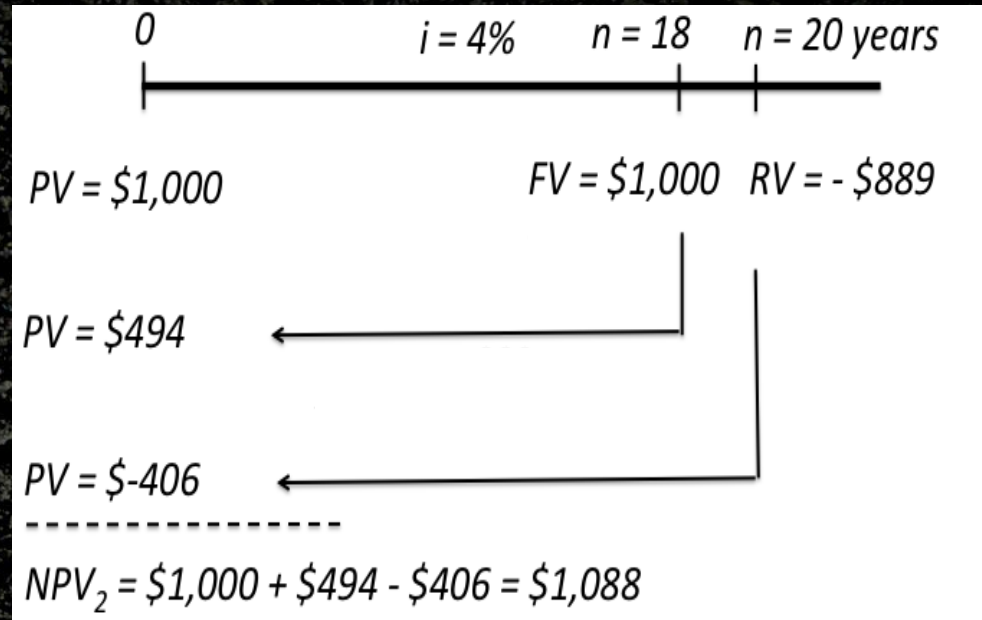
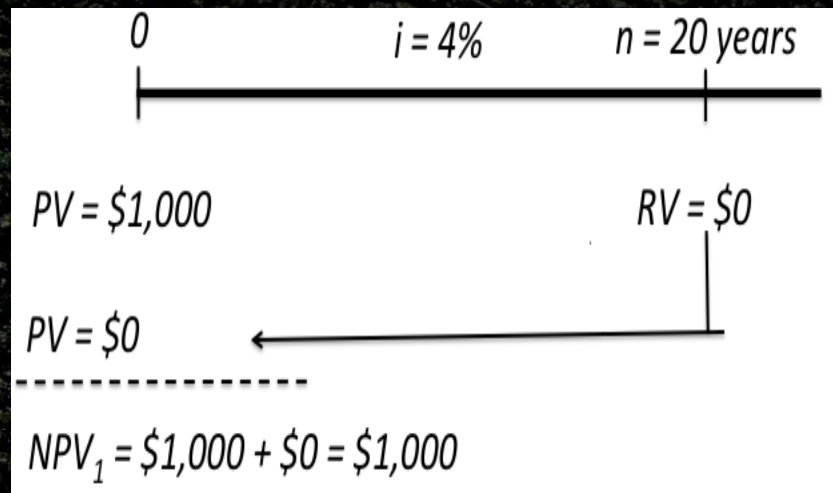


Laboratory and Field Cracking Performance of Asphalt Mixtures

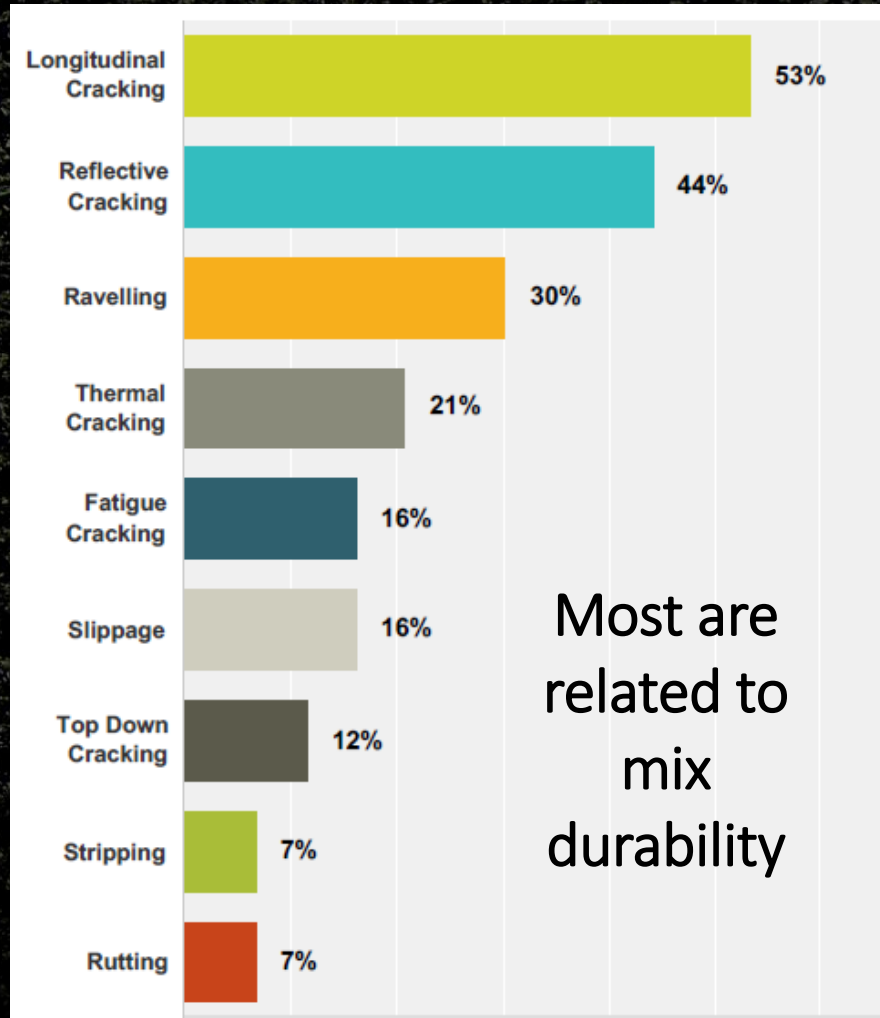
Dr. Nam Tran, PE, MBA
Assistant Director

Impact of Service Life on LCCA



The agency would see an NPV cost savings of \$88,000 on a \$1,000,000 paving project (or **8.8%**) by **increasing the service life** by **10%**.

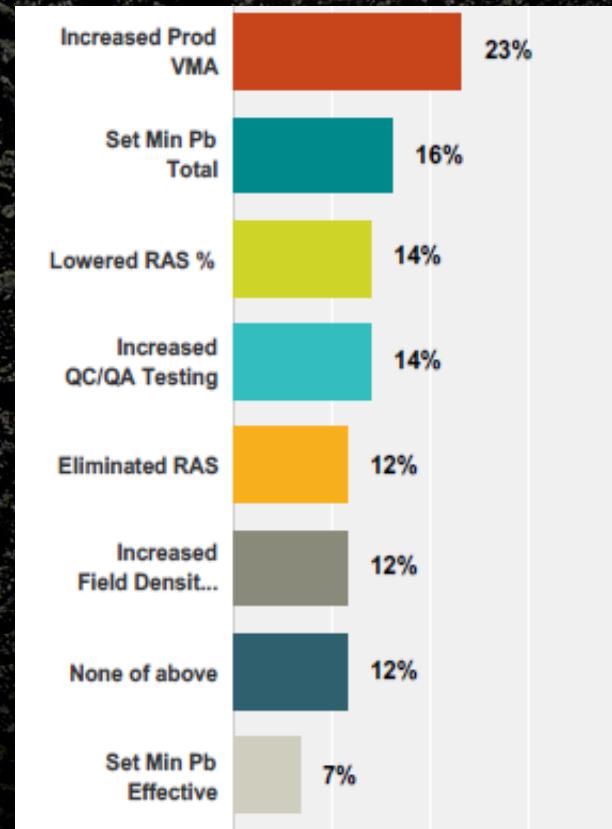
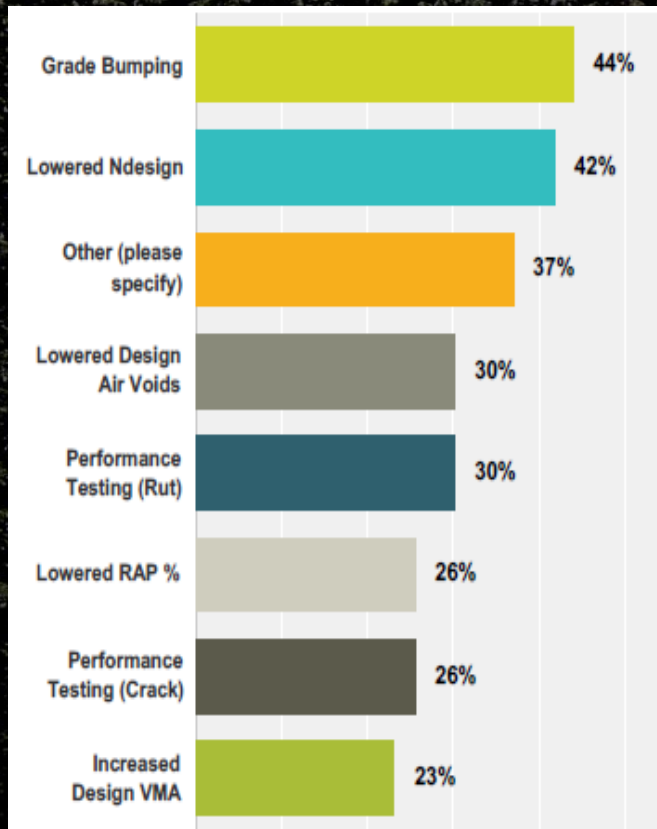
What Distresses are Occurring?



- Oldcastle survey of member companies in 30 states:
 - Within the past 5 years, what type of mix performance related distress has been most evident in your mixes?

What Changes Have Been Made?

- Which of the following specification changes has your DOT implemented in the last 5 years?

