



University of
New Hampshire

TPF-5(230)

Evaluation of Plant-Produced High-Percentage RAP Mixtures in the Northeast

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Northeast Asphalt User/Producer Group Meeting

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Research Team

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Participants

- New Hampshire (NH DOT) - Lead Agency
- Maryland (MDOT)
- New Jersey (NJ DOT)
- New York (NYSDOT)
- Pennsylvania (PennDOT)
- Rhode Island (RIDOT)
- Virginia (VDOT)
- Federal Highway Administration (FHWA)



Project Objective

Evaluate the performance of plant-produced RAP mixtures (in the laboratory and field) in terms of low temperature cracking, fatigue cracking and moisture sensitivity.



Project Status

- Phase I (2010 season): Interim report completed.
- Phase II (2011 season): Testing and data analysis almost completed. Interim report will be completed late winter.
- Phase III (2013 season): laboratory study. Testing and analysis almost completed. Interim report will be completed by end of the year.
- Silo Storage Study Additional Task: Testing new set of virgin mixtures from Phase II, will be completed next year.



Phase I Mixtures: 2010 Production

Plant	NMA5 (mm)	PG Grade	RAP Content (%)			
			0	20	30	40
Callanan NY (drum)	12.5	64-22	x	x	x	x
		58-28			x	x
Pike VT (batch)	9.5	58-28	x	x	x	x
		52-34	x	x	x	x
Pike NH (drum)	12.5	64-28	x	x	x	x



Phase I Conclusions

- Specimen preparation matters (PMLC vs PMPC)
- Softer binder grade effective in some cases, not in others
- Impact of plant production parameters
 - Mixing temperature
 - Silo storage time



Phase II Mixtures: 2011 Production

- Silo Storage Study
 - NY 12.5 mm mixture with PG 64-22
 - Virgin: 0, 2.5, 5.0, 7.5 hours storage (~340 F)
 - 25% RAP: 0, 2.5, 5.0, 7.5, 10.0 hours storage (~340 F)
- NH mixtures – field sections
 - PG 58-28: 0%, 15%, 25% RAP
 - PG 52-34: 25%, 30%, 40% RAP
- VA mixtures
 - PG 76-22: 0% RAP
 - PG 70-22: 20% RAP
 - PG 64-22: 30%, 40% RAP



Silo Storage Study

- 25% RAP mixtures
 - Increase in stiffness with longer storage times
 - Observed in binder and mixture testing
 - Implies additional aging is occurring in silo
 - Can't separate aging vs additional blending

- Vitrification

FAIL



Additional Silo Storage Study Task

- Replacement NY PG 64-22 virgin mixture has been produced
 - 0, 2.5, 5, 7.5 hr silo storage times
- Mixture: Plant compacted and lab compacted (reheated) specimens
 - $|E^*|$, S-VECD fatigue, TSRST
- Binder: Extracted and recovered from mixtures and RAP, and virgin binder
 - Continuous PG grading, CCT
- Pavement performance analysis using LVECD approach developed under FHWA PRS project



Phase III Laboratory Mixtures

Mixture	Asphalt content	RAP Content (total weight)		
		0	20	40
NH Phase I	-0.5%	PG 64-28	PG 64-28 PG 58-28	PG 64-28 PG 58-28
	optimum	PG 64-28	PG 64-28	PG 64-28
	+0.5%	-	-	PG 64-28



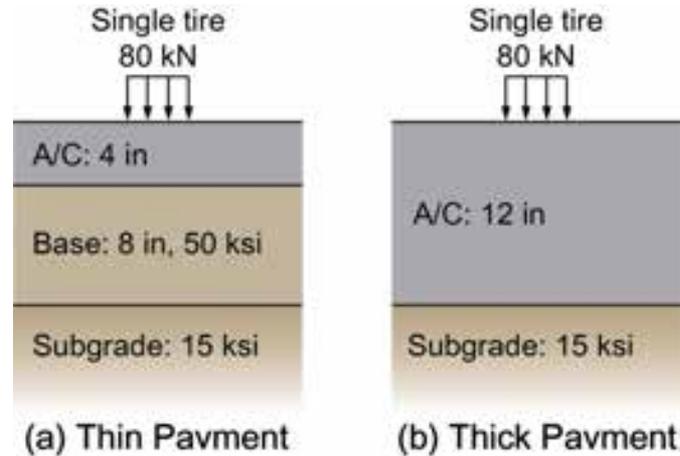
Phase III Testing

- Binder Testing
 - PG grading including CCT
 - G^* master curves
- Mixture Testing
 - Volumetrics at N_{des}
 - $|E^*|$
 - S-VECD fatigue
 - Triaxial Stress Sweep for rutting
 - TSRST
- Pavement Performance Analysis using LVECD



