PERFORMANCE ENGINEERED MIXTURES (PEM) FOR CONCRETE PAVEMENTS

DELIVERING CONCRETE TO SURVIVE THE ENVIRONMENT

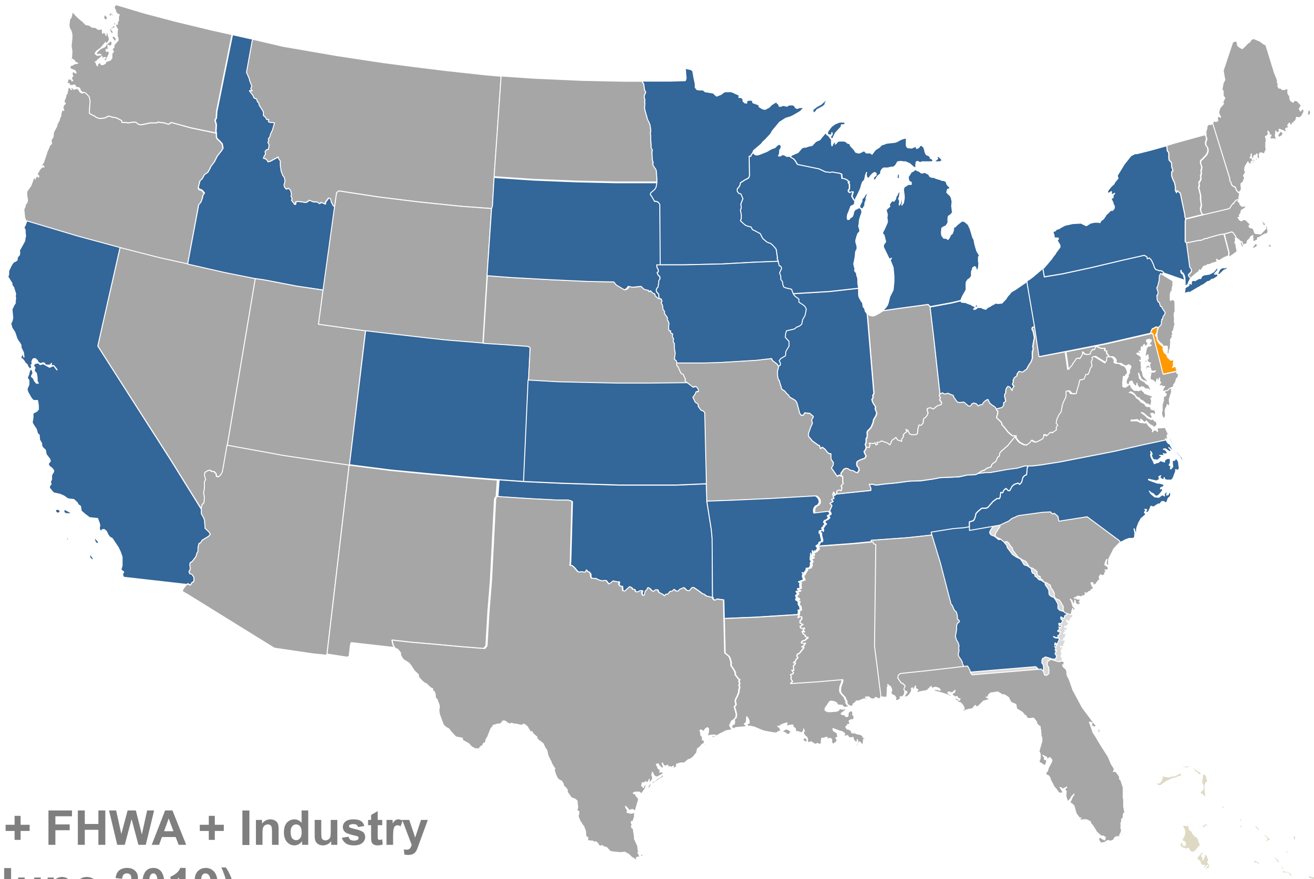
NC2 in Kalispell, MT - 2019

Gordon L. Smith, PE

IOWA STATE UNIVERSITY
Institute for Transportation

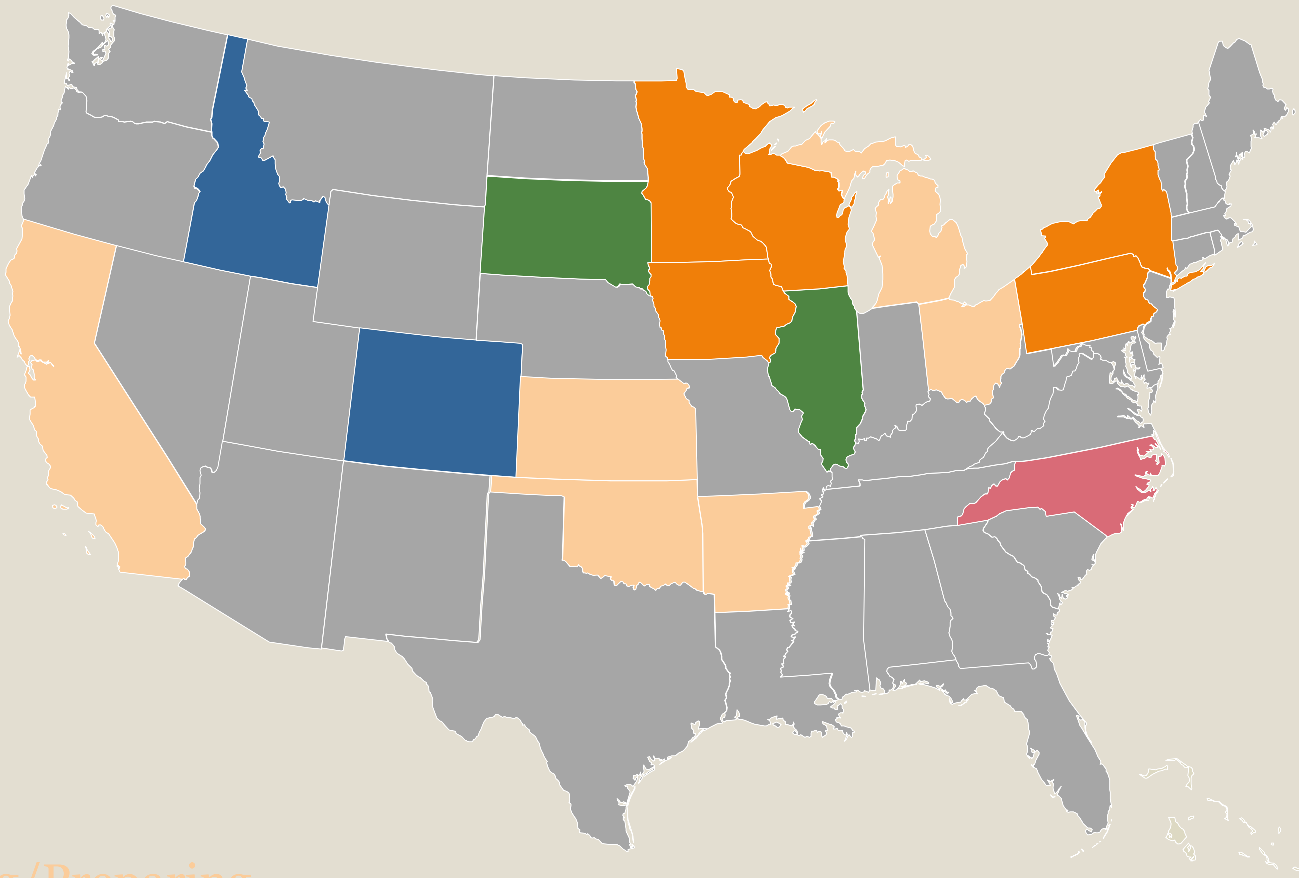
National Concrete Pavement Technology Center
Tech Center

PEM POOLED FUND PARTICIPANTS
TPF-5(368)



18 States + FHWA + Industry
(June 2019)

FHWA - PEM Implementation Incentive Funding



A, B, C, D

A, B, D

A, B

Considering/Preparing

No applicable project

PEM ACTIVITY 2019

- One-day engineering level PEM Workshop
- Specification review and SHA assistance in establishing their PEM implementation strategy
- Technician training
- Shadow testing data collection/analysis
- Test refinements and new tests (AASHTO Task Force)
- PP-84-20 revision
- Construction specification development
- Monitoring FHWA Incentive/Shadow Testing Projects
- MCT/PEM Open House/Demos in NC,CA (2), NV, KS, and IL
- Working with the states at various levels of PEM implementation

