

# TPF-5(368) PERFORMANCE ENGINEERED CONCRETE PAVING MIXTURES (PEM)

## TECHNICAL ADVISORY COMMITTEE MEETING

Minneapolis, Minnesota — November 18-19, 2019

**Monday, November 18; 1:00 PM**

FHWA			Associations				
✓	Ahlstrom	Gina	FHWA		Becker	John	ACPA-PA
✓	Ardani	Ahmad	FHWA		Burwell	Brent	OK/AR Chapter - ACPA
✓	Conway	Bob	FHWA	✓	Cuerdon	Bill	ACPA-New York State Chapter
✓	Matthew	Corrigan	FHWA	✓	Degraaf	Dan	Michigan Concrete Association
✓	McDaniel	Lisa	FHWA-Iowa	✓	Harris	Terry	GCP Applied Technologies
✓	Praul	Mike	FHWA	✓	Innis	Al	Slag Cement Association
<b>State DOT Reps</b>				✓	Lobo	Colin	NRMCA
	Baer	Patricia	Pennsylvania DOT	✓	McMullen	Kevin	Wisconsin Concrete Pavement Assoc
	Covay	Jeffrey	Arkansas DOT	✓	Mulder	Greg	Iowa Concrete Paving Association
	Dennis	Dan	New York State DOT		Obla	Karthik	NRMCA
✓	Hanson	Todd	Iowa DOT	✓	Tennis	Paul	Portland Cement Association
✓	Hayes	Chad	Wisconsin DOT	✓	Voigt	Jerry	American Concrete Pavement Assoc
✓	Hodges	Darin	South Dakota DOT	✓	Zeller	Matt	Concrete Paving Assoc. of Mn
	Hunter	Brian	North Carolina DOT	<b>Team</b>			
✓	Krstulovich	James	Illinois DOT	✓	Jones	Cecil	Diversified Engineering Services
✓	Lim	David	California DOT	✓	Ley	Tyler	Oklahoma State University
✓	Masten	Maria	Minnesota DOT		Van Dam	Tom	NCE
✓	Meggers	Dave	Kansas DOT	✓	Weiss	Jason	Oregon State University
	Mellons	Jason	Tennessee DOT	✓	Gross	Jerod	CP Tech/Snyder & Associates
	Miller	Dan	Ohio DOT	✓	Smith	Gordon	National CP Tech Center
✓	Prieve	Eric	Colorado DOT	✓	Taylor	Peter	National CP Tech Center
✓	Rob	Golish	Minnesota DOT	✓	Prochnow	Sharon	National CP Tech Center
	Romero	Matt	Oklahoma DOT				
✓	Staton	John	Michigan DOT				
✓	Waters	Jason	Georgia DOT				
✓	Wielenga	Craig	Idaho DOT				

### TPF Overview/Discussion

- The shared vision of FHWA, member agencies and industry was to define and implement a program to improve concrete mixtures. This pooled fund TAC meeting is an opportunity to discuss how the program is meeting that vision.
- FHWA incentive funding was requested by 9 states. Iowa and South Dakota are the only states with reports completed. Other projects are still in the process.
  - Shadow projects have been done; looking for pilot projects to be next step
  - New York did project with SAM for acceptance
- Additional incentive program offered by FHWA has not had any applicants.
- PEM Executive briefing has been offered, but no state has requested it.
  - At this point, the states involved have not needed to be persuaded, all levels have been supportive
  - HMA is pay for performance so the majority of executives are aware that PCC may follow that same route.

- Spec review
  - Spec review is being done on a one-one basis via a phone call (14 states completed). The 6 critical PEM components are discussed and a standardized report is prepared for each state. A spreadsheet is being assembled showing all of the state progress and will be on the website when completed.
  - Table 2 of PP84 can be used toward developing specific state specs
- PEM One Day Engineering Workshop
  - Involves technical information and discussions leading to an implementation roadmap specific for each state
  - Having QC managers at the workshops is helpful for the states.
  - Workshop and onsite field trip/demo together seems to be most successful.
- Training
  - Tyler Ley has been involved in training in a lot of states
  - Quite a few states have bought the SAM. New York, Wisconsin and Kansas are close to specifying for it.
  - Wisconsin: A local company has run parallel projects using SAM for 2 years. State could be specifying within a year or so; need to verify consistent results first.
- Monitoring
  - Tom Van Dam has a database. Need more information regarding mining the LTP database.
- Cooperative Agreement
  - Precision and Bias tests for appropriate PEM tests will be conducted in 2020/2021.
  - QC Guidance for PEM will be written in 2020
  - Model performance specs will be a later task
  - Training on areas other than PEM will also be part of contract
  - Ideas for training subject matter as well as ideas of mechanism should be shared with the Team (i.e., videos, YouTube, etc.)
- State level changes
  - Colorado, New York, Wisconsin have changed specs
  - Michigan has made lots of small changes which are hard to quantify as direct PEM function, but PEM has made a difference
  - Iowa indicated that more contractors need to be proficient before PEM can be used for acceptance
  - Team wants input on what states need to encourage implementation
  - States encouraged to set a milestone/goal
  - There is a significant potential to influence the market
- How many states are requiring a PEM test during the mix process?
  - Colorado, Iowa, Wisconsin, Michigan
- Who pays for training?
  - Oklahoma DOT contracts with OK State University to do the training, including certification
  - Pooled fund training should be for implementation
  - Long term program training and continued training of new hires is not part of PFS
  - FHWA trailer personnel does training now, and will add more training to the schedules. Contact Mike Praul for technical level training.
- PP84 guidance specification report
  - Cecil Jones reported there were no negatives in the balloting.
  - The team has addressed all the comments