Pavement Analysis

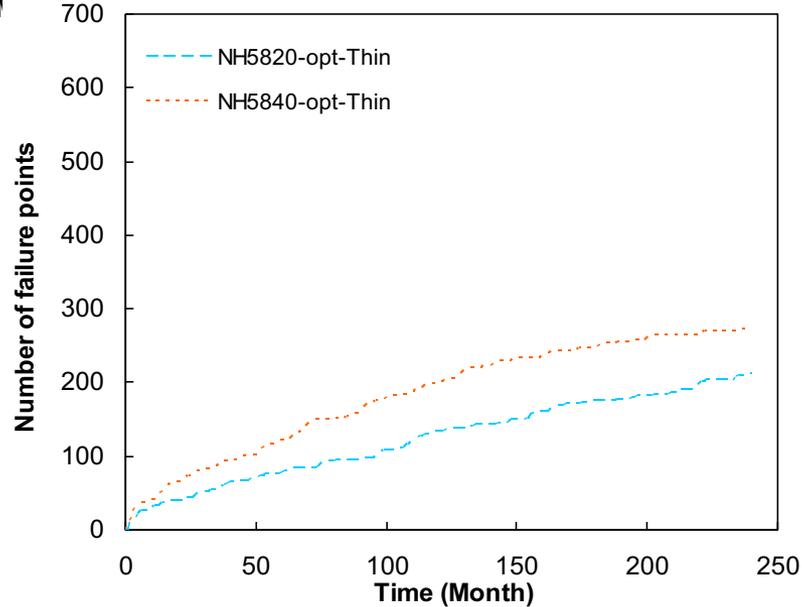
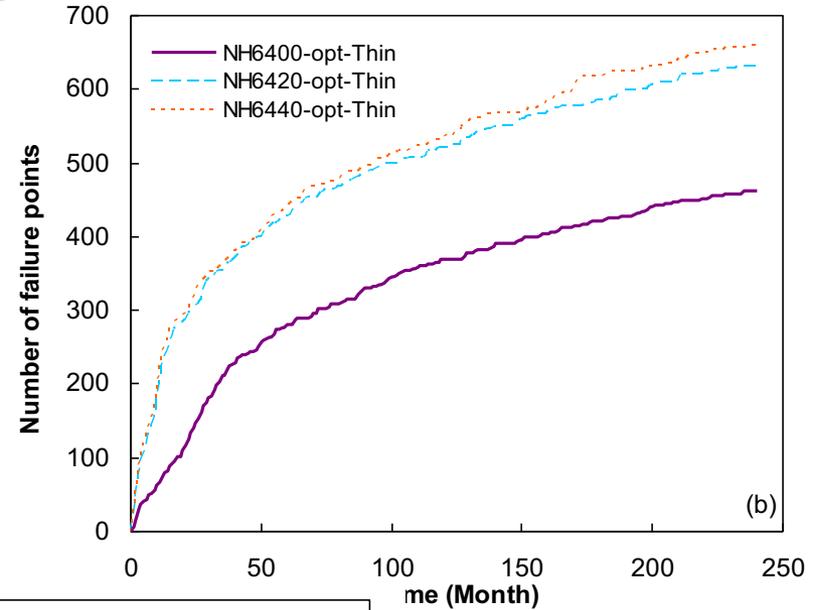
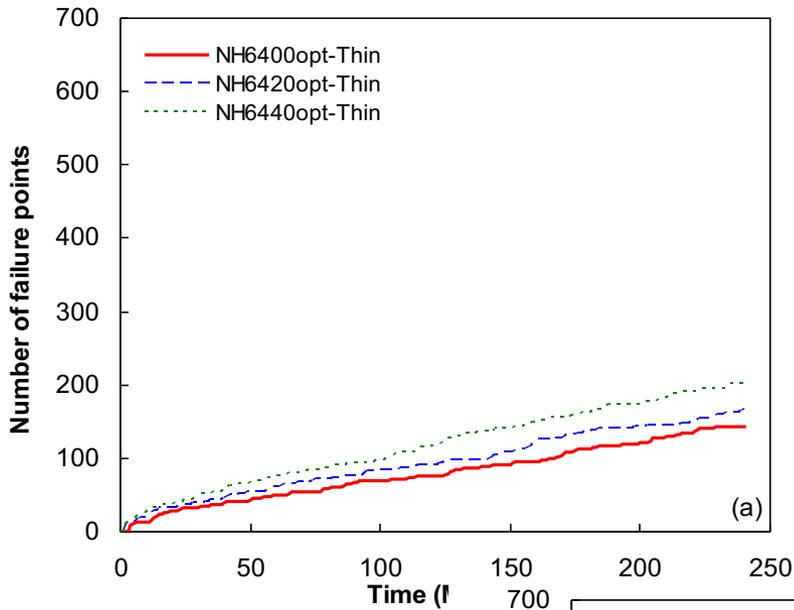
Boston, MA



