



2022 NEAUPG

Evaluating Long-Term Aging Protocols for Cracking Tests Used in Balanced Mix Design Across Northern New England States

Cheng Ling

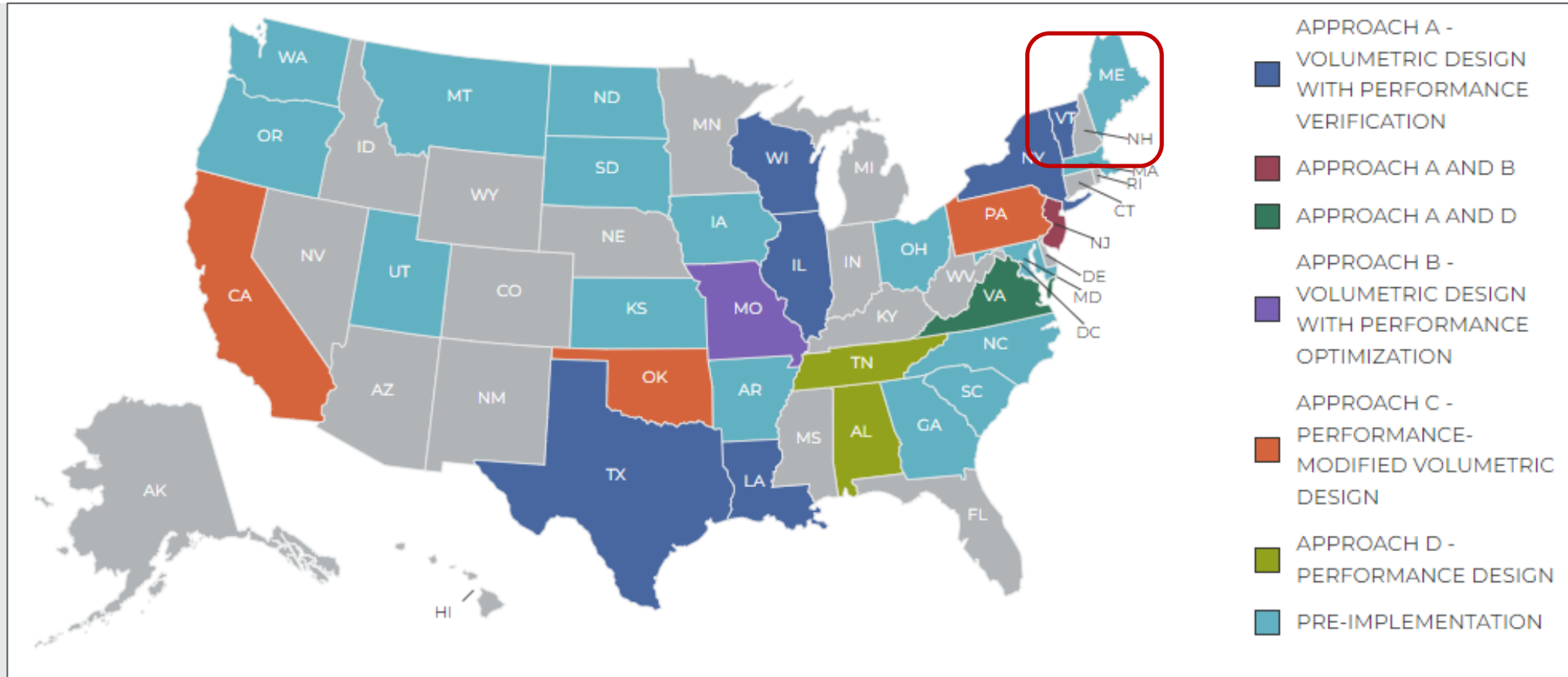
11/3/2022

Outline

- **Background**
- **Materials and Methods**
- **Mix Aging Results**
- **Binder Aging Results**
- **Summary**

