PEM Update

NESMEA 2019
OCTOBER 22, 2019 • PORTLAND, ME

MICHAEL F. PRAUL, P.E.
FHWA, OFFICE OF PRECONSTRUCTION, CONSTRUCTION, & PAVEMENTS

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

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

PEM vs. PRS

Performance Engineered Mixtures

- Initiative promoting engineering concrete mix designs to perform in their service environment. PEM also promotes a number of new test technologies along with enhanced QC practices.

Performance Related Specifications

- "QA specifications that describe the desired levels of key materials and construction quality characteristics that have been found to correlate with fundamental engineering properties that predict performance."

Source: Transportation Research Circular E-C137, Glossary of Highway Quality Assurance Terms

We Are Horrible With Change

- Timeframe for widespread use of SCMs

Image Pixabay

- 28-day strength testing

- Slump test

Evolution of Concrete Testing

Concrete

Slump Cone

1922
ASTM C143

Pressure Meter

1949
ASTM C231

Rapid Chloride Permeability Test

1981
FHWA/PCA

Cars

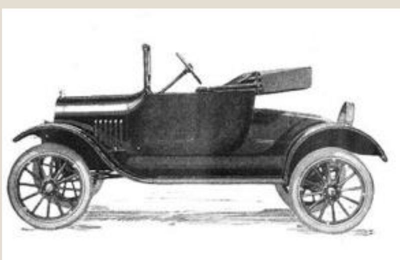


Image Pixabay

1920 1940 1960 1980 2000

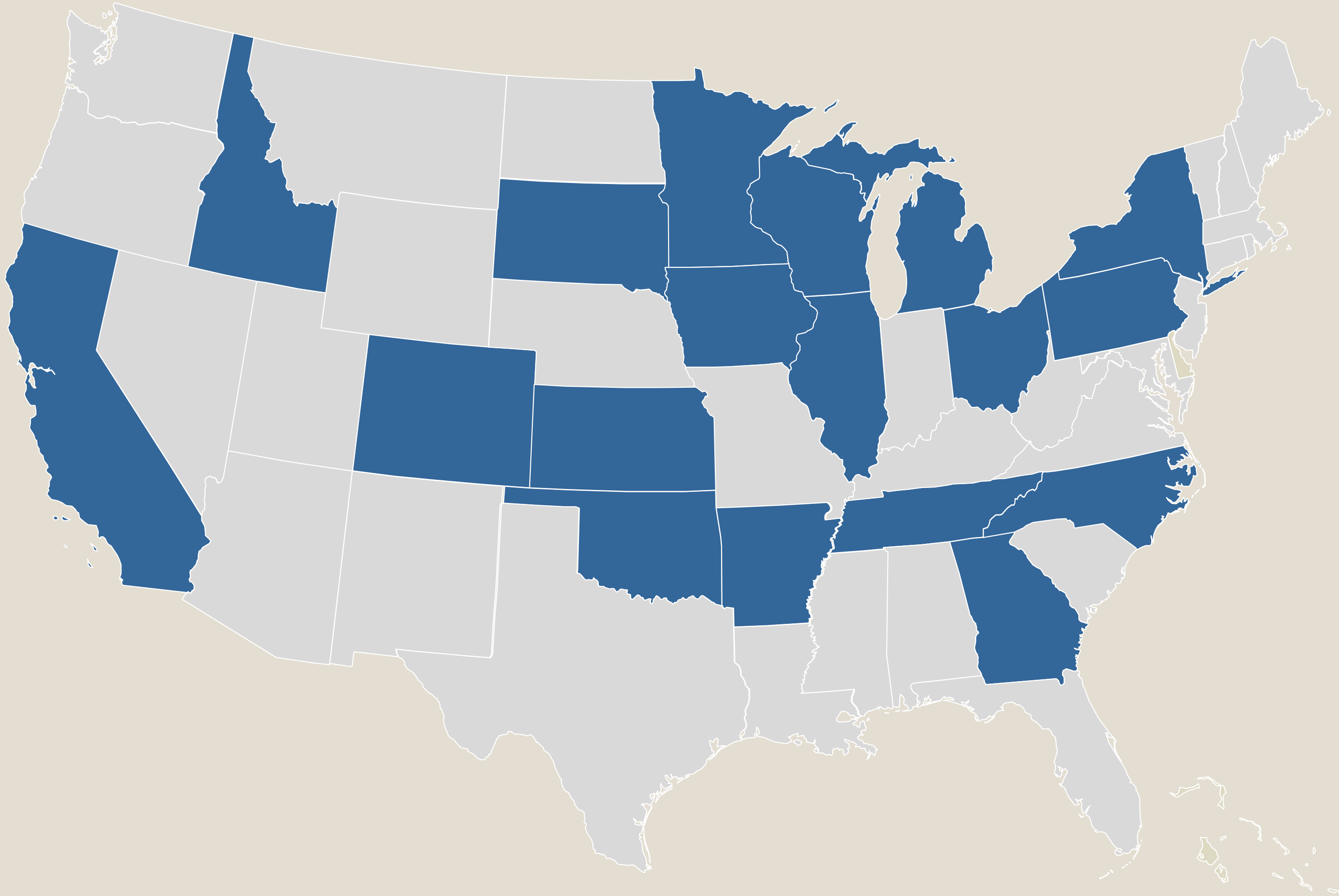
Implementing PEM

Prescriptive	Performance
• Agency dictates how the material or product is formulated and constructed • Based on past experience • Minimal/uncertain ability to innovate • Requires agency to have proper manpower and skill set to provide oversight	• Agency identifies desired characteristics of the material or product • Contractor controls how to provide those characteristics • Maximum ability to innovate • Reduced oversight burden on the agency

PEM-related Specification Changes

- Colorado
  - Surface Resistivity
  - Box test
  - V-Kelly
  - Removed Min/Max cement content
  - Allow up to 50% fly ash
- New York
  - SAM for acceptance
- Wisconsin
  - SAM for mix design approval
- Many others evaluating

PEM Pooled Fund Participants



18 STATES + FHWA & INDUSTRY
(AUGUST 2019)

PEM Pooled Fund Emphasis

- Implementation
- Education and Training
- Adjustments in specifications based on field performance
- Continued development of a knowledge base relating early age properties to performances

PEM Pooled Fund Partners

- FHWA
- State Departments of Transportation (DOTs)
- Industry (American Concrete Pavement Association, Portland Cement Association, National Ready Mixed Concrete Association, others)

Image Pixabay

PP 84 Implementation Incentive Funds

- Available to pooled fund participating states
- $40,000 for two or more new tests in the mix design/approval process (shadow testing acceptable)
- $20,000 for one or more new tests in the acceptance process (shadow testing acceptable)
- $20,000 for requiring an "enhanced" QC Plan from the contractor
- $20,000 for requiring the use of control charts
- Report required within 4 months of construction