Vehicle	ESAL
Design Velocity (mph)	60
AADTT	2000
Pressure Distribution	Constant
Contact Area	Rectangular
Aspect Ratio (length/width)	11/7
Tire Pressure (psi)	110
Growth Type	No Growth
Lane Distribution Factor	1

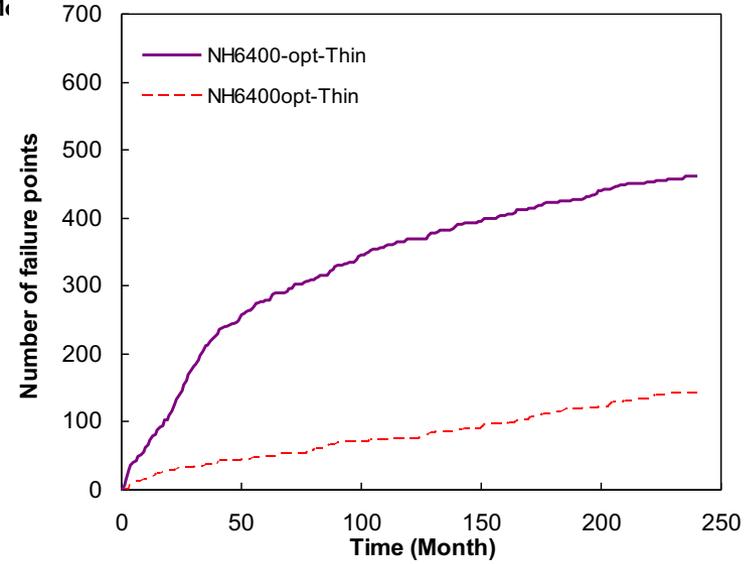
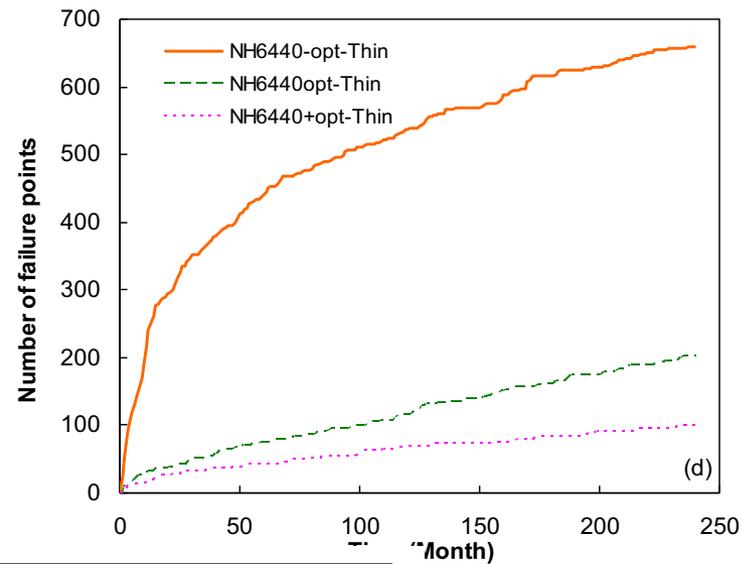
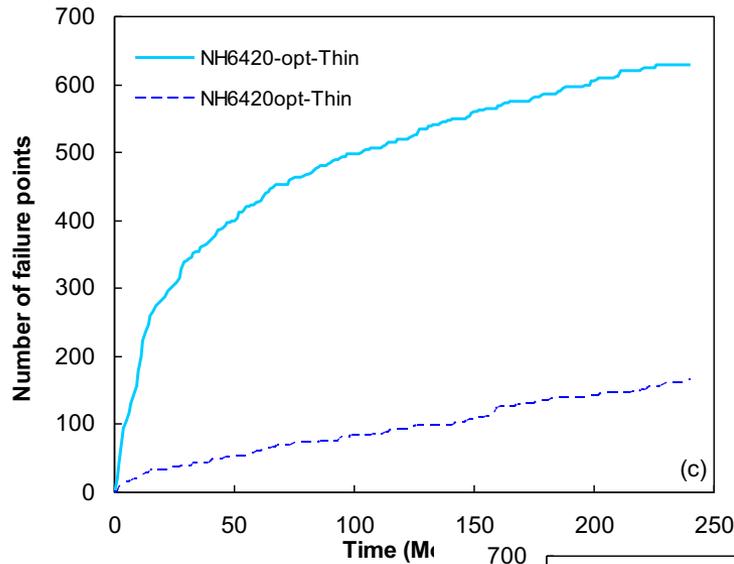