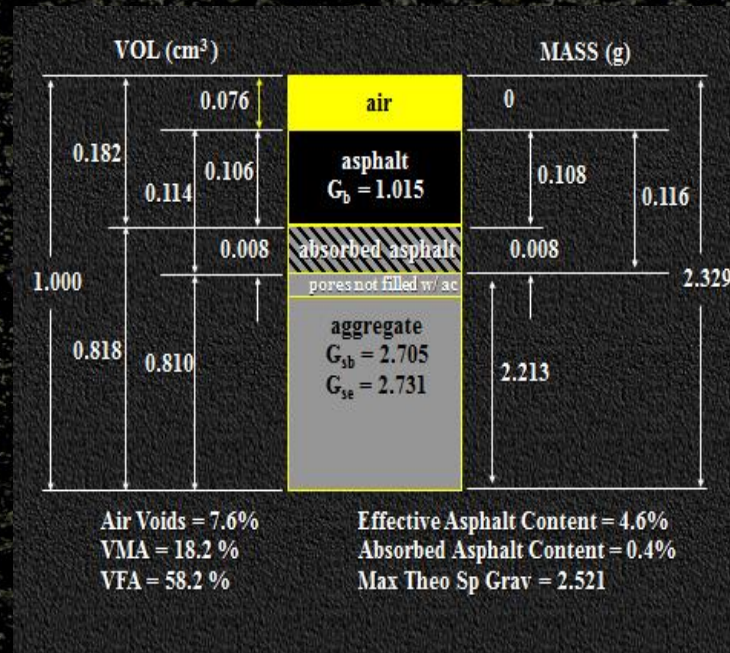


Agencies are changing volumetric mix design specifications to increase virgin binder content

Are Volumetric Changes Sustainable?



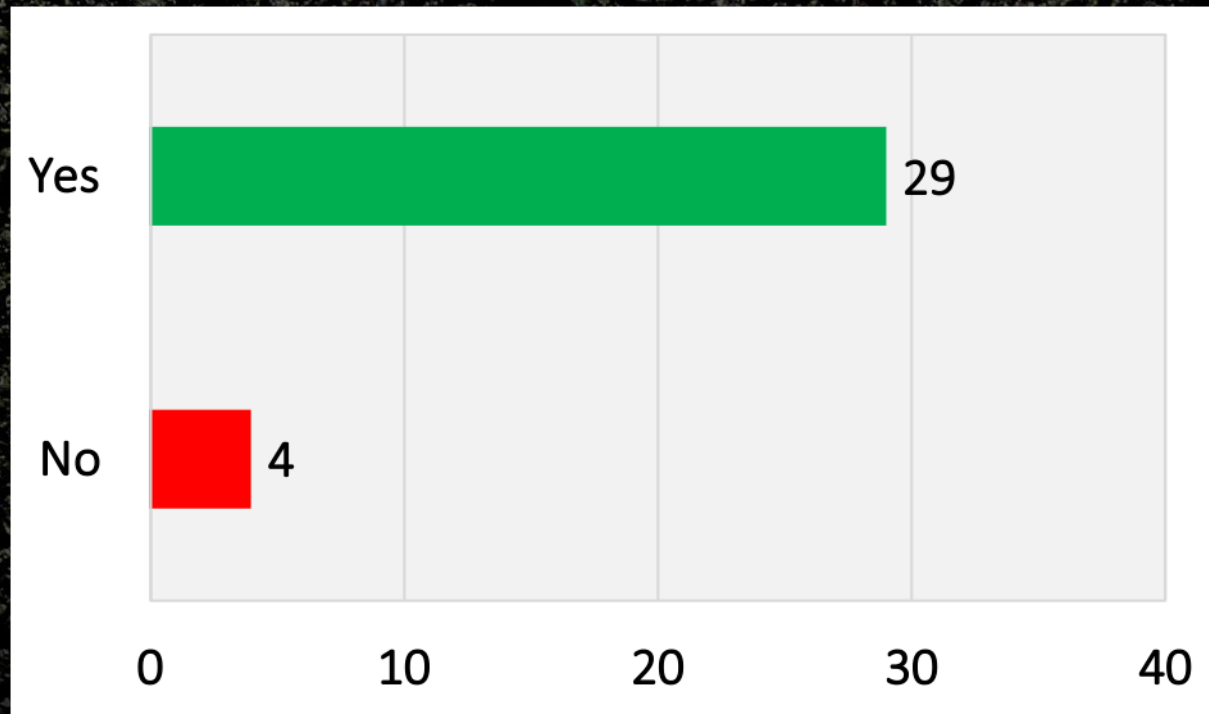
With the current volumetric mix design system, we can check quantity but not quality of binder in the mix



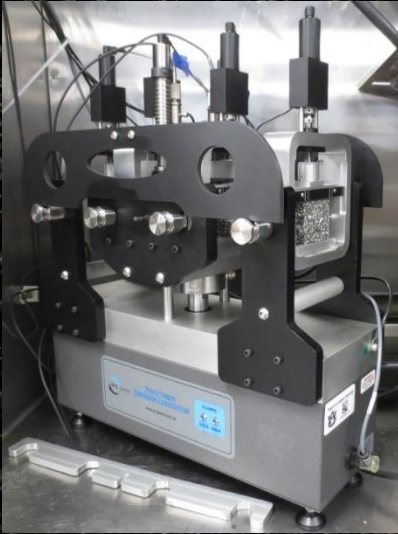
Source: R. West, BMD Webinar Series, Part 2

Do Agencies Recognize the Need?

- Will your agency consider modifying the current mix design procedure to include performance tests?



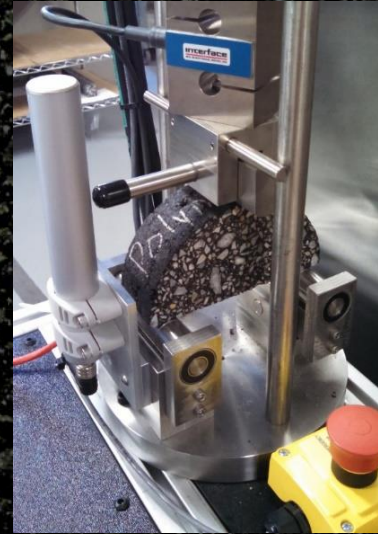
What Cracking Tests Are Available?



Bending Beam
Fatigue



Overlay Test



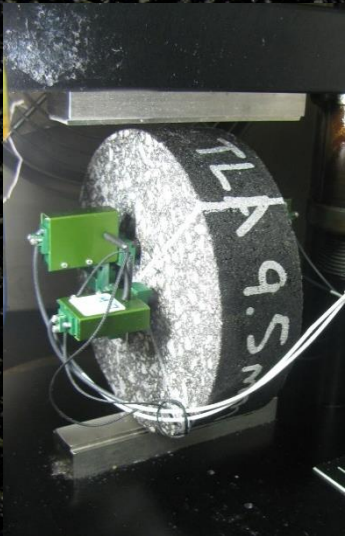
Semi-Circular
Bend (SCB)
(I-FIT)
(SCB-Jc)



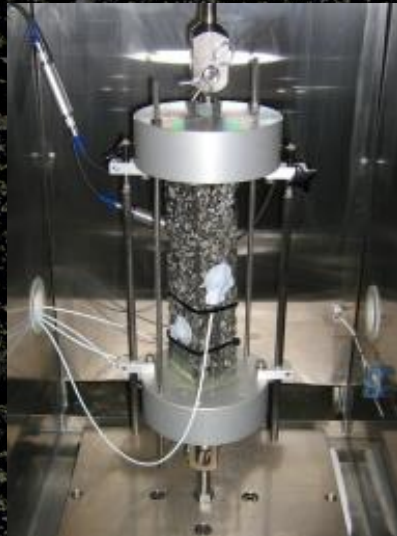
Cyclic Fatigue
(S-VECD)

Load-Related Cracking Tests

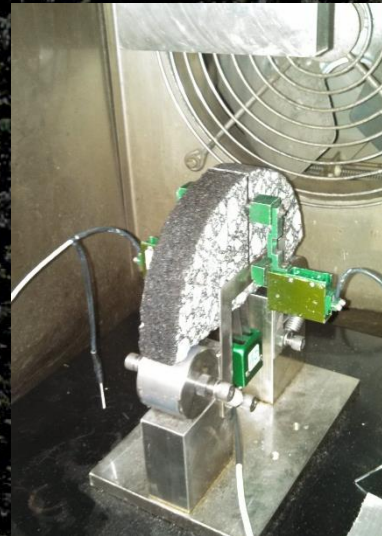
What Cracking Tests Are Available?



IDT Creep
Compliance



UTSST
(modified
TSRST)



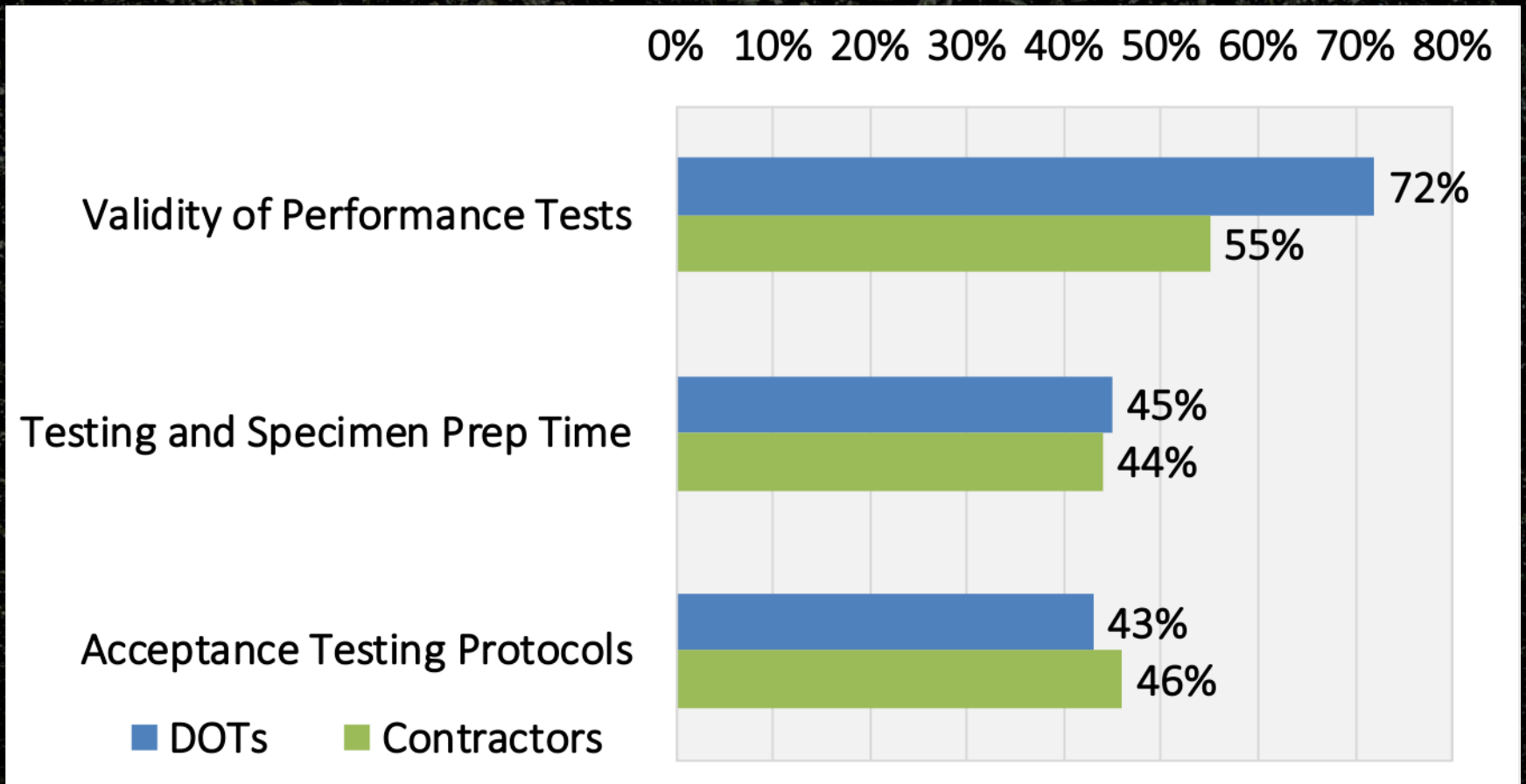
SCB at Low
Temperature
Test



Disk-shaped
Compact
Tension (DCT)