Iowa Early Success Story

- FHWA PEM Implementation Incentive Funds
- "New" QC Plan?
- Box test experience
- Contractor moving forward
- Similar experience in Wisconsin

Images: Pixabay

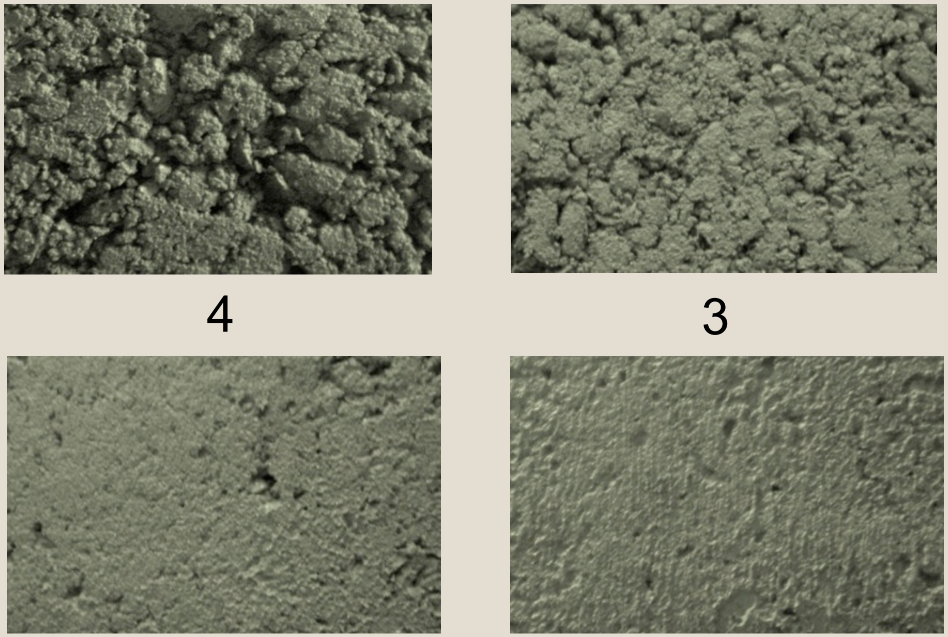
Box Test

- Developed by Dr. Tyler Ley, Oklahoma State University
- Mixture response to vibration
  - Consolidation check
  - Edge slump check
- Easy visual check
- Mix design tool
  - Evaluate the gradation
  - Cementitious content

Box Test

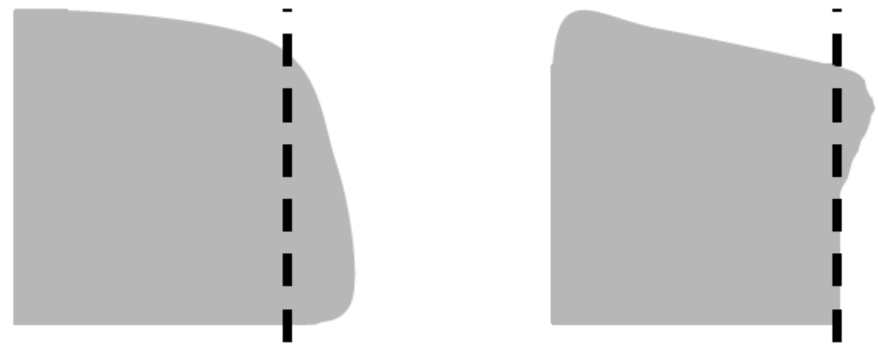
- A workability test
- Simple, quick, easy (lends itself to QC)
- Included in AASHTO PP 84 (PEM)
- Structural concrete equivalent in development

Box Test



4 3

2 1



Bottom Edge Slumping

Top Edge Slumping

If deflection is more than ¼" then it fails

Consolidation Issues

Edge Slump Issues

Box Test

Project A

Finishability Issues

Project B

Edge slump Issues

Accelerate Implementation and Deployment of Pavement Technologies

FAST Act Section 503 (c)(3)

(B) Goals.- The goals of accelerated implementation and deployment of pavement technologies program shall include-

- (i) the deployment of **new, cost-effective designs, materials, recycled materials, and practices** to extend the pavement life and performance and to improve user satisfaction;
- (ii) the reduction of **initial costs and lifecycle costs** of pavements, including the costs of new construction, replacement, maintenance, and rehabilitation;
- (iii) the deployment **of accelerated construction techniques** to increase safety and reduce construction time and traffic disruption and congestion;
- (iv) the deployment of **engineering design criteria and specifications** for new and efficient practices, products, and materials for use in highway pavements;
- (v) the deployment of **new nondestructive and real-time pavement evaluation** technologies and **construction techniques**; and
- (vi) the effective **technology transfer** and information dissemination to accelerate implementation of new technologies and to improve life, performance, cost effectiveness, safety, and user satisfaction.

FHWA Cooperative Agreement with Iowa State University

Advancing Concrete Pavement Technology Solutions

The purpose of the Agreement is to…

- Deploy innovative technologies to improve pavement performance
- Develop and transfer new technologies
- Deliver tools and guidance documents to States to support the increased knowledge of concrete materials, concrete pavement design, construction, and maintenance

FHWA Cooperative Agreement with Iowa State University

Six Work Areas

1. Extending pavement life and performance
2. Reduction of initial costs and lifecycle costs of pavements
3. Deployment of accelerated construction techniques
4. Deployment of design criteria and specifications for new practices/products/techniques
5. Deployment of non-destructive testing and real-time pavement evaluation techniques
6. Technology transfer and information dissemination