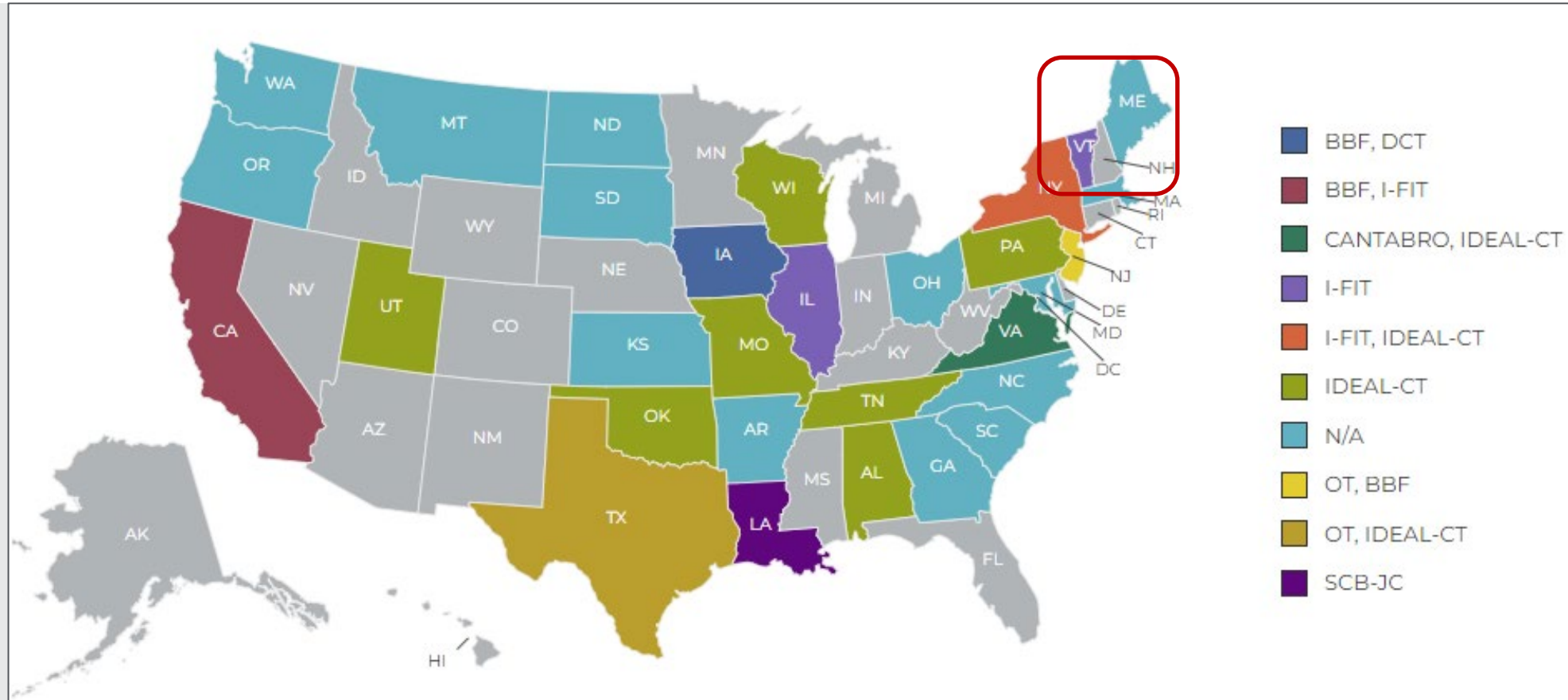


Background – BMD Implementation



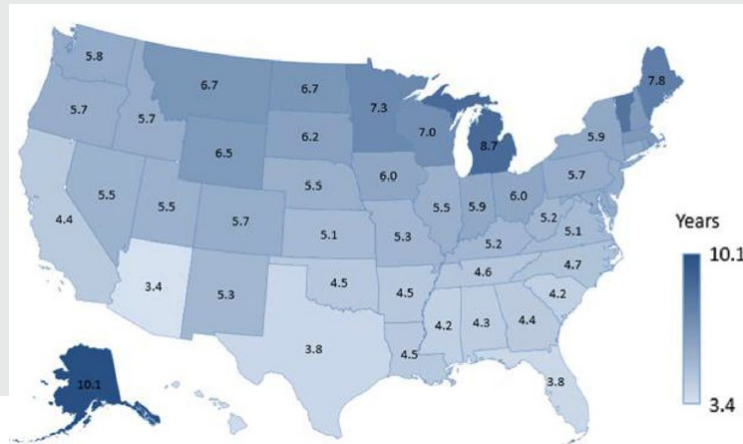
NAPA BMD Resource Guide: <https://www.asphaltpavement.org/expertise/engineering/resources/bmd-resource-guide/implementation-efforts>