Low-Temperature Cracking Tests

Top 3 Concerns Regarding Performance Tests



MnROAD + NCAT

Cracking Group Experiments

- What cracking tests are best for future...
 - Mix design
 - Production
 - {Pavement design}
- Can we engineer asphalt mixes to perform?
 - Binder modifications
 - Recycled materials

**Positive
Changes**

Innovation

Experimental Plan

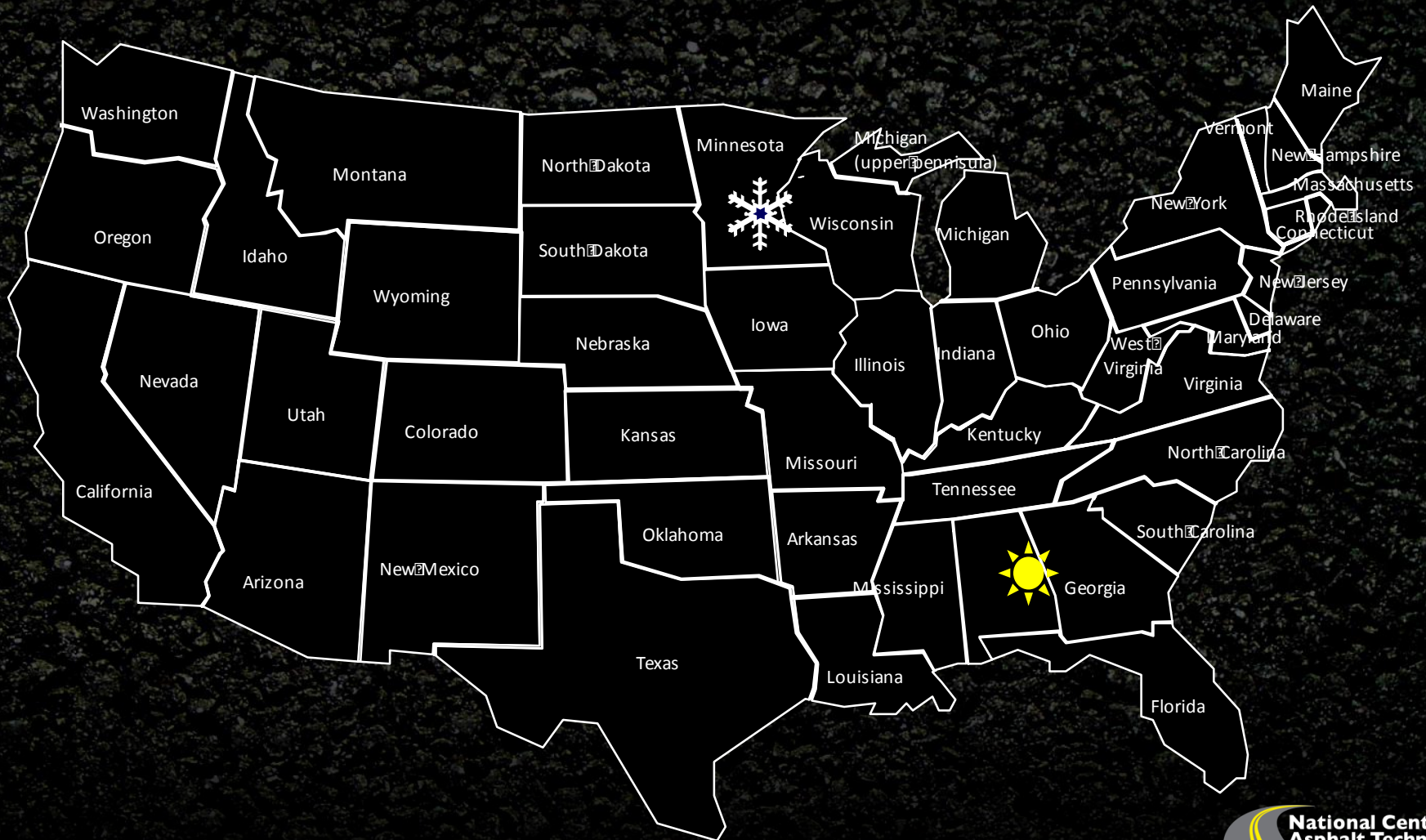
NCAT Test Track
Top-down Cracking



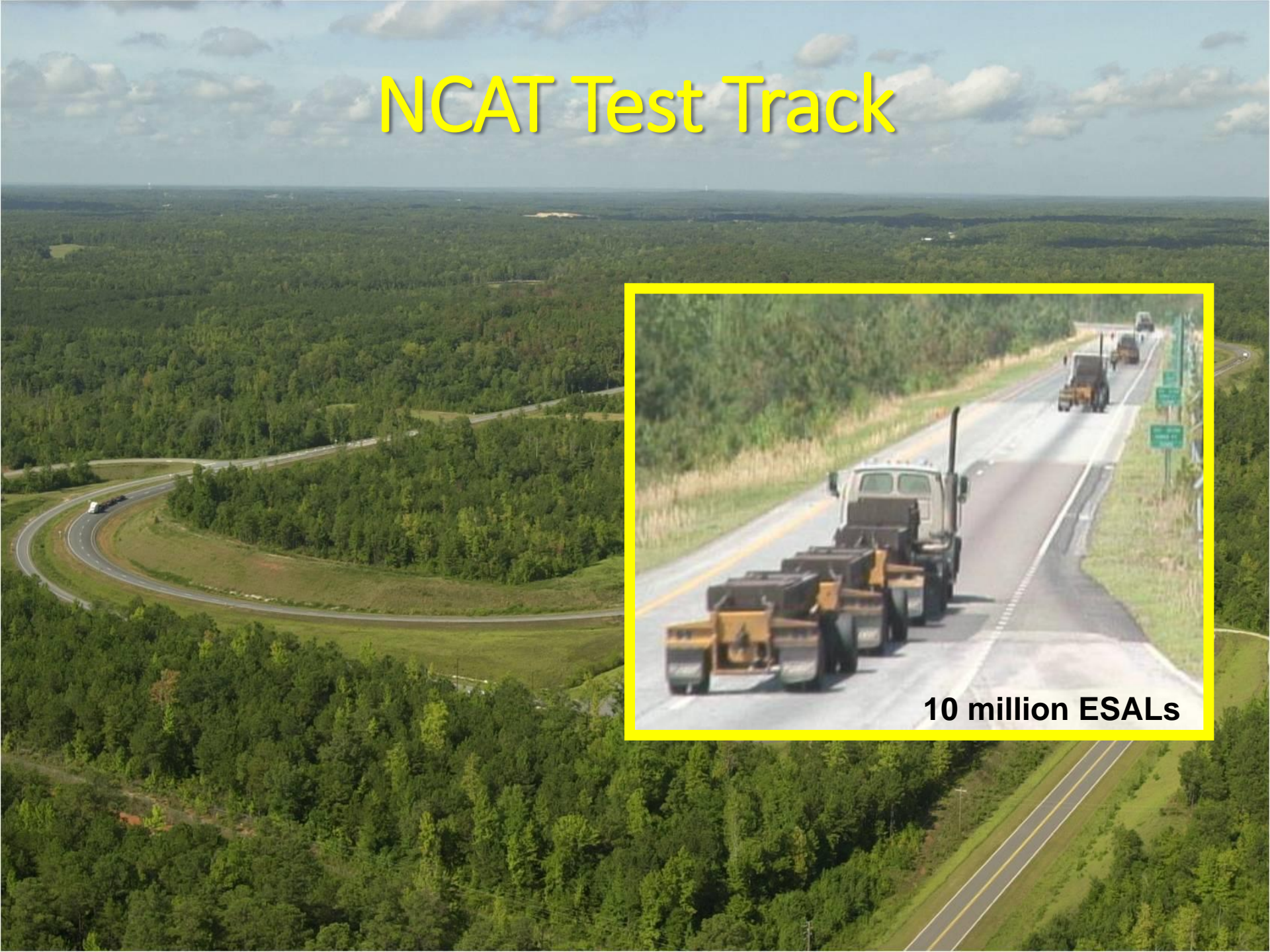
MnROAD
Low-temperature Cracking



Location of Test Sections

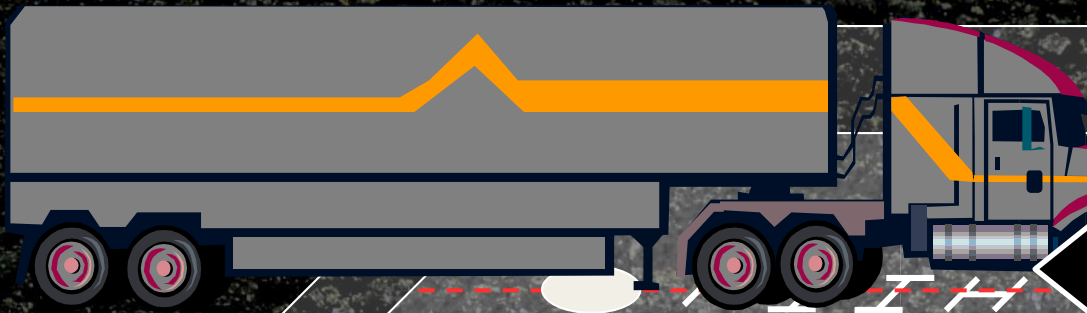


NCAT Test Track



10 million ESALs

Dynamic Instrumentation



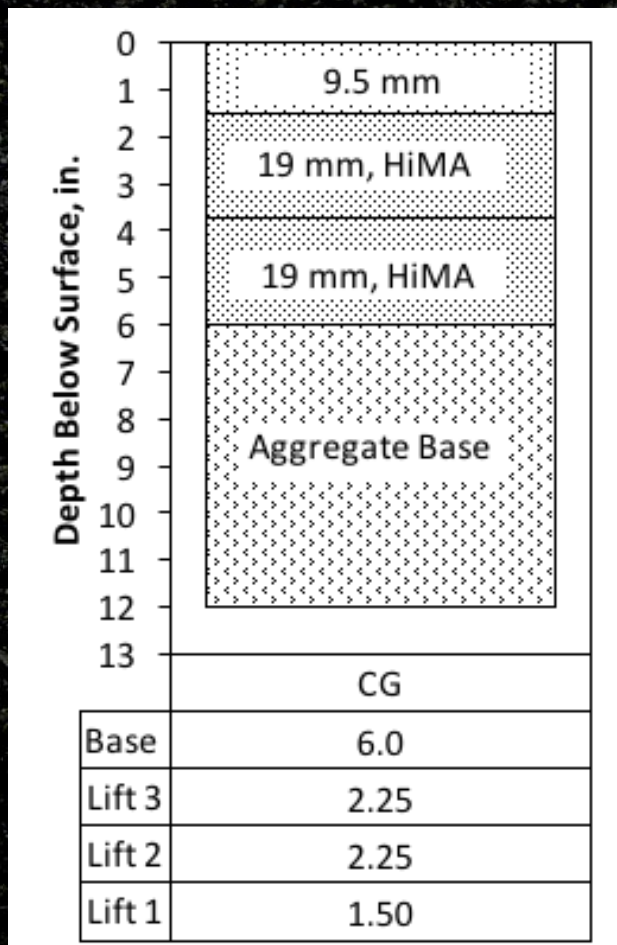
Backcalculated Moduli



