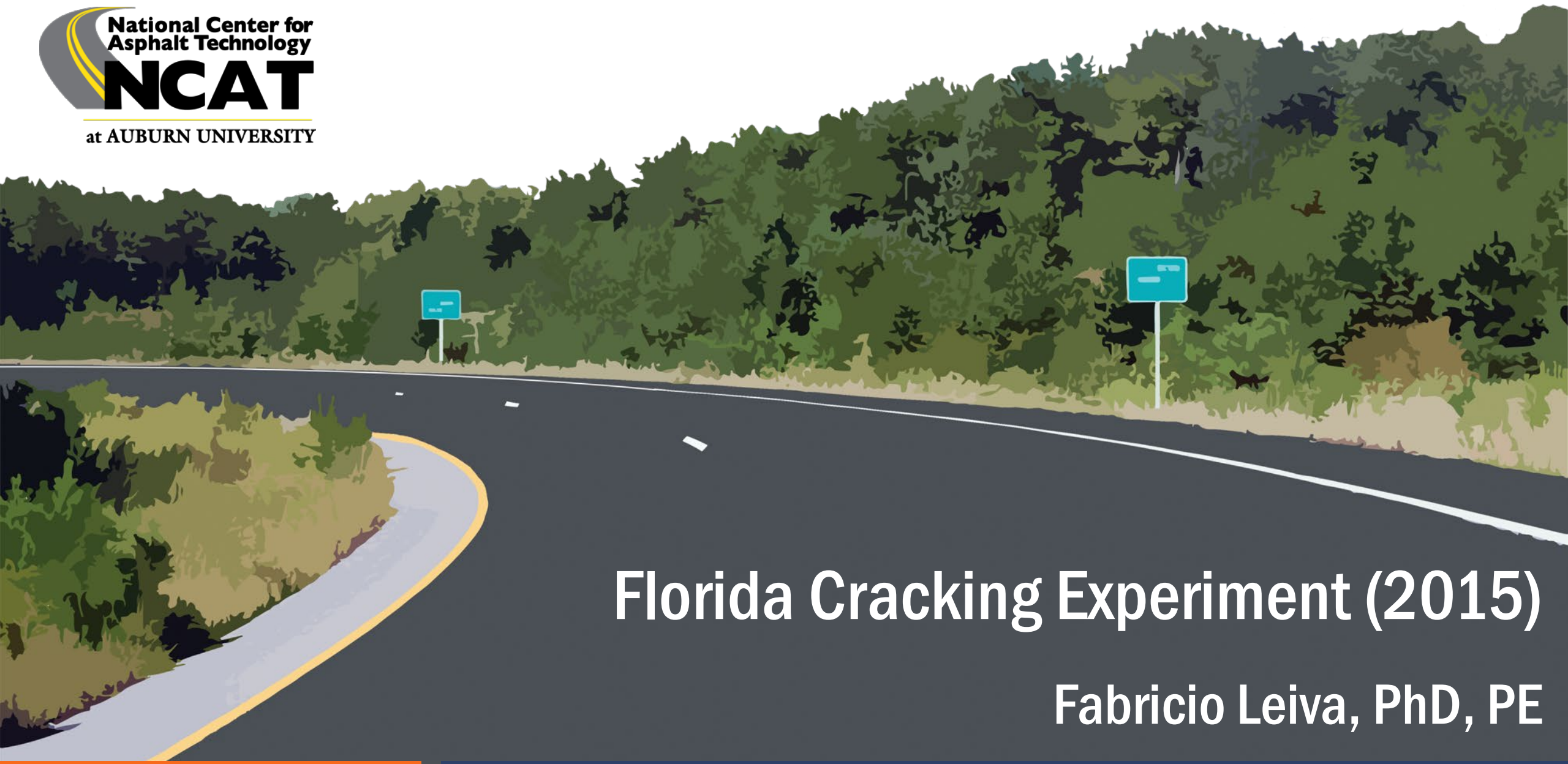
National Center for Asphalt Technology
NCAT
at AUBURN UNIVERSITY



Florida Cracking Experiment (2015)

Fabricio Leiva, PhD, PE

SEVENTH
RESEARCH CYCLE

NCAT TEST TRACK CONFERENCE

Florida Cracking Experiment (2015)

- Four surface mixes on deep foundation
  - E7-1A – 20% RAP with PG 76-22
  - E7-1B – 25% RAP with PG 76-22
  - E8-1A – 30% RAP with PG 76-22
  - E8-1B – 30% RAP with PG 64-28
- All mixes with polymer modified binder
- Surface mix cracking performance

Laboratory Performance Tests

- Surface Mixes
  - Energy Ratio (Florida)
  - SCB-LTRC (Louisiana Method)
  - I-FIT
  - OT – TX (Overlay Test – Tex-248-F)
  - OT – NCAT (Overlay Test – NCAT modified)
    - Faster frequency – Modified failure definition
  - HWTT
  - E*

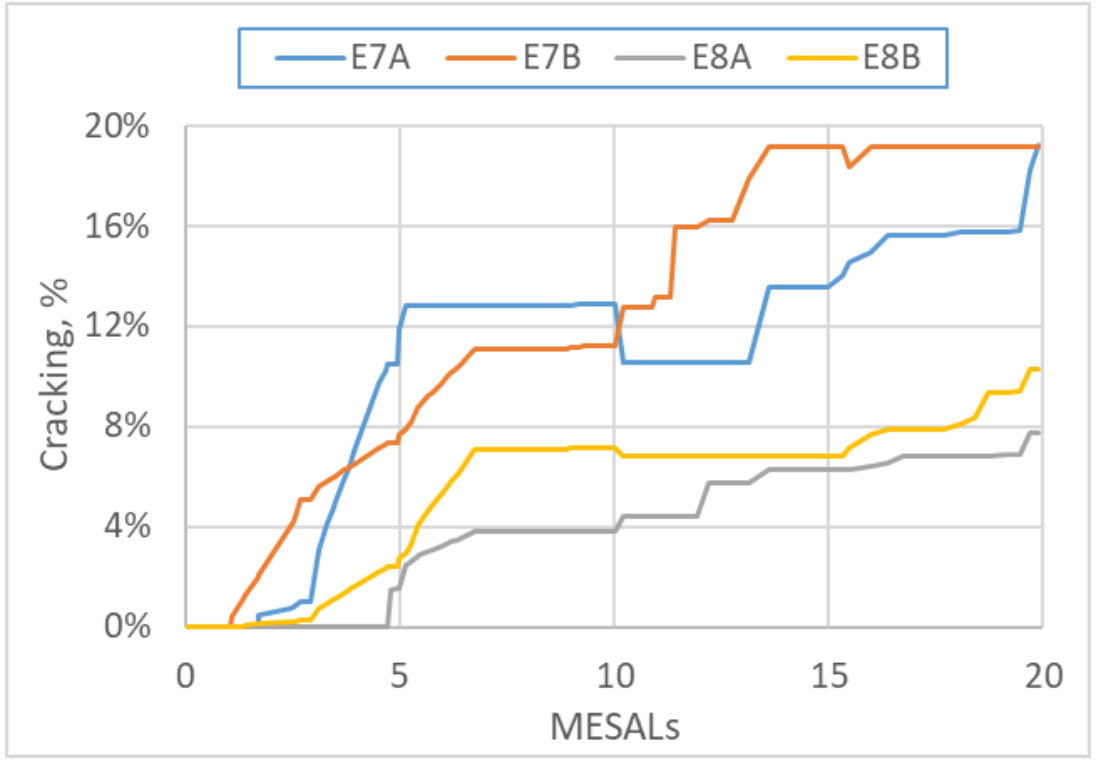
Lab Results – Rank Analysis

Mix ID	RAP%	ER	OT-NCAT	FI	SCB - Jc	-β/γ (Inflection Point)	E* 20C, 10 Hz (ksi)	
E7-1A	20	5.1	782	3.5	0.43	-1.95	986	
E7-1B	25	1.3	212	1.8	0.42	-2.66	1154	
E8-1A	30	6.1	591	1.9	0.36	-2.09	1042	
E8-1B	30*	5.3	816	5.6	0.30	-1.87	795	
Mix ID				**Individual Ranking**				**Combined Ranking**
E7-1A	20	3	2	2	1	2	2	2
E7-1B	25	4	4	4	2	4	4	4
E8-1A	30	1	3	3	3	3	3	3
E8-1B	30*	2	1	1	4	1	1	1

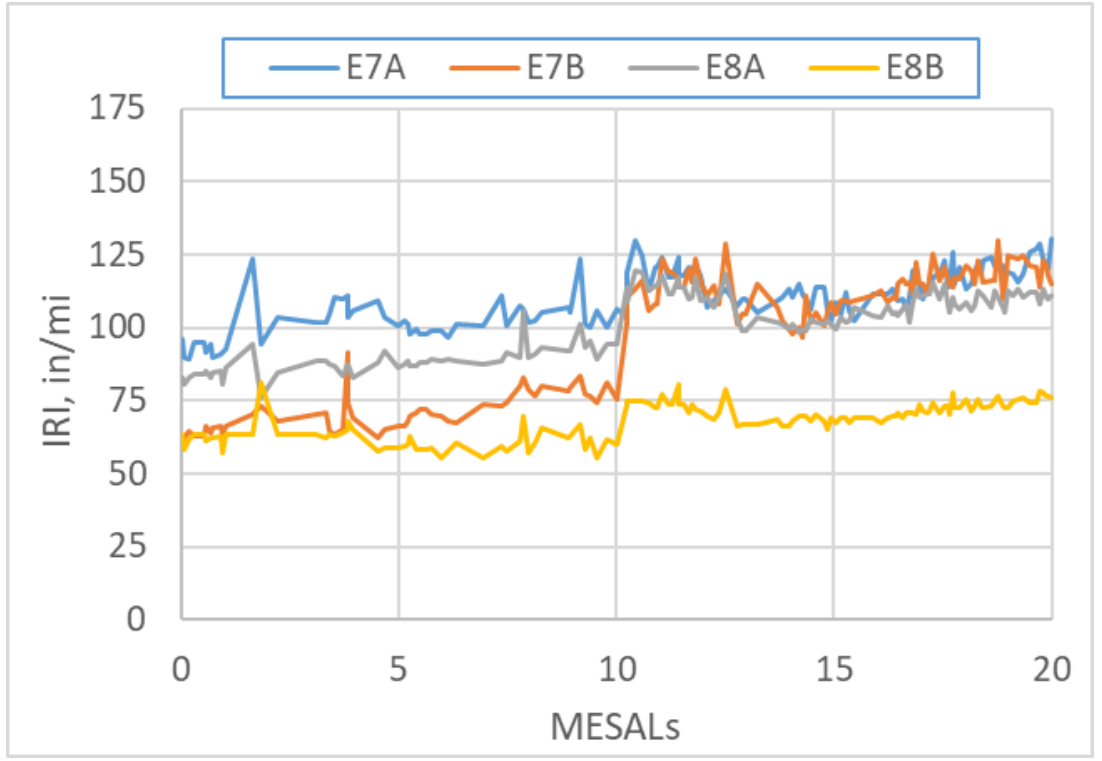
* Softer binder

Field Performance

Cracking (% Lane)

