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MCTC and Emerging Concrete Technology

38th Annual Local Roads Conference (Sioux Falls, SD)
October 17, 2023

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Senior Concrete Engineer
FHWA, Office of Infrastructure

U.S. Department of Transportation
Federal Highway Administration

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Mobile Concrete Technology Center

- Funded by the Accelerated Implementation and Deployment of Pavement Technologies Program
- Unique
- Program evolves to meet stakeholder needs

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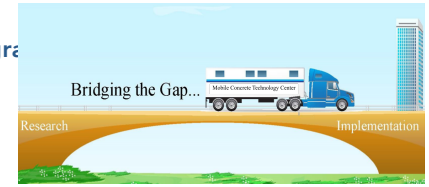
MCTC Program Mission

- Implement new & under-used concrete technologies
- Demonstrate benefits of performance specifications in both agency quality assurance (QA) programs & industry quality control (QC) applications
- Advance States' concrete progra
  - Specification review
  - Technical assistance
  - Training
  - Troubleshooting
- Better concrete



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Program Activities

- Field visits to active construction projects
- Quality in the Concrete Paving Process workshops
- Equipment Loan Program
- Technical assistance/specification reviews
- Conferences/Open houses
- Support TFHRC and other research
- Publications to promote the FHWA concrete program and advance

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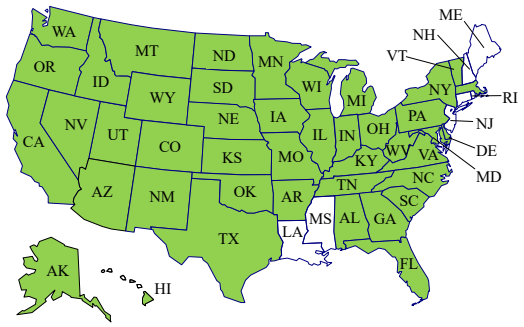
MCTC Field Visits (since 2008)



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Quality in the Concrete Paving Process Workshop

- Two-day workshop on concrete materials and construction
- Builds off data and observations from field visit and specification review
- Agency and industry participation (50/50)
- Goal: Action plan

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Caltrans Success Story

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Equipment Loan Program

- Agencies or industry can borrow MCTC equipment
- MCTC staff will provide training, if interested
- Contact me/Jagan if interested

Use of PEM/PP 84 (AASHTO R101) is not a Federal requirement.

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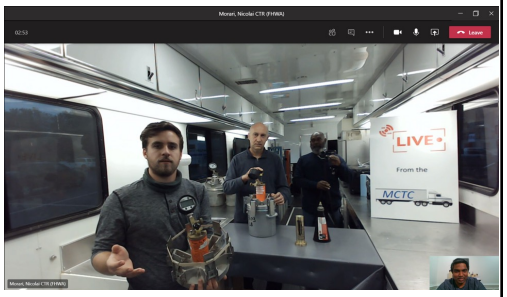
"Live From the MCTC" Training/Workshops

- Super Air Meter (SAM)
- Surface/Bulk Resistivity
- Maturity
- Box Test/V-Kelly
- Semi-adiabatic calorimeter
- Phoenix (fresh water content)
- Pulse Induction Technology (MIT-SCAN-T3)
- MIT-DOWEL-SCAN
- HIPERPAV®
- Optimized Gradation software



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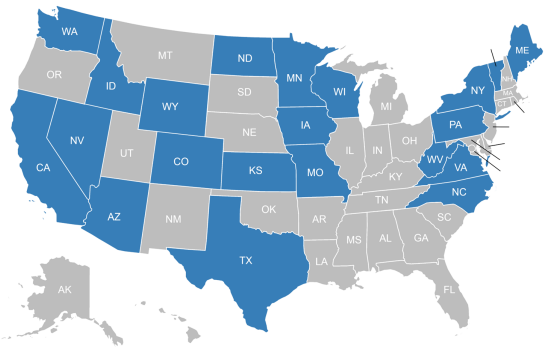
MCTC Virtual Sessions (2020-2021)



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Technology Tour Across Ohio

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College Program

- Practical Applications of Quality Control
- Concrete Testing Technologies
- FHWA Mobile Concrete Technology Center and Performance Engineered Mixtures

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College Program

Completed

- Virginia Military Institute
- Ohio State University
- Ohio Northern University
- Case Western Reserve
- Clarkson University
- Rensselaer Polytechnic Institute
- University of Connecticut

Planning

- Cleveland State University
- Auburn University
- Middle Tennessee State
- University of Nebraska

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One Pager Series

- Use MCTC data and experiences
- Narrowly focused
- Meant to stir interest and point reader to resourc

