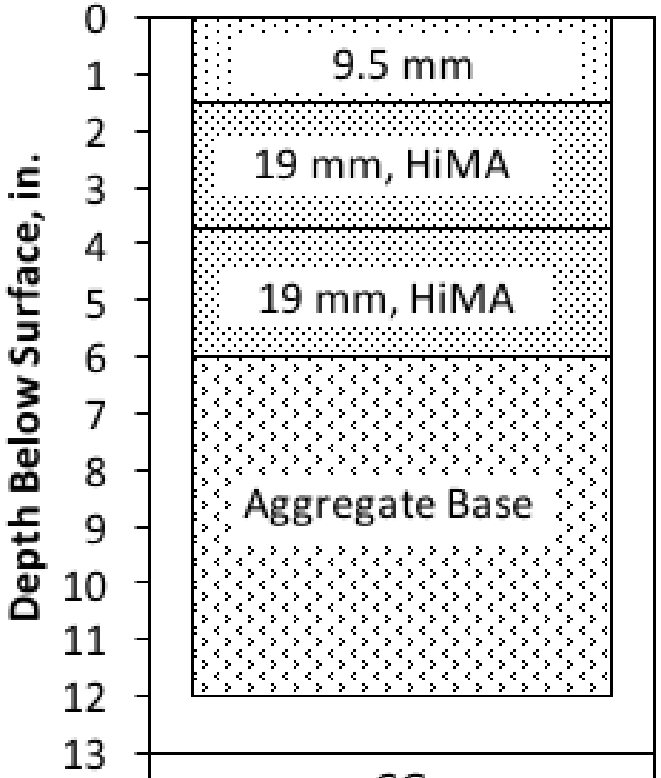
67th Annual Alabama Transportation Conference

February 6-7, 2024

Acknowledgements

- Data from two research projects
  - ALDOT Research Project 930-979
  - Cracking Group Experiment at the NCAT Test Track
- Plant mixes sampled with assistance from ALDOT engineers
- Lab mix specimens prepared by contractors and tested by M&T

How Will My Mix Perform?



	CG
Base	6.0
Lift 3	2.25
Lift 2	2.25
Lift 1	1.50

Sect.	Surface Mix Description	Base Binder
N1	20% RAP	PG 67-22
N2	20% RAP w/ high density	PG 67-22
N5	20% RAP w/ low AC, low density	PG 67-22
N8	5% RAS & 20% RAP	PG 67-22
S5	35% RAP	PG 64-28
S6	20% RAP	PG 88-22
S13	15% RAP	AZ rubber

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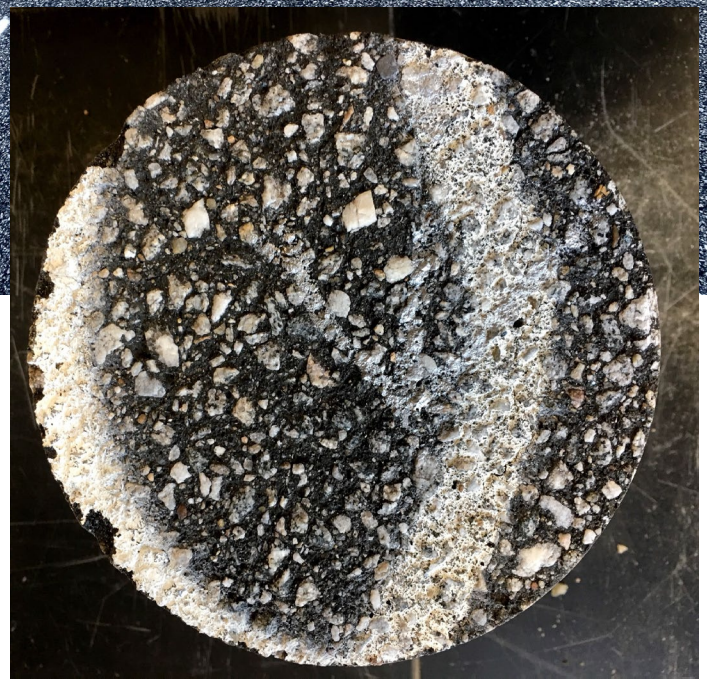
N1


