About the Speaker

- Mike Praul is the Senior Concrete Engineer with FHWA
- 34 years with FHWA
- Manages Mobile Concrete Technology Center program and leads FHWA's PEM initiatives
- Lives in Augusta, ME with wife Jody
- Loves dachshunds

FHWA Program Update

National Concrete Consortium, Spring 2021 Meeting
April 13, 2021

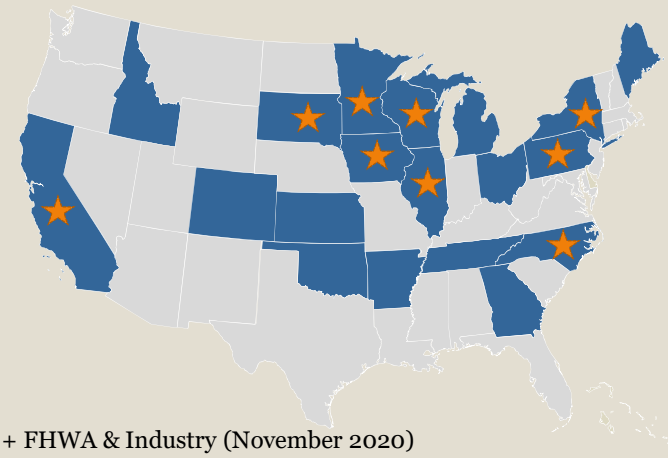
MICHAEL F. PRAUL, PE
SENIOR CONCRETE ENGINEER
FHWA, OFFICE OF INFRASTRUCTURE

U.S. Department of Transportation
Federal Highway Administration
Office of Infrastructure

FHWA is the source of all images in this presentation unless otherwise noted.

Pavement and Materials Program Areas

PEM Implementation Incentive



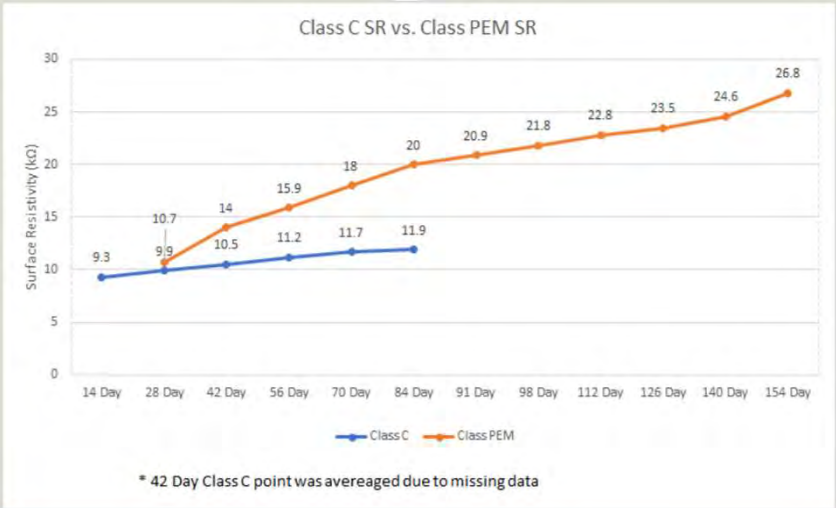
19 States + FHWA & Industry (November 2020)

★Performance-Engineered Mixtures (PEM) Implementation Incentive Pilot Project

New York Project Highlights

- PEM approach is beneficial to State and industry
- PEM mix tested better in all tests vs. Class C
- 2nd supplier was reluctant to participate
  - Determined QC requirements were not much more than they currently do
  - Mix looked and placed better than Class C
- Needs
  - Training in new tests
    - Understanding roles and responsibilities in a performance specification (including QC monitoring)
  - Consider 56-day testing for resistivity
- Developing next project in NYC area (structural)

New York Surface Resistivity Testing



North Carolina Project Highlights

- Box Test
  - Highly useful in mix development and evaluation (contractor)
  - Simple, easy test. Potential to add to specification (NCDOT)
- Super Air Meter
  - After some training, readily incorporated into quality control (QC) (contractor)
  - Doing more shadow testing and consider future use (NCDOT)
- Surface Resistivity
  - Easy. Readily incorporated into QC (contractor)
  - Easy. Affordable equipment. Will equip all State labs. (NCDOT)
  - UNC-Charlotte working to develop 28-day result to correlate with 56-day results

North Carolina Project Highlights

- "Valuable experience" (contractor and NCDOT)
- "Due to project schedule, we were unable to apply the PEM criteria during the preliminary mix design phase. However, going forward, we intend to implement PEM guidelines on future PCCP (portland cement concrete pavement) projects." (contractor)
- "The Department will continue to explore PEM to see how these tests and other AASHTO PP 84 provisions will work with our daily operations." (NCDOT)
- NCDOT will pilot PEM bridge project.

