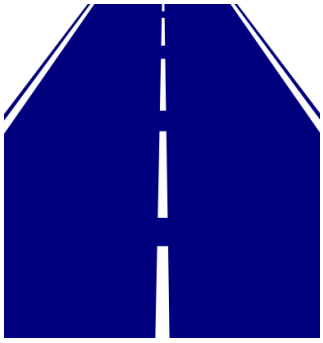
Cracking Performance of Asphalt Binders & Mixtures Over Time in New Hampshire

Technical Brief **June 2019**

Report Title

Incorporating Impact of Aging on Cracking Performance of Mixtures during Design

June 2019



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Report Link

\https://www.nh.gov/dot/org/projectdevelopment/materials/research/projects/documents/26962o_report.pdf

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Why was it studied?

Cracking, both environmental and load related, is a primary concern for asphalt pavements in New Hampshire. Aging can significantly affect the properties of asphalt binders and mixtures, causing an increase in stiffness, reduction in relaxation capability, and increase in brittleness. it was important to have an understanding of how the cracking resistance of a mixture will change over time when materials are selected and mix designs are performed. The primary objective of this project was to evaluate how the properties of typical NHDOT binders and mixtures change with different aging levels in order to capture the associated long-term

What was done?

Eleven NHDOT mixtures were evaluated using different laboratory conditioning protocols to determine how the properties of asphalt binders and mixtures, including rheological properties, fatigue, and fracture behavior, will change over time.

In order to capture the long-term performance of mixtures and binders and to simulate the physical and chemical changes of asphalt material in the field, appropriate laboratory aging conditioning methods are needed. Three long-term aging protocols were included and evaluated in this study.

Disk-shaped Compact Tension (DCT) Test

Direct Tension Cyclic Fatigue

By employing the various performance indices of asphalt mixtures and binders measured from the tests, the aging and cracking susceptibility of the mixtures and binders were quantitatively evaluated and investigated.

What did we learn?

The results show that the two virgin binders (extracted from two virgin mixtures), generally show the good cracking performance after each aging condition. The binders and mixtures with the softer grade and the largest difference between performance grade (PG) high and low temperatures typically have good cracking performance originally, however, exhibit higher aging susceptibility as compared to other materials.

		Mixture Performance Indices						Binder Rheological Parameters				Shape Parameters of Mixture Mastercurves			
		$G\text{-}R_m$	G_f SCB	FI	G_f DCT	FST	D^R	PGLT	ΔTc	R	G-R	γ	-β/γ	a	c
Mixture Performance Indices	$G\text{-}R_m$	1.000													
	G_f SCB	-0.141	1.000												
	FI	-0.720	0.227	1.000											
	G_f DCT	0.527	0.194	-0.618	1.000										
	FST	-0.530	0.301	0.851	-0.172	1.000									
	D^R	-0.523	-0.216	0.495	-0.582	0.211	1.000								
Binder Rheological Parameters	PGLT	0.727	-0.381	-0.712	0.178	-0.754	-0.012	1.000							
	ΔTc	-0.755	0.494	0.675	-0.222	0.687	-0.082	-0.916	1.000						
	R	0.663	-0.090	-0.530	0.670	-0.316	-0.419	0.561	-0.628	1.000					
	G-R	0.626	-0.323	-0.493	0.124	-0.551	0.052	0.904	-0.839	0.622	1.000				
Shape Parameters of Mixture Mastercurves	γ	0.725	-0.263	-0.664	0.631	-0.409	-0.388	0.507	-0.572	0.693	0.469	1.000			
	-β/γ	-0.661	0.387	0.554	-0.463	0.341	0.258	-0.482	0.563	-0.554	-0.409	-0.903	1.000		
	a	-0.723	0.078	0.587	-0.655	0.285	0.528	-0.560	0.620	-0.802	-0.622	-0.842	0.712	1.000	
	c	-0.723	0.297	0.635	-0.566	0.414	0.272	-0.566	0.674	-0.733	-0.527	-0.916	0.894	0.781	1.000

Comparisons and Correlations between the Mixture Performance Indices and Binder Rheological Parameters

How can we use it?

By incorporating the impact of aging, guidance was developed for NHDOT to quantitatively evaluate the aging and cracking susceptibility of asphalt binders and mixtures during material selection and mixture design.