Background – Cracking Tests in BMD

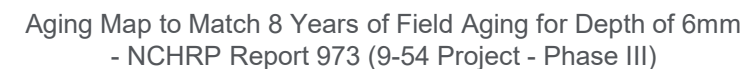


NAPA BMD Resource Guide: <https://www.asphaltpavement.org/expertise/engineering/resources/bmd-resource-guide/implementation-efforts>

- **AASHTO R30: 5 days at 85°C on compacted specimens**
- **NCAT Critical Aging: 6-8 hours at 135°C on loose mixes**
- **NCHRP 9-54: 2-5 days at 95°C on loose mixes (for New England)**
- **Illinois DOT: 3 days at 95°C on I-FIT specimens**



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Materials

➤ 10 Plant Produced Mixes Included:

- 5 from ME
- 2 from NH
- 3 from VT
- All Surface Mixes

Mix ID	Project	Mix Type	Binder Type	RAP%
ME-1	MDOT Lunt Rd	12.5mm 65 gyr	64-28	20
ME-2	MDOT Dixfield	12.5mm 65 gyr	70E-34	20
ME-3	MDOT Belgrade Rt 27	12.5mm 65 gyr	64E-28	20
ME-4	MDOT Dexter Rt 7	12.5mm 65 gyr	64E-28	20
ME-5	MDOT Holden Rte 1A	12.5mm 65 gyr	64E-28	20
NH-1	NHDOT Rt 101 Epsom	12.5mm 75 gyr	70-34	0
NH-2	NHDOT Rt 11 Farmington	12.5mm 75 gyr	64-28	20
VT-1	VTrans Poultney-Castleton	9.5mm 50 gyr	70-28	20
VT-2	VTrans Morristown-Wolcott	9.5mm 65 gyr	70-28	20
VT-3	VTrans Windsor-Hartland	9.5mm 65 gyr	70-28	20

Selected Aging Protocols

➤ Aging Protocols

- **RH**: Reheated
- **LTA**: Long-Term Aging Method A
 - 8 Hours at 135°C (NCAT Critical Aging)
- **LTB**: Long-Term Aging Method B
 - 5 Days at 95°C (NCHRP 9-54/NHDOT Aging Study)
 - Simulates about 4-8 years of field aging for surface mixes