FHWA Cooperative Agreement with Iowa State University

WOPR No. 02 – Performance Engineered Pavements

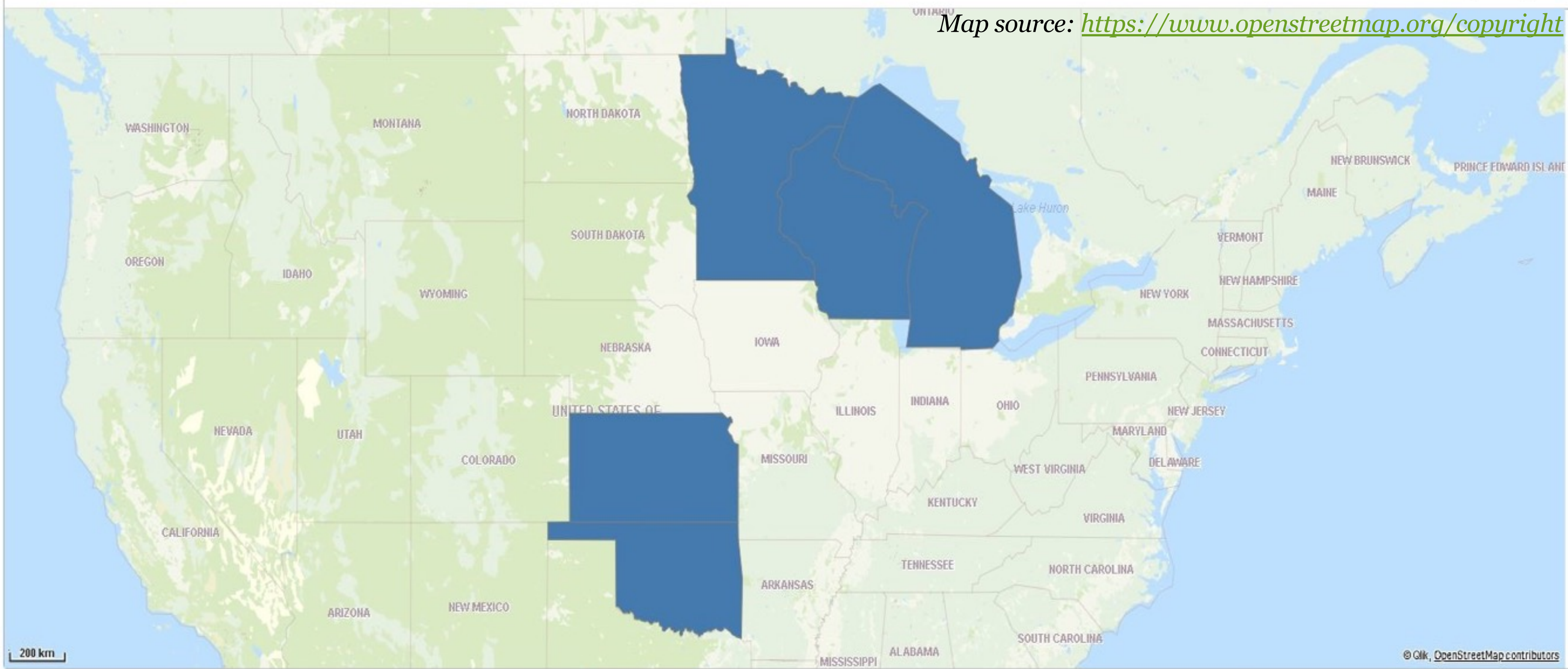
- Performance Engineered Mixtures (PEMs)/AASHTO PP84
  - Model QC Plan template for highway projects (with guidance)
  - QC control chart tools
  - Model performance specification
- Precision and Bias Statements

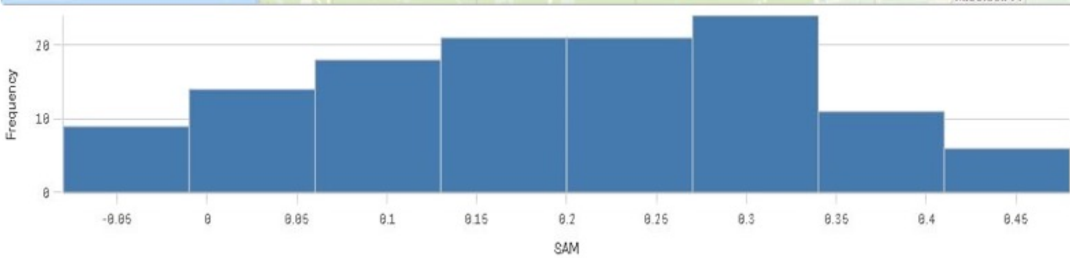
Suggestions for Cooperative Agreement

Implementing the Super Air Meter (SAM)

- Concerns with device durability
- Concerns with data variability
  - Multiple causes
  - New algorithm
- Concerns with time to perform
- Questions about appropriate use
  - QC?
  - Mix design approval?
  - Acceptance?

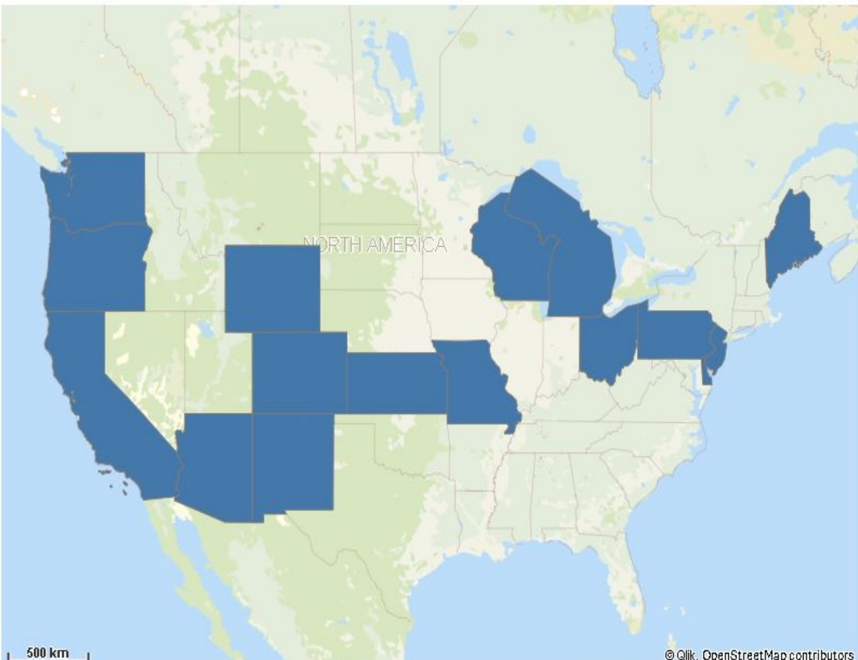
SAM Data Analyzed





SAM n	SAM Range	SAM Mean	SAM Std Dev
173	0.0-0.64	0.2034	0.12387
45	0.10 to 0.33	0.2327	0.04874
86	0.01 to 0.46	0.1864	0.08956
21	0.1 to 0.285	0.1698	0.04844
190	0.01 to 0.45	0.1592	0.06369