N2

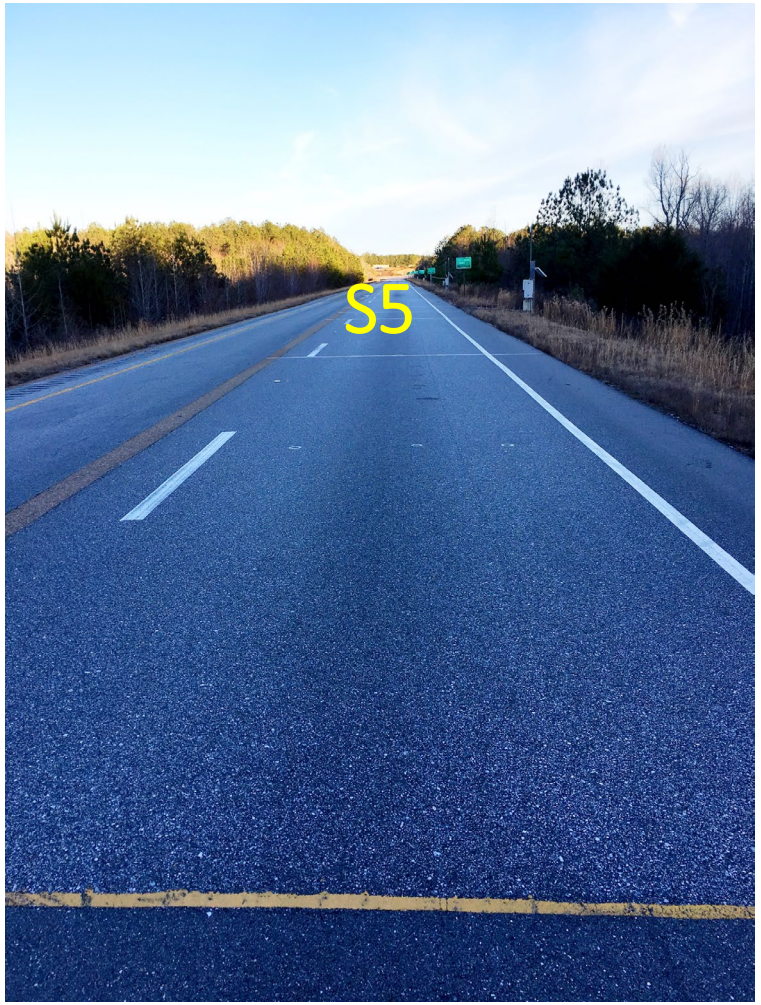



N5

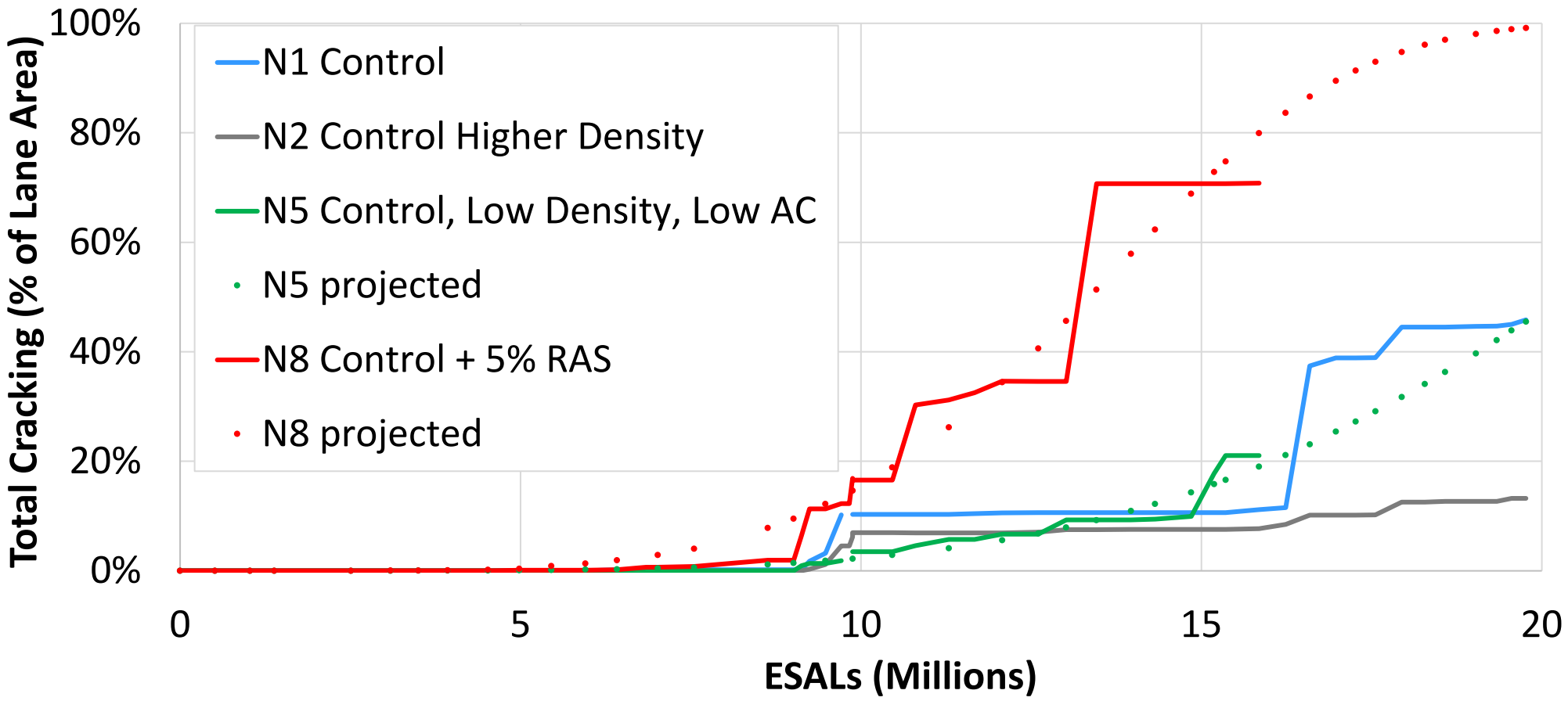

N8

N8 Cores show top-down cracking. Layers below are intact.

Sections S5, S6 and S13



Progression of Cracking



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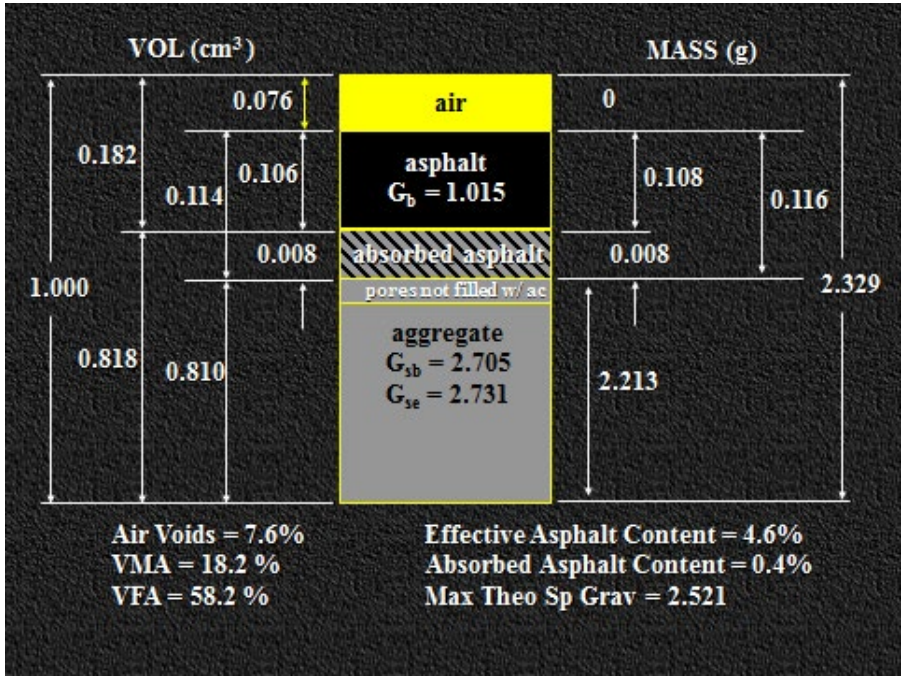
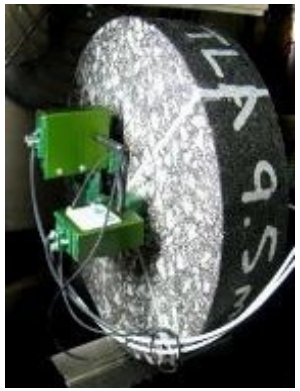
What are the Problems here?

With the volumetric mix design, we can check the quantity but not the quality of the binder in the mix



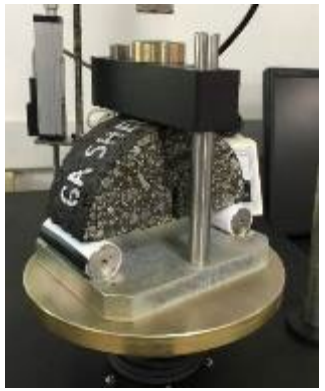
Source: R. West, BMD Webinar Series, Part 2

Can We Do Differently?



