

Pavement & Materials Partnering Committee
Work Product Scoping Document
New
CT 523 Method of Test for Flexural Strength of Concrete
04/18/2019

Task Group

Concrete

Title

Update CA Test 523 - Flexural Strength of Concrete

Problem Process

- Annual
 Expedited
 Emerging Initiative

Statement of Effort/Improvement

The use of American Society for Testing and Materials (ASTM) standards for determining concrete flexural strengths will become the standard test methods for materials acceptance. To accommodate this change, a revision of California Test (CT) 523 is necessary so that the test method can incorporate equivalent ASTM standards in making, curing, and testing concrete beam specimens for quality assurance tests in concrete pavement projects.

Purpose

In compliance with METS/GS Directive-05, this modification will ensure that testing is done to the equivalent ASTM standards with any necessary modifications to the standard specifications. It will also align flexural strength testing practices with current industry practice outside of Caltrans work. This CT revision also allows potential alignment with the Joint Training & Certification Program (JTCP).

Background

Previous Efforts:

The former Rock products Committee (RPC) undertook an effort by a joint work group between Cast-In-Place and Materials/Quality Assurance Sub-Task Groups for implementing ASTM standards in lieu of CT Methods for determining concrete flexural strength for both traffic opening decisions and acceptance of concrete pavement (See Appendix A). However, it was decided to investigate the validity of the current strength criteria, established based on CT Methods, under the investigation through a task order (See Appendix B). Findings and recommendations from the task order are listed below:

- In most cases, the average 28-day strength determined by CT 523 yielded higher values than the ASTM method. However, it was found that the average flexural strength values from the two test methods were statically equal in about half of the cases (44% or 8 of 18 cases).

- Overall, no statistical difference was found in 28-day flexural strength values from specimens cured with ASTM C 31 standard cure or field cure. It was noted, however, that the ambient temperatures under the field and standard curing conditions were not much different.
- Consolidation methods (rodding or internal vibration) have minimal to no impact on 28-day flexural strength values when properly executed.
- Keep the current flexural strength criteria when adopting ASTM C31/C78 methods.
- Use ASTM C31 Field Cure Method for traffic opening strength testing.
- Use ASTM C31 Standard Cure Method for acceptance testing.

Caltrans stakeholders (METS, Construction, and Office of Concrete Pavement-OCP) had a meeting to share the task order results and discuss plans for implementing the ASTM standards. Below is a summary of meeting outcomes.

- It was found that current Caltrans Independent Assurance (IA) practice wouldn't allow the use of ASTM standards as the acceptance method in the specification because Caltrans does not certify with ASTM test methods at this moment.
- To align the acceptance test method with IA requirements and practices, it was deemed best to implement the change through a revision to CT 523.
- OCP and METS held an additional meeting to determine the required process and timeline for revising CT 523 to specify its ASTM equivalent.

Comparison between CT 523 and ASTM C31/C78

CT 523 provides descriptions of all test procedures including sampling, making and curing beam specimens in addition to the procedures for testing. On the contrary, ASTM C78 describes testing procedures only, and the practices for sampling, making and curing beam specimens are specified under ASTM C31. Testing procedures under CT 523 are not significantly different from those under ASTM C78 and are considered technically equivalent. There are a few differences in procedures for sampling, making and curing beam specimens listed below:

- Sampling Fresh Concrete
 - Sampling procedures under CT 523 and ASTM C31 are equivalent to each other.
- Consolidation of test specimens
 - CT 523 allows rodding method only.
 - ASTM C31 requires different consolidation methods depending on concrete slump value. Either rodding or vibration is allowed for concrete having 1 in. or higher slump. For dense concrete with less than 1 in. slump, use of internal vibrator is required.
- Curing Practice

- ASTM C31 specifies two allowable curing practices: 1) standard curing for acceptance testing, and 2) field curing for opening age strength testing.
- See the table below for comparisons of curing practices between ASTM C31 and CT 523.