Current Portland Cement Concrete PWL Acceptance States



Map source: https://www.openstreetmap.org/copyright

Contractors tests in acceptance decision HMA
- N
- Y

Contractors tests in acceptance decision for PCCP
- N
- Y

Contractor test results with F&t tests for HMA using a minimum of...
- N
- Y

Contractor test results with F&t tests for PCCP using a
- N
- Y

Qualify sampling and testing personnel HMA
- N
- Y

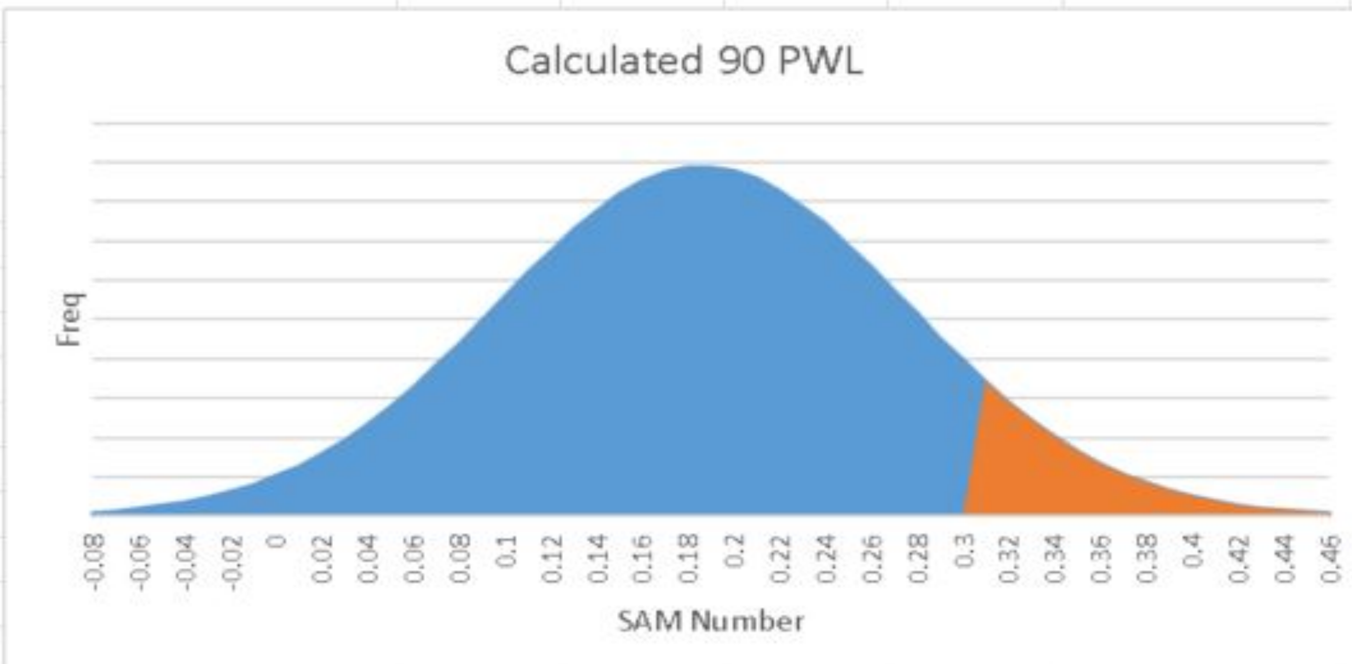
Qualify sampling and testing personnel Concrete
- N
- Y

PWL/ PD type specifications for payment for HMA?
- N
- Y

PWL/ PD type specifications for payment for PCCP?
- Y
- N

Establishing PWL Spec Limits

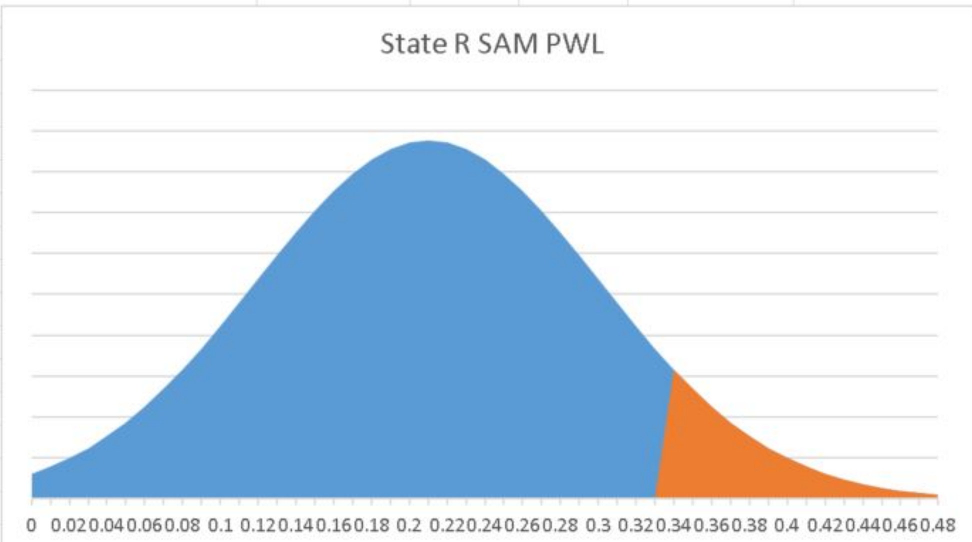
State S SAM			
n	86	If 90 PWL = Upper Spec Limit	
Pop. Range	0.01 to 0.46	90 PWL: 1 Limit z = 1.28	
Pop. Median	0.18	Z = (Mean – Spec. Limit)/Std. Dev.	
Population Mean μ	0.1864	Spec. Limit = Mean + (Z * Std. Dev.)	
Population Variance σ^2	0.008021		
Pop. Stand. Deviation σ	0.089559		Upper Spec Limit
		Calculated	**0.30**



Establishing PWL Spec Limits

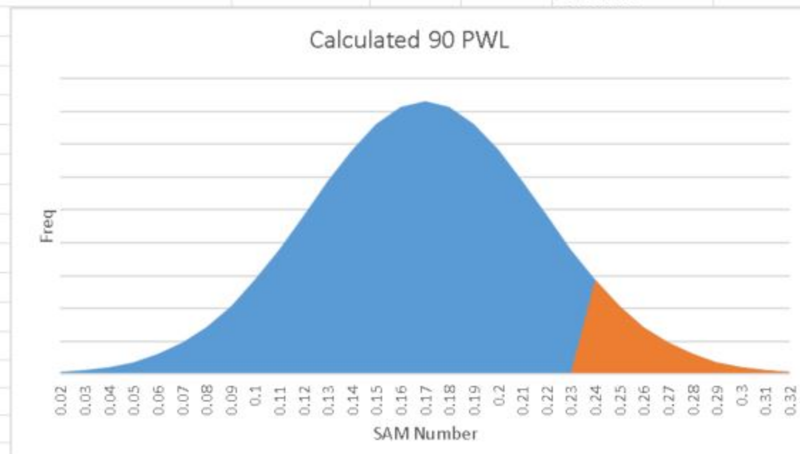
State R

n	124	If 90 PWL = Upper Spec Limit	
Pop. Range	0.03 to 0.58	90 PWL: 1 Limit z = 1.28	
Pop. Median	0.21	Z = (Mean – Spec. Limit)/Std. Dev.	
Population Mean µ	0.21	Spec. Limit = Mean + (Z * Std. Dev.)	
Population Variance σ²	0.00824667		
Pop. Stand. Deviation σ	0.090811178		Upper Spec Limit
		Calculated	**0.33**