Field Performance



Experimental Plan



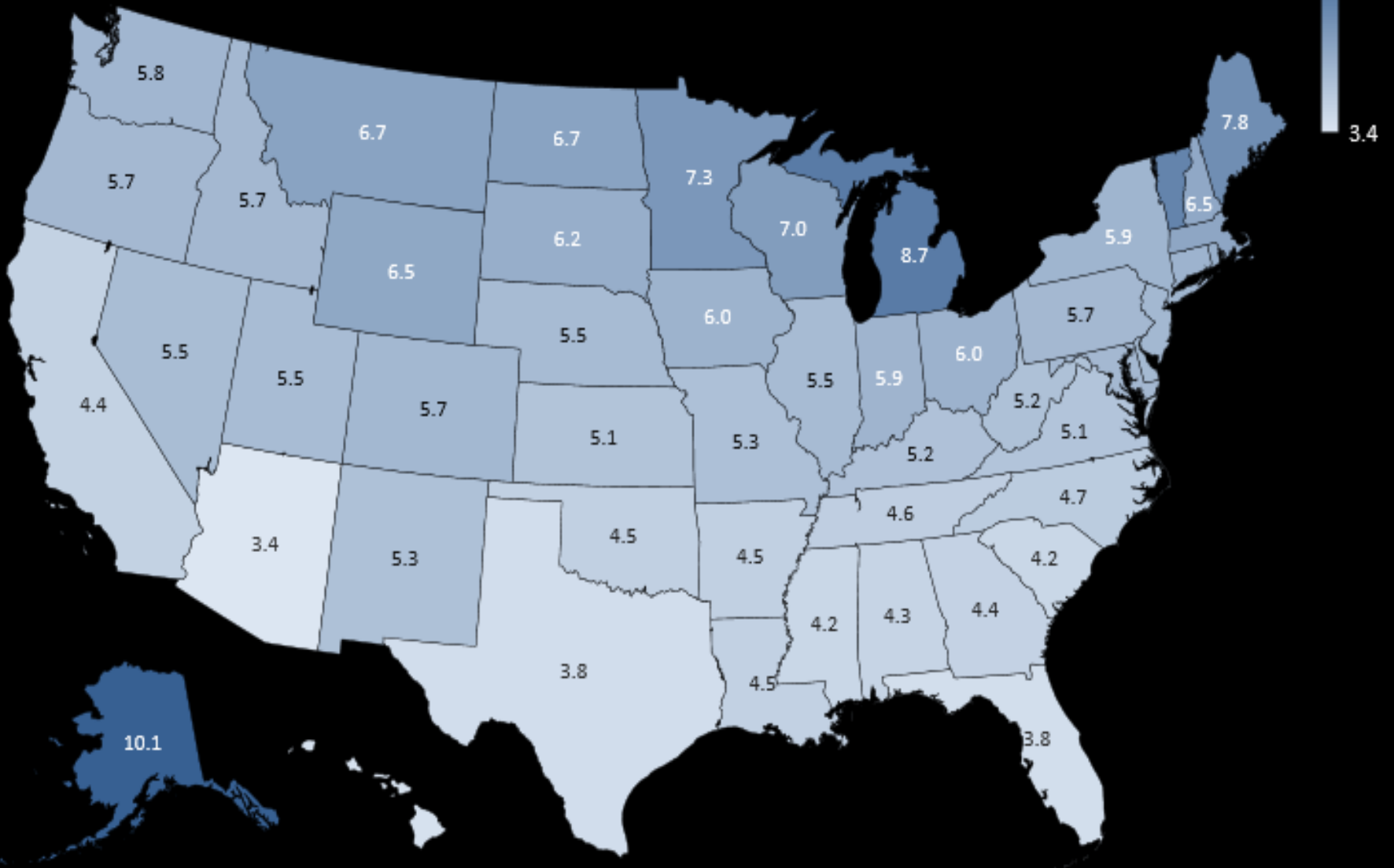
Sect.	Surface Mix Description	Base Binder
N1	20% RAP	PG 67-22
N2	20% RAP w/ high density	PG 67-22
N5	20% RAP w/ low AC, low density	PG 67-22
N8	5% RAS & 20% RAP	PG 67-22
S5	20% RAP	PG 88-22
S6	35% RAP	PG 64-28
S13	15% RAP	AZ rubber

Specimen Types

- Plant mix
 - Reheated
 - Reheated + critical oven aging (8 hrs at 135oC)
- Lab mix
 - Short-term oven aging (4 hrs at 135°C)
 - STOA + critical oven aging (8 hrs at 135oC)
- Field cores

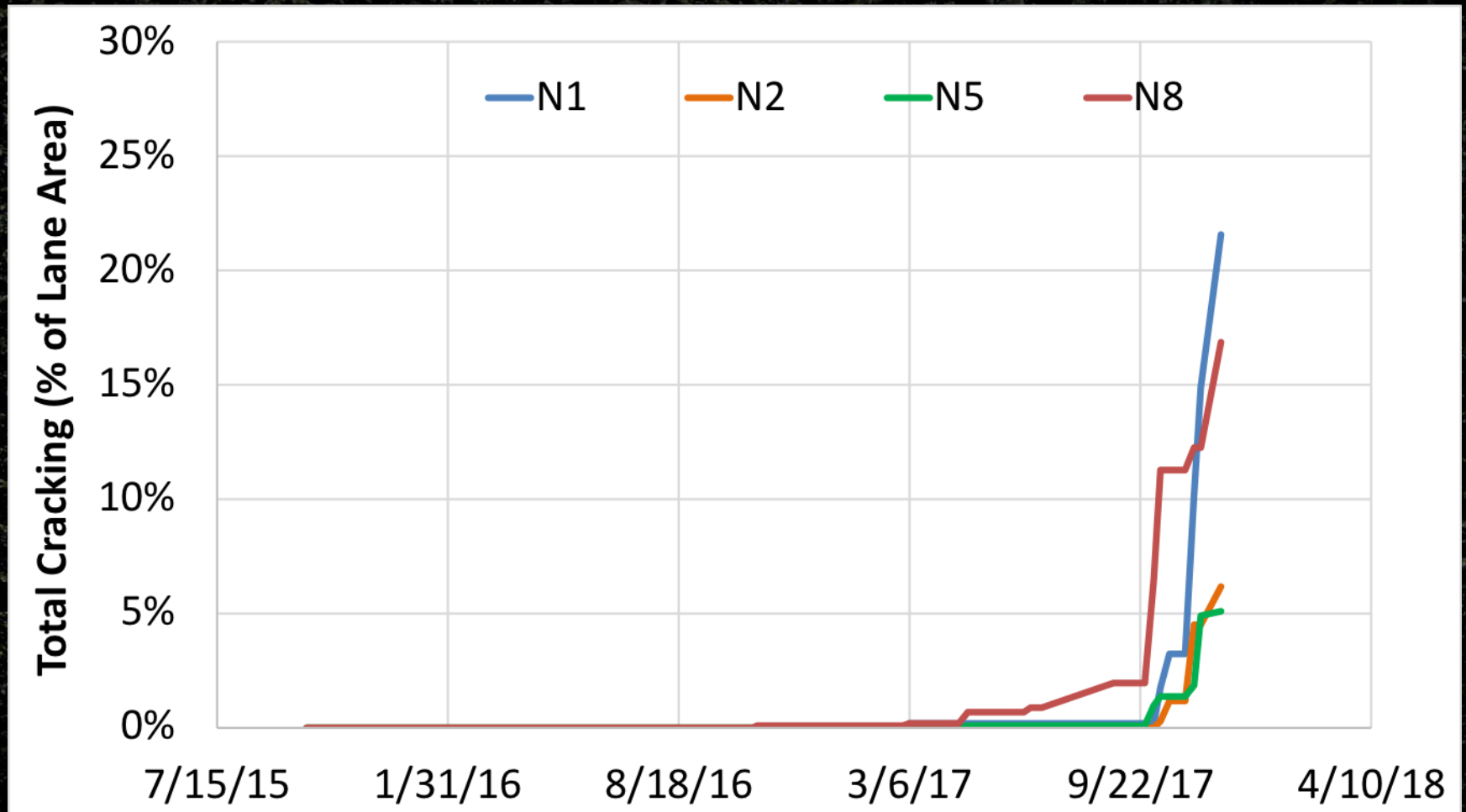


Critical Oven Aging – 8 hours @ 135°C



Chen, C. et al (2018). Selecting a Laboratory Loose Mix Aging Protocol for the NCAT Top-Down Cracking Experiment

