Pavement & Materials Partnering Committee
Work Product Scoping Document
New
Replacing the R-Value Testing for Unbound Materials with an Alternate Test Method
April 2, 2021

Task Group

Concrete Task Group

Problem Process

☒ Annual

☐ Expedited

☐ Emerging Initiative

Title

Replacing the R-Value Testing for Unbound Materials with an Alternate Test Method

Statement of Effort/Improvement

The California Department of Transportation (Caltrans) has been practicing R-value testing for the strength characterization of unbound materials and used R-value in pavement design to specify quality of unbound materials for pavement bases, subbase, subgrade, and backfill materials. The pavement design method has been changed to Mechanistic-Empirical (ME) pavement design and uses resilient modulus (M_r) as a design input parameter. The existing specifications specify materials strengths in R-values which utilize kneading compactor for the preparation of test specimens in the laboratory. The availability of kneading compactor and associated equipment and skilled laboratory technicians needed to perform the testing has been declining due to high cost of equipment, maintenance, and calibration.

The alternate testing method will provide a new strength parameter for pavement materials characterization and align specifications with the modified pavement design for unbound and backfill materials. The use of a new materials strength parameter will reduce anomalies arising from the use of correlated materials strength information. The direct input of materials test results into the pavement design for unbound and backfill materials will increase confidence, economical design, and construction quality.

Purpose

Provide a recommendation for an alternative strength testing method in lieu of R-value testing method for unbound bases, subbases, subgrade, and backfill materials to use in Caltrans projects.

Background

In the past, Caltrans used R-value to characterize strength of bases and unbound subgrade as well as backfill materials. The old Caltrans flexible pavement design was based on the unbound materials R-value and materials strength has been defined in terms of R-value in specifications. Moreover, the unbound materials specifications and pavement design requirements were aligned. Later, Caltrans moved from R-value

based pavement design to ME pavement design which utilizes resilient modulus (M_r) in lieu of R-value. However, the materials specifications were unchanged, and R-value has been used to define quality of materials, and alternatively M_r is determined through a correlation with R-value. The M_r determined through the correlations are inconsistent and often creates dispute depending on the correlation equations used.

R-value testing uses the kneading compactor which was previously used for asphalt concrete materials testing. The testing of asphalt concrete materials testing has moved from a kneading compactor to a gyratory compactor. This transition has reduced the utilization of kneading compactors and thereby serviceability and availability of equipment and skilled laboratory technicians.

ASTM or AASHTO test methods could be used to determine M_r, unconfined compressive strength (UCS), shear strength or other relevant unbound materials strengths in accredited laboratories. The use of new materials strength parameter will align current pavement design and materials specifications and may improve level of input parameters for pavement design. This change can also better select quality materials for embankment fills or structure backfills.

Approach

1. Street Ready Assurance

   Upon review of existing national standard test methods and other DOT specifications, street ready test method and specification language will be prepared.

2. Performance Tracking/Management

   Less efforts for performance tracking and management since established national standard test method will be adopted.

3. Consistently Implemented

   The Pavement Program in coordination with HQ Materials Engineering and Testing Services (METS) will implement this new test method. New specification languages will be developed, documented, and consistently monitored by METS.

   Statewide round robin testing will be conducted for a consistent and accurate implementation.

4. Pilot Projects (if anticipated)

   Not anticipated

5. Research Needs (if necessary)

Not necessary

Team Members

CT/Industry	Division/Firm Name	Member Name
CT Chair	HQ Pavements	Deepak Maskey
CT	HQ Pavements	Raghubar Shrestha
CT	HQ Materials Engineering and Testing Services (METS)	Biplab Bhattacharya
CT	HQ Construction Standards	Samir Ead
Industry Lead	Sully Miller Contracting	Don Vivant
Industry	Labelle Marvin	Tom Williams
Industry	G3 Quality	Jordan Roper
Industry	Bennett Engineering Services	Carlton Allen

Objectives/Deliverables/Due Dates

Description:

1. Review Replacing the existing R-value approach of strength measurement on unbound materials with a national standard testing method.
2. Review available national test methods to evaluate strength parameter for unbound materials e.g. ASTM, and AASHTO test methods including sampling, handling, fabrication, sample preparation, and testing.
3. Literature review on other State DOTs test methods and specifications.
4. Introduce an alternate test method and develop specification languages.
5. Recommend amending existing highway design manual (HDM), standard specifications, and other relevant guides, as needed.