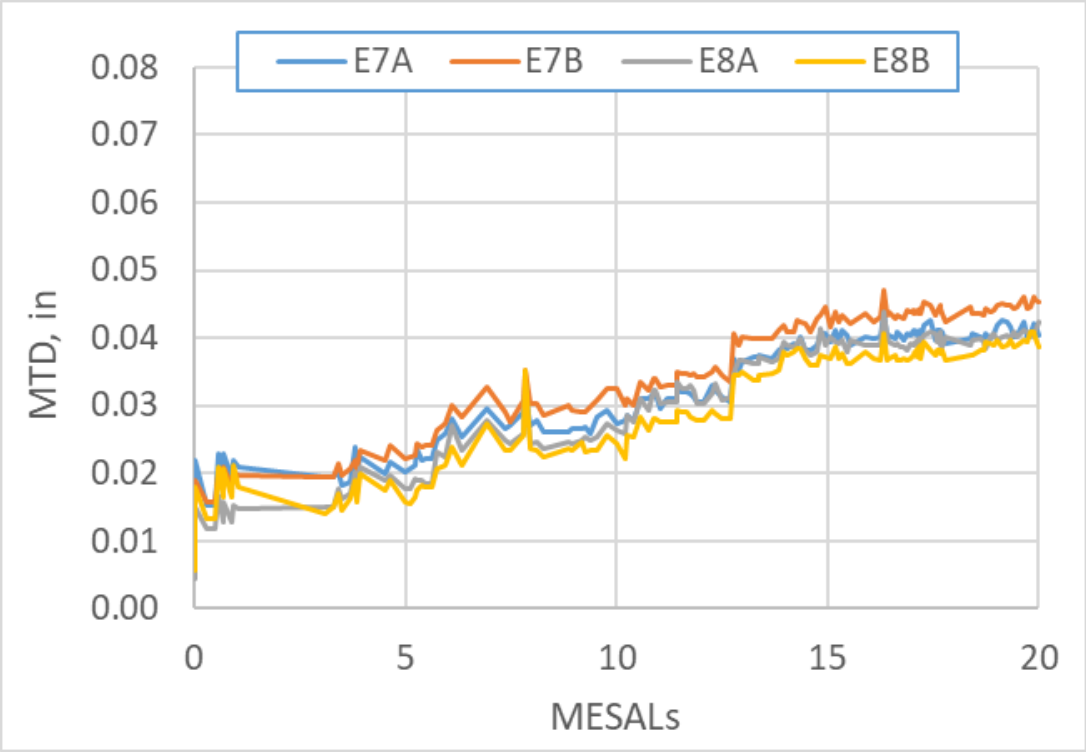


IRI

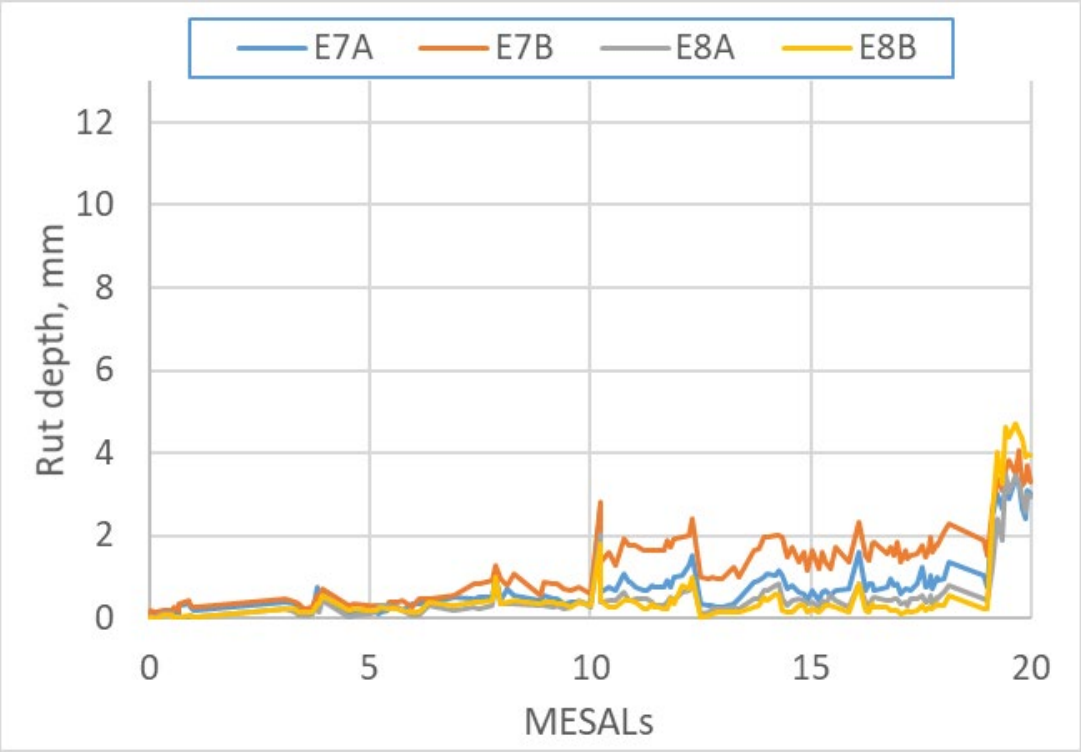


Field Performance

Texture



Rutting

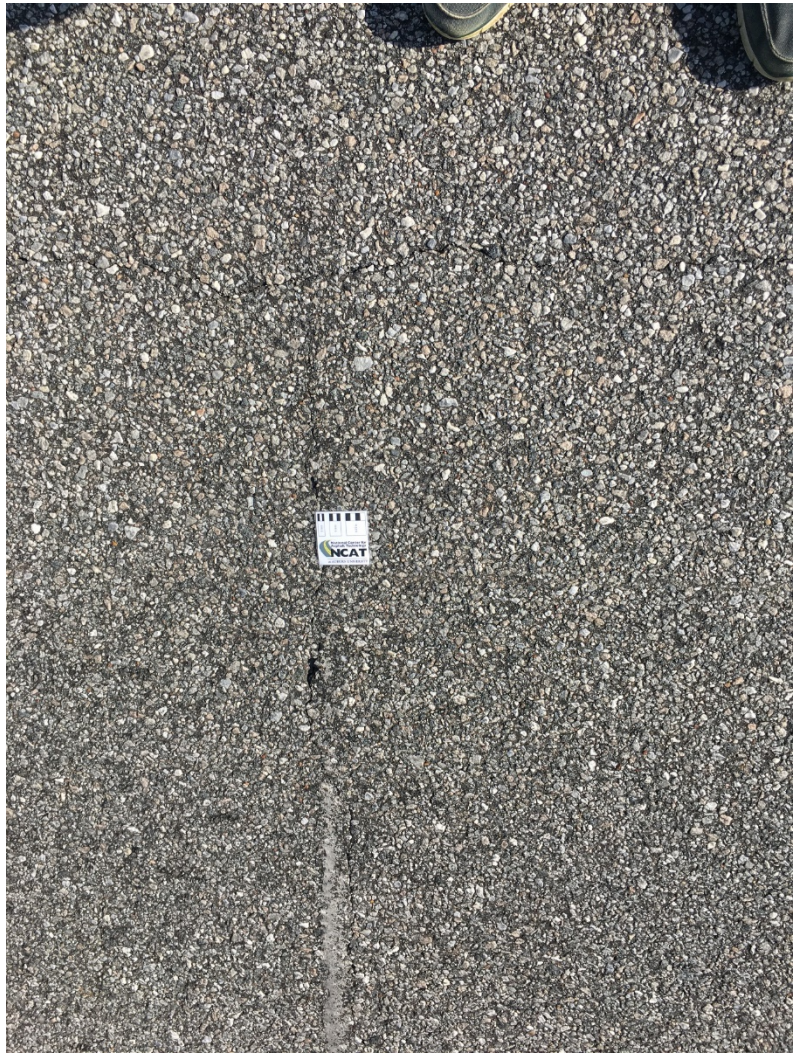


Field Performance

3 to 5mm Cracks

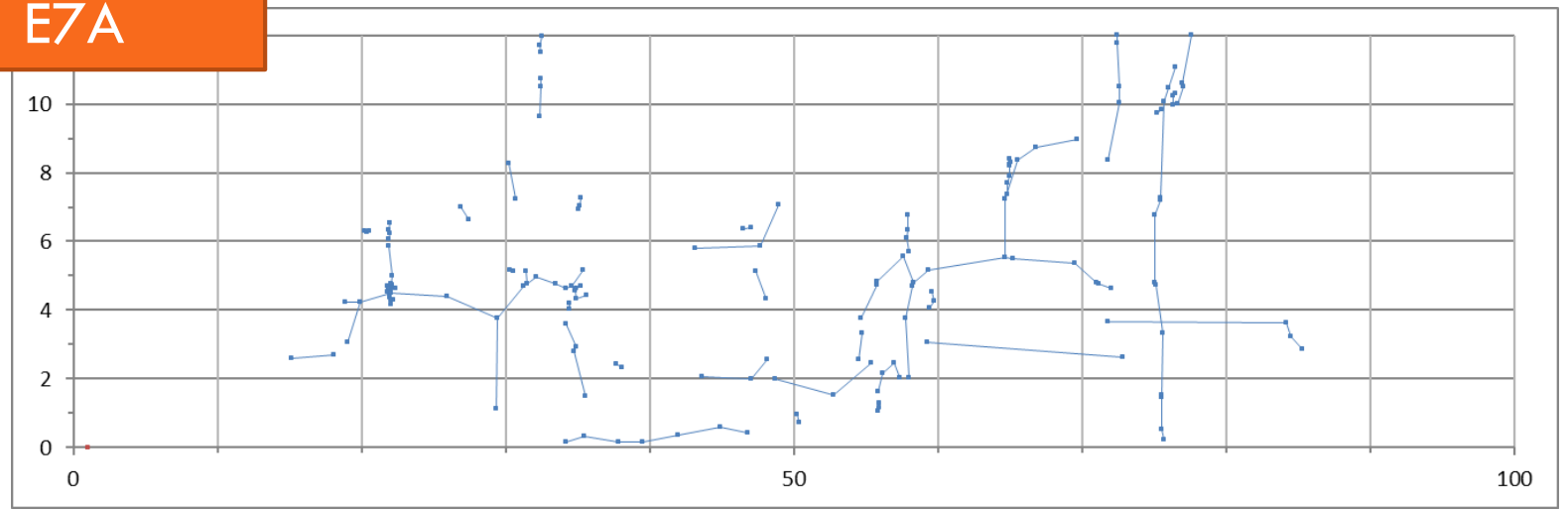
Field Performance

Up to 3mm Cracks

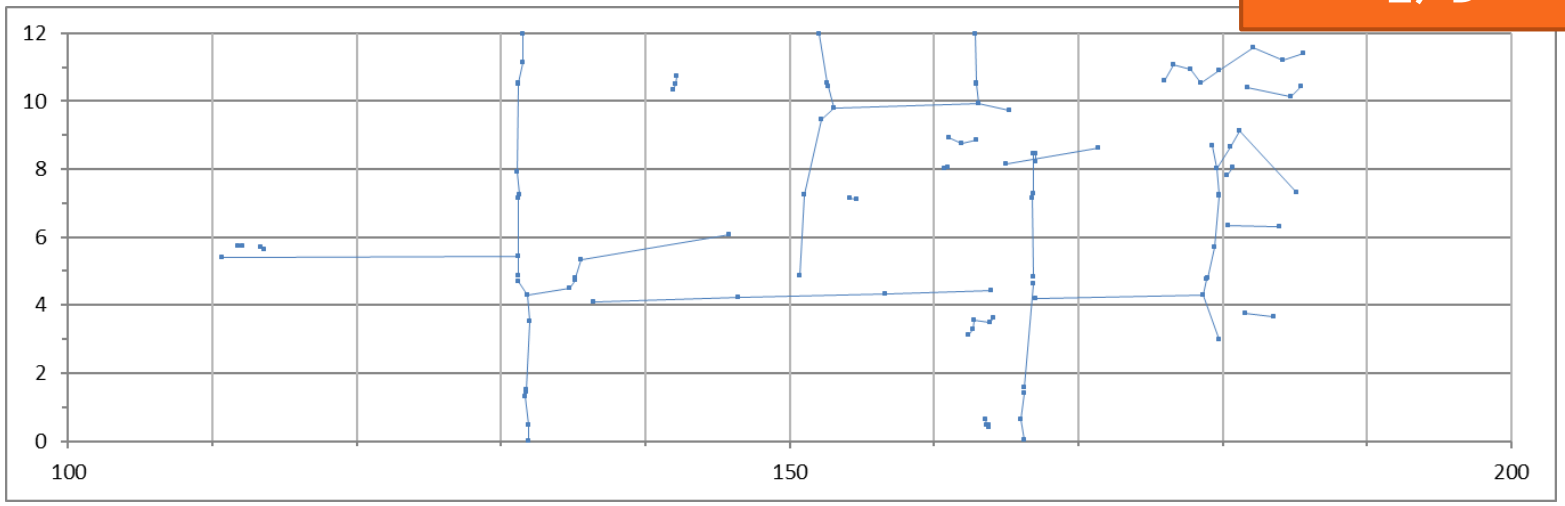


Field Performance

E7A

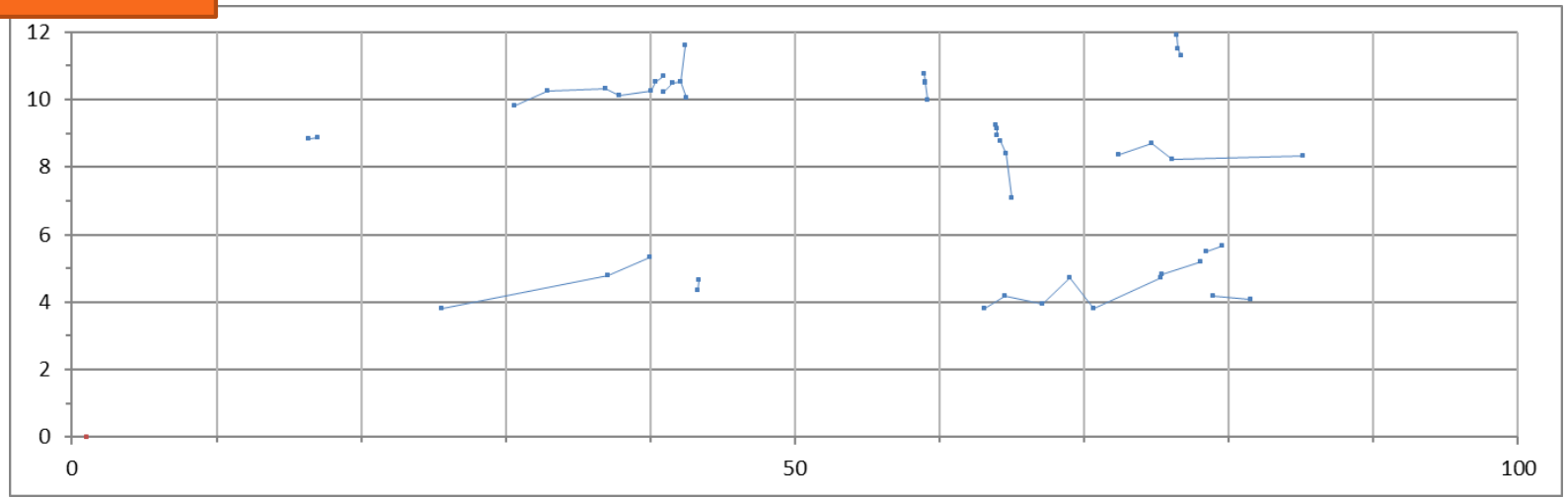


E7B

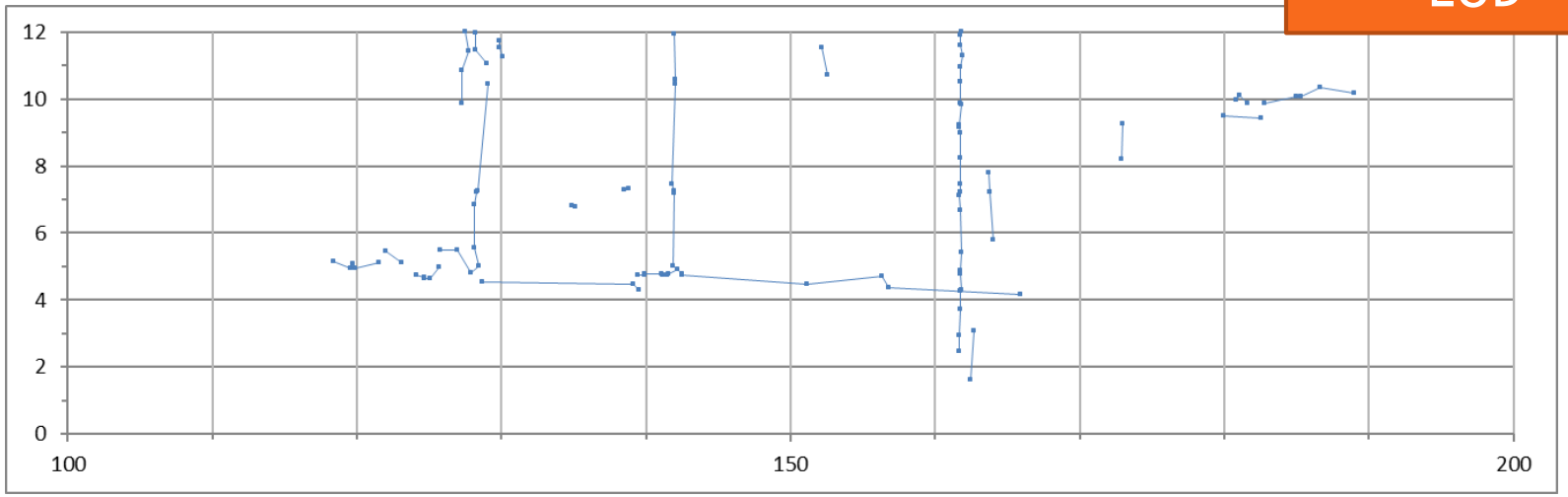


Field Performance

E8A

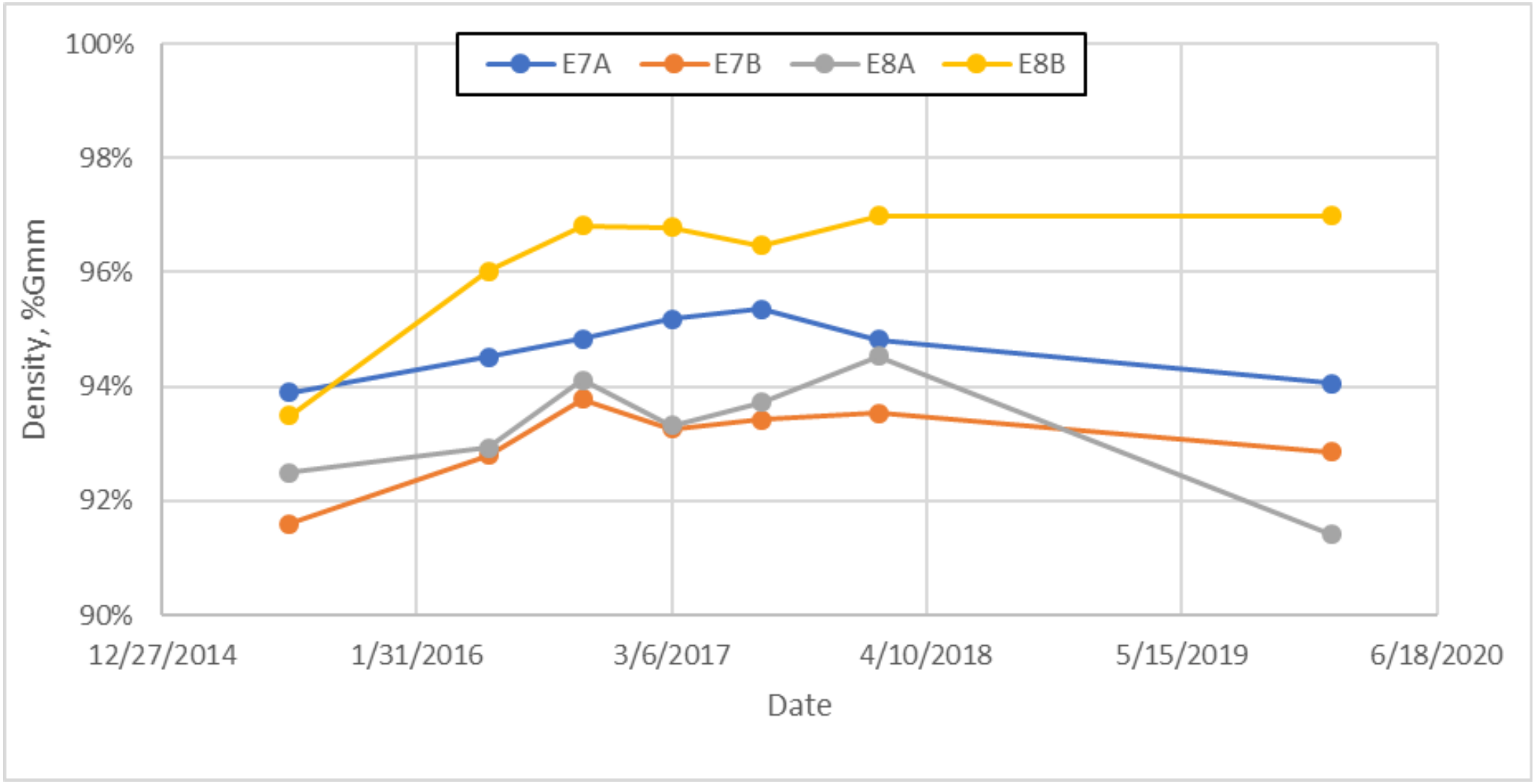


E8B



Field Performance

Density



Field-Lab Correlation

Cracking, % Lane	10 Million ESALs	20 Million ESALs
OT-TX, cycles	0.15	-0.05
OT-NCAT, cycles	-0.15	-0.36