Field Cracking Performance







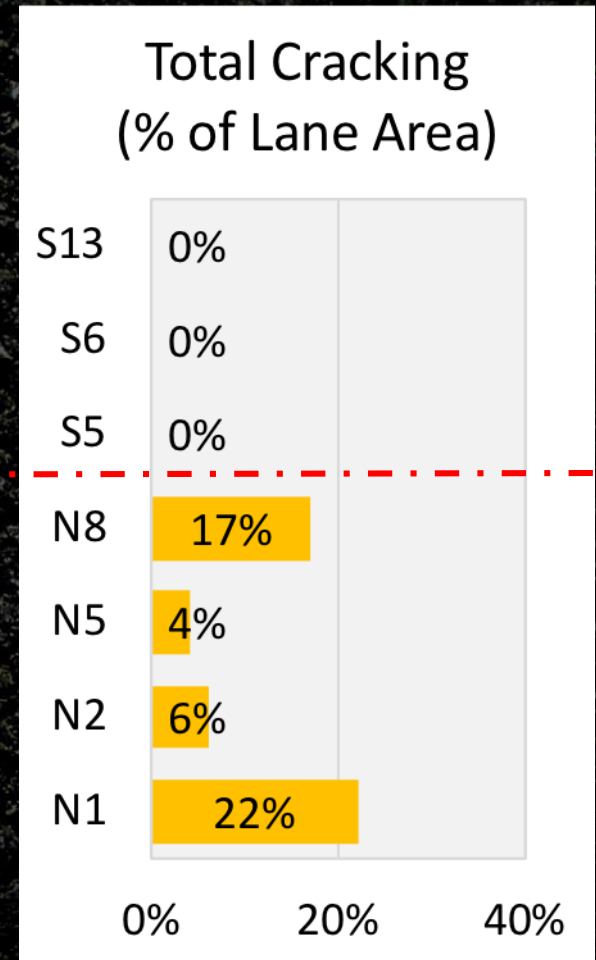
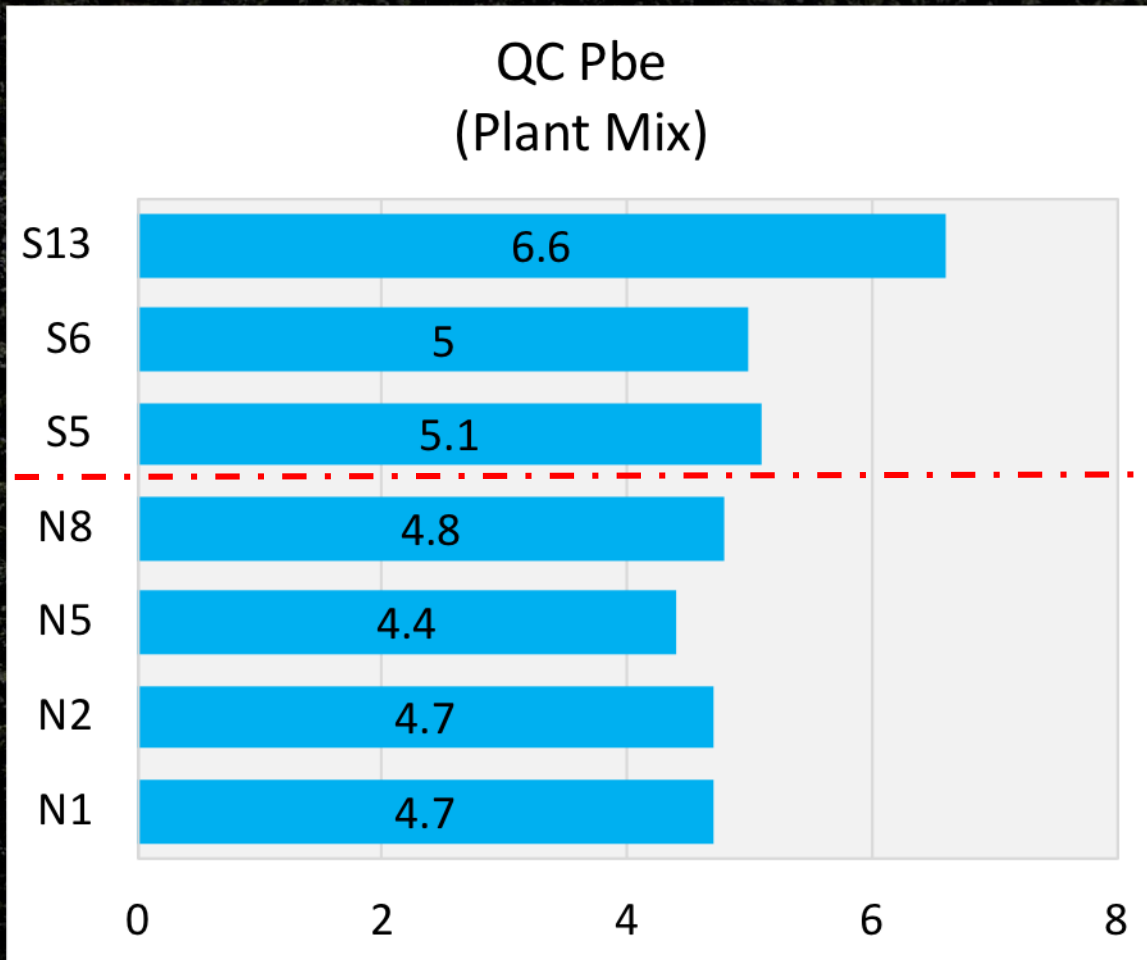


N8 Cores
show top-
down
cracking.
Layers below
are intact.

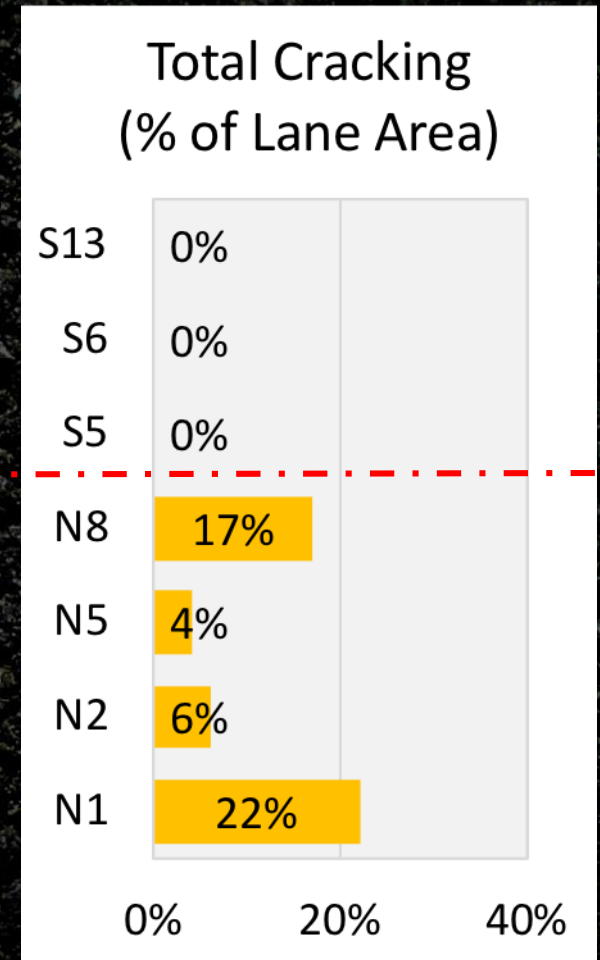
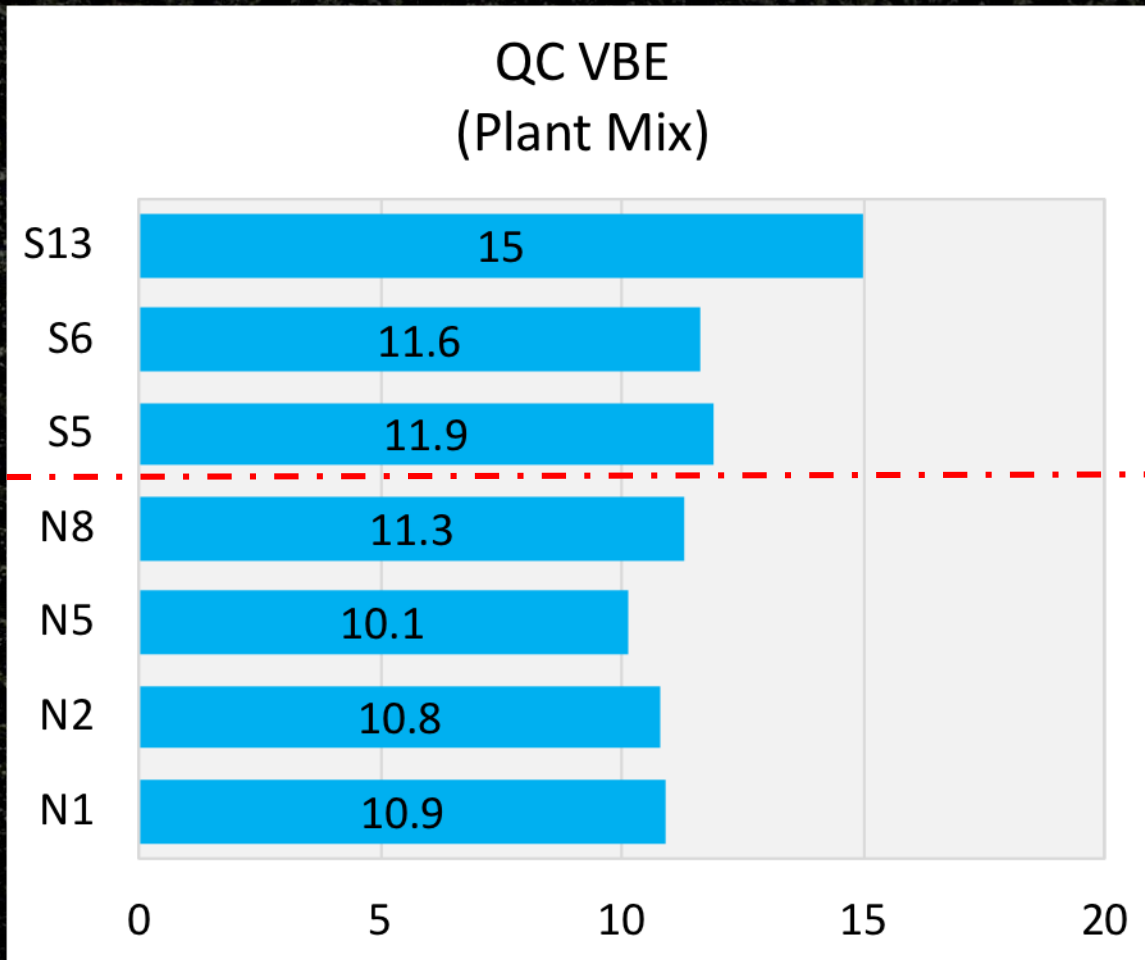
Sections S5, S6 and S13