Iowa Project Highlights

- Box Test: 45#/cy reduction in cement
  - Contractor now using to develop mixes
- Super Air Meter comments
  - Need for technician training
  - Attention to detail for correlation testing
  - Concern with gauge durability
- Surface Resistivity
  - Invaluable information for agency and industry
  - Easy to perform, no changes needed
- Expanded typical QC requirements without issue
- 2020 project use proposed by contractor. Approved!

Iowa Impact Analysis

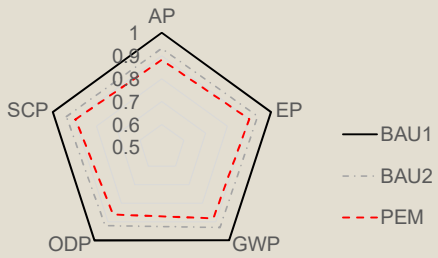
- Collaboration with MCTC
- Comparison of conventional and performance engineered concrete mixtures

	Std mixes		PEM
Year	2019	2019	2020
	QMC	QMC	PEM
	ML	ML&S	ML&S
Material constituents [lbs/yd3]			
Cement	463	427	399
Fly ash	116	107	100
Slag or other pozzolans	0	0	0
Coarse aggregate	1188	1427	1441
Intermediate aggregate	0	0	0
Fine aggregate	1744	1708	1752
Water	274	214	199
Total aggregate:	2932	3135	3193
Total weight:	3785	3883	3891

Life Cycle Impact Assessment

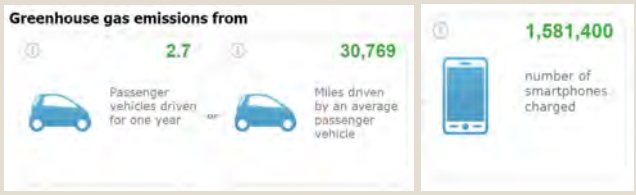
- TRACI 2.1 by the U.S. Environmental Protection Agency
- Impact categories:
  - Acidification potential (AP)
  - Eutrophication potential (EP)
  - Global warming potential (GWP)
  - Ozone depletion potential (ODP)
  - Smog creation potential (SCP)

Preliminary Results: Mixture Comparison



- Reduction of cement by 36 lbs/yd^3 → 7% savings in all impacts.
- Reduction of cement by 64 lbs/yd^3 → 10-14% savings in all impacts.

Total Savings: Shoulder



Total CO_2-eq savings

- 1 m^3 of concrete= 21 kg.
- Shoulder (6' by 8"- Iowa project from 2019)= 12.4 t/ mile.

Source: https://www.epa.gov/energy/greenhouse-gas-equivalencies-calculator

Total Savings: Main Line + 2 Shoulders per Mile

Total CO2-eq. savings:

- Shoulder (6' and 10' by 8"- Iowa project from 2020)= 33.1 t.
- Main lane (12' by 11"- Iowa project from 2020)=34.1 t
- TOTAL= 67.2 t

Source: https://www.epa.gov/energy/greenhouse-gas-equivalencies-calculator

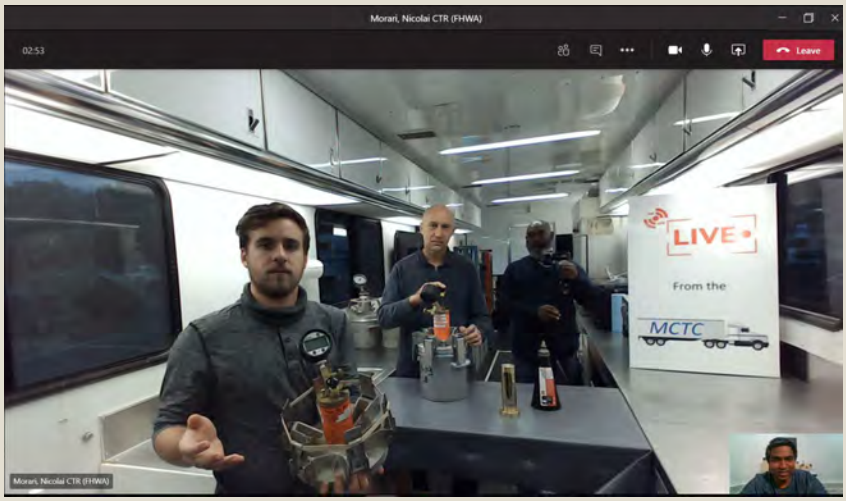
FHWA Mobile Concrete Technology Center (MCTC) Program