Energy Ratio

SCB-LA



I-FIT

OT-TX

OT-NCAT

IDEAL-CT

AMPT Cyclic Fatigue

Tests* were conducted on:

1. lab prepared mix after short-term aging
2. lab prepared mix after short-term and critical aging
3. plant mix samples that were reheated
4. plant mix samples that were reheated and critically aged

*AMPT Cyclic Fatigue Tests were tested only on plant mix samples

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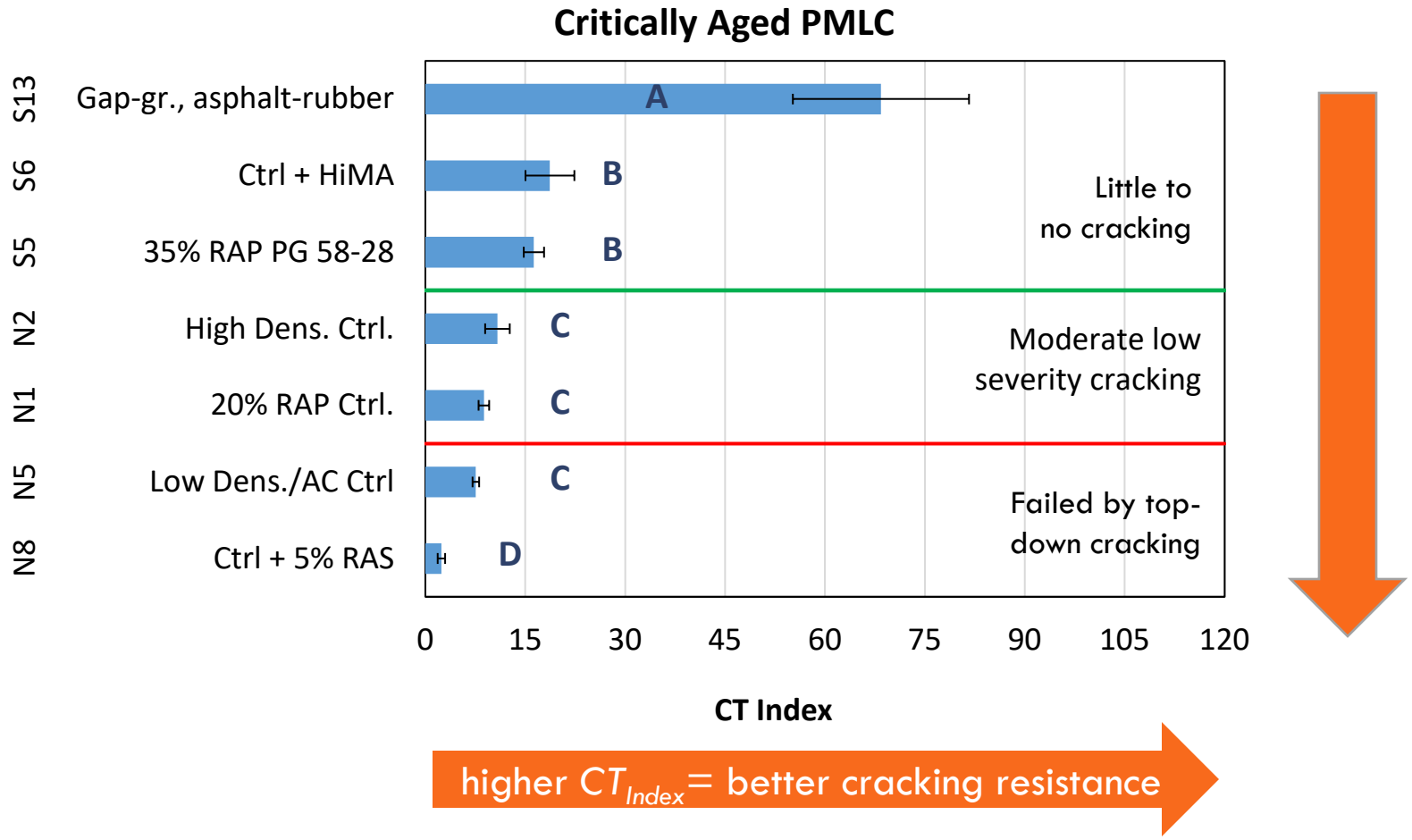
Can One of the Tests Distinguish Performance?

AL-CT (IDEAL-CT)