Selected Cracking Tests

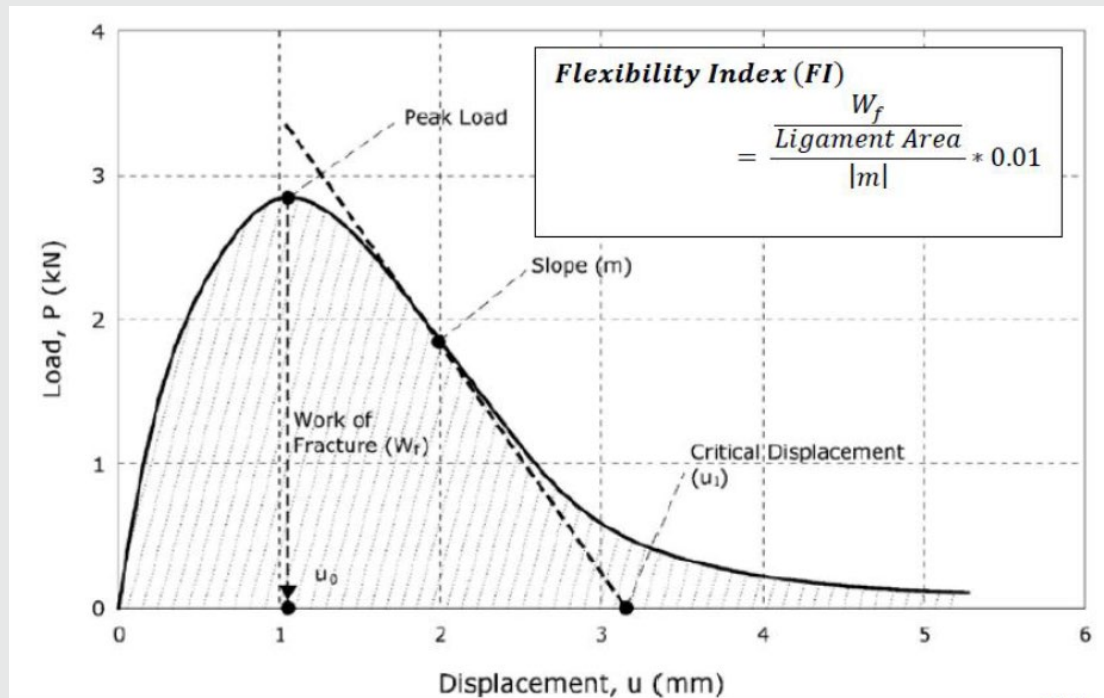
➤ I-FIT & IDEAL-CT



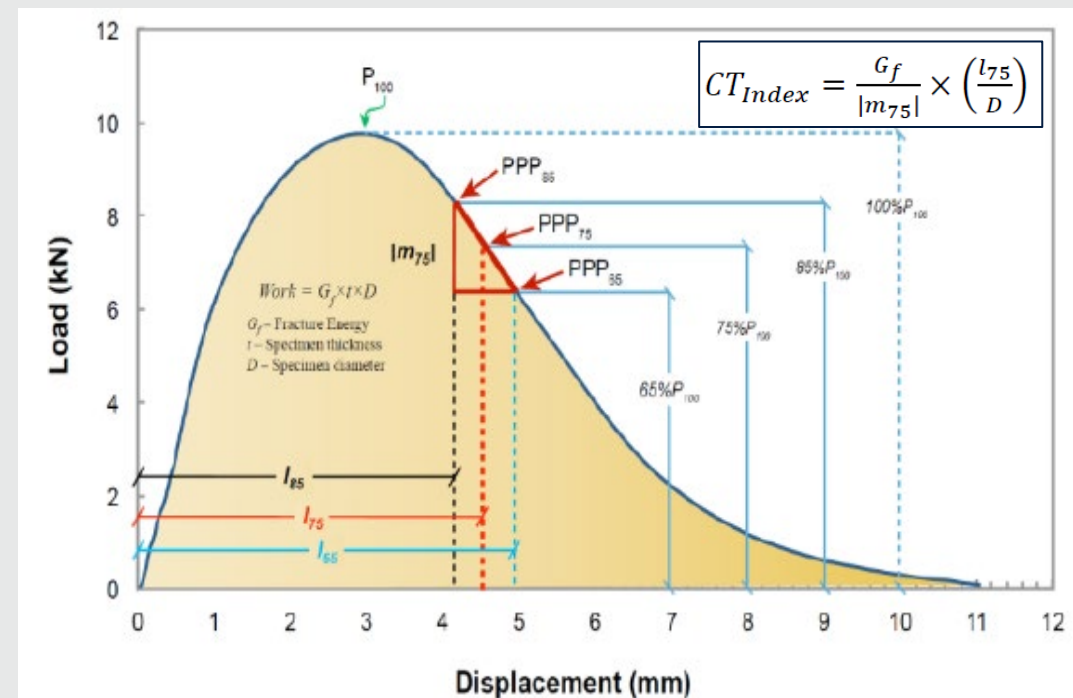
I-FIT



IDEAL CT



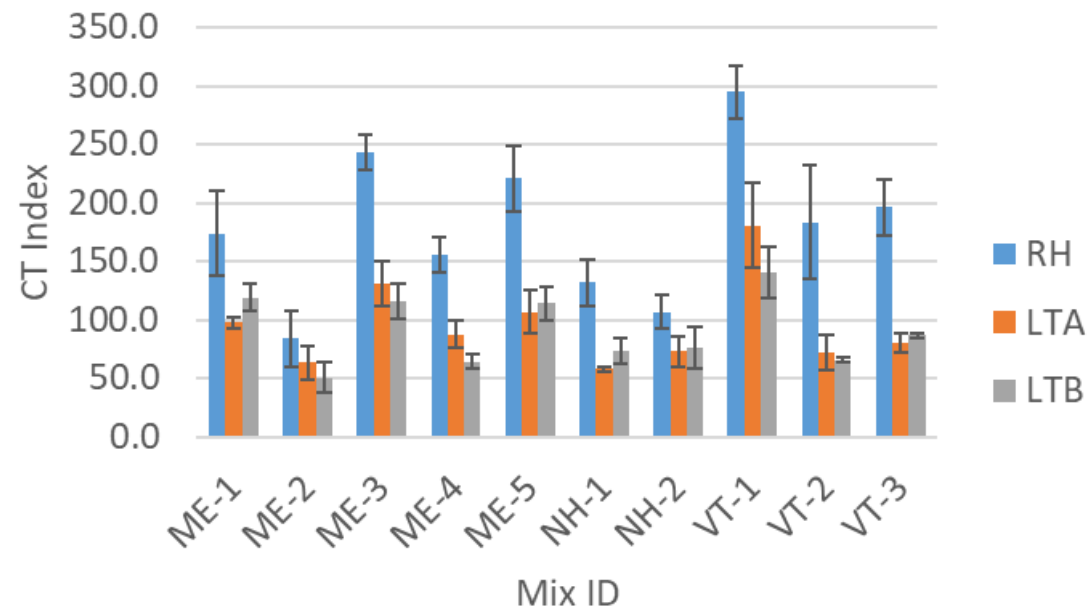
I-FIT (AASHTO T393)