- All the appendices have been removed, with references to them in the main document.
- Discussions with AASHTO sub-committee chairs are continuing
- The items that have gone through balloting will be published in April
- VKelly is provisional. Peter is working on a redesign on how it's run

## State Highway Agency Discussions

- **Colorado:** CO removed all the min and max cement content requirements. Slipform barrier wall or pavement must be run through box test in lab. Spec rewrite for every mix design must be lab evaluated. CO allows optimized gradations on everything – not required but allowed. Prescriptive on sulfate classes. Requires min 20% F ash. Class C can be used but has to show good results on oxychloride test. Paving requires SAM numbers in mix design, but not an acceptance test; they are being used for data collection. W/C ratio in field is acceptance test and has to match mix design. Colorado wants to see Tyler's numbers and compare it to others across the country.
- **California:** CA is starting a shadow test in Los Angeles and plans to do more shadow tests and then move forward. Recently had a PEM training session. Currently mix design requires shrinkage and air in freeze/thaw areas. More requirements from PP84 are being considered. Mix design is up to the contractor, CA only approves mix, doesn't prescribe it.
- **Iowa:** QMC mix has been in place for over 20 years. This has allowed contractors to lower cement content. Can see SAM being used for QC testing. Have seen some variability in resistivity testing based on porous limestone sources. Mix design using SAM and Box test.
- **Michigan:** Optimization of aggregates – developed special provisions, reduced cement, optimized gradation. Long life training projects - resistivity and SAM, brought Tyler in twice for training. AASTOWARE is big issue right now. Optimization software seems to have many variations.
- **Illinois:** Is at the exposure stage. Completed shadow testing on box test and resistivity. Still collecting data for the report for FHWA. Biggest issue has been staffing and program size. Bridge project has been identified that will incorporate SAM testing and resistivity. Lots of max and mins in Illinois specs.
- **Minnesota:** Two projects using PEM right now, one done this year, one will be done next year. Trial batch testing, V Kelly, Box, surface resistivity and maturity. Super trainer is a consultant who Tyler trained. Consultant has trained technicians – but more training is needed. Also using the Phoenix on projects – and feel it has been good, probably will spec it sooner than SAM.
- **Idaho:** Idaho had a shadow project this year. Aggregate gradation using tarantula curve was included in shadow testing. This allowed reduction of cement. Held field training for SAM in the spring and used it on the same project. Interested in more SAM training for other districts. Resistivity testing using AASHTO T368 - Need to learn more about it and get more up-to-date. Updating some specs., i.e. lower cement, taking out slump test.
- **Wisconsin:** Wisconsin had their own research project using PP84 on 8 different projects (4 times per day). Research team included Tyler and Jason. Extensive data from testing and looking to evaluate the mixes. Phase 2 will make the changes discovered in phase 1. Wisconsin has used SAM in shadow tests for two years and is on the cusp of actual numbers for acceptance in paving. In structures, SAM testing will be required during mix design and during construction, but just for data not for acceptance yet. There will be a 3% incentive on structures, but not mandatory. SAM will be moving into required for paving. Will look into resistivity.
- **Kansas:** Mix designs, optimization has been required for 10 years. Have performed surface resistivity testing for 5 years. Kansas is looking to develop a Kansas SAM number. SAM is critical – contractors would like to get rid of AVA. Checklist of 12 items for SAM being developed. Also looking at F factor.

- **Georgia:** Georgia is not implementing anything yet, it is still a prescriptive state. Hope to get started on something.
- **South Dakota:** Is planning a pilot project for mix design – SAM and box testing. Shadow testing has been done. Resistivity during shadow testing was completed without taking temperatures but was completed in the lab. Surface resistivity was not planned, but CP Tech trailer came to SD with buckets and added this as an additional test. SAM data needs some help – SD needs some help on how to interpret. Next season SD plans to do some shadow testing for other data. Need to look at all the data