Sorted from best to worst field cracking performance

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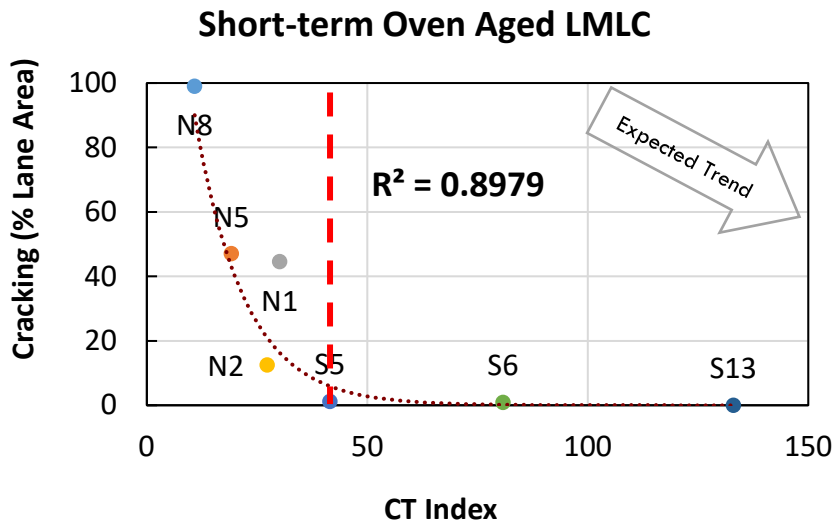
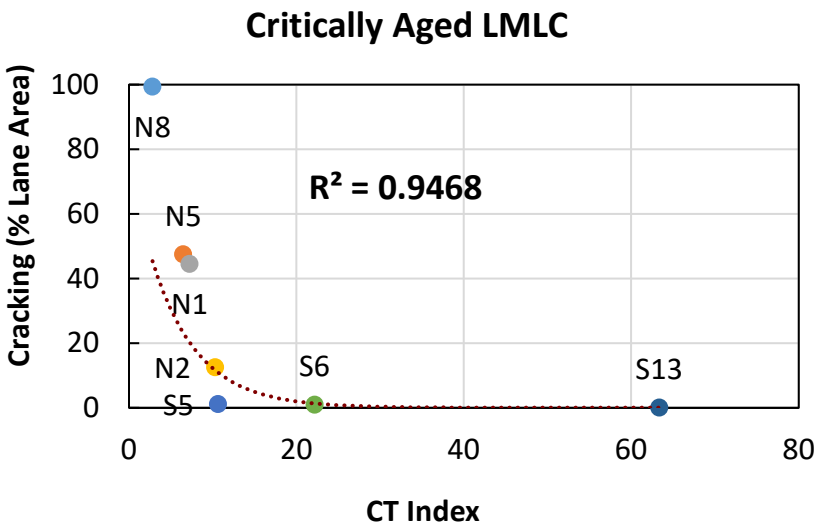
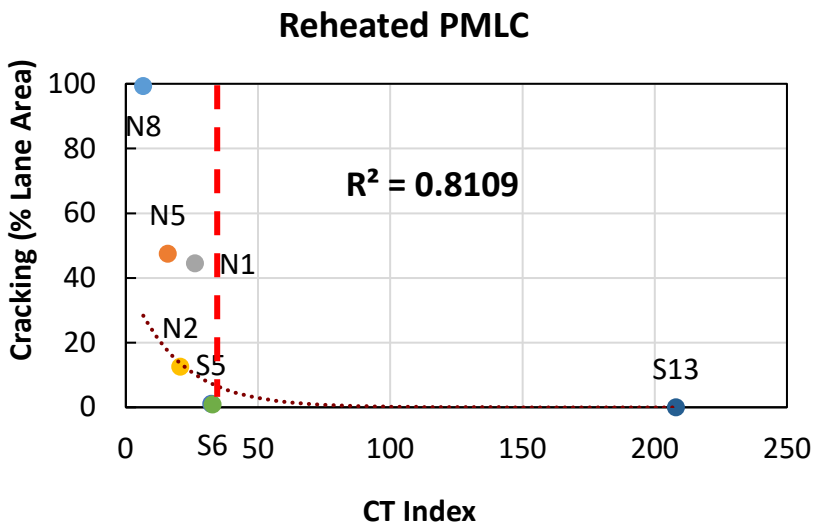
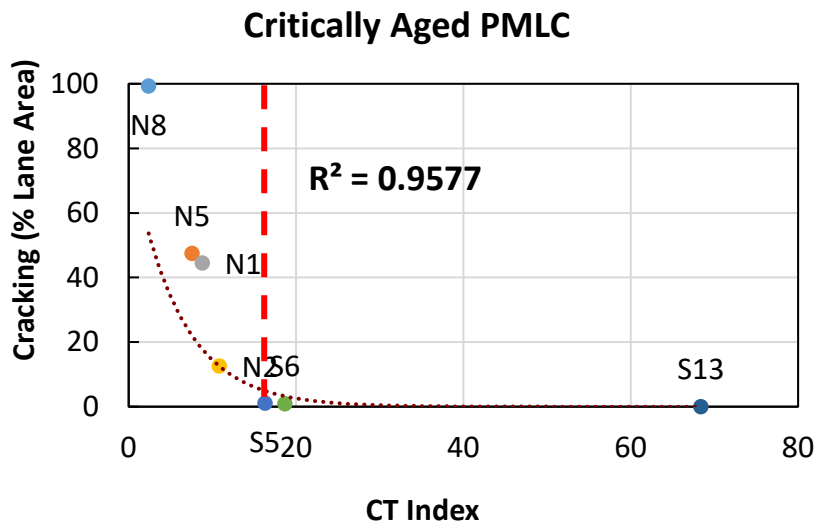
How About Lab Mix and Aging Condition?