- 1st: Cement content
- 2nd: Optimized Mix Design
- 3rd: Cores vs. Cylinders
- 4th: NDT Pavement Thickness
- 5th: Tining/Surface Texture
- 6th: Surface Resistivity Test
- 7th: Maturity
- 8th: Curing
- 9th: SCM's
- 10th: Calorimetry
- 11th: Workability
- 12th: Air Entrainment
- 13th: Stringless Paving
- 14th: Water Reducing Admixtures

www.fhwa.dot.gov/pavement/concrete/trailer/resources

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Let's Get To the Fun Stuff! 5 Things To Make You Think

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1. Optimized Gradation

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Performance Engineered Mixtures and Sustainability

Ways to Optimize Cement Content

- Performance-type specifications; eliminate mandatory minimum cement content requirements
- Optimize aggregate gradation
- Use supplementary cementitious materials
- Use maturity to determine opening times
- Quality control during production to

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Optimized Gradation Tool

- Spreadsheets available for structural or paving applications.

Wisconsin					
Sieve Size, in	Fine 1 Agg	Fine 2 Agg	Inter Agg	Coarse Agg	Combined % Passing
2"	100		100	100	100
1.5"	100		100	93	99
1"	100		100	39	91
3/4"	100		98	5	85
1/2"	100		55	1	67
3/8"	100		33	1	58
No. 4	98		3	0	45
No.8	85		1	0	39
No.16	68		1	0	31
No.30	38		1	0	18
No.50	9		1	0	5
No.100	2		1	0	1
No.200	1		1	0	1
Weights					
%'s	45%		40%	15%	100%

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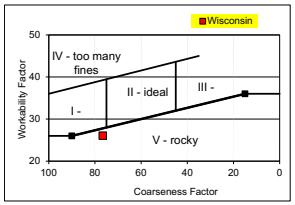
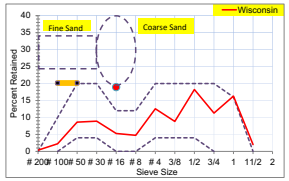
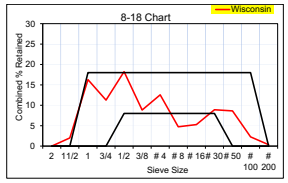
Too Coarse

Wisconsin				
Sieve Size, in	Fine 1 Agg	Fine 2 Agg	Inter Agg	Coarse Agg
%'s	30%		40%	30%







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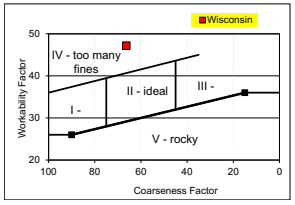
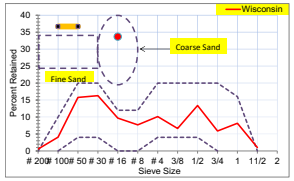
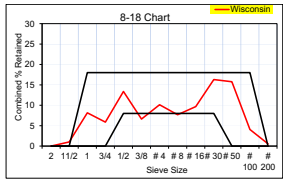
Too Fine

Wisconsin				
Sieve Size, in	Fine 1 Agg	Fine 2 Agg	Inter Agg	Coarse Agg
%'s	55%		30%	15%







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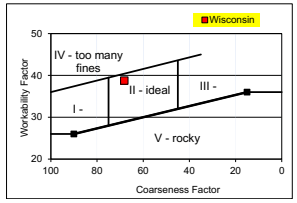
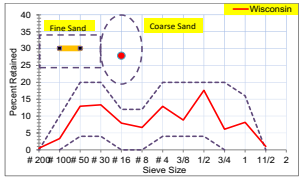
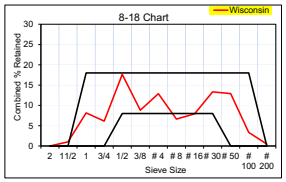
Optimized?

Wisconsin				
Sieve Size, in	Fine 1 Agg	Fine 2 Agg	Inter Agg	Coarse Agg
%'s	45%		40%	15%







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Changes in Slump Test

100 Years ago

Today

What has changed?

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Box Test and VKelly

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Phoenix vs. Microwave Water Content

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3. 56-day Testing

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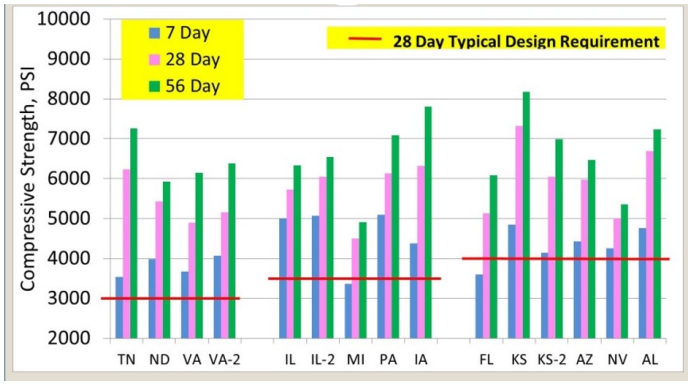