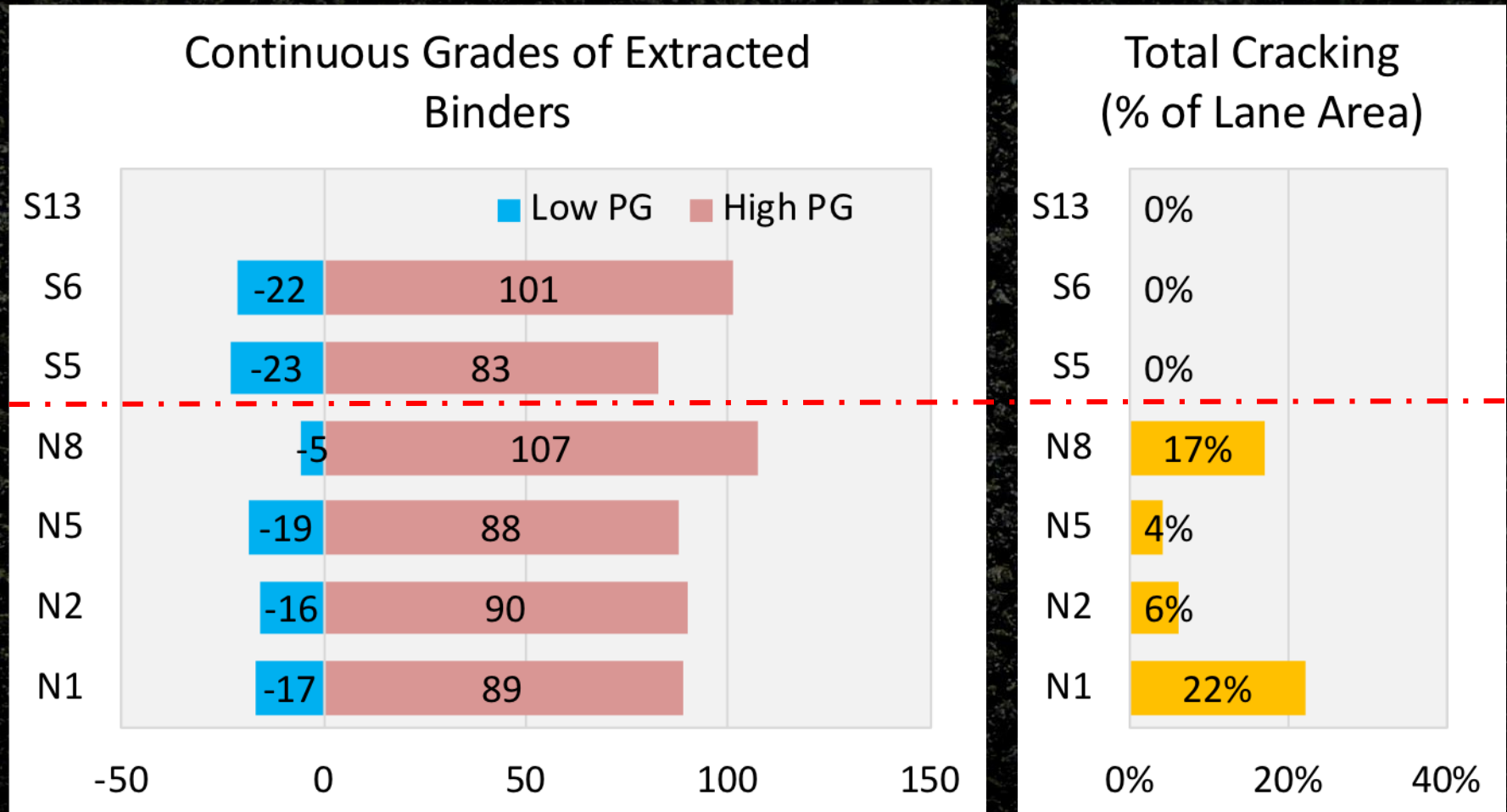
Effective Binder Content



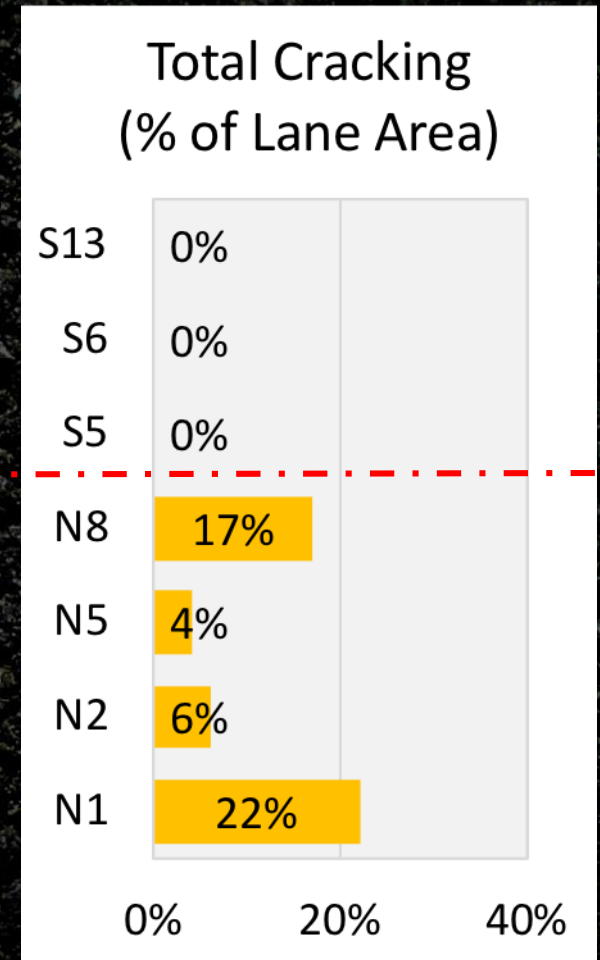
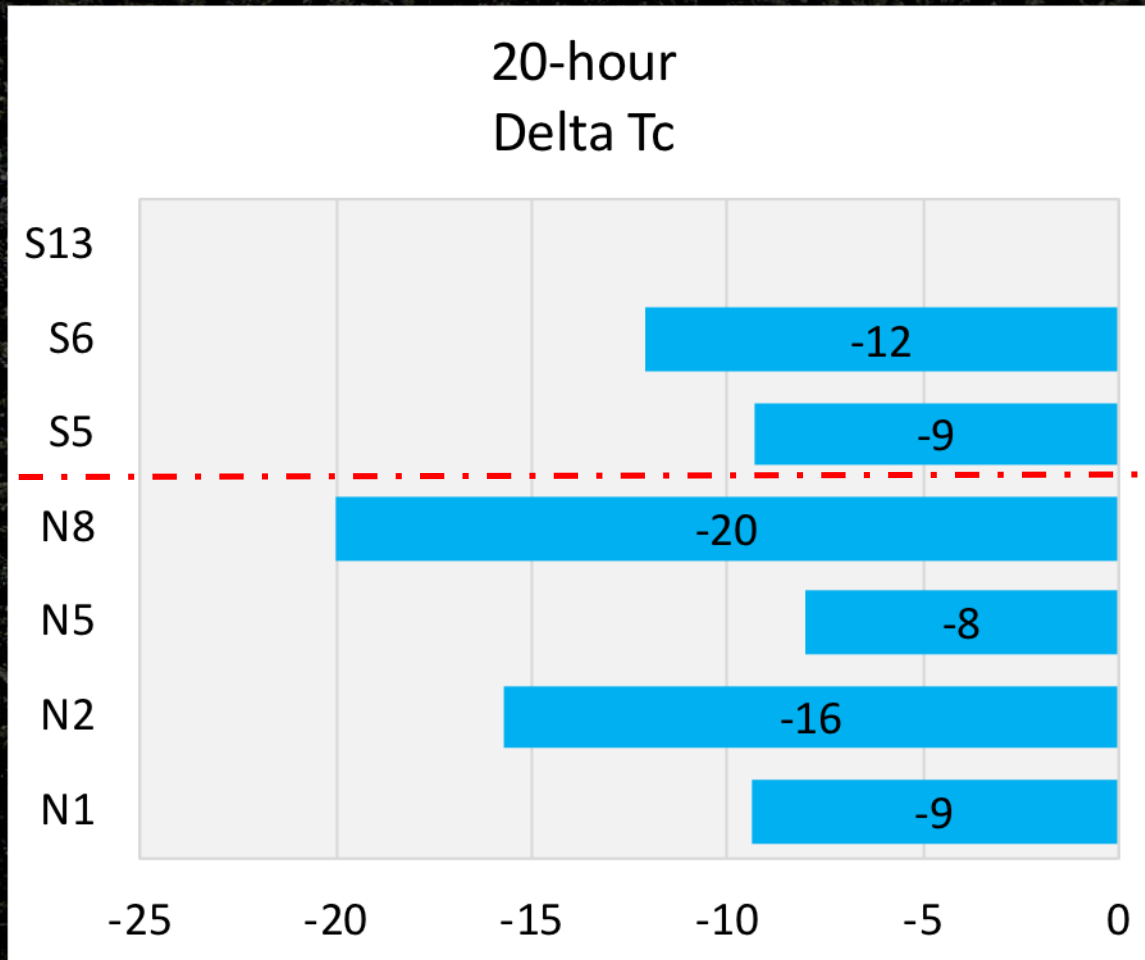
Effective Binder Volume