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How are Current ALDOT Mixes Compared to the Test Track Mixes?

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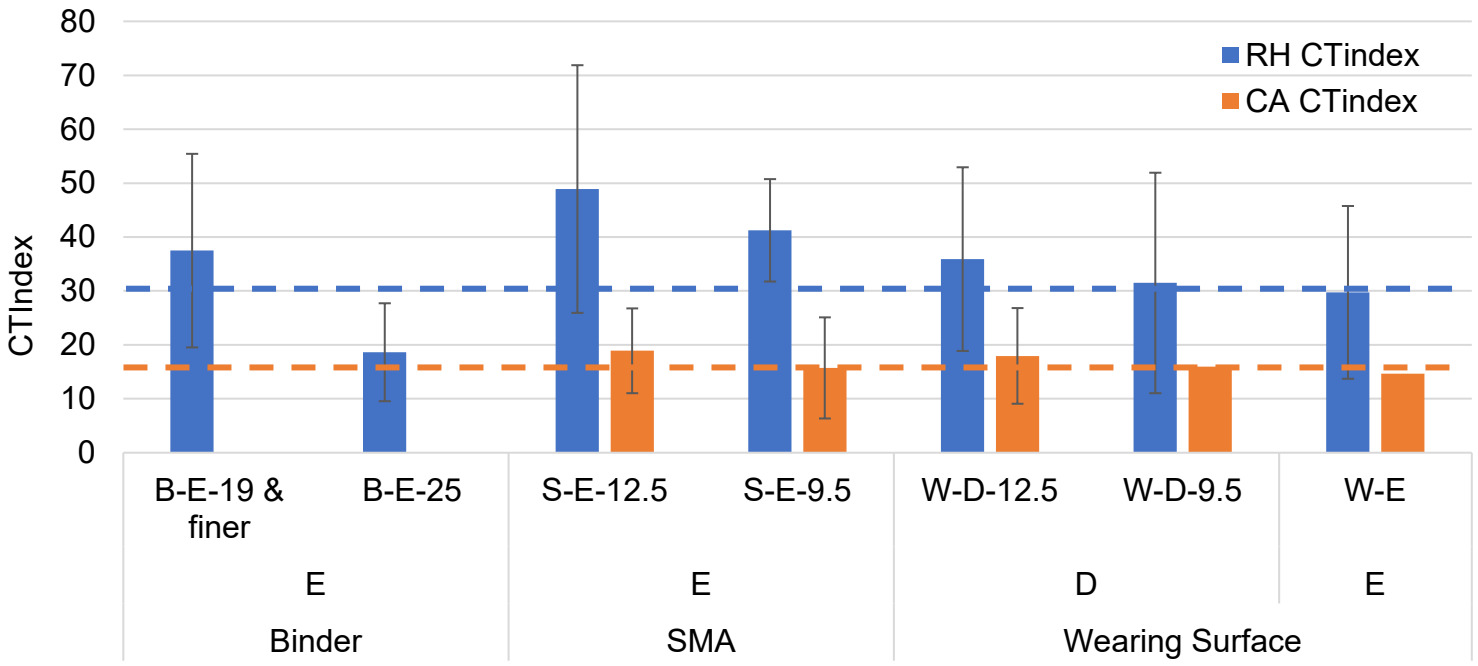
Mix Type	Traffic	MAS (mm)	Group	Number of Mixes
Binder (B)	A/B, C/D, E (E)	19 and finer	B-E-19 & finer	8
	A/B, C/D, E (E)	25	B-E-25	6
SMA (S)	A/B, C/D, E (E)	12.5	S-E-12.5	4
	A/B, C/D, E (E)	9.5	S-E-9.5	3
Wearing Surface (W)	A/B, C/D (D)	12.5	W-D-12.5	9
	A/B, C/D (D)	9.5	W-D-9.5	5
	A/B, C/D, E (E)	9.5, 12.5, 19	W-E	3

How are Current ALDOT Plant Mixes Compared to the Test Track Mixes?



ANOVA Results	
Factors	**P-Value**
Mix Type	0.429
Traffic Level	0.084
MAS	0.293
Total AC (%)	0.823
Effective AC	0.419
Recycled AC (%)	0.671
VMA (%)	0.753
Dust/asphalt Ratio	0.480

How About ALDOT Lab Mixes?