ASTM C31	CT 523
<p>1. Standard Curing</p> <ul style="list-style-type: none"> - Apply to acceptance testing - Initial curing for up to 48 hrs. (under 60 to 80 F and preventing moisture loss) - Moisture control during initial curing: 1) put molded beams into lime water with plastic lid, 2) use of wooden box, 3) place in damp sand pits, 4) cover with plastic lids, 5) plastic bags, 6) cover with plastic sheets and damp burlap. - Demold after the initial curing. - Within 30 min. after demolding, place the beams in lime water (73.5 ± 3.5 F) at least 20 hrs. prior to testing. <p>2. Field Curing</p> <ul style="list-style-type: none"> - Apply to opening age strength testing - Cure beams in the same manner as pavement. - After the initial curing, move the molded beams to final curing location, and demold. - Place the beams on ground with top surfaces up. - Bank the sides and ends of beams with damp earth or sand. - Apply the same curing medium on the top surface. - Remove the beams and store them in lime water (73.5 ± 3.5 F) for 24 ± 4 hrs. immediately before testing. 	<ul style="list-style-type: none"> - Place earth or sand around the sides and ends of the molds. - Apply the same curing medium on the top surface. - Remove side molds after 24 hrs., and transport the beam resting on its base plate to curing location. - Remove base plate and bury the beams in damp earth or sand with at least 4 in. cover. - Place test beams in a lime water (73 ± 9 F) 24 ± 6 hrs. before testing.

- Precision and Bias
 - CT 523: single operator precision 16%, multi-lab precision 19%, no bias statement
 - ASTM C78: single operator precision 104 psi (18.2% for 570 psi), multi-lab precision 19.3%, no bias statement

Approach

1. Street Ready Assurance

Notify stakeholders (construction, industry, testing labs/technicians, etc.) of upcoming change. Allow time for review and comments so any concerns can be addressed. Update existing specifications and manuals to align with this test method change

2. Performance Tracking/Management

Monitor any tracked test result data on DIME for correlation. Recommend monitoring number of claims associated with this test method, historically and for next 2-4 years after implementation. Begin semi-annually, consider annually if quantity of data points insufficient.

3. Consistently Implemented

Update specifications and manuals to ensure language aligns with requirements of ASTM C31/C78.

4. Pilot Projects (if anticipated)

Not anticipated, see Item 2. Performance Tracking/Management.

5. Research Needs (if necessary)

Completed

Team Members (Indicate CT Chair and Industry Lead)

CT/Industry	Division/Firm Name	Member Name
Caltrans	Materials Engineering and Testing Services	Jacquelyn Wong
Caltrans	Office of Concrete Pavement	David Lim
Caltrans	Office of Construction Standards	Samir Ead
Caltrans	Materials Engineering and Testing Services	Patrick Lo
Industry	CNCA	Nathan Forrest

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Industry	SWCPA	Bruce Carter
Industry	G3 Quality	Marc Robert
Industry	National Ready Mix	Subhada Gadker

Team should not include any more than 4 Caltrans staff and 4 members from Industry. See PMPC Standard Operating Procedures for more information.

Objectives/Deliverables/Due Dates

Description: CT 523 is referenced in sections 40 and 41 in the Standard Specifications for quality assurance in cast-in-place concrete pavement projects. The proposed revision is to perform CT 523 in accordance with the equivalent ASTM standards listed below.

ASTM C31-17: Standard Practice for Making and Curing Concrete Test Specimens in the Field

ASTM C78-18: Standard Test Method for Flexural Strength of Concrete (Using Simple Beam with third-Point Loading)

Milestones	Name - Responsible Party	Due Date (Start/Complete)
Draft Revised CTM	Jacquelyn Wong – CTM Owner	Complete: 6/1/19
Stakeholder Reviews and Comment Resolution (two circulations, 2-week review period each)	Jacquelyn Wong and See Stakeholder List – CTM Owner and See Stakeholder List	Start 1 st Circulation 06/01/19. Stakeholders comments due 06/15/19. Start 2 nd circulation 06/21/19. Stakeholder comments due 07/05/19.

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Specification revisions, as necessary, to include provisions for site curing conditions (all concurrences complete to Office of Construction Contracting Standards by 7/19/19 posting for October incorporation)	David Lim	Complete: 07/05/19
Provide Signed Sealed Memo to METS Executive Committee (EC)	Jacquelyn Wong – CTM Owner	Complete: 08/01/19
CTM Revision Approved	Keith Hoffman and Timothy Greutert – METS EC	Complete: 08/15/19
CTM Revision Approved	Daniel Speer – State Materials Engineer (SME)	Complete: 09/01/19
Review CTM, Notify Stakeholders of Final CT	Jennifer Moore – CTM Coordinator	Complete: 09/15/19
Post CTM to website (date may adjust to coincide with RSS posting)	Jennifer Moore – CTM Coordinator	Complete: 09/30/19