St (MPa)	-0.07	-0.12
MR (GPa)	-0.40	-0.19
DCSEf (kJ/m3)	-0.23	-0.44
ER	-0.55	-0.68
FI	0.01	-0.20
OT-TX-PRO	0.29	0.44
OT-TX-INI	0.30	0.50
beta/gamma (Inflection Point)	-0.27	-0.47
E* 20C, 10 Hz (ksi)	0.24	0.45
Cantabro %Loss	0.66	0.79

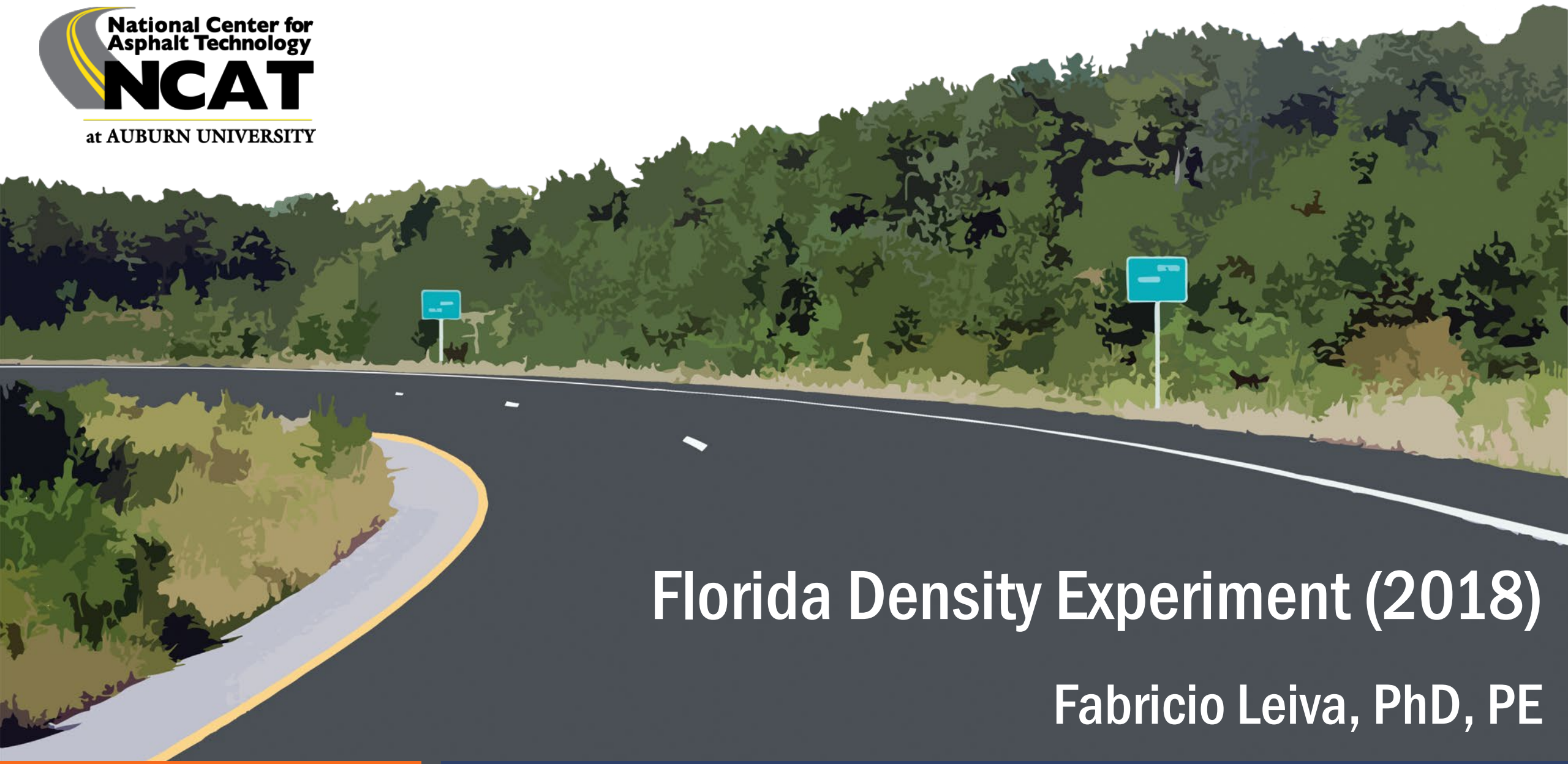
Summary

- After 20 million ESALs of traffic:
  - Field cracking was classified as low severity
  - Field cracking showed good correlation with Cantabro loss and fair correlation with Energy Ratio.
  - Field performance for these sections was good overall in terms of roughness (relatively constant through the study and below 125 in/mi) and permanent deformation (below 5 mm).