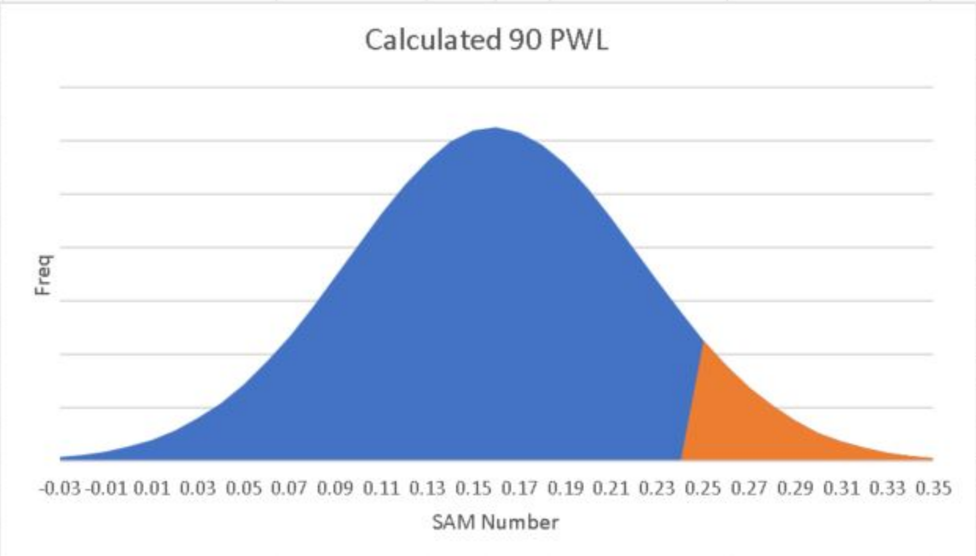
State T SAM

n	21	If 90 PWL = Upper Spec Limit	
Pop. Range	0.1 to 0.285	90 PWL: 1 Limit z = 1.28	
Pop. Median	0.15500	Z = (Mean – Spec. Limit)/Std. Dev.	
Population Mean µ	0.16976	Spec. Limit = Mean + (Z * Std. Dev.)	
Population Variance σ²	2.3464E-03		
Pop. Stand. Deviation σ	0.048439363		Upper Spec Limit
		Calculated	**0.23**

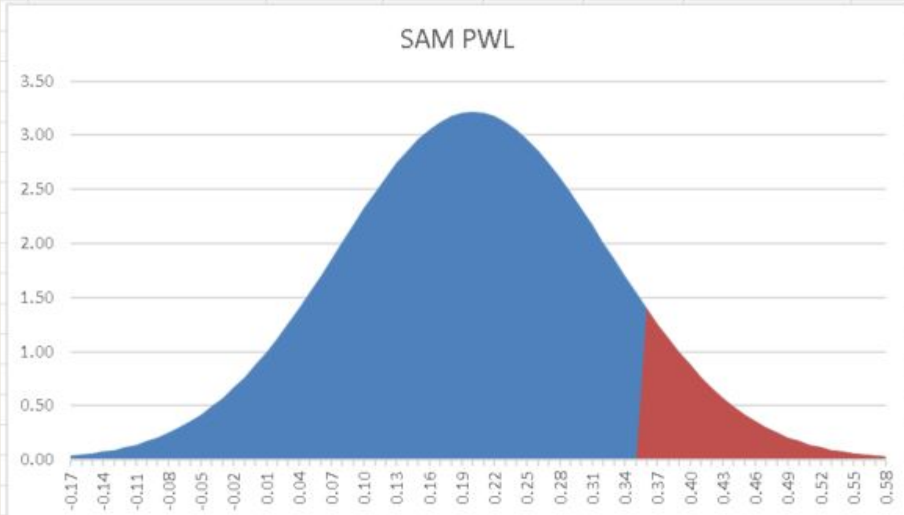


Establishing PWL Spec Limits

State U SAM			
n	190	If 90 PWL = Upper Spec Limit	
Pop. Range	0.01 to 0.45	90 PWL: 1 Limit z = 1.28	
Pop. Median	0.16500	Z = (Mean – Spec. Limit)/Std. Dev.	
Population Mean μ	0.15921	Spec. Limit = Mean ± (Z * Std. Dev.)	
Population Variance σ²	4.0569E-03		
Pop. Stand. Deviation σ	0.063693539		Upper Spec Limit
		Calculated	**0.24**