Details:

Milestones	Name - Responsible Party	Due Date (Start/Complete)
1. Review of ASTM, and AASHTO test methods	Raghubar – Caltrans Lead Don Vivant – Industry Lead Caltrans Team Members and Industry Team Members	May 01, 2021 / Oct 31, 2021
2. Literature review on other State DOTs specifications	Raghubar – Caltrans Lead Don Vivant – Industry Lead Caltrans Team Members and Industry Team Members	May 01, 2021 / Oct 31, 2021
3. Test method selection, draft test method, and specification languages	Raghubar – Caltrans Lead Don Vivant – Industry Lead Caltrans Team Members and Industry Team Members	Nov 01, 2021 / Jan 31, 2022
4. Deliver a final test method and specifications	Raghubar – Caltrans Lead Don Vivant – Industry Lead Caltrans Team Members and Industry Team Members	Feb 01, 2022 / May 31, 2022
5. Prepared lists of potentially impacted by these changes into HDM, specifications, and other guides	Raghubar – Caltrans Lead Don Vivant – Industry Lead Caltrans Team Members and Industry Team Members	Jun 01, 2022 / Oct 31, 2022

Resources To Develop and Implement

	Caltrans Hours in FY 21/22/23	Industry Hours FY 21/22/23
Review of ASTM, and AASHTO test methods	100	100
Review other State DOT specifications	80	80
Test method selection, draft test	60	60

	Caltrans Hours in FY 21/22/23	**Industry Hours FY 21/22/23**
method, and specification languages		
Deliver a final test method and specifications	20	20
Prepared lists of potentially impacted by these changes into HDM, specifications, and other guides	50	50

Benefits

- Test method will be consistent and comparable to national standard.
- More reasonable strength parameter of materials will be achieved.
- Simplifies testing method and increase testing efficiency.
- Expected to reduce laboratory testing time and quick turnaround time.
- Reduce cost of equipment and testing.
- Widespread availability of testing facilities and certified testers.
- Current obsolete equipment will be replaced by modern equipment and simplifies equipment calibration.

Estimated Impact to Caltrans and Contractor

- Change in Caltrans Test Method and Standard Specifications.
- Amendment to HDM and other guides.
- May need an additional cost for laboratory equipment and technician training.
- More certified testers will be available to run Mr test rather than for R-value test in the past.
- Smooth and efficient project construction.
- Reduce test results turnover time.
- Benefit of implementing new test method outweighs all initial expenses from this change.

Impediments to Completion of Deliverables

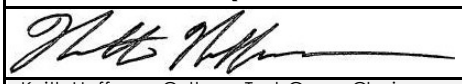
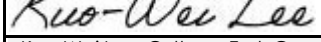
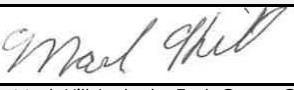
- Lack of understanding, coordination, and contribution of the task group members.
- Lack of resources e.g. skilled person and/or materials.
- Lack of support by managers, functional units, and staffs.

Recommendation and Approval

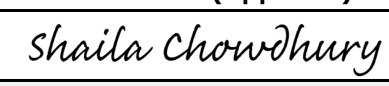
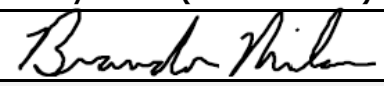
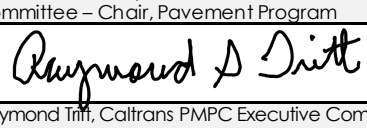
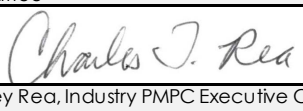
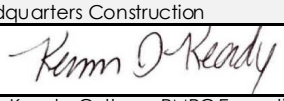
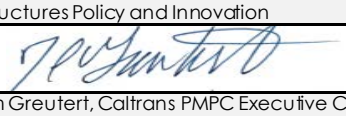
This scoping document for Replacing the R-value testing for unbound materials was prepared by *Pavement Foundation Sub Task Group* to address a priority issue with statewide significance and is within the Pavement & Materials Partnering Committee mission as described in the Pavement & Materials Partnering Committee Charter. The Subtask Group members have determined the scope, resources required and timeline for delivery of this project to attempt to ensure that the deliverables are achievable. A signature here indicates that each Task Group and PMPC Executive Committee is committed to providing the resources to support this effort within the prescribed timeframes. Furthermore, it is everyone's responsibility to ensure that the final effort/improvement will be:

1) Street-Ready,
2) Monitored and reported for performance,
3) Successfully implemented statewide as appropriate.

Scoping Document Recommendation and Industry Concurrence by (name and date):

Caltrans Name (Recommendation)	Date	Industry Name (Concurrence)	Date
	04/14/2021		04/14/2021
Keith Hoffman, Caltrans Task Group Chair		George Butorovich, Industry Task Group Lead	
	04/21/2021		04/20/2021
Kuo-Wei Lee, Caltrans Task Group Member		Mark Hill, Industry Task Group Co-Member	
	04/22/2021		
Ken Solak, Caltrans Task Group Member		Chu Wei, FHWA	

Scoping Document Approval and Industry Concurrence by (name and date):

Caltrans Name (Approval)	Date	Industry Name (Concurrence)	Date
	04/30/2021		04/22/2021
Shaila Chowdhury, Caltrans PMPC Executive Committee – Chair, Pavement Program		Brandon Milar, Industry PMPC Executive Committee	
	04/23/2021		04/22/2021
Raymond Tritt, Caltrans PMPC Executive Committee Headquarters Construction		Charley Rea, Industry PMPC Executive Committee	
	04/23/2021		
Kevin Keady, Caltrans PMPC Executive Committee Structures Policy and Innovation			
	05/06/2021		
Tim Greutert, Caltrans PMPC Executive Committee Materials Engineering and Testing Services			

Approval Date: 05/06/2021