Summary

- Field cracking did not follow the expected trend with regards to RAP content. Sections E7A and E7B with the 20 and 25% RAP, respectively, showed the highest amount of cracking compared to the other sections with 30% RAP.
- The use of a softer modified binder did not show significant differences in field performance (E8B vs. E8A), but shows promise for increased levels of RAP.

National Center for Asphalt Technology
NCAT
at AUBURN UNIVERSITY



Florida Density Experiment (2018)

Fabricio Leiva, PhD, PE

SEVENTH
RESEARCH CYCLE

NCAT TEST TRACK CONFERENCE

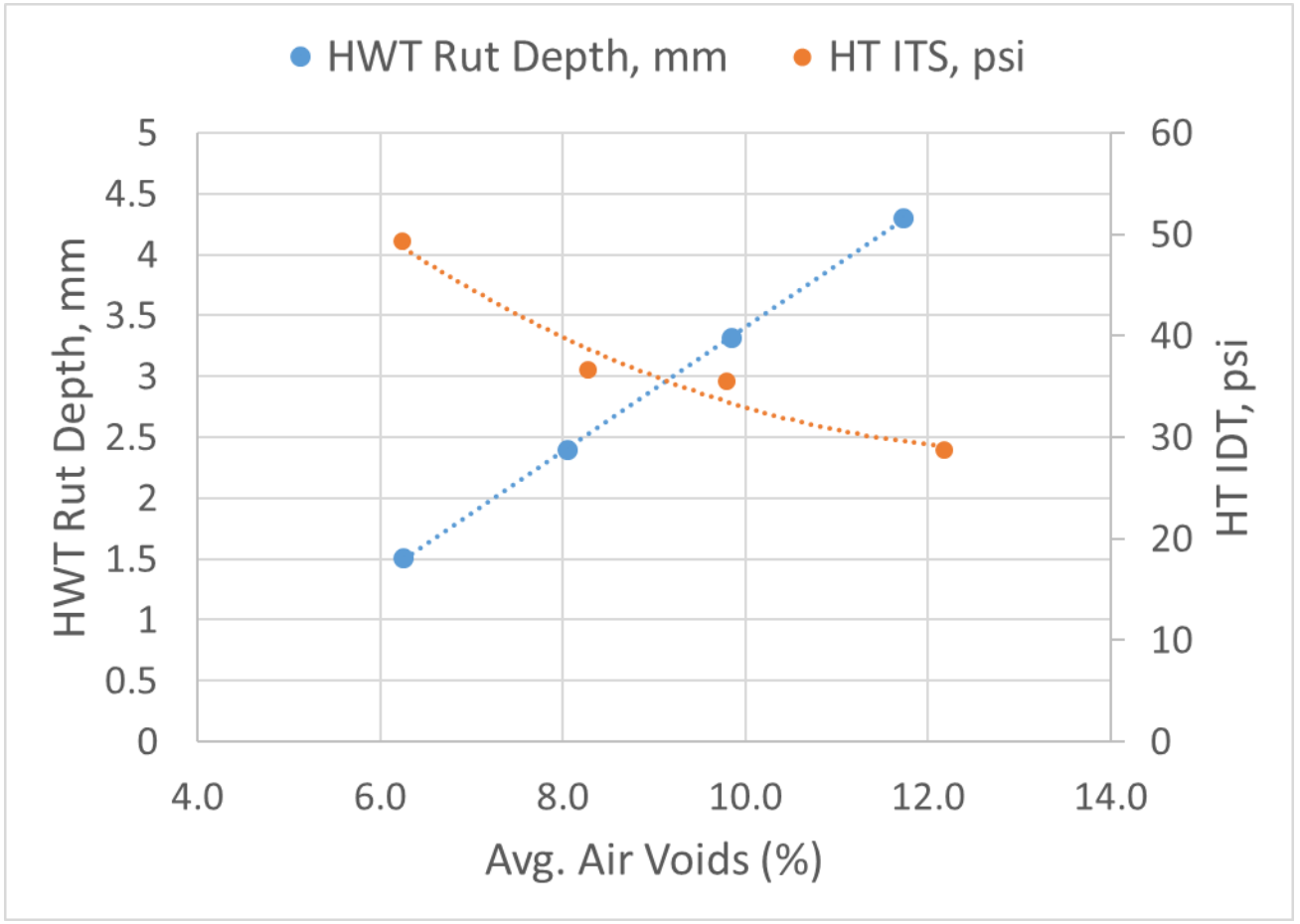
Florida Density/Durability Experiment (2018)