PEM ONE DAY WORKSHOP AGENDA

8:30	Road to PEM –Why change things?
9:00	Group discussion – What makes a good specification?
9:30	AASHTO PP-84, philosophy and goals
10:00	Break
10:30	Group discussion – Barriers to performance evaluation
11:00	Science and tests for PEM (Property-Test-Remedy)
12:00	Lunch
1:30	Science and tests for PEM (Property-Test-Remedy) continued…
2:00	Group Discussion – What next?
2:30	Break
3:00	PEM in practice, Quality, Implementation, Training
4:00	Wrap up

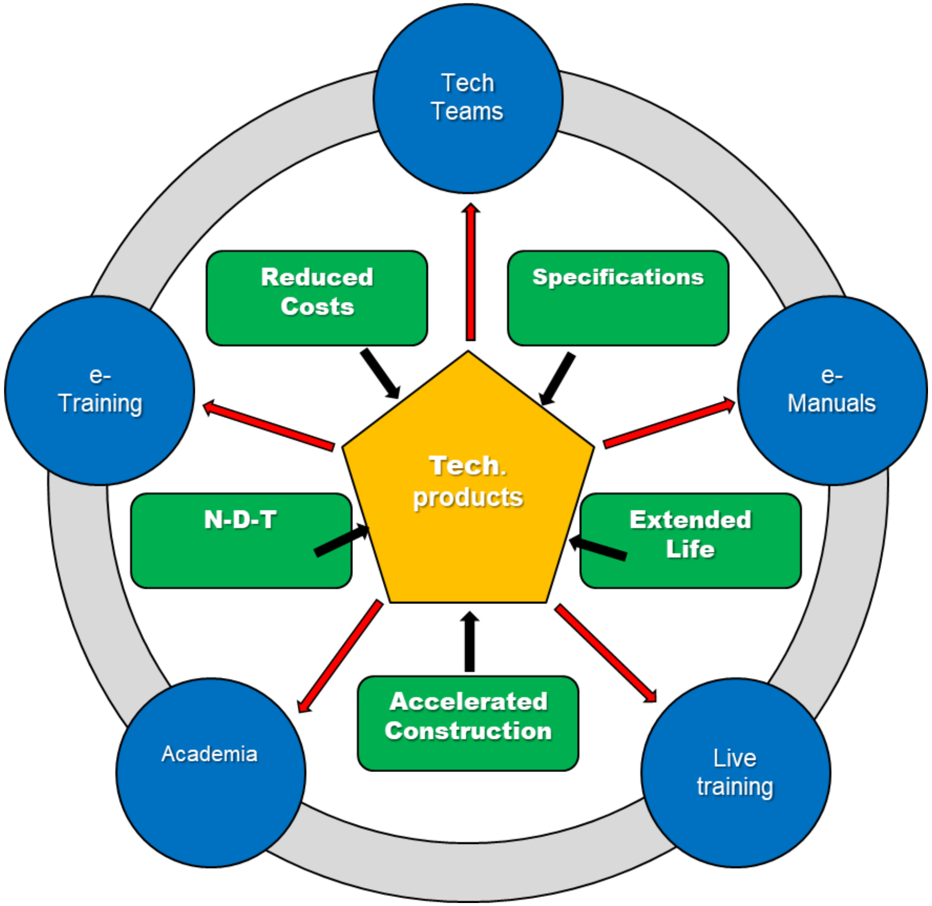
Table 3—Specification Worksheet

Section	Property	Specified Test	Specified Value		Mixture Qualification	Acceptance	Selection Details	Special Notes
			6.3 Concrete Strength					
6.3.1	Flexural Strength	T 97	4.1 MPa	600 psi	Yes	Yes	Choose either or both	—
6.3.2	Compressive Strength	T 22	24 MPa	3500 psi	Yes	Yes		—
			6.4 Reducing Unwanted Slab Warping and Cracking Due to Shrinkage (if cracking is a concern)					
6.4.1.1	Volume of Paste	—	25%		Yes	No	Choose only one	—
6.4.1.2	Unrestrained Volume Change	ASTM C157	420 με	At 28 days	Yes	No		Curing conditions
6.4.2.1	Unrestrained Volume Change	ASTM C157	360, 420, 480 με	At 91 days	Yes	No		—
6.4.2.2	Restrained Shrinkage	T 334	Crack free	At 180 days	Yes	No		—
6.4.2.3	Restrained Shrinkage	TP XXX	Σ < 60% f ′r	At 7 days	Yes	No		Dual ring test is currently under consideration as an AASHTO Provisional Test Method
6.4.2.4	Probability of Cracking	Appendix X1		As specified	Yes	No		—
Commentary	Quality Control Check	—	—	—	No	Yes		Variation controlled with mixture proportion observation or F factor and porosity measures
			6.5 Durability of Hydrated Cement Paste for Freeze–Thaw Durability					
6.5.1.1	Water to Cementitious Ratio	—	0.45	—	Yes	Yes	[a]	—
6.5.1.2	Fresh Air Content	T 152, T 196, TP 118	5 to 8	%	Yes	Yes	Choose only one	—
6.5.1.3	Fresh Air Content/SAM	T 152, T 196, TP 118	≥4% air; ≤0.2	%, psi	Yes	Yes		—
6.5.2.1	Time of Critical Saturation	"Bucket Test" Specification	30	yr	Yes	No	[a, b]	Variation controlled with mixture proportion observation or F factor and porosity measures
6.5.3.1	Deicing Salt Damage	—	35%	SCM	Yes	Yes	Choose only one	Are calcium or magnesium chloride used