Thin Pavement-RAP% Effect



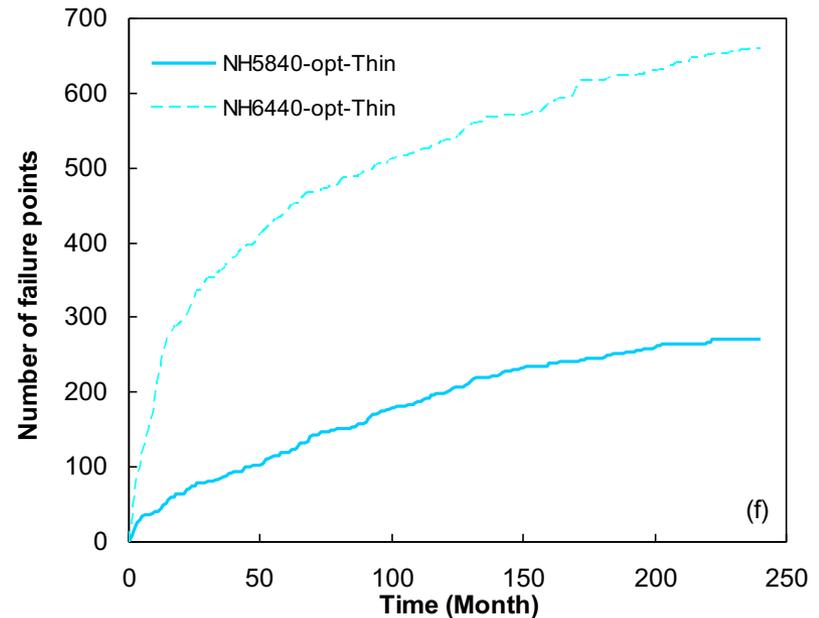
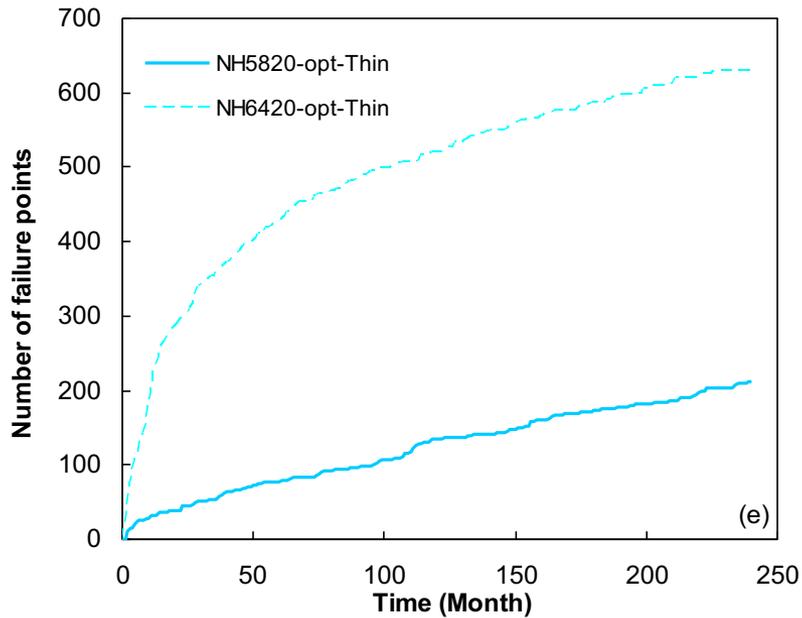