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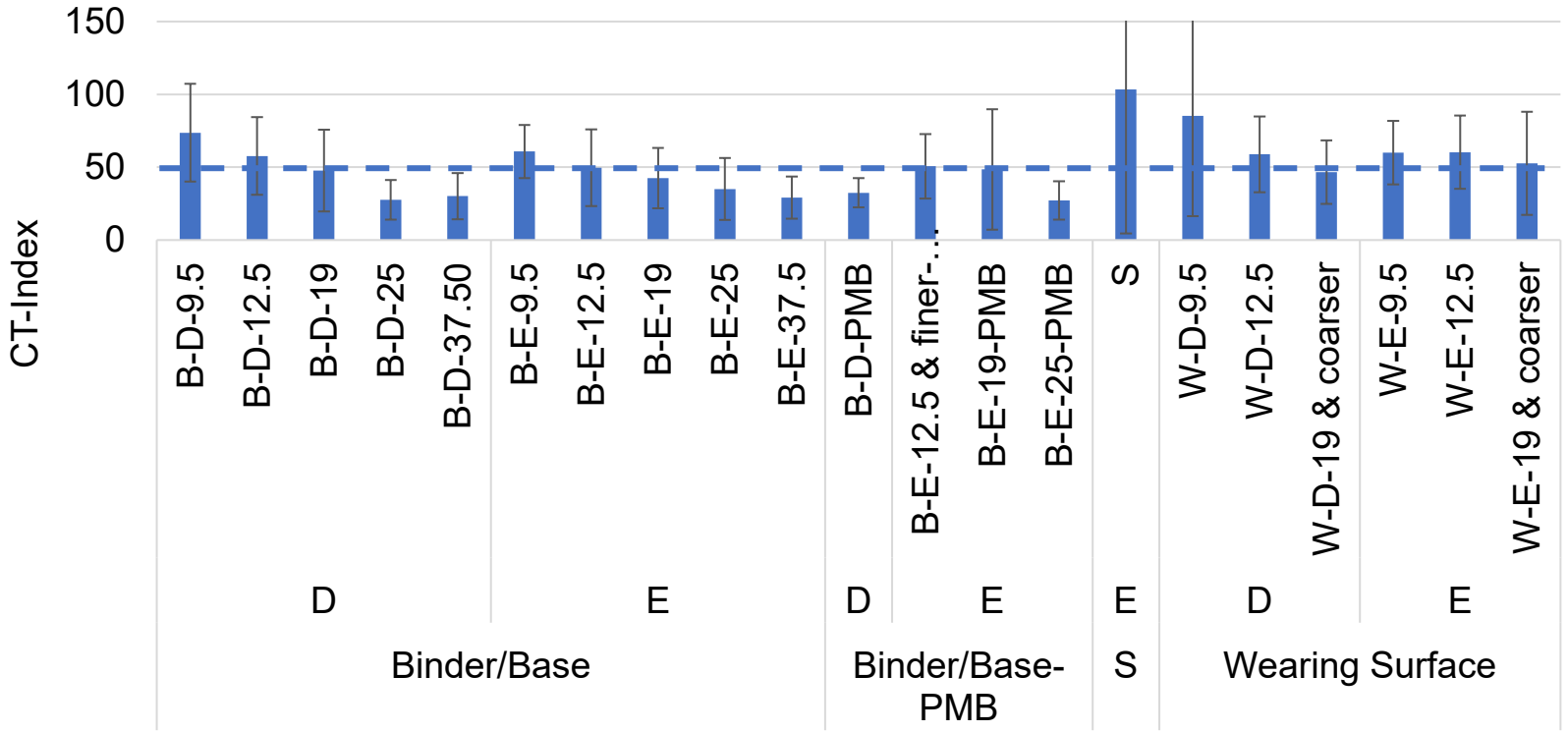
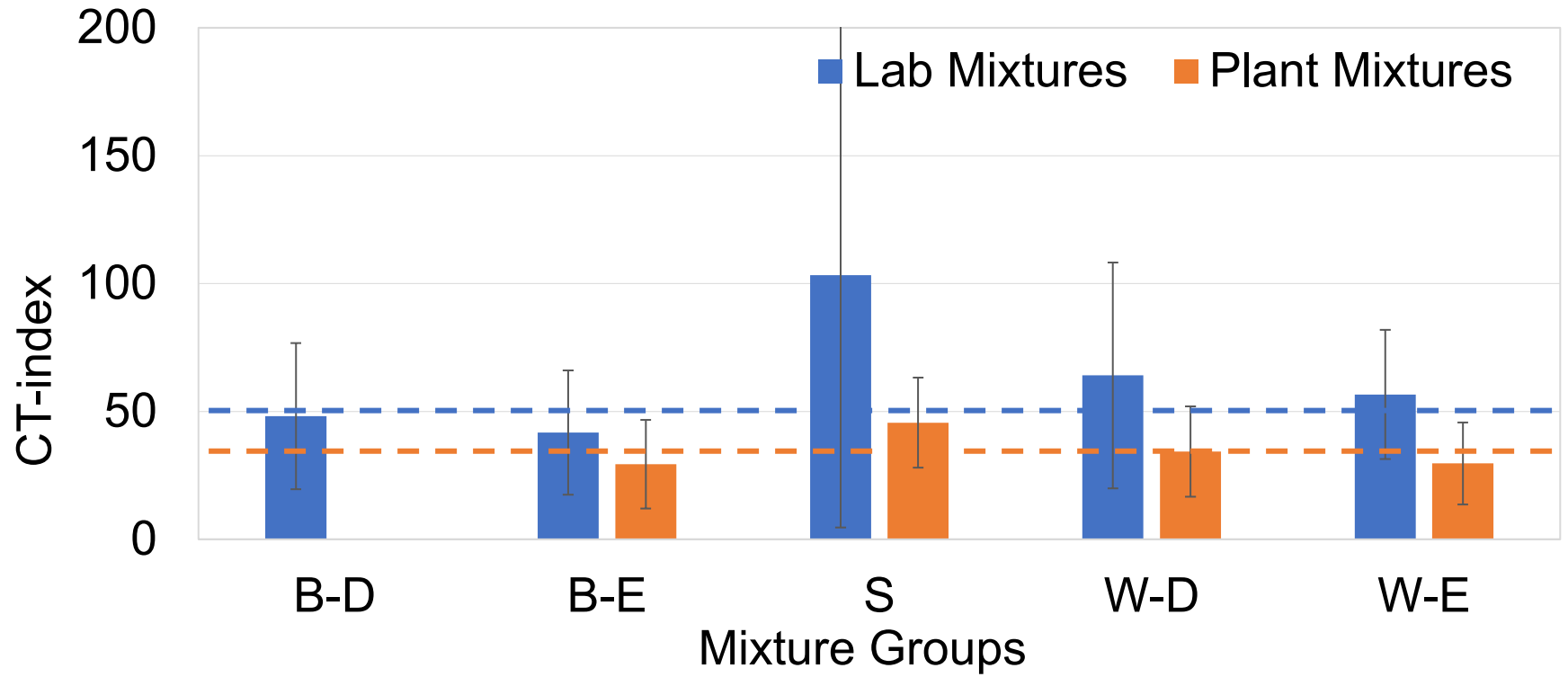
Mix Type	Traffic Level	MAS (mm)	Group	Number of Mixtures
Binder/Base-PG 67-22	A/B, C/D (D)	9.5	B-D-9.5	12
		12.5	B-D-12.5	34
		19	B-D-19	25
		25	B-D-25	20
		37.5	B-D-37.50	8
	A/B, C/D, E (E)	9.5	B-E-9.5	5
		12.5	B-E-12.5	22
		19	B-E-19	34
		25	B-E-25	38
		37.5	B-E-37.5	10
Binder/Base- PG 76-22 (PMB)	A/B, C/D (D)	19 and 25	B-D-PMB	4
	A/B, C/D, E (E)	9.5 and 12.5	B-E-12.5 & finer-PMB	20
		19	B-E-19-PMB	12
		25	B-E-25-PMB	12
SMA	A/B, C/D, E	9.5, 12.5, 19, and 25	S	10
Wearing Surface	A/B, C/D (D)	9.5	W-D-9.5	28
		12.5	W-D-12.5	50
		19, 25, and 37.5	W-D-19 & coarser	24
	A/B, C/D, E (E)	9.5	W-E-9.5	16
		12.5	W-E-12.5	47
		19, 25, and 37.5	W-E-19 & coarser	25

