

**TPF-5(368) PERFORMANCE ENGINEERED CONCRETE PAVING MIXTURES (PEM)
WESTERN REGION STATE-INDUSTRY PEM CALL**

January 5, 2021
Meeting Minutes

Attendees:

Name	Organization	Name	Organization
Peter Taylor	CP Tech Center	David Lim	CalTrans
Gordon Smith	CP Tech Center	Craig Wielenga	Idaho DOT
Jerod Gross	Snyder & Associates, Inc.	Jim Powell	Northwest Chapter ACPA
Mike Praul	FHWA	Charles Stuart	Southwest Concrete Pavement Association
Bob Conway	FHWA		
Tom Van Dam	NCE		
Cecil Jones	Diversified Engr Services		
Jason Weiss	Oregon State University		

Discussion items:

- 1. Has your state agency recently implemented any new tests to your concrete program or are you planning to implement any in the near future?**

California: Just started shadow testing with 4 tests, SAM, Box, V-Kelly & surface resistivity. Finished shadow testing program in July. Preparing report to FHWA. Planning is underway but no implementation yet. Training in late 2019 and workshop was productive for the shadow testing and received good feedback. There was some trial and error on the testing procedures. More effort is needed for training and certification of testers.

Industry – It is good to have new tools, sees as research tools at this point. There is a need for ACI type certification and training. Need to be more widely accepted and better knowledge. Some of the new PEM tests could be used in contractor’s QC program. This would require a different approach by working with the contractors. Implementation is a ways off in California. Need support and guidance for opportunities to move forward. Contractor success stories can help move this forward.

Jerod – California is moving ahead well with just starting a little over a year ago. We are looking forward to the data and how to help move this forward.

Idaho: SAM training in 2019 and shadow testing. Looking to expand and for additional SAM training in districts. Have completed some resistivity testing and working with Turner-Fairbanks to review results. Using the Proceq for the resistivity testing. Talking about doing the bucket test hopefully in 2021. Had paving project utilizing tarantula curve and accepted a mix with lower cement content. Seeing bridge deck cracking. CP Tech can look at mix designs that have shrinkage crack history.

Industry – Contractor is using the Box test and looking at the tarantula curve. Some requirements may be conflicting with construction scheduling requirements. Oregon has some mixes with high SCM contents, but short construction windows. Montana had some issues with bridge deck cracking related to high percentages of microsilica. FHWA was involved in the review of some projects. Montana

worked with Wiss, Janney, Elstner Associates to work with them on a spec change and proposed a temperature management approach to curing in lieu of moisture management approach to curing. Other issues were found related to mix design, transport of the mix, quality control as well as silica curing. This was presented at the Denver NCC meeting by MT DOT.

Jason Weiss – If paste content is too low, you can get permeability issues (<24%). IF mixtures are optimized and have both low paste and high early strength. Jason can share more information on this.

2. Do you currently leverage QC in your specification? In other words, do you require QC and does the state do any monitoring of QC? This question is NOT asking if you use contractor data for acceptance.

California: They do require QC planning and monitoring for aggregate gradations, air content, penetration and unit weight. If something happens it is required for the contractor to correct. Contractor QC data sometimes used for acceptance (rapid strength) using 10 day strength tests.

Industry – QC plan is required by specification. Plan could be improved for example control charts. Suspension limits and action limits are in the specification but some items are not clearly defined. . There is a need for contractor training with respect to how to use and monitor control charts in real time. There is a need to incentivize quality control through the specifications and let the contractor develop the tools and implement the plan. There is an open mind towards using incentives including incentives for smoothness and allowing use of HIPERPAV for monitoring.

FHWA – The cooperative agreement is developing a QC tool to raise awareness for contractor and owner. A template in the appendix provides good, fair and poor language for QC. This is a comprehensive document being reviewed by an expert TAC.

Industry – Reviewers of QC plans need this QC tool for guidance. Contractors and agencies need QC guidance and training.

Idaho: Require QC for class 30 or less concrete (air, slump, strength). Looking to add QC plan requirement in specification.

Industry – haven't seen much for requirements of QC plans. Noted need for improvement. Training will help contractor and agency.

3. Have you engaged your agency construction staff in a PEM discussion/planning? If so, what are the details?

California: At this time, no but provide status updates on a regular basis. Have a committee including industry for spec related discussions and update them on the PEM effort. Probably will not involve construction staff until implementation.

Idaho: Some discussion centered around staffing for new tests.

Industry – It is important to get the construction staff involved. One example is a project that included a combined aggregate gradation. Field personnel was enforcing the spec with penalties because the

gradation was not complying with the specification. However, the software they were using was not capable for dealing with four aggregate stockpiles.