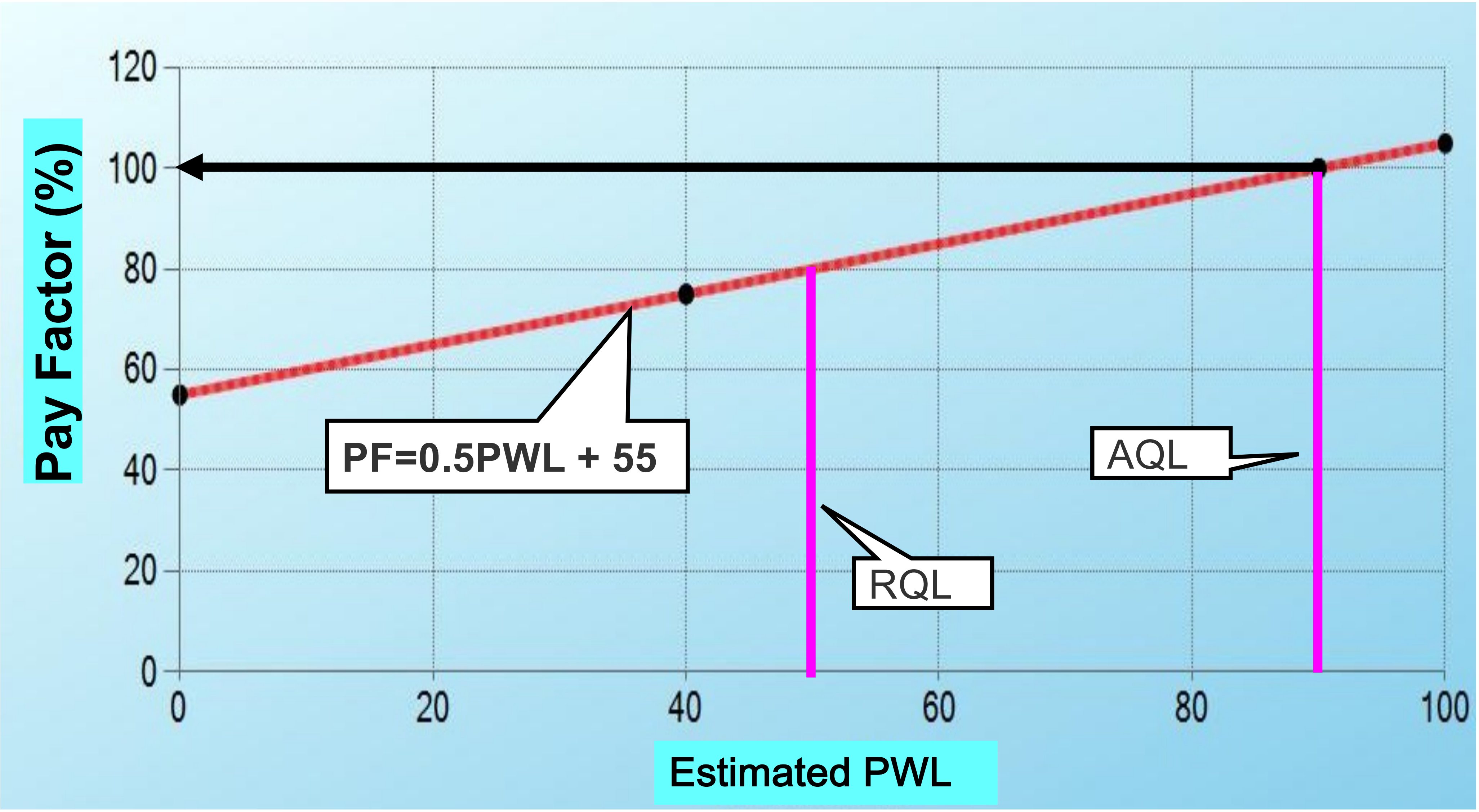
State V SAM			
n	173	If 90 PWL = Upper Spec Limit	
Pop. Range	0.0-0.64	90 PWL: 1 Limit z = 1.28	
Pop. Median	0.18	Z = (Mean – Spec. Limit)/Std. Dev.	
Population Mean μ	0.20	Spec. Limit = Mean ± (Z * Std. Dev.)	
Population Variance σ²	0.015		
Pop. Stand. Deviation σ	0.124		Upper Spec Limit
		Calculated	**0.36**



SAM Data Analyzed

State	n	Mean	Std Deviation	Calc Upper Spec Limit
R	124	0.21	0.0908	0.33
S	86	0.19	0.0896	0.30
T	21	0.17	0.0484	0.23
U	190	0.16	0.0637	0.24
V	173	0.20	0.124	0.36

Payment Plan with 5% Incentive



PWL Hypothetical Pay

- Hypothetical payment scenarios
- PWL Spec with upper specification limit from pilot population

SAM PWL at 0.33 Upper Spec Limit							
Mean	Std. Dev	Q_U	n	d2	x	PWL	PF
0.26	0.01924	3.7431	5	2.23607	0	**100**	**105.00**
0.22	0.05148	2.13683	5	2.23607	0	**100**	**105.00**
0.23	0.04879	2.13179	5	2.23607	0	**100**	**105.00**
0.27	0.05508	1.14993	3	1.73205	0.00206	**97**	**103.55**
0.20	0.03	4.33333	3	1.73205	0	**100**	**105.00**
0.25	0.09381	0.8528	5	2.23607	0.26163	**79**	**94.58**

FHWA/ACI Workshops

- FREE to the host
- Host provides: Room, projector, attendees
- Under a cooperative agreement, FHWA/ACI provide instructors, all training materials
- 1-2 month lead time
- States may request multiple presentations
- Agreement expires September 18, 2020
- Contact: Tom Yu
  - tom.yu@dot.gov
  - (202) 366-1198

Performance Mixtures for Sustainable Concrete

Performance Mixtures for Sustainable Concrete

FHWA/ACI
One-day Workshop

Location ▶
Nevada Department of Transportation
District 1 — Training Room B
123 E. Washington Avenue
Las Vegas, NV 89101

Tuesday, Sept. 26, 2017
Registration: 7:45 a.m.
Workshop: 8:00 a.m. - 4:30 p.m.

Continuing Education
Attendees receive 0.75 CEUs (7.5 PDHs).

To register for the workshop, contact:
Mario C. Gomez, NDOT
Phone: +1.702.385.6502
E-mail: mgomez@dot.nv.gov

American Concrete Institute
Always advancing

Workshop Overview

This Workshop, developed under a cooperative agreement between the Federal Highway Administration (FHWA) and the American Concrete Institute (ACI), will focus on steps DOTs can take toward improving the quality of their concrete pavements by specifying the performance they want. While many associate improved performance with longer life, other aspects such as reduced maintenance, earlier opening to traffic, or improved sustainability will also likely be significant contributing factors. The presenters will first summarize the background of performance specifications and the current state of testing methods for concrete performance. The presenters will then facilitate a discussion of the process of moving to performance specifications. Participants will then break into groups to discuss what a performance specification for their state would look like. Finally, performance specification implementation experiences by other states and the steps needed for implementation in the host state will be discussed.

Who Should Attend

Performance specifications affect all the parties involved in a project. Participation by a wide range of parties will benefit the discussion. Attendance by DOT management, DOT engineers, pavement contractors, consultants, material suppliers, and testing lab personnel is highly recommended.

Topics to be covered

- Evolution of specifications and concrete technology
- Motivation to advance performance specifications
- Implement issues
- Performance properties of fresh and hardened concrete
- Testing methods for performance properties
- Transitioning to performance specifications
- Elements of a performance specifications
- Acceptance criteria
- Examples of performance specification implementation
- Steps to introducing performance specification

Free Resource Materials

- Slide handout
- ACI 329R-14, "Report on Performance-Based Requirements for Concrete"

Performance Mixtures for Sustainable Concrete

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Mario C. Gomez, NDOT
Phone: +1.702.385.6502
E-mail: mgomez@dot.nv.gov

American Concrete Institute
Always advancing

Faculty

Cecil L. Jones is President of Diversified Engineering Services, Inc., located in Raleigh, NC, and has over 40 years of experience in construction and materials related to transportation. He provides quality management services to clients along with specification development, research, new technology development support, training, and general consulting services.

Prior to establishing Diversified Engineering Services, he worked with the North Carolina DOT for over 30 years with assignments ranging from field construction engineering to the position of State Materials Engineer, with responsibility for the overall management of the materials quality system for the Department's 80,000-mile state-maintained highway system.