2020 Program Activities

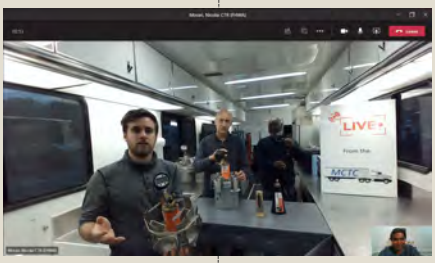
- Live training
- Virtual tours (conference)
- Training video briefs: “how-to’s” of MCTC equipment being deployed
- Turner-Fairbank Highway Research Center collaboration
- Equipment Loan Program
- Technical assistance/data analysis
- Specification reviews
- Technical publications

"Live From the MCTC" Training/Workshops



"Live From the MCTC" Topics

- Super Air Meter (SAM)
- Surface/Bulk Resistivity
- Maturity
- Box Test/V-Kelly
- Semi-adiabatic calorimeter
- Phoenix (fresh water content)
- MIT Scan T3
- MIT Dowel Scan
- HIPERPAV
- Optimized gradation software



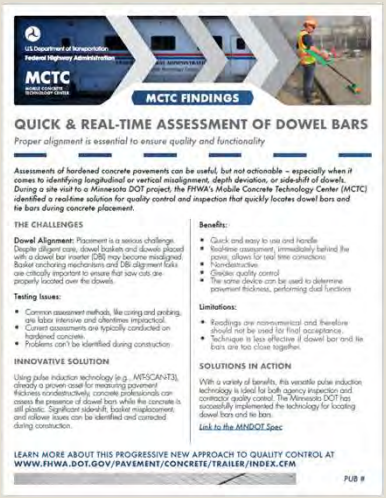
Endorsement

"I was at the MO/KS ACPA workshop and the Live Tour of the MCTC was absolutely fabulous - clear, informative, and felt like we were together (as much as 2021 could allow anyway). Jim & Josh did a fantastic job leading this effort!"

Jesse Jonas
ACPA-Missouri

One-Pager Series

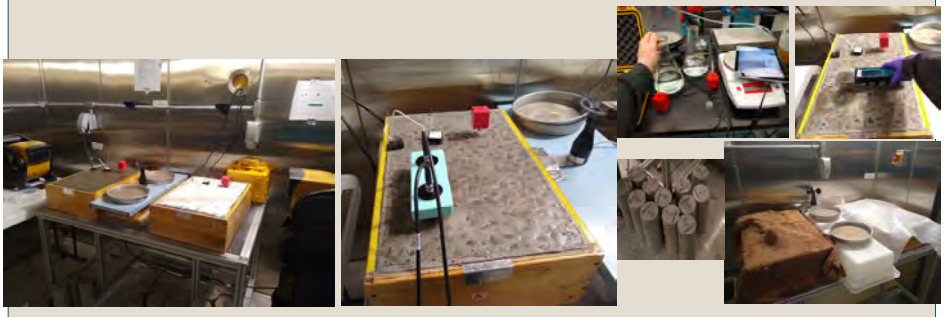
- Effort to use MCTC data and experience
- Narrowly focused
- Meant to stir interest and point reader to resources
  - 1st : Cement Content
  - 2nd : Optimized Mix Design
  - 3rd : Cores vs. Cylinders
  - 4th : NDT Thickness Measurement
  - 5th : Surface Resistivity
  - 6th : Texture of Concrete Pavements
  - 7th : Maturity
  - 8th : Curing
  - 9th : Workability
  - 10th: Air Entrainment
  - 11th : Stringless Paving



TFHRC Update

Curing Quantification

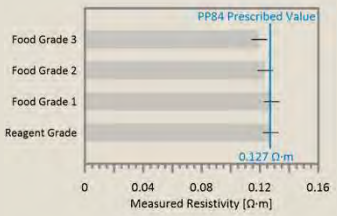
Identify implementation-ready technologies to provide a tool to quantify if curing best practices are followed.