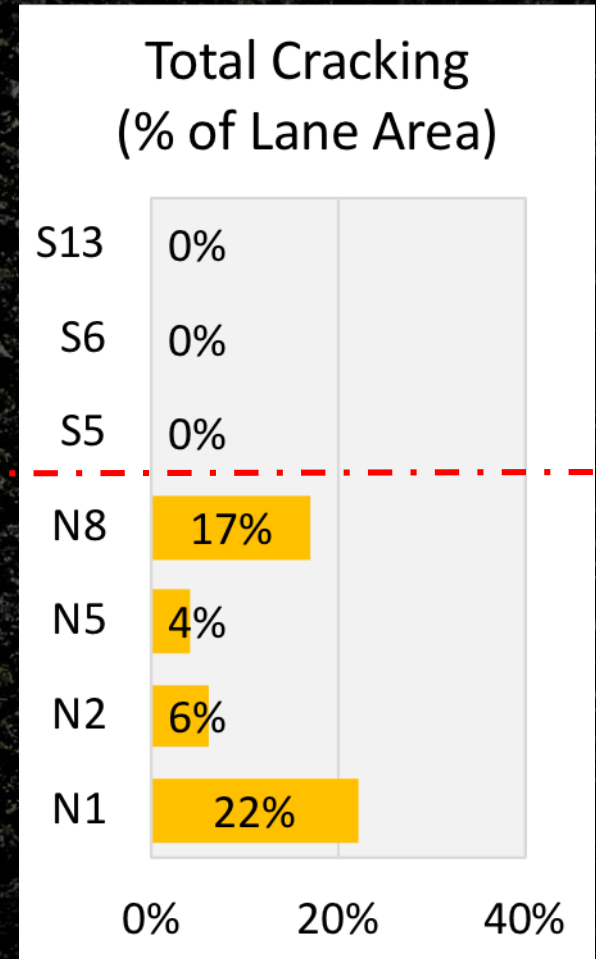
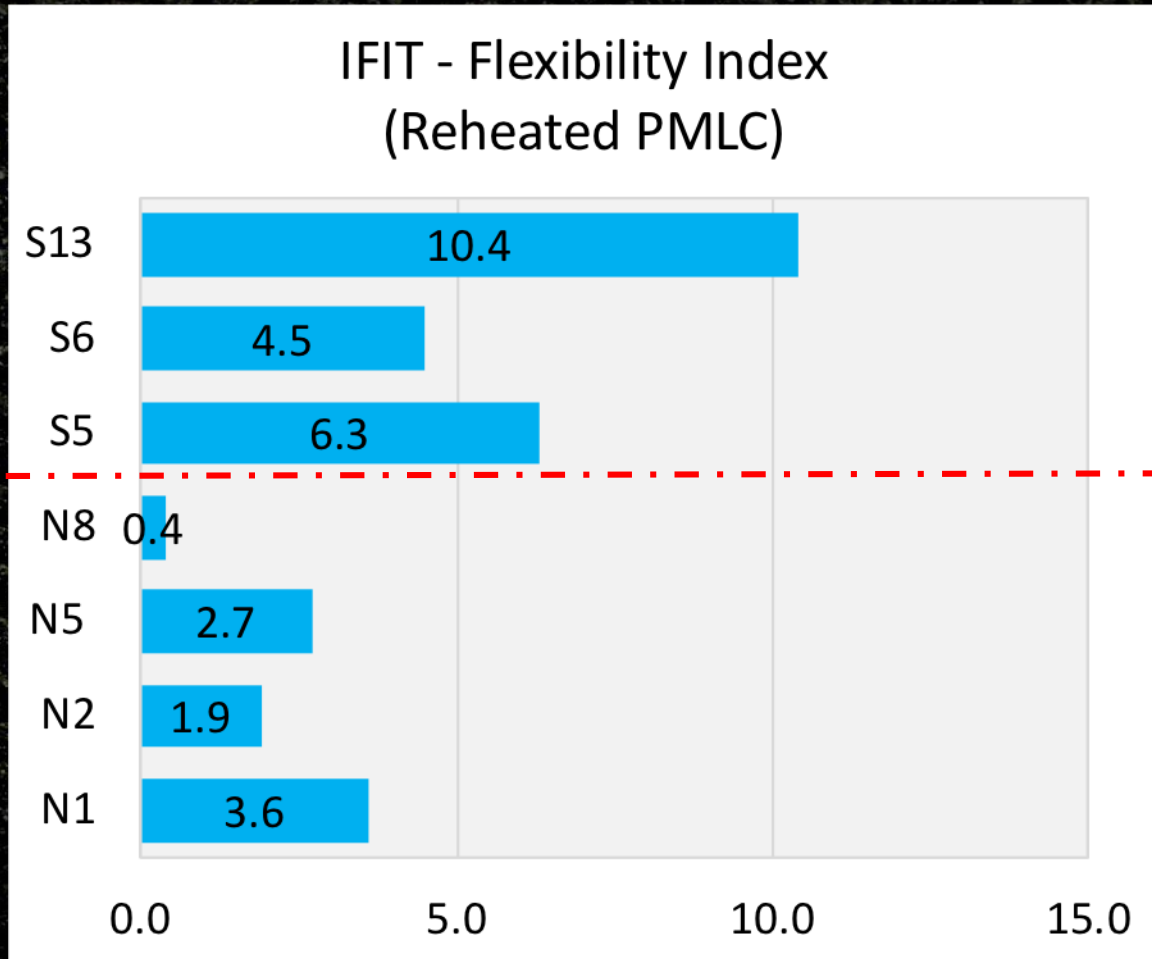
Continuous Grades of Extracted Binders



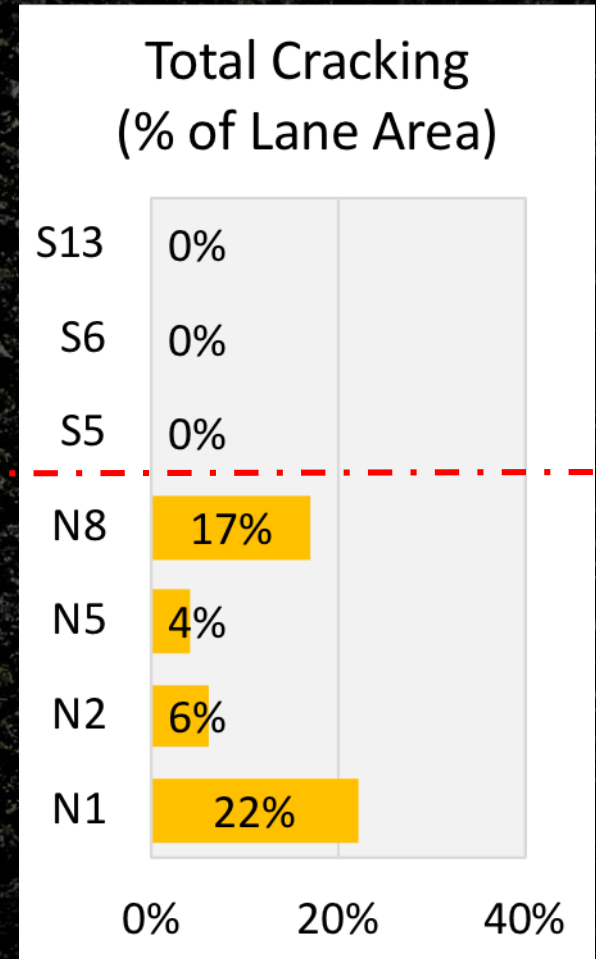
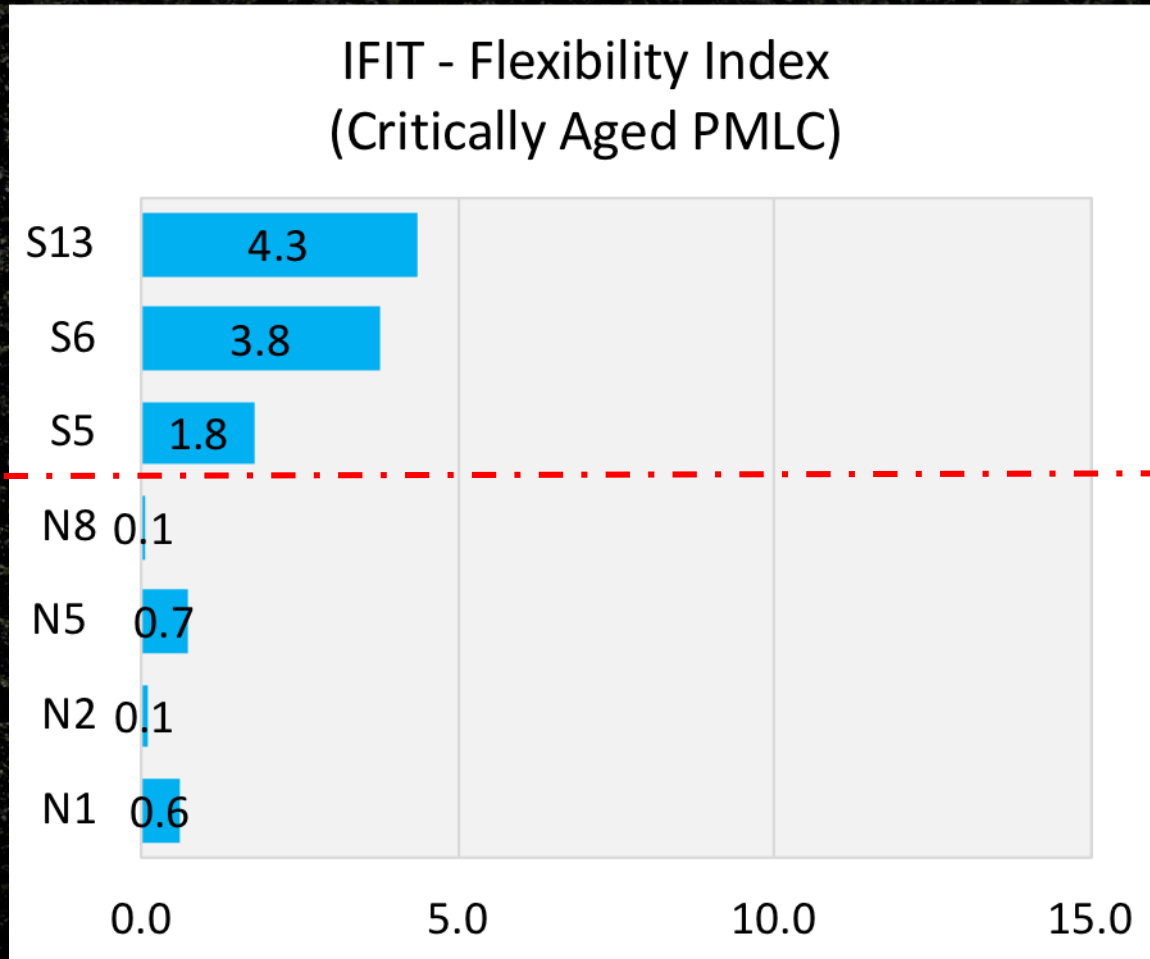
20-Hour Delta Tc