Cecil received his BS in civil engineering from North Carolina State University and is a licensed professional engineer in North Carolina. He is active in several professional organizations including ACI, AASHTO, and ASTM International.

Tyler Ley, FACI, has more than 16 years of experience in the field of cement-based materials. He has worked as an engineer with a design consultant, construction contractor, government agency, and as a professor. This practical experience blended with his technical expertise has elevated both his teaching and research.

His research focuses on studying the durability and construction of cement based materials. His research has developed national and state specifications, test methods, and policy changes. Some of the technologies developed in his research lab include: The Super Air Meter, the Box Test, the Tarantula Curve, Pulpcure, Ctags, and a new method to classify fly ash.

Ley is a fellow of American Concrete Institute and the American Ceramic Society and has received several national awards, including the NSF Career Award, the ACI Faculty Achievement Award, and the Regents Research Award from Oklahoma State University.

Paul J. Tikalsky, PhD, PE, FACI, is Dean of the College of Engineering, Architecture and Technology at Oklahoma State University. He received his BS in civil and environmental engineering at the University of Wisconsin–Madison and his MS and PhD in structural engineering at the University of Texas at Austin. He serves on FHWA's High-Performance Concrete Implementation Task Force and its Concrete Pavement Oversight Group. He has received numerous awards, including Utah Engineering Educator of the Year.

Chemical Admixtures for Concrete

Chemical Admixtures for Concrete

FHWA/ACI
One-day seminar

Location ▸

A facility of your choosing

Registration: 7:45 a.m.
Workshop: 8:00 a.m. - 5:00 p.m.

Continuing Education

Attendees receive 0.75 CEUs (7.5 PDHs).

American Concrete Institute®
Advancing concrete knowledge

Seminar Overview

This seminar, presented under a cooperative agreement between the Federal Highway Administration (FHWA) and the American Concrete Institute (ACI), will refresh and extend the practitioners' knowledge and understanding of chemical admixtures used in concrete. The two presenters listed below will clearly explain the benefits and limitations of chemical admixtures in concrete for pavements, bridges, and other transportation-related structures. This information will help designers understand the positive and negative effects of various types of admixtures and help construction personnel identify and prepare for possible issues in the field. In addition, a local representative will provide an overview of the particular practices and issues that are most common in the geographic area.

Who Should Attend

The variety of topics covered make this seminar beneficial to a broad range of attendees including DOT engineers, civil engineers, material testing technicians, specifiers, project superintendents, construction supervisors, QA/QC managers, inspectors, contractors, and concrete producers.

Topics to be covered

- Introduction to Chemical Admixtures
- Air Entrainment of Concrete
- Water Reduction and Set-Controlling Admixtures
- Durability-Enhancing Admixtures
- Special Admixtures: Viscosity-Modifying and Rheology-Controlling
- Compatibility Issues Between Chemical Admixtures and Other Concreting Materials
- Admixtures for High-Performance Concrete

Free Resource Materials

- ACI 212.3R, "Chemical Admixtures for Concrete"
- ACI 212.4R, "Guide for the Use of High-Range Water-Reducing Admixtures (Superplasticizers) in Concrete"
- ACI 305R, "Hot Weather Concreting"
- ACI 305.1, "Specification for Hot Weather Concreting"
- ACI 306R, "Cold Weather Concreting"
- ACI 306.1, "Standard Specification for Cold Weather Concreting"
- ACI Education Bulletin E4, Chemical Admixtures for Concrete
- PCA Design and Control of Concrete Mixtures – 14th Edition (Chapter 6)
- Glossary of Terms (from ACI's website)

Chemical Admixtures for Concrete

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Advancing concrete knowledge

Faculty

Two of the following will be your instructors:

Darrell F. Elliot, FACI, is a Technical Service Manager with Buzzi Unicem USA, Metairie, LA, and has over 30 years of experience in the concrete construction industry. He is the Chair of ACI Committee 233, Ground Slag in Concrete, and serves on several ACI committees for mass concrete, materials, certification, and education. He was named an ACI Fellow in 1999. He has served as President of the ACI Louisiana Chapter. He is also an active member of ASTM International, serving on committees for cement, concrete and concrete aggregates, and concrete pipe. He has been an instructor for PCA and NRMCA training programs.

Charles K. Nmai, PhD, PE, FACI, is Manager of Engineering Services at BASF Construction Chemicals, LLC, a leading manufacturer of specialty construction chemicals headquartered in Cleveland, OH. His duties include providing technical leadership and strategic guidance in the marketing of admixtures and high-performance concrete technologies, and troubleshooting concrete problems. He is also actively involved in high-performance concrete technology transfer activities. He is a past member of the ACI Board of Direction and Educational Activities Committee; past Chair of ACI Committees E701, Materials for Concrete Construction, and 222, Corrosion of Metals in Concrete; and a member of numerous ACI, ASTM, and PCI committees.

Celik Ozyildirim, FACI, is a Principal Research Scientist with the Virginia Transportation Research Council in Charlottesville, VA, a division of the Virginia Department of Transportation (VDOT). He received his PhD in civil engineering from the University of Virginia. He has been conducting research in concrete technology for over 30 years. He is active in ACI, ASTM International, and the Transportation Research Board (TRB). Ozyildirim is a past Chair of the TRB section on concrete and member emeritus of TRB Committee AFN10, Basic Research and Emerging Technologies Related to Concrete. He is an instructor in civil engineering at the University of Virginia and is a registered professional engineer in Virginia.

Paul J. Tikalsky, PhD, PE, FACI, is the new Dean for the College of Engineering, Architecture and Technology at Oklahoma State University. He received his BS in civil and environmental engineering at the University of Wisconsin at Madison and his MS and PhD in structural engineering at the University of Texas at Austin. He serves on FHWA's High-Performance Concrete Implementation Task Force and its Concrete Pavement Oversight Group. He has received numerous awards, including Utah Engineering Educator of the year, and is a trained ABET Program Evaluator.

Michelle Wilson is Director of Concrete Knowledge at the Portland Cement Association (PCA), where she is responsible for PCA's education and training programs and technical products covering concrete technology and cement manufacturing. Prior to joining PCA in 1999, she worked for Construction Technology Laboratories. She is a member of ACI Committees 201, Durability of Concrete; 301, Specifications for Concrete; and 311, Inspection of Concrete. She was awarded the prestigious ACI Young Member Award for Professional Achievement in 2008 and received her BS in architectural engineering from Milwaukee School of Engineering, with an emphasis in structural engineering and concrete materials.

Cementitious Materials for Concrete

Cementitious Materials for Concrete

FHWA/ACI
One-day seminar

Location ▸

A facility of your choosing

Registration: 7:45 a.m.
Workshop: 8:00 a.m. - 5:00 p.m.