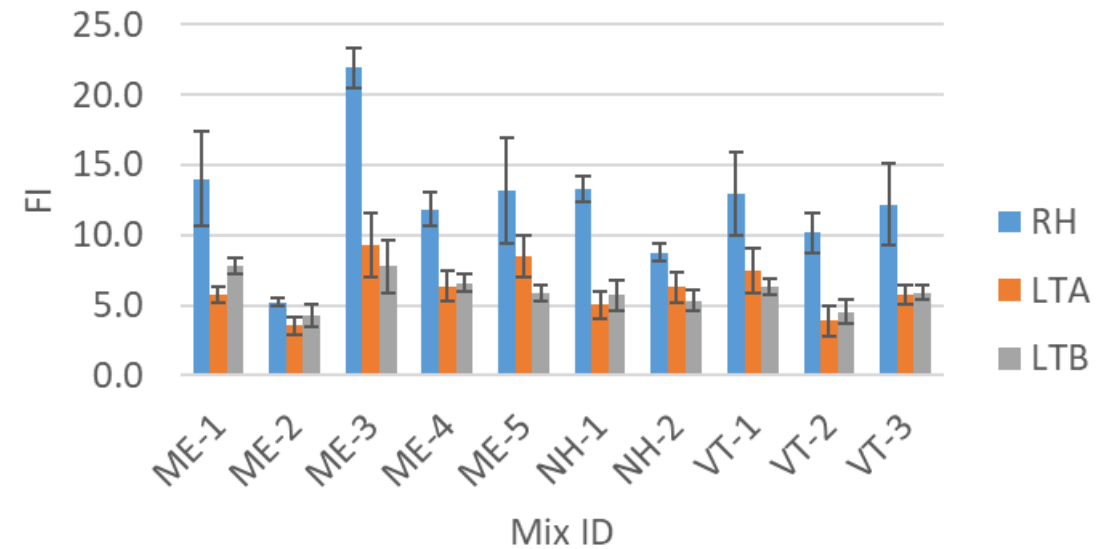
IDEAL-CT (ASTM D8225)