Thin Pavement-Binder Content Effect



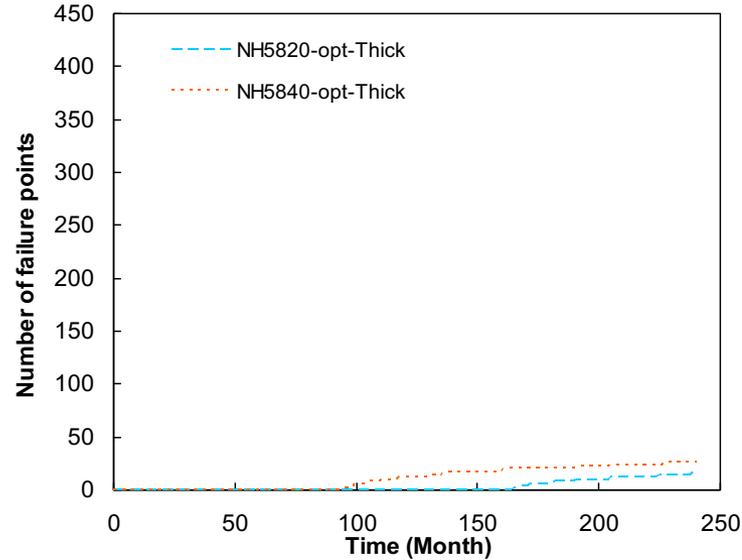
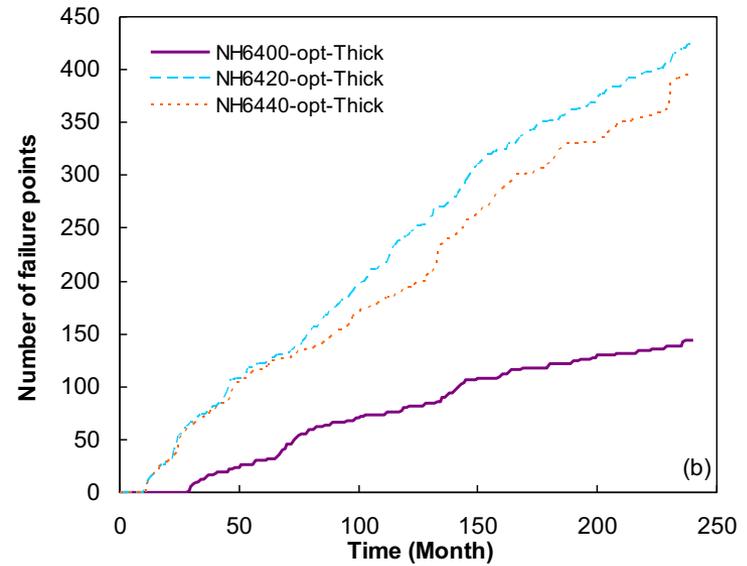
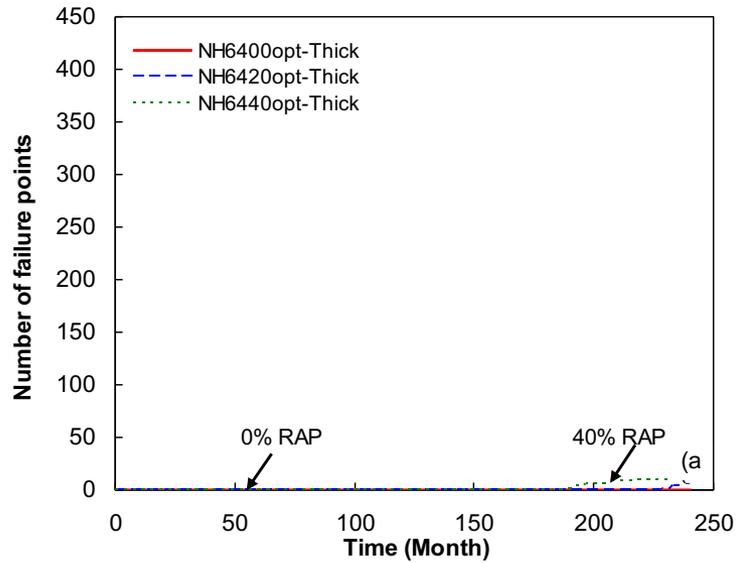