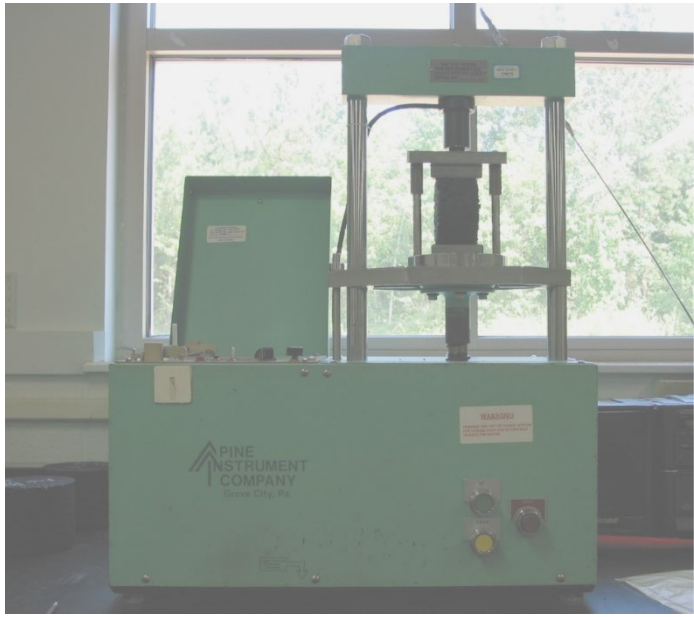
- Four surface mixes on deep foundation
  - E5-1A – Density 93.6%
  - E5-1B – Density 92.0%
  - E6-1A – Density 87.8%
  - E6-1B – Density 89.7%
- All mixes with polymer modified binder, PG 76-22, 20% RAP
- Surface mix cracking/durability performance

Laboratory Performance Tests

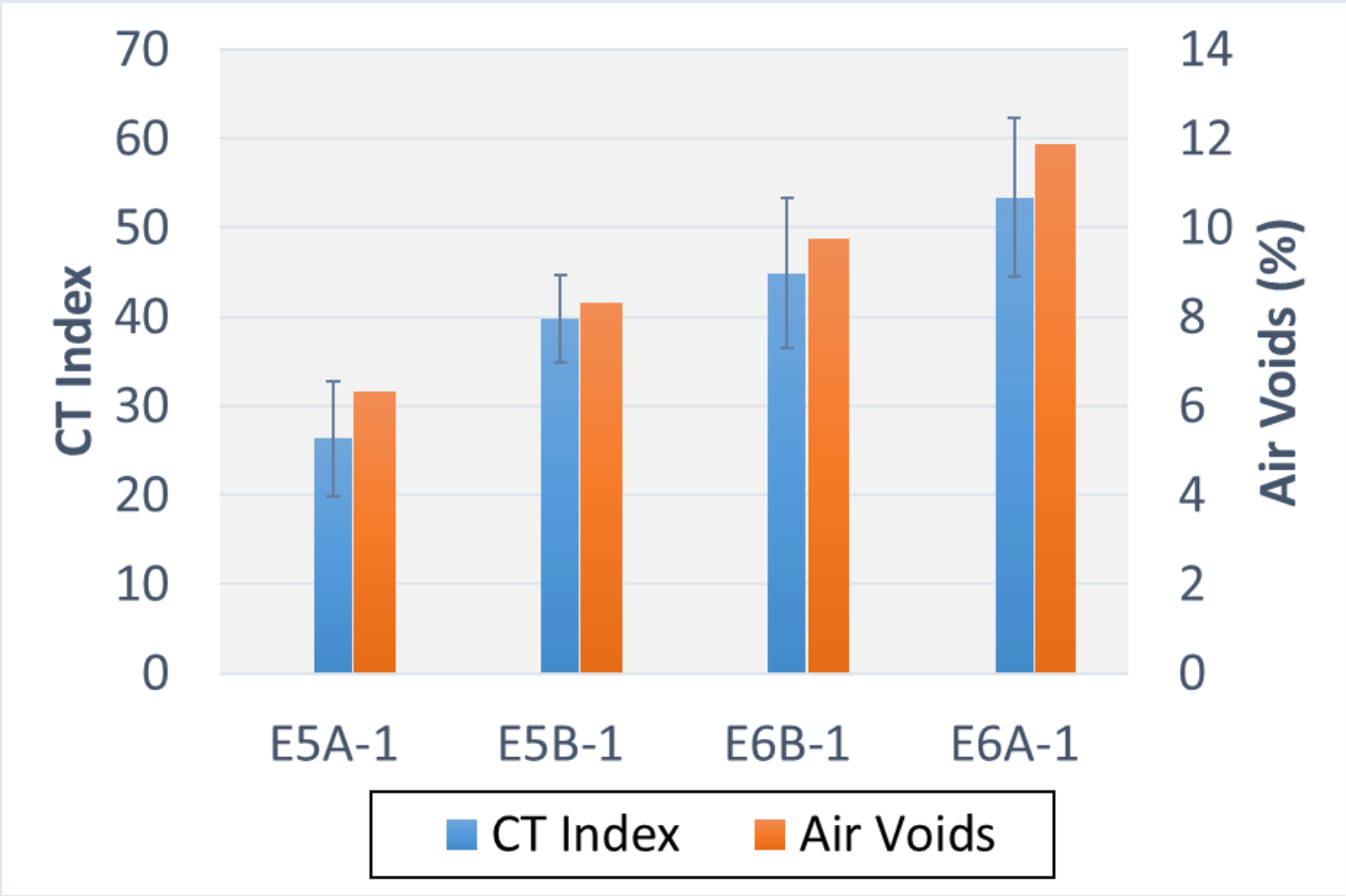
- Mixture tests @ field air voids
  - HWTT
  - HT-ITS (High PG temp)
  - Energy Ratio
  - Ideal CT
  - IFIT
  - E*
  - Cantabro

HWTT & HT-IDT

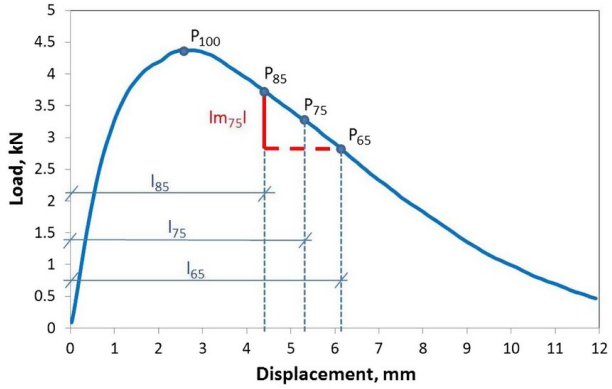

HWT Rut Depth, mm
HT ITS, psi
HWT Rut Depth, mm
HT IDT, psi
Avg. Air Voids (%)
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5
0
10
20
30
40
50
60
4.0
6.0
8.0
10.0
12.0
14.0


PINE
INSTRUMENT
COMPANY

IDEAL-CT

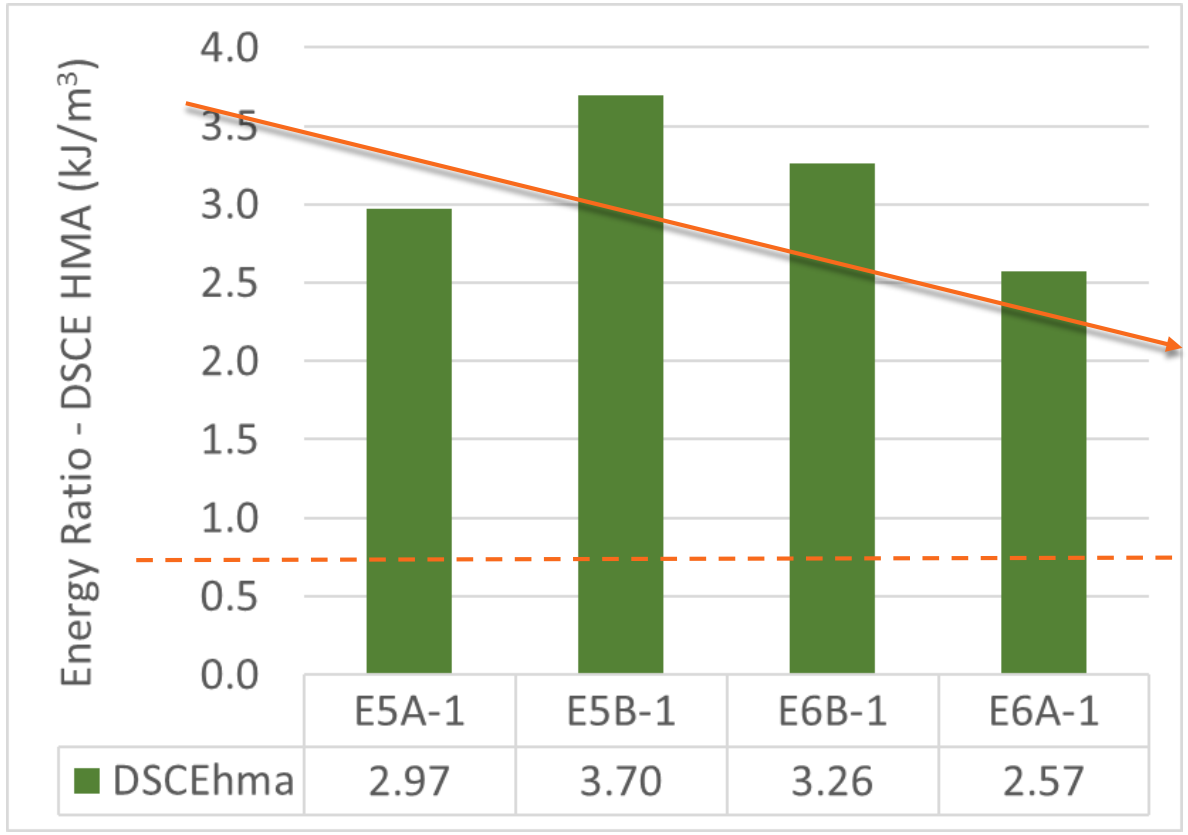

70
60
50
40
30
20
10
0
CT Index
14
12
10
8
6
4
2
0
Air Voids (%)
E5A-1
E5B-1
E6B-1
E6A-1
CT Index
Air Voids