Mix Aging Results

CT Index Under Various Aging Conditions

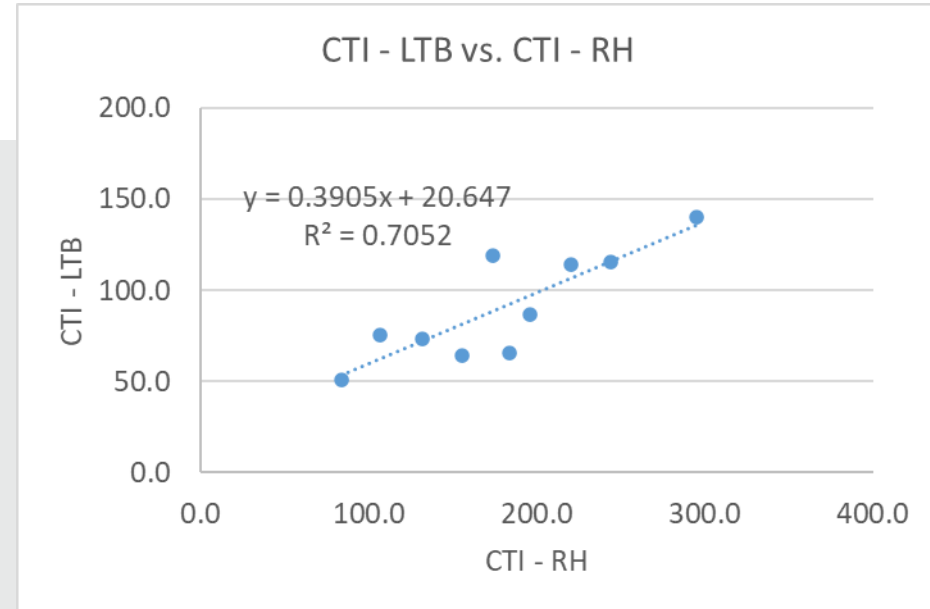
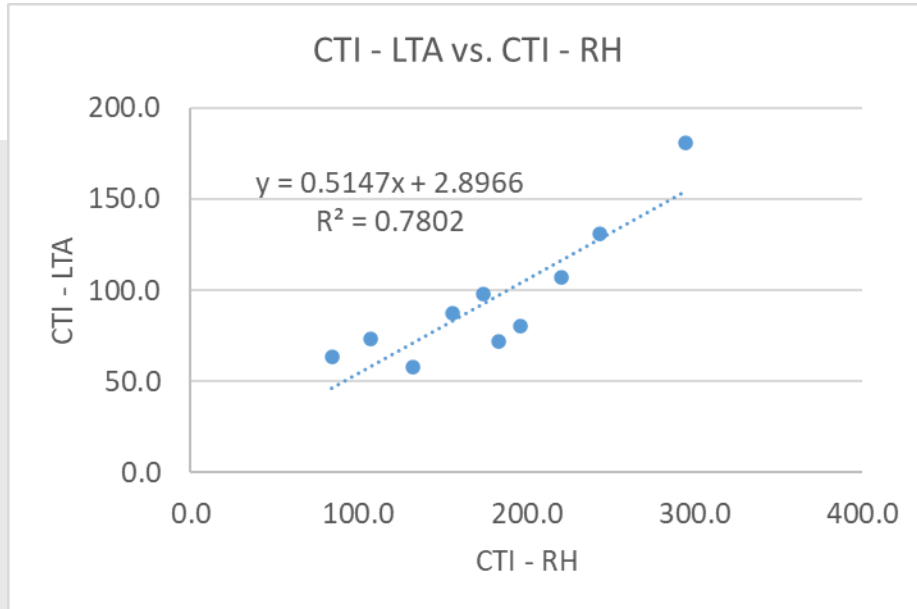


Flexibility Index Under Various Aging Conditions

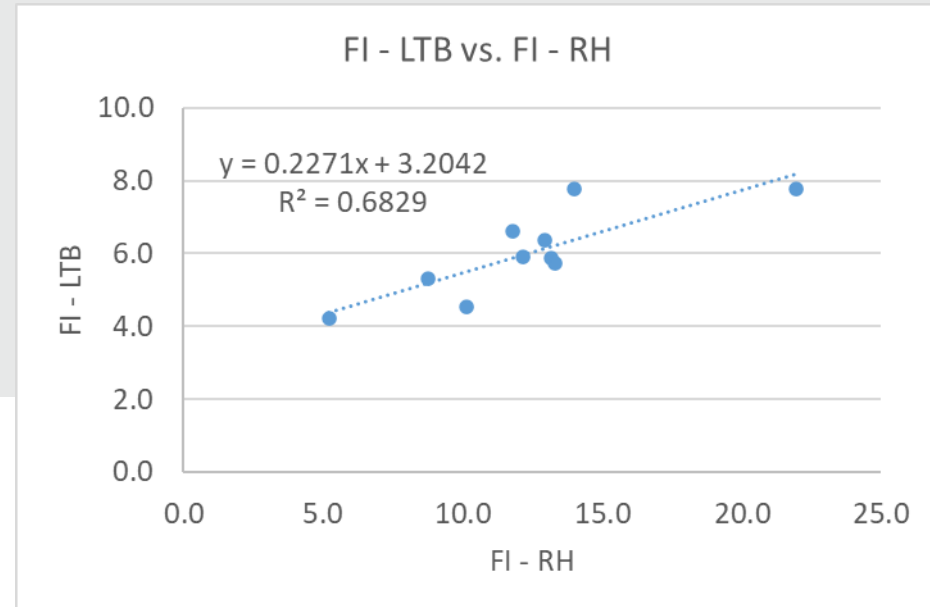
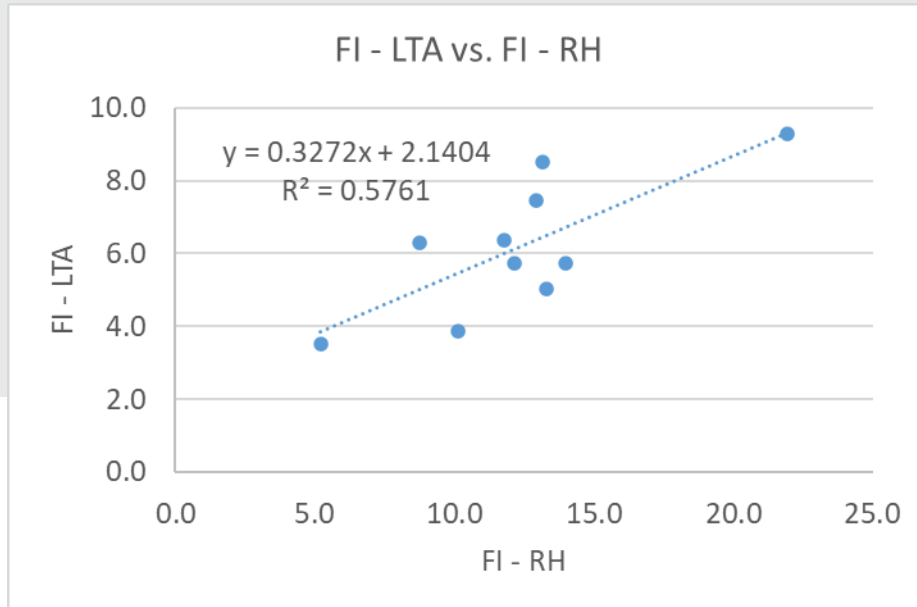