6.5.3.2	Deicing Salt Damage	M 224	—	Topical treatment	Yes	Yes		Are calcium or magnesium chloride used; use specified sealers
6.5.4.1	Calcium Oxychloride Limit	Test sent to AASHTO	<0.15 g CaOXY/g paste		Yes	No		Are calcium or magnesium chloride used
			6.6 Transport Properties					
6.6.1.1	Water to Cementitious Ratio	—	≤0.45 or ≤0.50	—	Yes	Yes	Choose only one	The required maximum water to cementitious ratio is selected based on freeze–thaw conditions
6.6.1.2	Formation Factor	Table 1	≥500 or ≥1000	—	Yes	Yes		Based on freeze–thaw conditions; other criteria could be selected
6.6.2.1	Ionic Penetration, F Factor	Appendix X2	25 mm at 30 yr		Yes, *F*	Through ρ		Determined using guidance provided in Appendix X2
			6.7 Aggregate Stability					
6.7.1	D Cracking	T 161, ASTM C1646	—	—	Yes	No		—
6.7.2	Alkali Aggregate Reactivity	R 80	—	—	Yes	No		—
			6.8 Workability					
6.8.1	Box Test	Appendix X3	<6.25 mm, <30% surface void			No		—
6.8.2	Modified VKelly Test	Appendix X4	15–30 mm/root s			No		—

Notes:
[a] Choose either 6.5.1.1 or 6.5.2.1.
[b] Choose either 6.5.1.2, 6.5.1.3, or 6.5.2.1.

ADVANCING CONCRETE PAVEMENT TECHNOLOGY SOLUTIONS

(FHWA Cooperative Agreement)

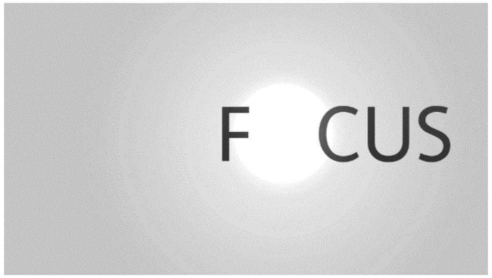


- **Design criteria and specifications**

  PEM

  - QC for PEM
  - Precision & Bias for PEM Tests
  - Proficiency training
  - E-Construction

LOOKING AHEAD



- Continued collaboration with SHAs, FHWA and Industry along the road toward PEM implementation for concrete pavements – (Specs/Training/Questions)
- Emphasis on a PEM QC guide/control charts
- Shadow testing-shadow testing-shadow testing
- Data gathering/analysis/sharing for PEM test verification and long term pavement performance records
- Precision and Bias for PEM tests
- Training/Certification(?) for PEM technicians (Who, when, where and how)
- A PEM model construction specification
- Pilot projects . . . . . .

PEM POOLED FUND TAC MEETING

November 18-19, 2019

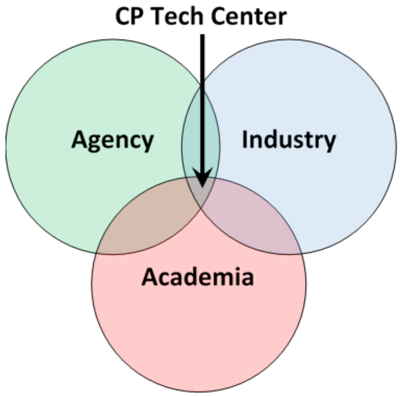
Embassy Suites by Hilton Minneapolis Airport

7901 34th Avenue South

Bloomington, MN 55425

Thank you for your support of the PEM Pooled Fund Initiative

Please let us know how we can help



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