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Concrete Acceptance Practices

- How do we accept concrete?
  - Slump
  - Strength
  - Total air
  - Temperature
  - Thickness
  - Ride
- How do we adjust price?
  - Strength

Lower Right Image: Pixabay

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The Great 28

- Wrong time
- Wrong cementitious system
- Implications
  - Cost
  - Durability
  - Deck Cracking

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New specification

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4. PWL For Strength

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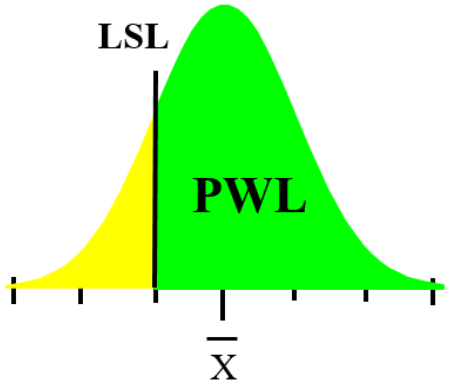
PWL – Concrete Strength



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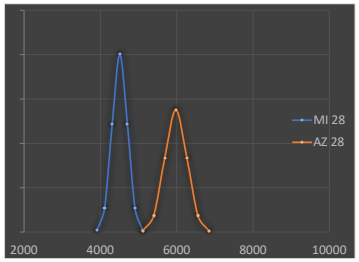
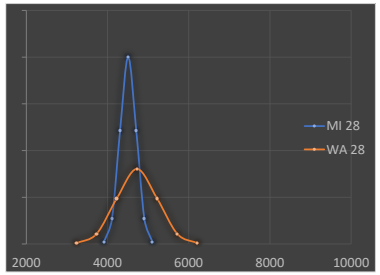
States With PWL Requirements

- 28 Day Strengths
- Lower Variability
- Lower Average Strength





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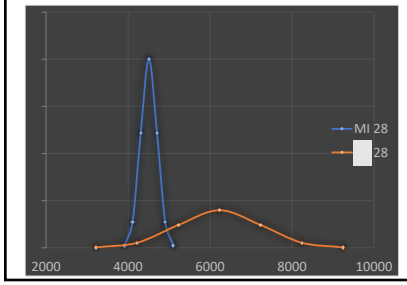
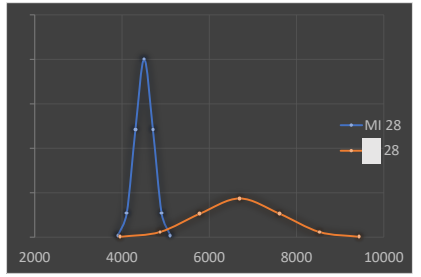
States Without PWL requirements

- 28 Day Strengths
- Higher Variability
- Higher Average Strength





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5. Specify Quality Control

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Better Assessment of Quality?

Option 1

- QC Info: None
- Strength
- Slump
- Total Air

Option 2

- QC Info:
  - Unit weight
  - Calorimetry
  - Water content (Phoenix)
- Resistivity
- Strength
- SAM number*
- Box/Float Test*

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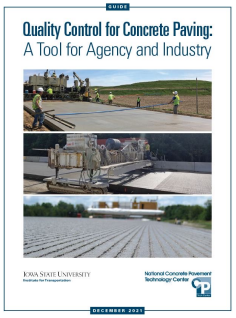
New!

- Guidance to leverage QC in agency specifications
- Model QC Plans (format and language)
- QC guidance for contractors
  - Establishing a QC program
  - Evaluating and improving an existing QC program
- Statistical tools
- Available on the National Concrete Pavement Technology Center website (https://bit.ly/3uurMJV)
- Tech Briefs and training



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TAC Roster

State Agencies	Contractors	Industry/Associations
Maine DOT – Rick Bradbury	Rieth-Riley – Pete Capon	ACPA – Leif Wathne, Gary Mitchell
Michigan DOT – John Staton	Cedar Valley – Craig Hughes	NRMCA/RMCREF – Colin Lobo
Ohio DOT – Dan Miller	AJAX – Hugh Luedtke	PCA – Paul Tennis
Iowa DOT – Todd Hanson	Duit Construction – John Privat	WCPA – Kevin McMullen
Minnesota DOT – Maria Masten		**FHWA**
Illinois Tollway – Cindy Williams		Mike Praul, Bob Conway, Sam Tyson, Dennis Dvorak, Jeff Withee

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Questions?

Image Pixabay

Contact info:

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207-458-8823

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