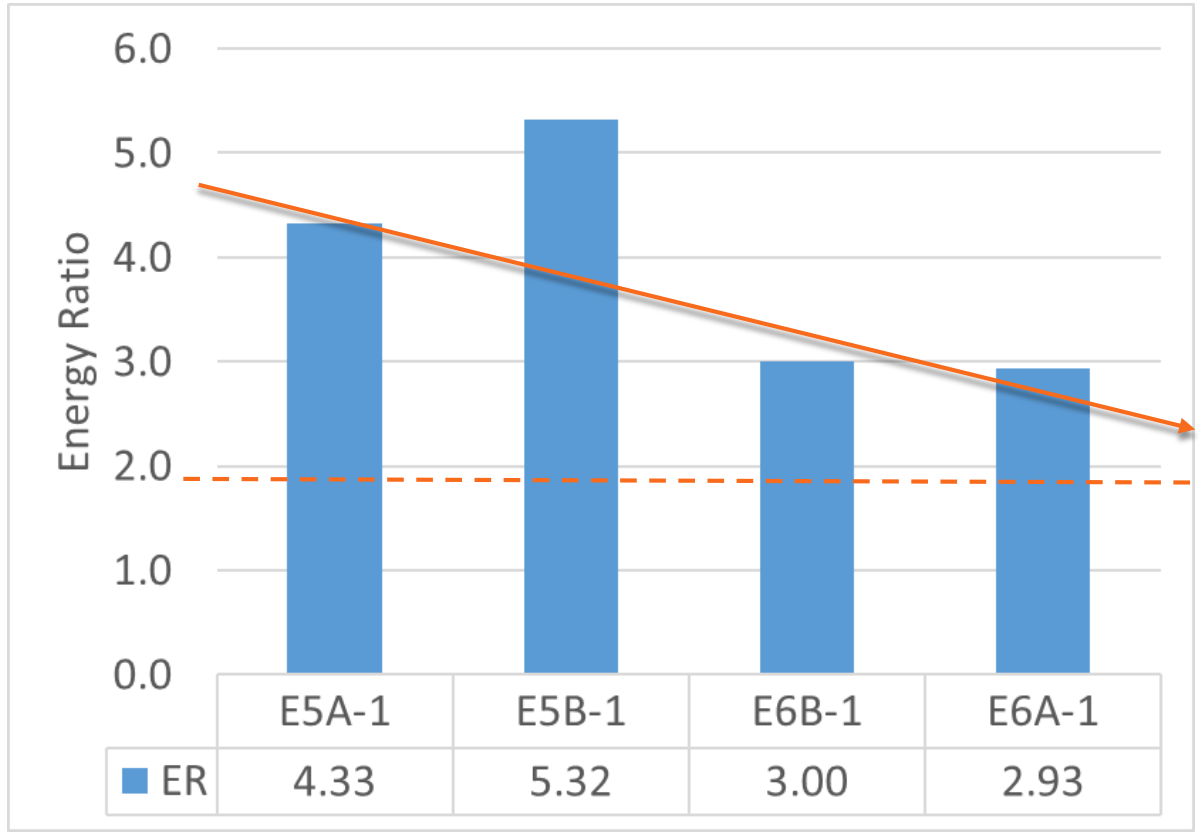
(a)


Load, kN
Displacement, mm
P100
P85
P75
P65
Im75I
I85
I75
I65

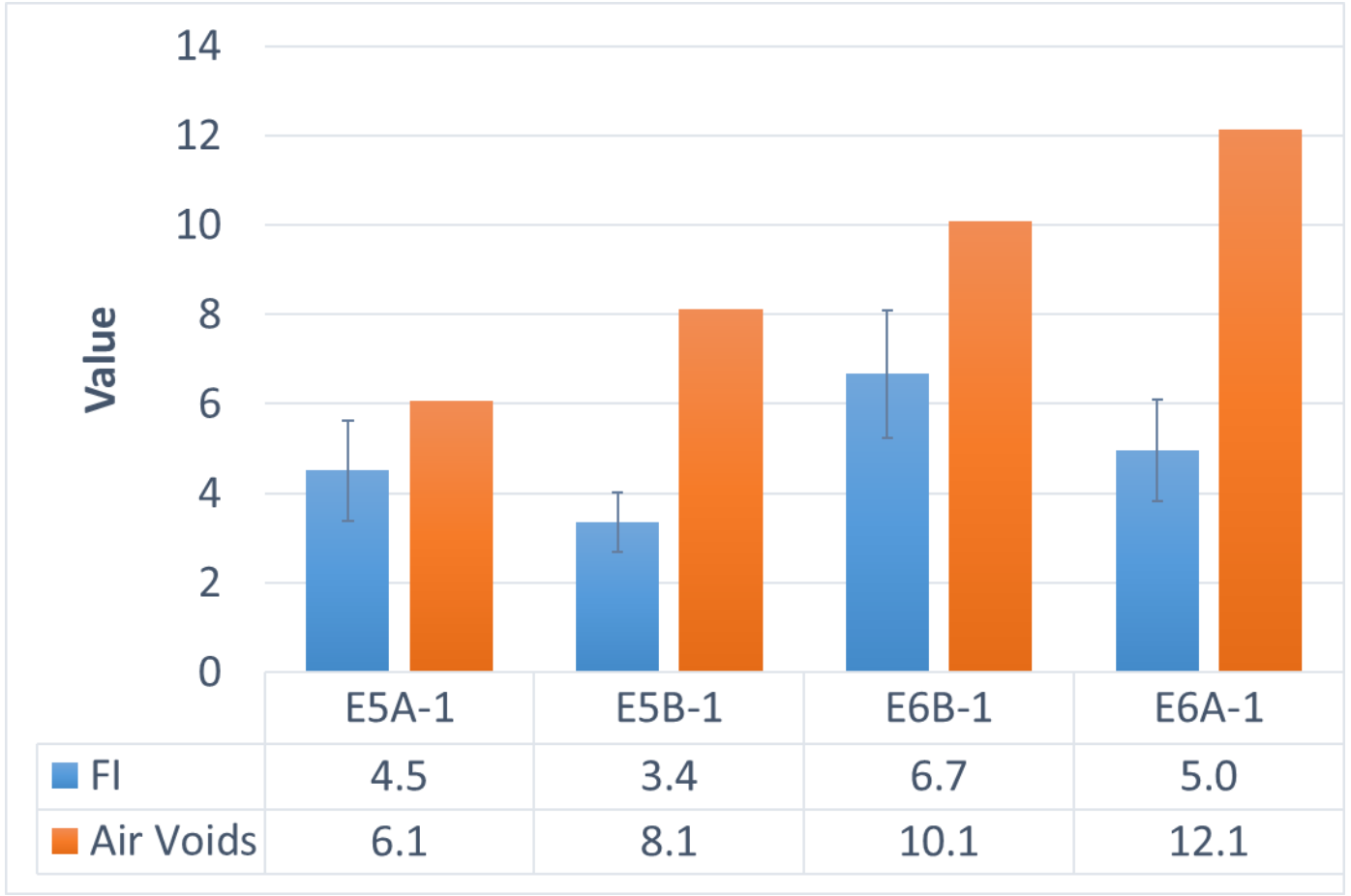
(b)