Continuing Education
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(Photo Courtesy of FIGG Bridge Engineers, Inc., and Tim Davis)

Seminar Overview

This seminar, presented under a cooperative agreement between the Federal Highway Administration (FHWA) and the American Concrete Institute (ACI), will refresh and extend the practitioners' knowledge and understanding of cementitious materials used to make concrete. The presenters will clearly explain the attributes of various cementitious materials that affect performance, design, and construction and how chemical reactions and hydration processes impact the performance of both plastic and hardened concrete. This information will help design personnel select and specify the proper cementitious materials for a particular project and help construction personnel understand and prepare for the field behavior of concrete mixtures containing various cementitious materials. In addition, a local representative will provide an overview of the particular practices and issues that are most common in the geographic area.

Who Should Attend

The variety of topics covered make this seminar beneficial to a broad range of attendees including DOT engineers, civil engineers, material testing technicians, specifiers, project superintendents, construction supervisors, QA/QC managers, inspectors, contactors, and concrete producers.

Topics to be covered

- Cementitious and Pozzolanic Materials
- Cement Manufacturing, Process & Properties
- Cementitious Materials Specifications
- Hydration Mechanisms
- Concrete Properties
- Influence of Cementitious Materials on Concrete
- Regional Issues
- Future Trends

Free Resource Materials

- ACI 211.1, Standard Practice for Selecting Proportions for Normal, Heavyweight and Mass Concrete
- ACI 225R, Guide to the Selection and Use of Hydraulic Cements
- ACI 232.2R, Use of Fly Ash in Concrete
- ACI 233R, Slag Cement in Concrete and Mortar
- ACI 234R, Guide for the Use of Silica Fume in Concrete
- ACI Education Bulletin E3, Cementitious Materials For Concrete
- Integrated Materials and Construction Practices for Concrete Pavements (Chapter 4)
- Glossary of Terms (from ACI's website)

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Darrell F. Elliot, FACI, is a Technical Service Manager with Buzzi Unicem USA, Metairie, LA, and has over 30 years of experience in the concrete construction industry. He is the Chair of ACI Committee 233, Ground Slag in Concrete, and serves on several ACI committees for mass concrete, materials, certification, and education. He was named an ACI Fellow in 1999. He has served as President of the ACI Louisiana Chapter. He is also an active member of ASTM International, serving on committees for cement, concrete and concrete aggregates, and concrete pipe. He has been an instructor for PCA and NRMCA training programs.

David M. Suchorski, PE, FACI, is Senior Technical Services Manager/Sales Manager for the Ash Grove Cement Company, Des Moines, IA, and has over 30 years of experience in the cement and concrete industries. He serves on the ACI Board of Direction and is Chair of ACI Committee 308, Curing Concrete. He is also a member of several ACI committees for materials, concrete, certification, and education. He was named a Fellow of ACI in 2010. He has served as President of the ACI Kansas and Iowa-Minnesota chapters and is a member of the ACI Iowa, Nebraska, and Kansas chapters. He is a licensed professional engineer in Kansas and Wisconsin.

Paul J. Tikalsky, PhD, PE, FACI, is the new Dean for the College of Engineering, Architecture and Technology at Oklahoma State University. He received his BS in civil and environmental engineering at the University of Wisconsin at Madison and his MS and PhD in structural engineering at the University of Texas at Austin. He serves on FHWA's High-Performance Concrete Implementation Task Force and its Concrete Pavement Oversight Group. He has received numerous awards, including Utah Engineering Educator of the year, and is a trained ABET Program Evaluator.

Oscar Tavares has more than of 30 years of knowledge and work experience in the cement and concrete industries. He is experienced in new plant start-up, possesses technical expertise in manufacturing portland cement, and has been involved in new product development and direct sales. He presently runs his own consulting company, Innovative Alternatives LLC, which provides expertise and consulting services to the cement and concrete industries. Tavares holds a BS Degree in chemistry from the University of Texas at El Paso.

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Advancing concrete knowledge

Self-Consolidating Concrete

Self-Consolidating Concrete

FHWA/ACI
One-day seminar

Location ▶

A facility of your choosing

Registration: 7:45 a.m.
Workshop: 8:00 a.m. - 5:00 p.m.

Continuing Education
Attendees receive 0.75 CEUs (7.5 PDHs).

Seminar Overview

This seminar, presented under a cooperative agreement between the Federal Highway Administration (FHWA) and the American Concrete Institute (ACI), will provide highway and transportation personnel with a comprehensive understanding of self-consolidating concrete (SCC). The two presenters listed below will clearly explain how SCC can be used to produce better and more durable concrete in transportation structures. In addition, a local representative will provide an overview of projects in the geographic area that have used SCC and relate their experience working with the material.

Who Should Attend

The variety of topics covered make this seminar beneficial to a broad range of attendees including DOT engineers, civil engineers, material testing technicians, specifiers, project superintendents, construction supervisors, QA/QC managers, inspectors, contractors, and concrete producers.

Topics to be covered

- History and Basic Overview
- Standardization Efforts and SCC Test Methods
- Materials and Mixture Proportioning Considerations
- Fresh and Hardened Properties of SCC
- Applications and Economic Benefits of SCC
- SCC in Drilled Shaft Construction
- Constructibility Issues/Formwork Pressure
- Specification Considerations

Faculty

Charles Nmai, PhD, PE, FACI, is Manager of Engineering Services at BASF Construction Chemicals, LLC, a leading manufacturer of specialty construction chemicals headquartered in Cleveland, OH. His duties include providing technical leadership and strategic guidance in the marketing of admixtures and high-performance concrete technologies, and troubleshooting concrete problems. He is also actively involved in high-performance concrete technology transfer activities. He is a Fellow of ACI; a past member of the ACI Board of Direction and Educational Activities Committee; Past Chair of ACI Committees E701, Materials for Concrete Construction, and 222, Corrosion of Metals in Concrete; and a member of other ACI, ASTM, and PCI committees.

Anton K. Schindler, PhD, PE, is the Gottlieb Associate Professor at Auburn University where he teaches courses in engineering mechanics, structural design, and concrete materials in the Civil Engineering Department. He received his MS and PhD in civil engineering from The University of Texas at Austin. He is a member of TRB's Technical Committee AFN20, Properties of Concrete, and a member of ACI Committees 231, Properties of Concrete at Early Ages, and 237, Self-Consolidating Concrete. He was a panel member on NCHRP Project 18-12 "Self-consolidating concrete for precast, prestressed concrete bridge elements." He is an active member of ACI, TRB, ASCE, RILEM, and ASTM and received ACI's Wason Medal for Concrete Materials Research in 2006.

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Questions?

- Contact info

Michael.Praul@dot.gov

207-512-4917