List of Stakeholders

Title	Name
Statewide Independent Assurance (IA) Coordinator	Veera Nanugonda
Joint Training and Certification (JTCP) Manager	Jeremy Peterson-Self
Data Interchange for Materials Engineering (DIME) Coordinator	Brett Soldano
Construction Standards	Blair Anderson
Office of Concrete Pavement	Kuo-Wei Lee
Industry Stakeholder (Representative)	Mark Hill
District Materials Engineers	Multiple

Resources to Develop and Implement

	Caltrans Hours	Industry Hours
Draft Revised CTM	30	0
Stakeholder Reviews and Comment Resolution (two circulations, 2-week review period each)	100	100
Provide Signed Sealed Memo to METS EC	20	0
Approval of CTM Revision	30	0
Review CTM, Notify Stakeholders, Post to Website	20	0

Benefits

This modification will bring more consistency to how beams for flexural strength are sampled, consolidated and cured for purposes of determining flexural strength of concrete. This revision also helps relieve any confusion with which standard since two methods currently exist (CT 523 and C31/C78) by aligning the CT standard with the national standard. It is the belief of both Industry and Caltrans that ASTM C31 and C78 better minimize variables in curing, fabrication and storage of testing specimens which should result in fewer claims due to inconsistent or uncharacteristic flexural beam fabrication and testing. This revision also enables Caltrans IA to evaluate the use of external certification programs that may potentially fulfill Caltrans' responsibility for Quality Assurance as set forth in the Code of Federal Regulations, making it possible to integrate IA and external certification programs for a more efficient use of resources to certify and become certified in these material testing procedures.

Estimated Impact to Caltrans and Contractor -

This will impact construction personnel who perform the test on a regular basis including both Caltrans and Industry staff. Minor adjustments to concrete pavement specifications are likely needed to maintain consistency between housing procedures in the test method and requirements for acceptance in the specifications. The Construction Manual will need revisions to align with this test method change.

This change may incur minor equipment costs due to a new requirement to use vibrators for concrete with a slump of less than 1” which accounts for an insignificant amount of typical concrete pavement mixes. Specification revisions to be added to address initial curing requirements on jobsite.

Impediments to Completion of Deliverables

Potential impediments include other related committee activities that take precedent over this effort (e.g. stakeholders involved in other ongoing working groups or committee responsibilities, other or shifting workload priorities). Stakeholder engagement could delay timely completion of deliverables (e.g. late or no response, misunderstanding of purpose to revise test method, or comments out of the scope of this revision). Revision language must be kept simple and consistent as possible to avoid any confusion in following this new test method.

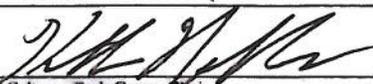
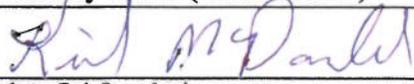
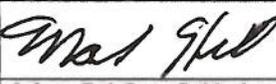
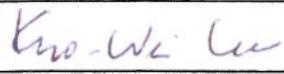
Recommendation and Approval

This scoping document for *CT 523 Method of Test for Flexural Strength of Concrete* was prepared by *the Concrete 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:

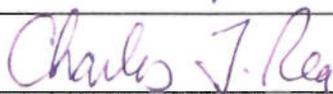
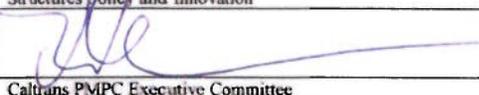
- 1) Street-Ready,
- 2) Monitored and reported for performance,
- 3) Successfully implemented statewide as appropriate.

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

Caltrans Name (Recommendation)	Date	Industry Name (Concurrence)	Date
 Caltrans Task Group Chair	3/13/19	 Industry Task Group Lead	3-13-19
 Caltrans Task Group Member	3/19/19	 Industry Task Group Co-Member	3-13-19
 Caltrans Task Group Member	3/19/19		

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

Caltrans Name (Approval)	Date	Industry Name (Concurrence)	Date
 Caltrans PMPC Executive Committee - Chair Pavement Program	4/18/19	 Industry PMPC Executive Committee	04/18/19
 Caltrans PMPC Executive Committee Headquarters Construction	4/18/19	 Industry PMPC Executive Committee	4/18/19
 Caltrans PMPC Executive Committee Structures Policy and Innovation	4/18/19		
 Caltrans PMPC Executive Committee Materials Engineering and Testing Services	4/18/19		

Approval Date: _____