Energy Ratio



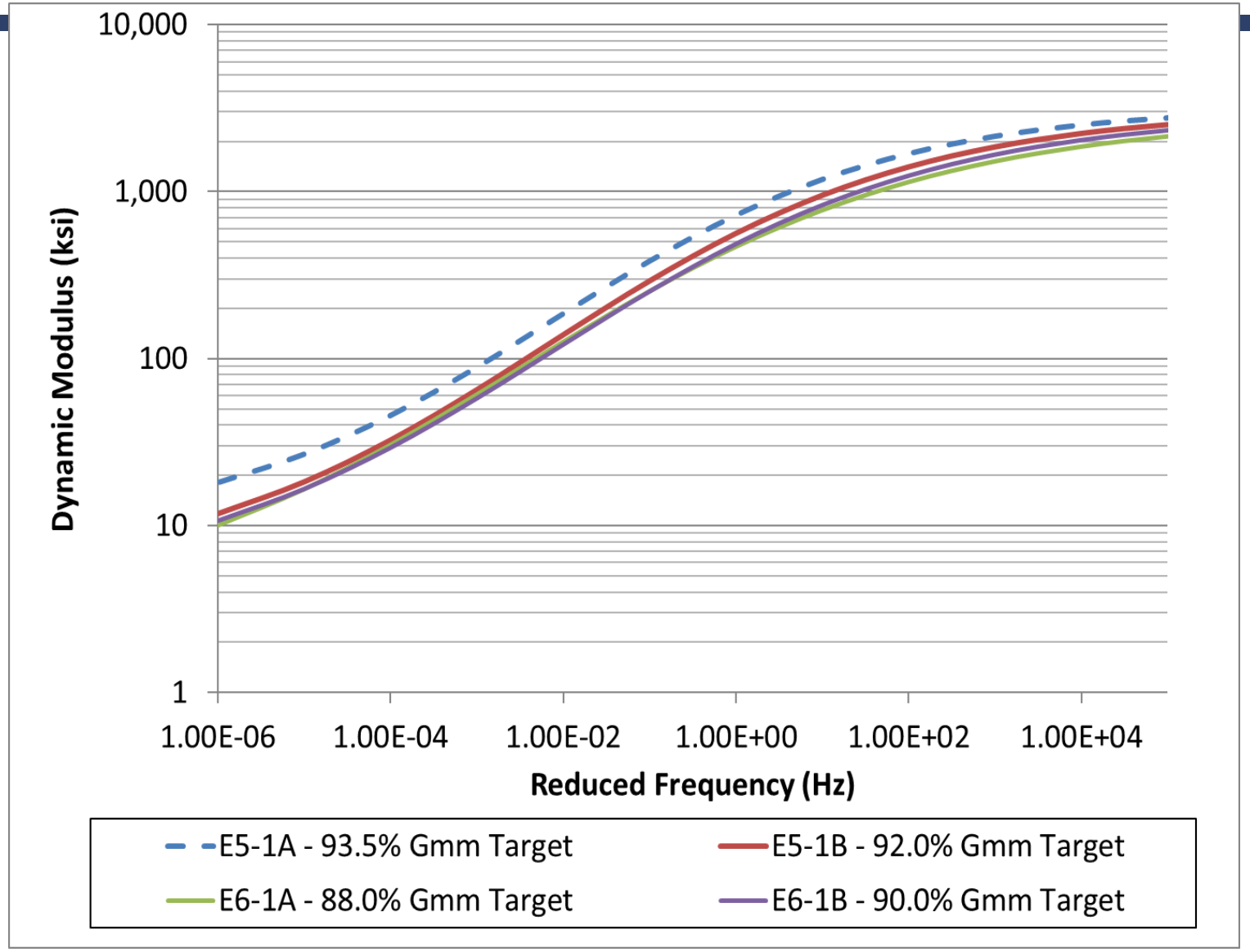


I-FIT



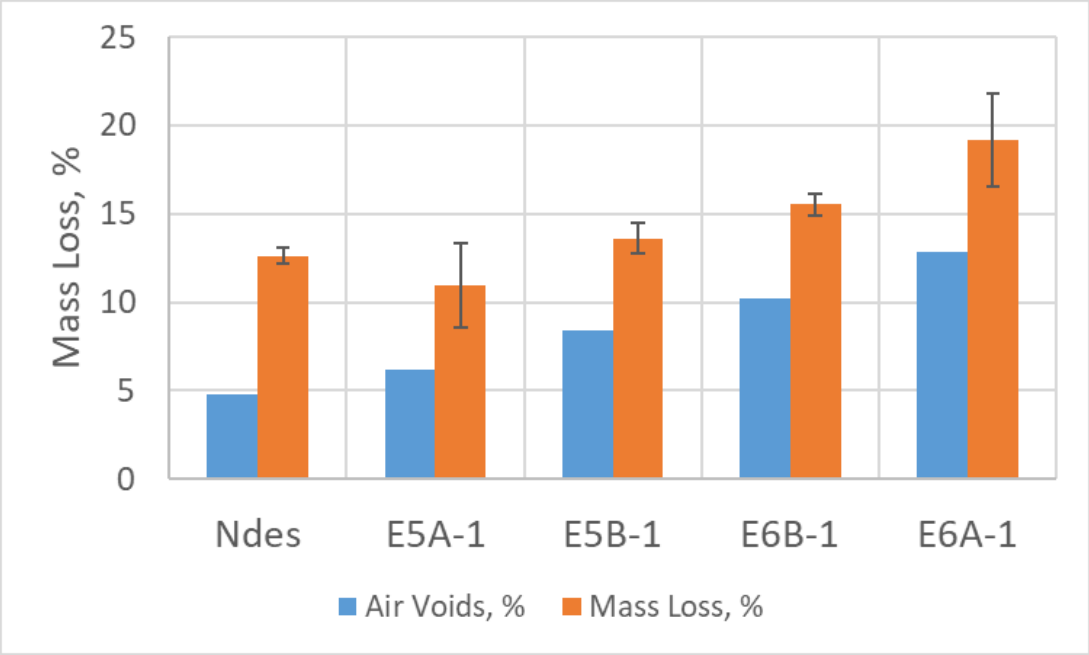
	E5A-1	E5B-1	E6B-1	E6A-1
FI	4.5	3.4	6.7	5.0
Air Voids	6.1	8.1	10.1	12.1

Dynamic Modulus

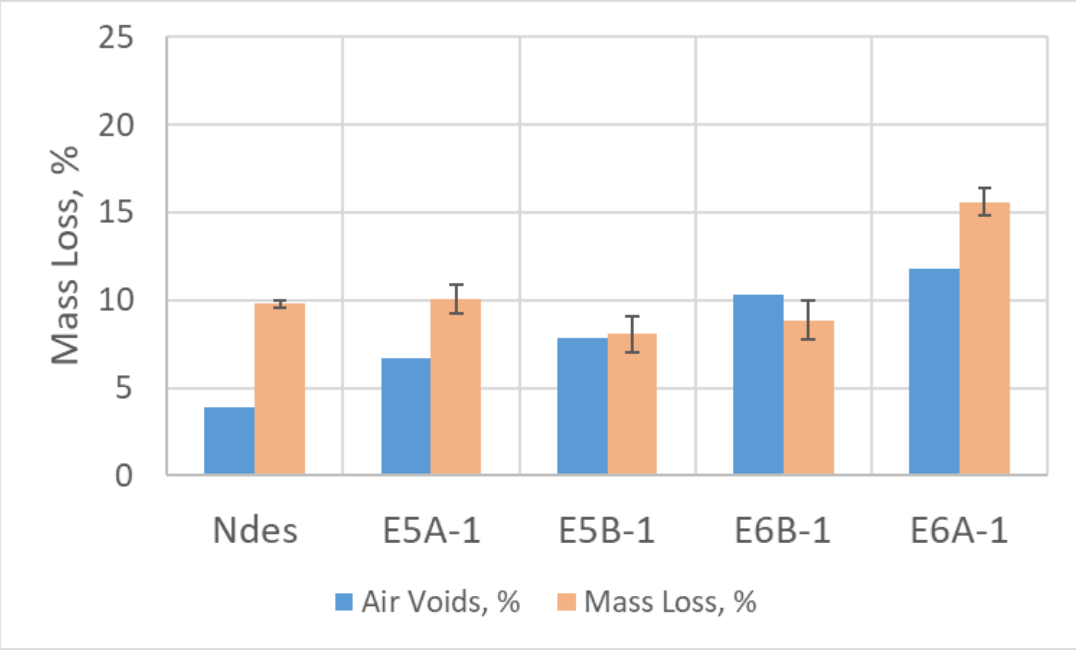


Cantabro

Lab Produced



Plant Produced



Correlation Analysis

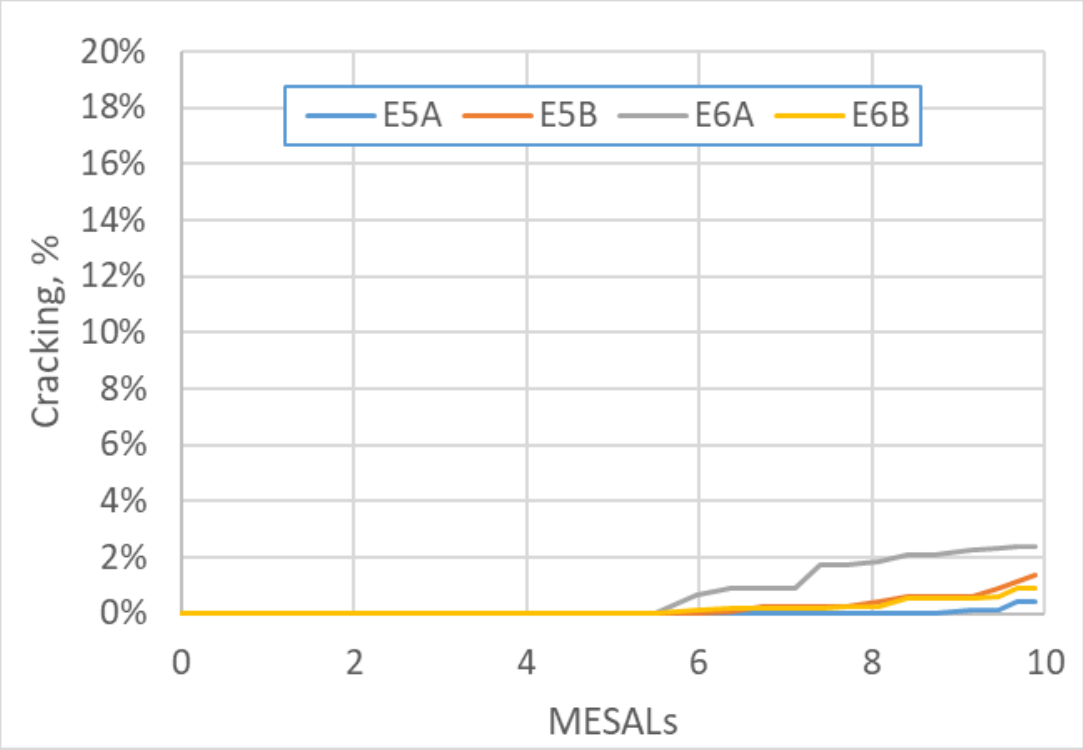
	Air Voids	*FI*	*CT Index*	*HWT*	*HT IDT*	*Mr*	*DSCE*	*ER*	*Cantabro*
Air Voids	1								
FI	0.43	1							
CT Index	0.99	0.33	1						
HWT	1.00	0.43	0.98	1					
HT IDT	-0.95	-0.21	-0.99	-0.94	1				
Mr	-0.97	-0.41	-1.00	-0.99	0.98	1			
DSCE	-0.52	-0.31	-0.30	-0.46	0.19	0.31	1		
ER	-0.79	-0.85	-0.60	-0.74	0.48	0.66	0.71	1	
Cantabro	0.67	0.09	0.57	0.68	-0.51	-0.55	-0.90	-0.61	1

Ranking Analysis

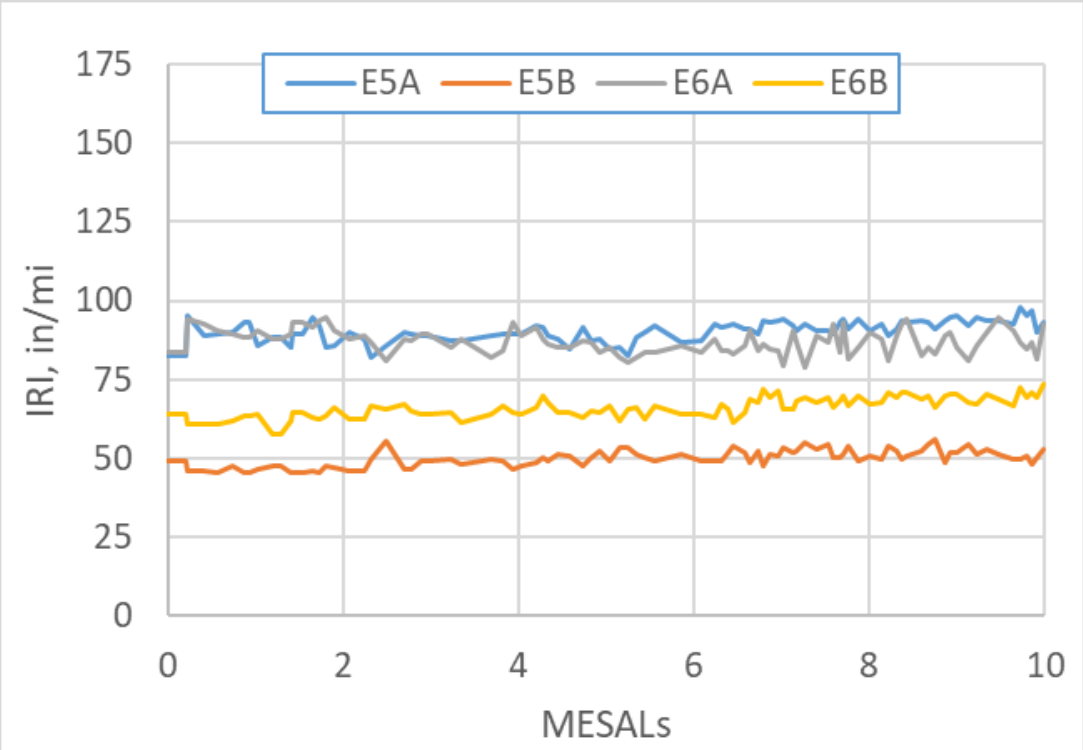
ID	FI	CT_{Index}	ER	Cantabro Mass Loss	E* 40C, 1 Hz (ksi)	HWTT	HT-IDT
E5A	4.5	26.3	4.3	10.1	157.7	1.5	49.3
E5B	3.4	39.8	5.3	8.0	108.7	2.4	36.6
E6B	6.7	44.9	3.0	8.9	95.2	3.3	35.5
E6A	5.0	53.4	2.9	15.6	96.1	4.3	28.7
	Individual Ranking						
Field Density (%)	FI	CT_{Index}	ER	Cantabro Mass Loss	E* 40C, 1 Hz (ksi)	HWTT	HT-IDT
93.6	3	4	2	3	1	1	1
92.0	4	3	1	1	2	2	2
89.7	1	2	3	2	4	3	3
87.9	2	1	4	4	3	4	4