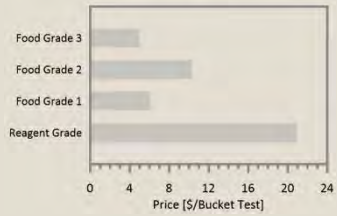


Contact: Robert.Spragg@dot.gov

AASHTO Resistivity Task Force

- AASHTO COMP 3C Task Force 20-01: Resistivity
  - 19 members (8 DOTs & Others)
  - Meeting since November 2020
- Harmonization where applicable
- Consensus on how to specify curing
  - Specifically looking at the "Bucket Test"
  - Proportions vs. measurement of solution
- On going efforts at FHWA are looking to see if strength/resistivity can be conducted on same specimens in curing solution





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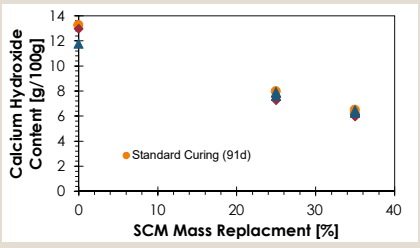
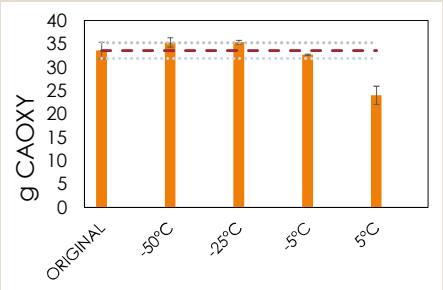
Extension of Existing Tests

- Accelerated Curing To Determine Transport Properties



Montanari, et al. (2021). *Accelerated Curing of Concrete Mixtures for Resistivity and Formation Factor Evaluation.* In Preparation.

Increased Accessibility of Calcium Oxychloride Testing



Montanari, et al. (2020). *Quantification of Calcium Oxychloride by Differential Scanning Calorimetry: Validation and Optimization of the Testing Procedure.* Submitted to *Advances in Civil Engineering Materials.*

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Is your agency experiencing **premature joint deterioration in concrete pavements** or **interested if CaOXY evaluation** might be a useful addition to your pavement program?

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FHWA-TFHRC Aggregates & Petrographic Lab Program

Materials Performance in Highways

- Alkali Aggregate Reactions in Concrete
  - Alkali-Silica & Alkali-Carbonate
- Research Highway Materials & Aggregates in – Concrete, Asphalt, & Granular Bases
- Several University Exploratory Advanced Research (EAR) and Small Business Innovative Research (SBIR) Projects on Fly Ash & the Quality of Entrained Air-Voids in Concrete
- Provide Forensic Microscopy Help to State DOTs, FHWA Offices, NTSB, etc. on Pavement & Concrete Investigations – *Identify Rock Types, Minerals, Micro-Cracks & Reaction Products*

Example Forensic Petrography and Research Investigations

- Alkali Reactive Coarse Aggregates – Siliceous & Carbonate Constituent Effects
- Open-Graded Aggregate Tested in Geotech Lab Large-Scale Shear-Boxes
- Aggregate Quality – Cause of Low Concrete Strength in Slip-Form Pavement
- Coarse Aggregate Polishing in Low Friction Asphalt Pavement
- Organic Materials in Natural Sand Failing the Organic Colorimetric Test
- Evaluation of Recycled Concrete Aggregates (RCA) from Urban Rubble
- Rebar Shadowing in Bridge Deck Placement Over Prestressed/Precast Panels
- NTSB Investigation of the Hardened Concrete Mixture Properties in Bridge Failure & Investigations of Bus Crashes Involving Asphalt Pavements
- Blend Aggregate Properties in Stripping Asphalt Mixture Tested in the Lab

CONTACTS

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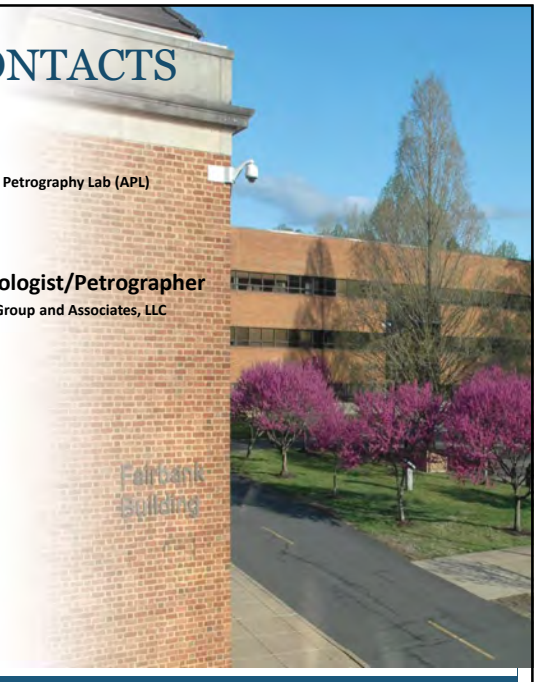

Questions?

Image Pixabay

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