How About ALDOT Lab Mixes?



ANOVA Results	
Factors	**P-Value**
Mix Type	0.00
Traffic Level	0.39
MAS	0.00
Total AC	0.00
%RAP	0.00

ALDOT Lab Mixes Vs. Plant Mixes



Key Takeaways

- Should we continue using the volumetrics as quality indicators?
  - They are good for quantity checks but not for quality checks.
- If not, what are the alternatives?
  - The AL-CT test can separate good cracking resistance mixes from others.
- Is there a preliminary criterion for AL mixes?
  - A CT_{index} of 50 is a reasonable initial threshold.
- Are there differences between lab and plant mixes?
  - Results for plant mixes are typically lower.

Ongoing Work

- Balanced Mix Design (BMD) Field Trial Projects in Alabama
  - Conduct field trial projects constructed with BMD asphalt mixtures to validate the proposed cracking and rutting thresholds

- Strategies for Improving the Cracking Resistance of Alabama Mixes
  - Determine how mix components affect the cracking resistance of asphalt mixtures in Alabama
  - Evaluate changes to mixture composition and the use of additives that can improve the cracking performance of Alabama mixtures.

Thank You

nam.tran@auburn.edu

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End-of-Cycle Conference for the 2021 NCAT Pavement Test Track and the MnROAD Pavement Research Partnership

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May 7-9, 2024

Auburn, AL