Field Performance

Cracking (% Lane)

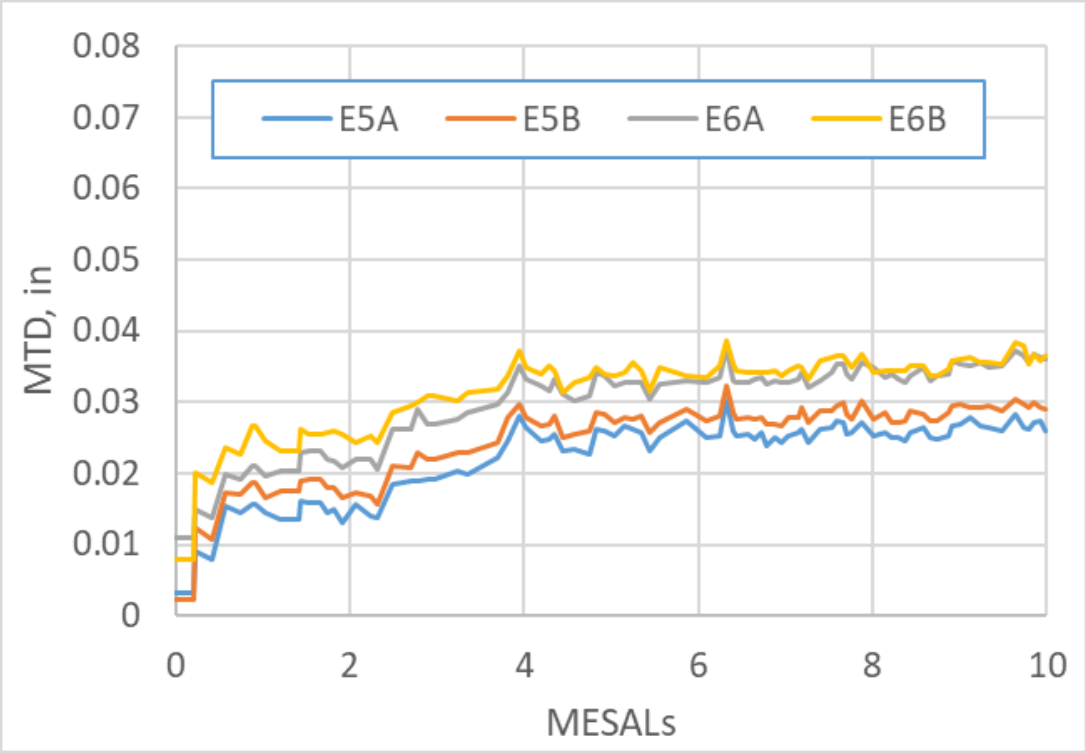


IRI

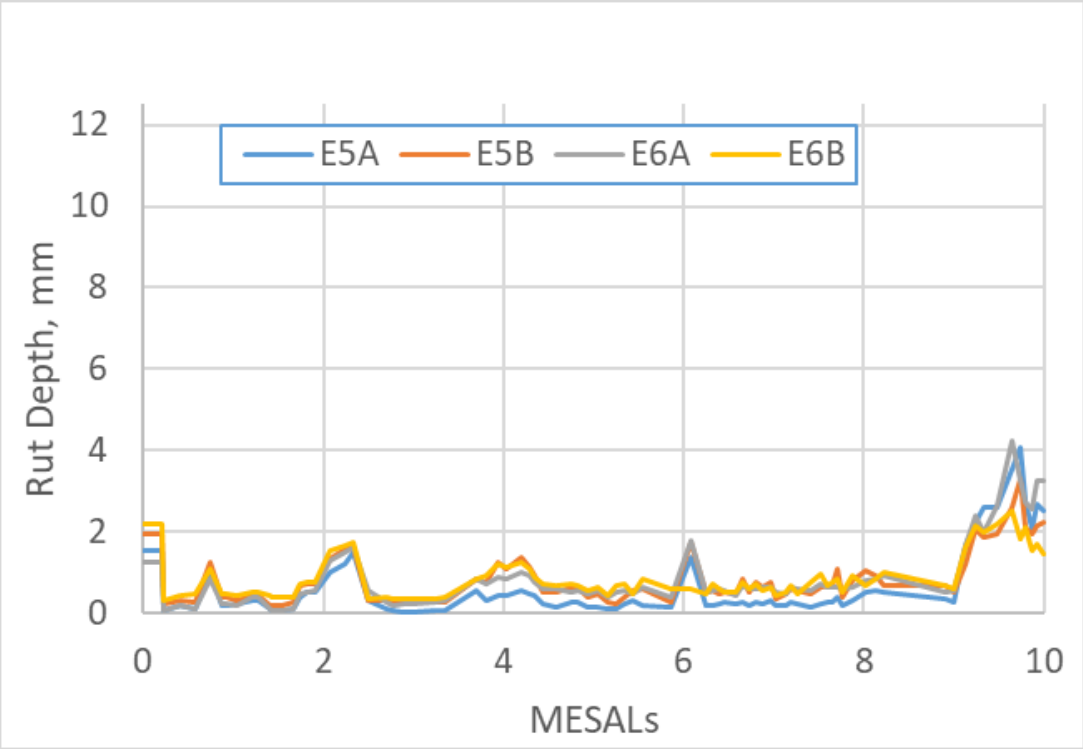


Field Performance

Texture



Rutting



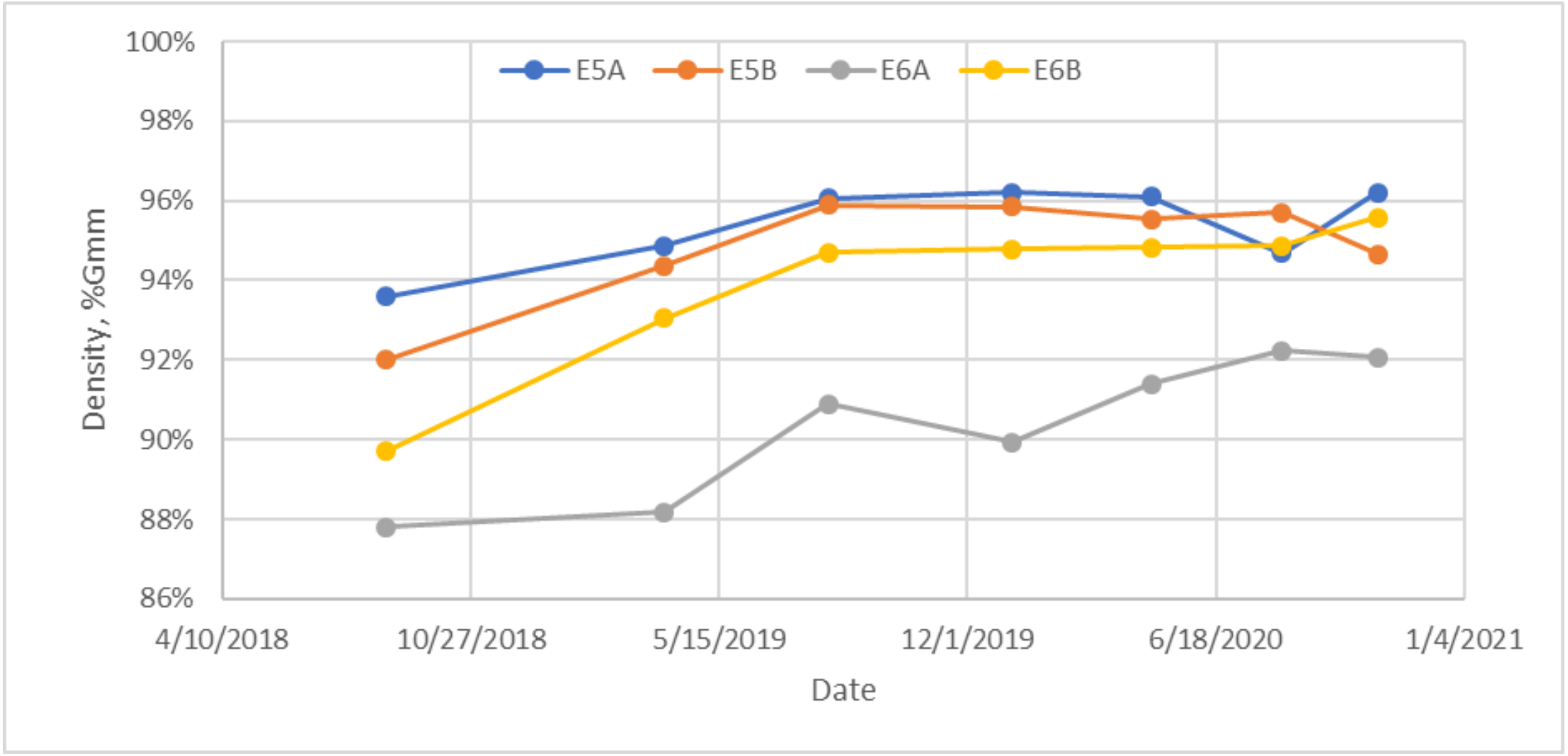
Field Performance

Texture E5A (93.6%)

Texture E6A (87.8%)

Field Performance

Density



Summary

- Laboratory cracking test results did not exhibit expected trends in terms of density or air voids. However, a reversed trend for the I-FIT and IDEAL-CT tests with respect to density was expected based on past experience.
- There was no consensus among parameters to define a top performer in the lab.

Summary

- Mixtures were not susceptible to rutting in the laboratory regardless of the density levels used in this study based on HWTT results. No evidence of moisture damage was observed in the HWTT.
  - This agrees with the observations of minimal rutting and no moisture damage seen in the field.

Summary

- At the end of trafficking, field performance was good with cracking at less than 5% of the lane in each section, no changes in roughness, little permanent deformation, and no significant changes in texture.
- At the end of trafficking, observed cracking in the test sections was classified as low severity.

Questions and Answers

SEVENTH
RESEARCH CYCLE

NCAT TEST TRACK CONFERENCE