Mix Aging Results

CTI



FI



Mixes with PGXX-34

Mix ID	Project	Mix Type	Binder Type	RAP%
ME-1	MDOT Lunt Rd	12.5mm 65 gyr	64-28	20
ME-2	MDOT Dixfield	12.5mm 65 gyr	70E-34	20
ME-3	MDOT Belgrade Rt 27	12.5mm 65 gyr	64E-28	20
ME-4	MDOT Dexter Rt 7	12.5mm 65 gyr	64E-28	20
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NH-2	NHDOT Rt 11 Farmington	12.5mm 75 gyr	64-28	20
VT-1	VTrans Poultney-Castleton	9.5mm 50 gyr	70-28	20
VT-2	VTrans Morristown-Wolcott	9.5mm 65 gyr	70-28	20
VT-3	VTrans Windsor-Hartland	9.5mm 65 gyr	70-28	20

Ranking of CTI			
Mix ID	RH	LTA	LTB
ME-2	10	9	10
NH-1	8	10	7

Ranking of FI			
Mix ID	RH	LTA	LTB
ME-2	10	10	10
NH-1	3	8	7

“The mixtures with soft binders generally show higher aging susceptibility.”

Binder Aging

➤ Methods

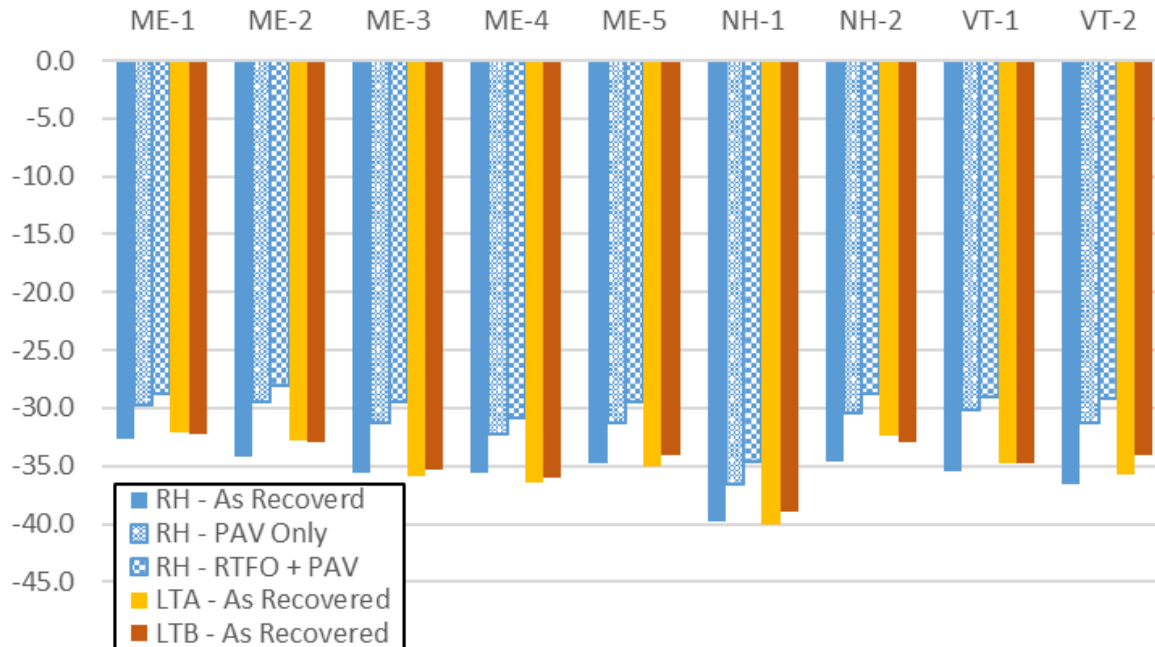
- ASTM D8159: Automated Extraction
- AASHTO R59: Abson Recovery
- Aging Conditions
 - RH: As Recovered/PAV Only/RTFO+PAV
 - LTA/LTB: As Recovered
- Parameters: S, m and ΔT_c from BBR