**Tuesday, November 19, 8:00 a.m.**

**Industry comments/discussion**

- **Slag Cement Association:** Industry is moving faster than many realize. Concrete producers need to be buying SAMS (or hire a testing lab that has one) to get comfortable using them before agencies begin specifying for them.
  - Many DOTs are still not at spec stage; some have numbers they want, but if mix is not within range of acceptability, they don't know what needs to happen to correct it.
  - Wisconsin is ready for specs; SAM numbers: 2.0 is good, 2.5 is OK, 3.0 is rejected. Dispute resolution process needs to be determined.
  - Research team needs to develop a test method for contractors so they can develop a good mix in the lab, test it in the field, and know what adjustments to make when the SAM numbers are non-compliant.
  - A typical process could be: 1) Get a SAM and meet with industry and have a training class, 2) develop a certification program, 3) education (SAM #s) 4) what to do when the number is off, (add air, look at aggregates, etc)
  - Michigan Concrete Assoc. bought a couple SAMS for contractors to try. Experience of the user is critical for consistency in valid testing.
  - Question as to whether SAM should be a measure of process but not a critical path test.
  - ACPA is looking into whether to add a specific committee for PEM.
  - Buying equipment and training is going to cost industry money, so “why” needs to be clearly communicated.
  - FHWA: More work needs to be done before testing can be written into spec, and there will need to be lots of communication before it can be used for pay criteria. A robust QC plan would need to be implemented before performance pay measures could be established.
  - Goal for 5 years might be if half of the PFS states were implementing PEM; it could be 15 years before most of the states complete implementation. Goal should be for every state to make some improvement to their process/spec.
  - The pooled fund is made up of states, FHWA & Industry so Industry needs to facilitate a discussion with the paving contractors.
- **New York Chapter ACPA:** Some pavers are supportive because they can use the technology advancement to build better concrete and become more competitive. Paving industry is supportive of PEM but needs help with training and becoming comfortable with equipment. There has been some PEM push back from contractors due to higher cost.
- **Michigan Concrete Association:** Industry has been working with state agency. They have had a few training events with OSU. For SAM, they complete the water test. They have used the SAM with and without the CAPE.

- **ACPA:** Two segments. 1) Process with PEM. The conversations reminds him of a past situation when smoothness specs were introduced. Industry needs to be innovative and forward looking and standby our hallmark of delivering a durable pavement. It is agency's responsibility to implement this. We are in the middle of this process. Some are ahead of others. Fed partners are supportive. We are all in different spots with PEM so we need to keep this in mind. 2) PEM has been in front of their contractor members. Looking at forming a task force of contractors and material suppliers. We need to come back and tell them why we are doing this because it costs them money. They need to justify the change. This leads us to a question. We are 3/5 of the way through PEM. We are at different levels. After 5 years, what does success look like? We may not be done in 5 years. Where do we go from here? It is not too early to think about this. PEM is not PP84.
- **FHWA:** This is a long term process. It can take 10-15 years for some to implement PEM. Full implementation means looking at Table 2 in PP84 and each state reviews and selects the properties that make sense for them. Cannot succeed without a robust QC program. Success means states making some improvements to their spec.
  - Success means 1-2 states that are close to a pilot. (Taylor)
  - Full implementation does not mean the state adopts each of the tests and all of the properties (Voigt)
- **Portland Cement Association:** How can PCA support their members and help them become successful? What is needed to make a mix acceptable? Are there some mixes being excluded unnecessarily because of new test methods? What do we do when a test result is outside the limit that we are typically getting today? Resistivity is gaining support.
- **Iowa Concrete Paving Association:** Iowa has good mixes already and is close to doing a pilot project. Iowa is considering adding QC for box test. There is an ongoing effort to keep contractors informed and knowledgeable on new methods.
- **NRMCA:** Intent of PP84 is to be reasonable and attainable. There are 8 different properties and 25 different options. SAM is going to need different numbers when being used for structures. Need to make sure that a good SAM number still consistently meets freeze-thaw criteria. Still some work to be done to define all of the criteria involved. Hopefully SAM numbers will not need to be unique for every state.
- **Wisconsin Concrete Pavement Association:** Need to help industry see that PEM is important to their DOT and they want to be responsive to their biggest customer. But industry also needs agency to be responsive; a two-way street. If a contractor has evidence that their mix is adding to good and longer-life pavements, then it should influence asset management decisions. Specs are just one part; pavement management and the pavement selection/design process should also be part of the discussion.
- **GCP Applied Technologies:** Regarding the SAM meter, it appears there are 3 groups of people: never heard of it; heard of it and scared; and don't care. Big fear: many have heard that testing is difficult and inconsistent. If SAM number is bad, but hardened air turns out good – what then? Will that affect pay?
- **CP Tech Center:** Even though there are details to be worked out, the vision is still correct, we are still moving in the right direction. It is encouraging to see how many states are moving forward and willing to guide others.

### **Additional Comments**

- Training is critical, but it is not cost effective or possible to do it on a one-one basis.
- Need to look at possible methods: more step-by-step videos? web-based system? Regional training sessions? Train the trainer?
- Tom Van Dam needs all the data available. Send Peter the data again to make sure Tom Van Dam has received it all.

- Decisions need to be based on solid data. Spacing factor data has been standard – how doesn't it stack up with other data now being collected, SAM testing, etc.
- Dispute resolution needs to be part of discussion. Guidelines for good, bad, but also for borderline results
- States are at different stages and those that are further a long need to tell their story – need to share their roadmap to help other states develop an implementation plan. It could be a simple one page resource of steps to take.
- Robust QC program is necessary.
- Concrete industry is on an evolutionary journey and needs to commit for the long haul – it will be worth it!

#### **Future meeting schedule**

**To be determine at a later date.**