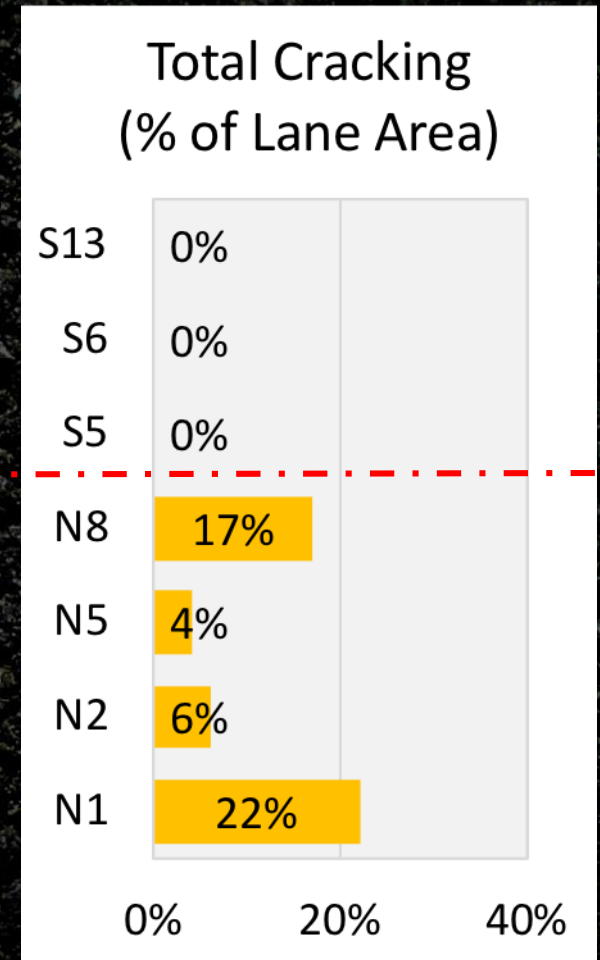
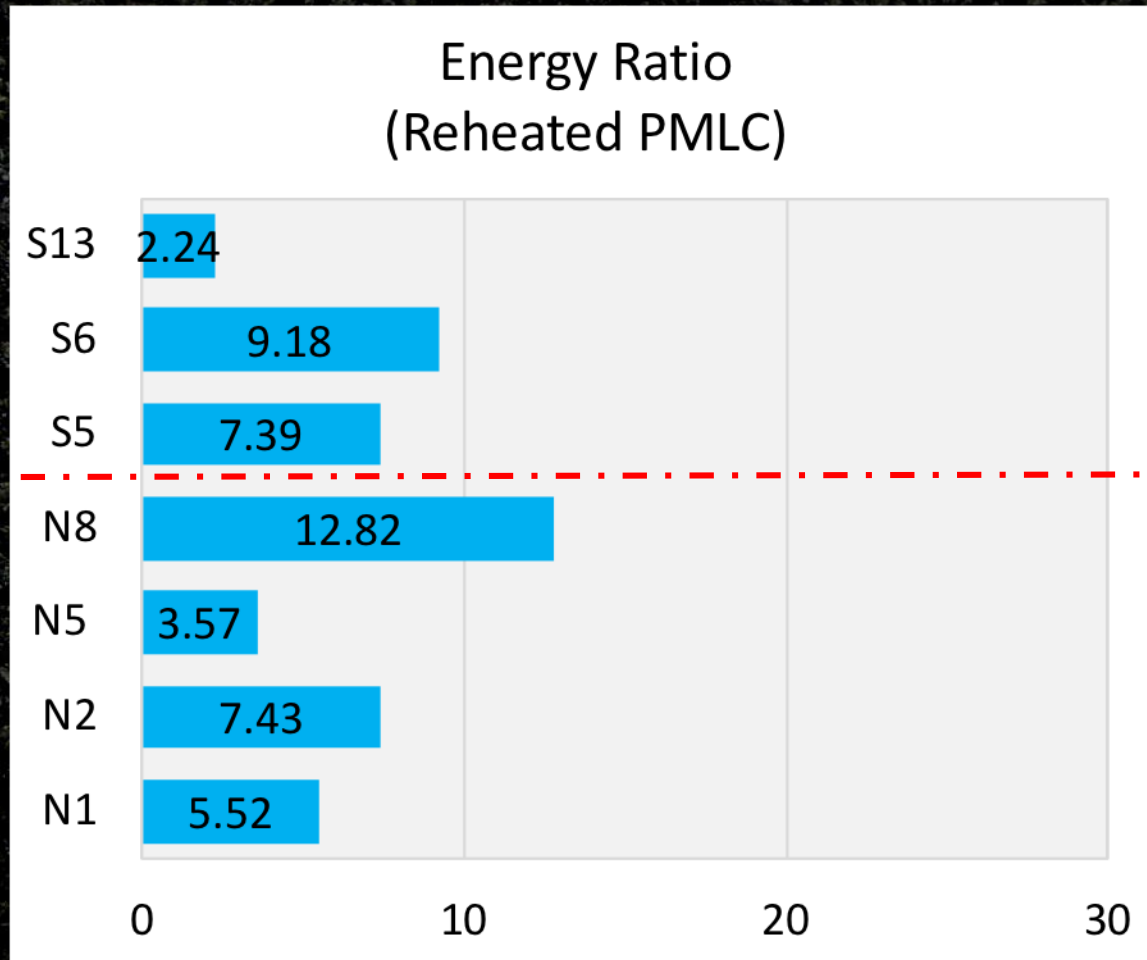
IFIT-FI (Reheated PMLC)



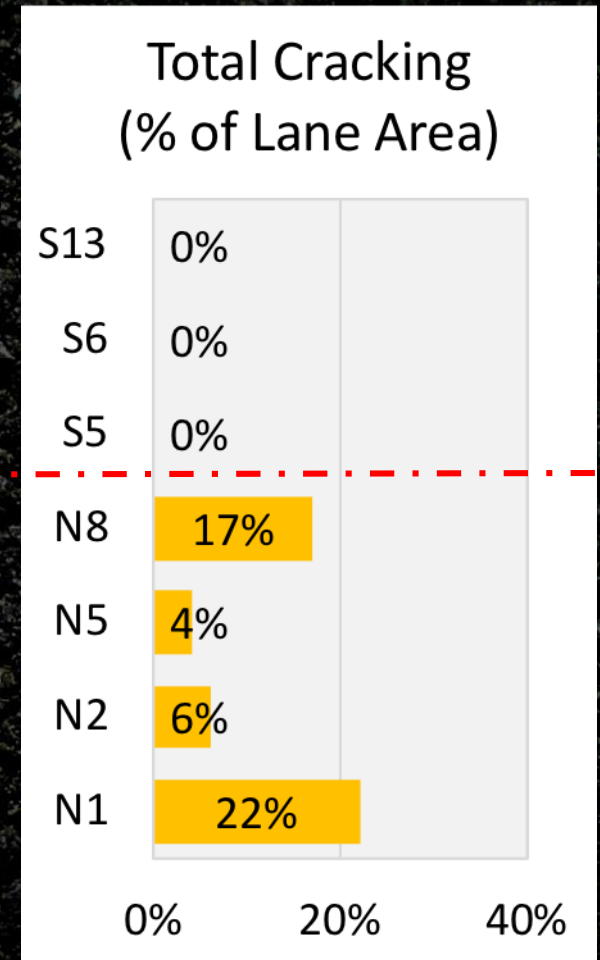
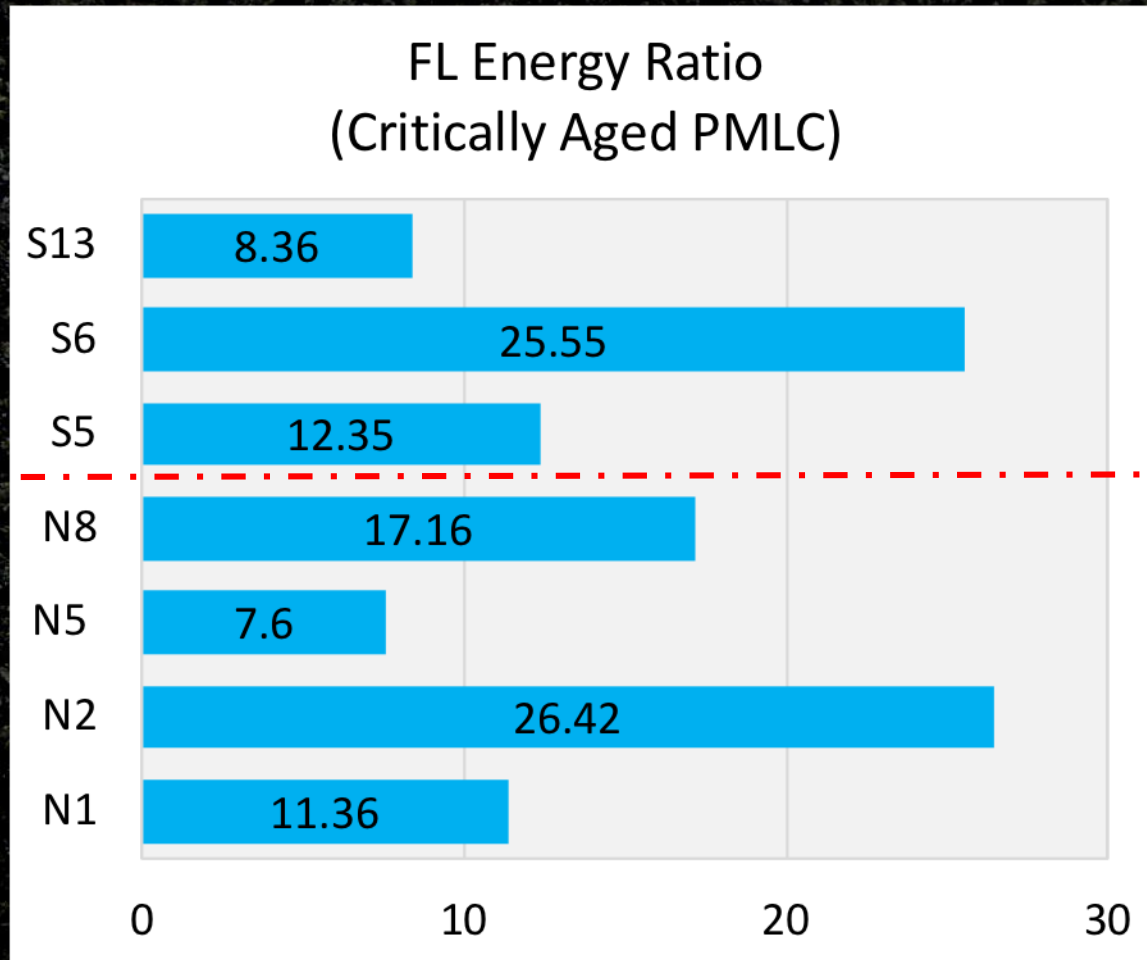
IFIT-FI (Critical Oven Aging PMLC)



FL-ER (Reheated PMLC)



FL-ER (Critical Oven Aging PMLC)



Preliminary Results

- Critical aging protocol yields reasonable results
 - Loose mix, 8 hours at 135°C
- Promising correlations between lab and field performance for some cracking tests
- Binder modifications help improve field cracking performance of RAP mixes

Expected Impacts

- Higher asphalt contents
- Lower recycled materials contents
- Increased use of additives and modifiers
- Greater investment in lab equipment
- More time to complete mix design process

Depend on
tests and
criteria



Increased pavement service life

Remaining Work for CG Experiment

- Continue trafficking test sections at NCAT Test Track and MnROAD
- Validate critical oven aging protocol with annual field cores
- Finish all lab tests
 - SCB-LTRC, I-FIT, OT, FL-ER, IDEAL-CT, AMPT Cyclic Fatigue
 - Low-temperature cracking tests for MnROAD mixes

More results will be presented at...

2018 NCAT TEST TRACK CONFERENCE

The Hotel at Auburn University
and Dixon Conference Center
Auburn, Alabama

March 27-29, 2018



ncat.us/pavetrack/conference

SAVE
THE
DATE