NCHRP NATIONAL COOPERATIVE HIGHWAY RESEARCH PROGRAM

Framework for Balanced Mix Design
NCHRP 20-07/Task 406

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Objectives

- Develop a framework that addresses alternate approaches to devise and implement BMD procedures incorporating performance testing and criteria.

- The framework shall be in the format of an AASHTO recommended practice and will provide DOTs with options on which performance tests to use and how the tests can be used in the overall mix design framework.

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Tasks

No.	Description	Status
1	Survey DOTs and industry to determine status of BMD practices	✓
2	Literature review on asphalt mix performance testing	✓
3	Daft AASHTO format recommended practice for BMD	✓
4	Develop Research Problem Statements to address gaps	✓
5	Prepare final report	In progress

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Identifying Gaps – Example: Thermal Cracking Tests

Steps	Low-temperature SCB	DCT	I-FIT	IDT Creep and Strength	TSRST and UTSST	BBR Mixture
Selected at the NCHRP 9-57 Workshop	Yes	Yes	Yes	No	No	No
BMD Survey Responses*	40	28	2	17	14	1
1. Develop draft test method and prototype equipment	(1)	(8)	(16, 17, 18)	(25, 26)	(32, 33)	(38, 39)
2. Laboratory sensitivity to materials and relationship to other lab properties	(1, 2, 3, 4)	(9, 10, 11, 12, 13)	(13, 16, 19)	(27, 28, 29, 30)	(32, 34)	(39)
3. Establish preliminary field performance relationship	(3)	(3)	(15)	(3, 25, 26)	(32, 34, 35)	(38, 40)
4. Conduct ruggedness experiment to refine its critical aspects	(5)	(5)	(5, 20)	(31)		(40)
5. Develop commercial equipment specification and pooled fund purchasing	(6, 7)	(6)	(7, 21, 22)		(36, 37)	(41, 42, 43, 44)
6. Conduct round-robin testing to establish precision and bias information		(14)	(23)	(31)		
7. Conduct robust validation of the test to set criteria for specifications	(3)	(3, 15)	(15)	(3, 15)		
8. Conduct training		(14)	(24)			
9. Implement into engineering practice		IA, MN, MO	IL			

Green = completed
Yellow = partially complete
Blue = ongoing work
White = not addressed

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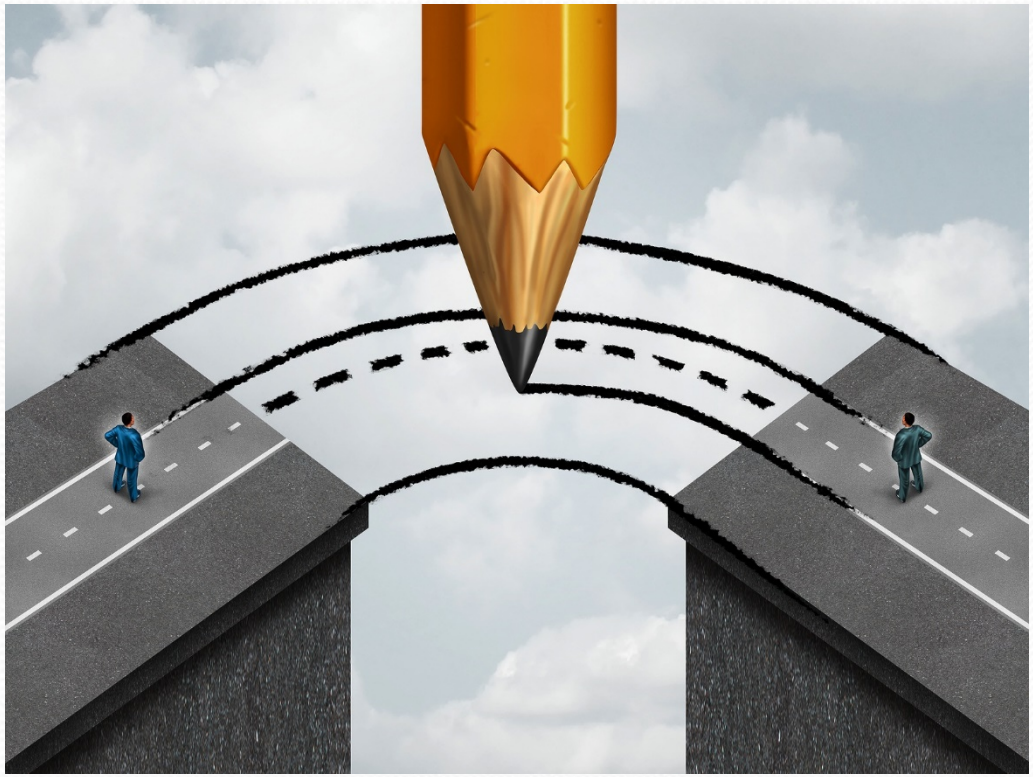
Bridging the Gap(s)