Asphalt Analyzer at Pike Central Lab

Binder Aging Results

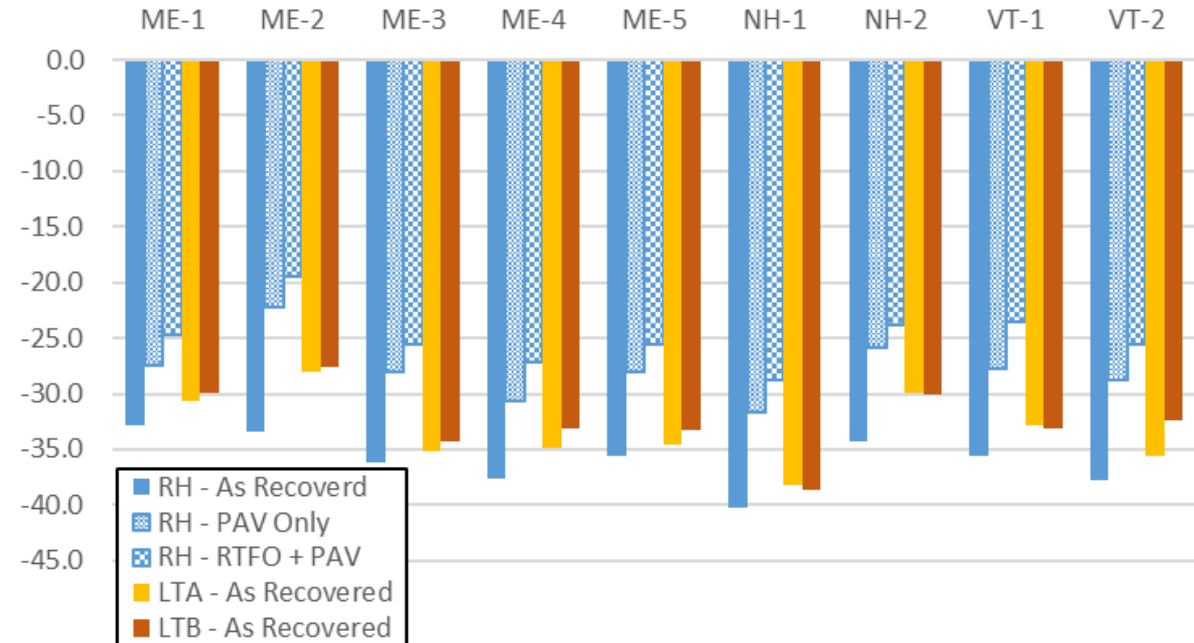
LT TG - Stiffness



ΔT_c Correlations

RH-LTA	48.9%
RH-LTB	18.9%

LT TG - m



	ΔT_c vs. CTI	ΔT_c vs. FI
RH	9.3%	10.0%
LTA	4.7%	21.4%
LTB	25.4%	16.1%

Summary

- The cracking test results of plant produced mixes under selected long-term aging protocols correlated well with those of reheated mixes. Tests on reheated mixes in QC/Acceptance could be sufficient in a specific region.
- The mixes with softer grade binders showed higher aging susceptibility and poor IT cracking resistance after long-term lab aging.
- The durability index (ΔT_c) of binders extracted from long-term aged mixes did not correlate well with binders extracted from reheated mixes.
- Binder ΔT_c was not found to correlate with the mix cracking test results under various aging conditions.

Thank you!

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