Thin Pavement-Softer Base Binder Effect



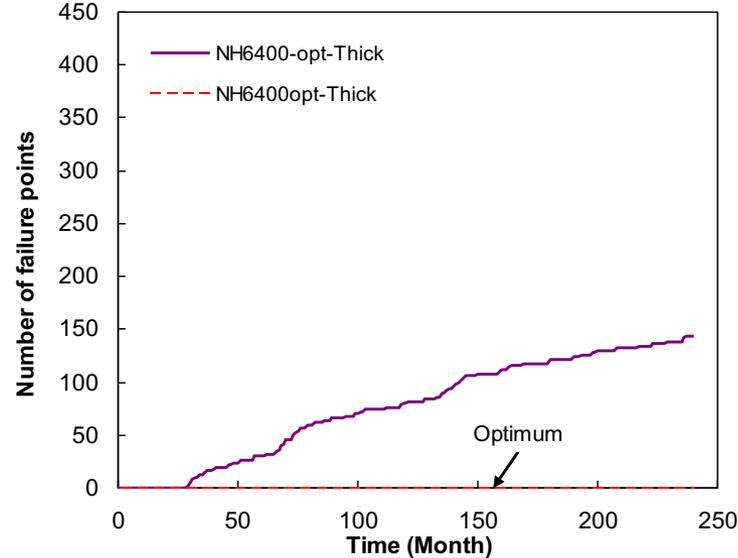
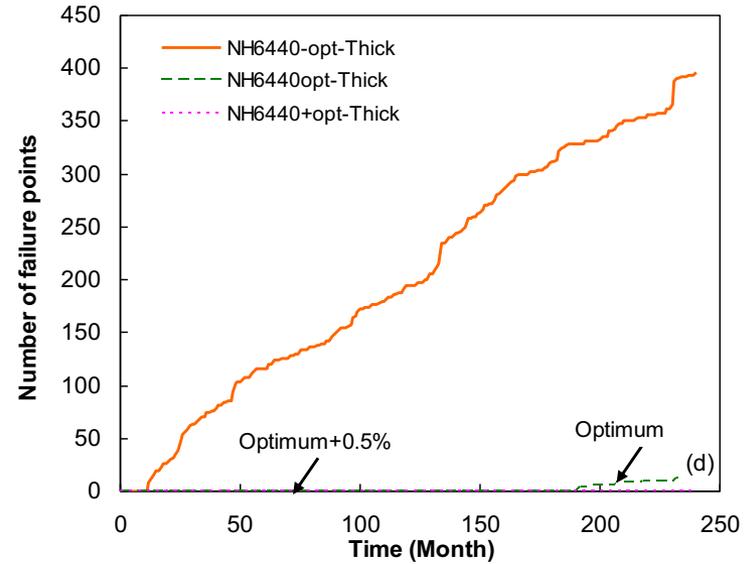
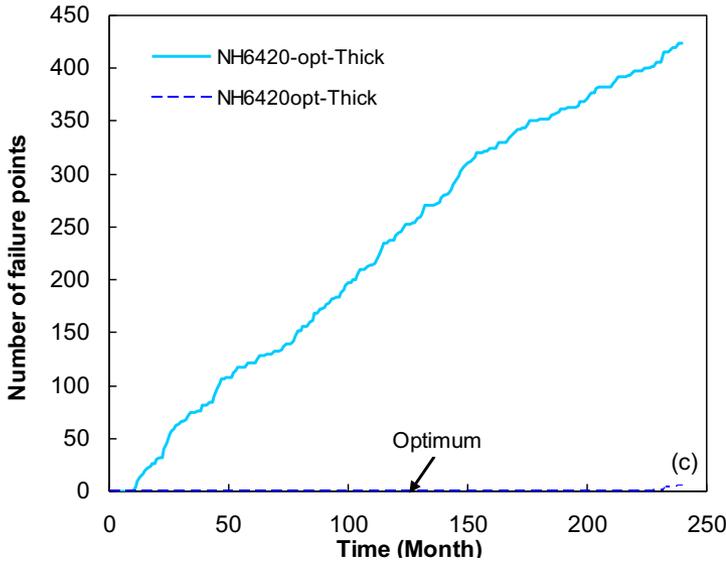