- 4. Have you made, or will you be making, spec changes to transition from prescriptive requirements to a performance approach? Some examples of this are:**
 - a. Eliminating slump testing for acceptance**
 - b. Eliminating minimum cementitious content requirements**
 - c. Eliminating single aggregate gradation requirements**

California: Current spec is mix of prescriptive and performance based. Do not have a mix design requirement; it is up to the contractor. Spec requires specific properties. Trying to move to the performance based spec. Twice a year they revise spec. They require 505-675 pcy of cement for paving.

Idaho: They are considering eliminating slump testing (this is more of a QC test). No gradation changes yet. Cementitious content has been lowered for bridge deck overlays with silica fume and considering a max content. Spec does allow paving mixes with cement content below the minimum specified value when using a combined aggregate gradation. Washington state can be used as an example for eliminating slump test. Idaho currently has a minimum cement content of 660 pcy. In the mid 90's Maine had set the max amount of 660 pcy for structures while at the same time, New Hampshire had a minimum of 658 pcy. New Hampshire then adjusted their spec to benefit industry.

- 5. Which statements describe your agency's approach to PEM:**
 - a. We are satisfied with the status quo and do not envision making significant changes.**
 - b. We will be keeping our program as is but planning to add a new test or two.**
 - c. We are enhancing our spec approach and adding QC requirements.**
 - d. We plan to develop robust QC requirements and include some level of agency monitoring of QC.**
 - e. We will be reducing/eliminating prescriptive requirements and moving to a performance approach.**

California: b and e

Idaho: b and would like to get to e. Next step is probably going to be c.

- 6. The current PEM initiative focuses heavily on the mix and mix design ("design the mix properly for its service environment"). Moving forward, do you see the next step towards performance specifications as an effort to develop ways to assess the impact of construction activities? (the ultimate goal is being able to test the concrete to be sure we "build the concrete to perform in its service environment.") Some examples include effect or pumping/transport, vibration, and real-time curing assessment.**

California: In shadow testing project they had materials group and consultants observe testing procedures and provided feedback. They see the value in PEM. They see some tests for QC in mix design. They see some correlation with mix results. Construction activities should be considered and is part of performance.

Peter – PEM is not a performance based specification but it is headed in that direction. Paste content is dependent on gradation. Recommending a lot of testing up front to reduce the amount of work needed in the field. Need to prove that the mixture delivered resembles the mixture in the mix design phase. Amount of testing of in-place pavements is limited.

FHWA – The amount of in-place concrete tests is limited. There are a number of research efforts underway in these areas. Should the effort be accelerated?

Industry – Stress the importance of curing and how to measure and provide guidance for managing curing. What is the best way to look at the concrete in place and understand if we will get performance? How do you get a value based on deficient smoothness or strength?

Idaho: A great mix may not perform if not placed correctly. Need to focus to educate inspectors for good placement and construction activities. Bridge decks – consider internal curing approach. Ohio research project is an example. IMCP Manual is a good resource also.

Industry – Construction specifications may need to be adjusted for PEM mixtures (for example vibration requirements may be too high for combined gradation mixes that have good workability).

Jason – concept of internal curing has been used a lot to get good performance. How to determine long-term freeze thaw performance, long-term properties.

Tom – other states have high cement contents (for example Nevada).

Homework questions:

What can the PEM Team do to assist you today in accomplishing your PEM vision?

Comments below are from the chat window of the meeting:

Weiss, William Jason

Do you happen to know your paste content or your water and cement contents

Weiss, William Jason

27% paste is generally where you start to see cracking develop

Weiss, William Jason

Just to aide in the notes - transport has a 'sweet spot' in terms of paste content. If the paste becomes to low transport can increase however if the paste becomes to high the transport increases.

Shrinkage decreases with decreasing paste content generally 5% decrease per 1% paste

Weiss, William Jason

SCMs use and rate of strength development depends a lot on particle size and reactivity. I would strongly suggest a bit of reactivity testing if this is a concern and we could help to optimize these blends.

ptaylor@iastate.edu

Agreed. The sweet spot is dependent on the aggregate gradation. Also. adding cement does not aid strength, early or otherwise...

Weiss, William Jason

Cement	w/c = 0.38	w/c = 0.42	w/c = 0.46
505	21%	22%	23%
525	22%	23%	24%
550	23%	24%	25%
575	24%	25%	27%
600	25%	26%	28%
625	26%	27%	29%
650	27%	28%	30%
675	28%	30%	31%

Paste Contents as a reference