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RPS Example: Fatigue Test Validation

Title	Validation of Laboratory Tests for Fatigue Cracking
Background / Description	Fatigue cracking is a common form of distress caused by accumulated damage from high tensile strains that occur at the bottom of an asphalt pavement. Fatigue cracking is a costly distress to remedy because the damage occurs deep in the pavement structure. Consequently, highway agencies frequently are unable to feasibly address the problem and utilize rehabilitation methods that only temporarily cover the distress, leading to reduced service lives.
Objective	To establish relationships between candidate laboratory fatigue test results and measured fatigue cracking of actual pavements so that specification criteria can be established for the lab test(s).
Potential Benefits	Validated cracking tests and criteria for use in mix design and quality assurance will result in longer-lasting, better performing pavements by ensuring that appropriate mixtures are used in asphalt pavement construction. The use of mixture performance tests will enable mix designers to be more innovative in the selection and proportioning of materials to meet the test criteria. The experiment will also be useful for validating mechanistic-based pavement design programs (e.g. MEPDG, Flexpave, PerRoad)
Related Research	Pending NCHRP 09 - 57A is intended to establish precision statistics for selected mixture performance tests. Ongoing NCAT Cracking Group experiment is designed to validate top-down cracking. Ongoing MnROAD Cracking Group experiment is designed to validate thermal cracking. Ongoing MnROAD NRRA experiment is designed to validate reflection cracking.
Tasks	Design experiment: multiple sites, 5 to 10 test sections per site Design pavement structures and mixtures for each site Instrument and construct test sections to high level of control Sample mixtures and conduct mixture performance tests (specifically fatigue tests) Monitor and collect traffic data, environmental data, response data, and surface performance Analyze and summarize results, establish correlations, make recommendations for appropriate criteria for use in specifications.
Implementation	Target audience: asphalt producers and contractors, highway agencies, consulting engineers, and researchers that are interested in performance-based asphalt mixture design and the state of the practice for balance mix design.

Suggested Research Needs Statement from NCHRP Project 20-07, Task 406 Development of a Framework for Balanced Asphalt Mixture Design

	Products: Tests and specification criteria for use in mix design and quality assurance. Likelihood of success: high potential for implementation especially on paving projects with large production volumes and design-build projects. Barriers: Cost of the experiment.
Relevance	The industry needs a timely, repeatable, performance tests to assess mixtures for resistance to bottom-up fatigue cracking. Without a validated performance-based test, we will not be able to improve performance of pavements or utilize innovative mix designs.
Estimated Funding	$ 5 million per site on a controlled facility such as MnROAD or NCAT Test Track. The disadvantage of using a regular highway project is that the test sections must be allowed to "fail" to generate the needed data. Failed pavement sections are a liability on public highways.
Estimated Research Period	48 -60 Months
RNS Developer	NCAT staff
Source Info:	• NCHRP 09-57A [RFP]. Field validation of laboratory tests to assess cracking resistance of asphalt mixtures. http://apps.trb.org/cmsfeed/TRBNetProjectDisplay.asp?ProjectID=447, accessed on January 19, 2018. • Ma, W., N. H. Tran, A. Taylor, J. R. Willis, and M. Robbins (2015), Comparison of Laboratory Cracking Test Results and Field Performance, Association of Asphalt Paving Technologists, 2015. • Zhou F., Im S., Hu S., Newcomb D., & Scullion T., Selection and preliminary evaluation of laboratory cracking tests for routine asphalt mix designs. Road Materials and Pavement Design. Volume 18, 2017 - Issue sup1. • Pfeifer, B. 2018. Illinois Department of Transportation's Practices for Balanced Mix Design. TRB Workshop 124, Balanced Asphalt Mixture Design: Implementation Efforts and Success Stories. • Bennert T., Haas E., and Wass E., Round Robin Testing Program for the Overlay Tester, NJDOT B-10. Center for Advanced Infrastructure and Transportation (CAIT) Rutgers, the State University of New Jersey. December 2017.
Date Developed:	Feb. 2018

Suggested Research Needs Statement from NCHRP Project 20-07, Task 406 Development of a Framework for Balanced Asphalt Mixture Design