Thick Pavement-RAP% Effect



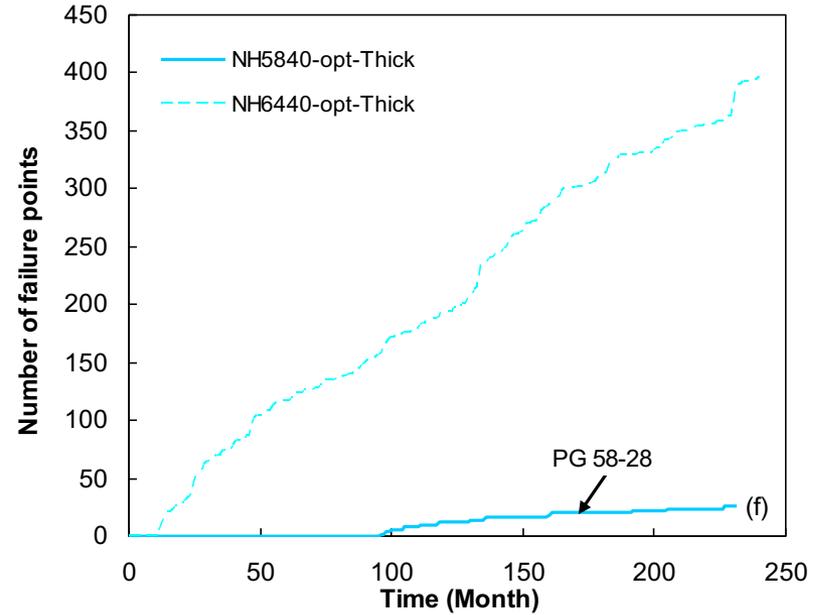
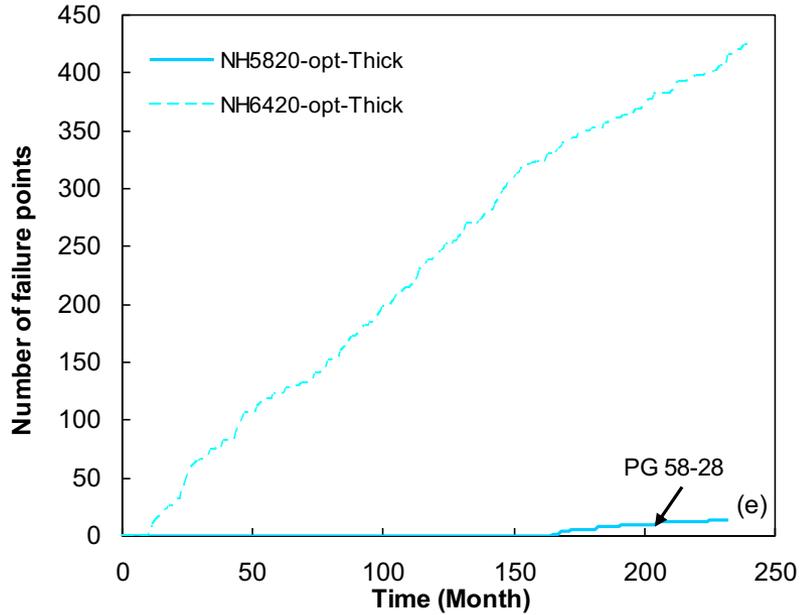


Thick Pavement-Binder Content Effect





Thick Pavement-Softer Base Binder Effect





Phase III Preliminary Conclusions

- Factors that improved fatigue resistance decreased rutting resistance
- Balance possible to produce mix that performs well
- Softer base binder and thicker layers accommodate higher RAP levels



Future Work

- Silo Storage Study
 - additional task
 - more extended study in future
- Additional plant produced mixtures and evaluation of field performance



Questions?