CPTech Center 2024

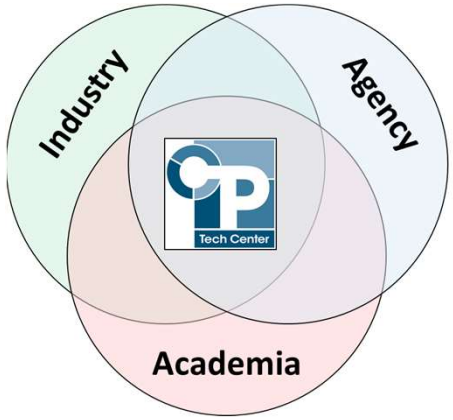
Peter Taylor

IOWA STATE UNIVERSITY
Institute for Transportation

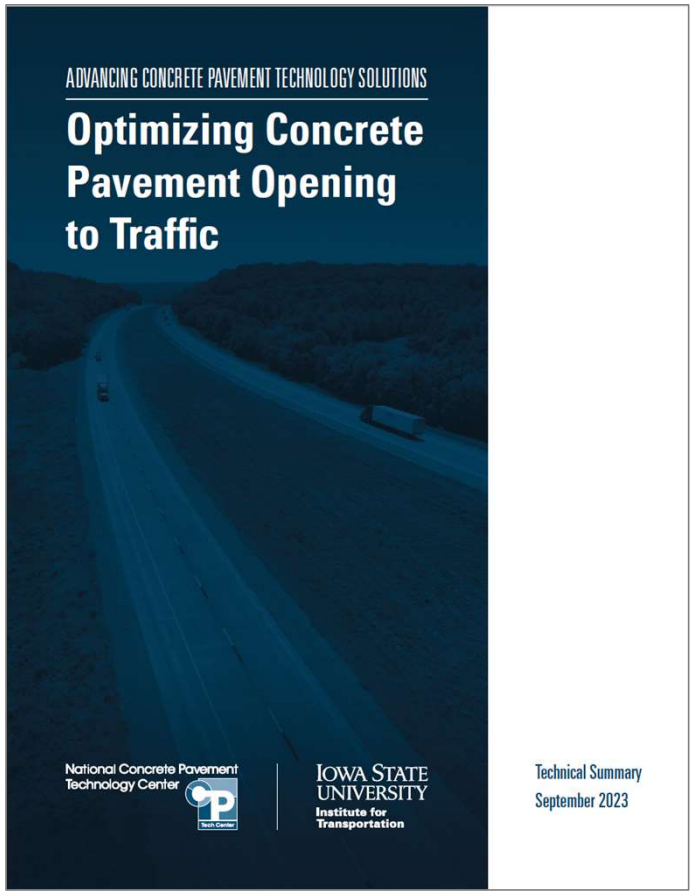
National Concrete Pavement
Technology Center
CP Tech Center

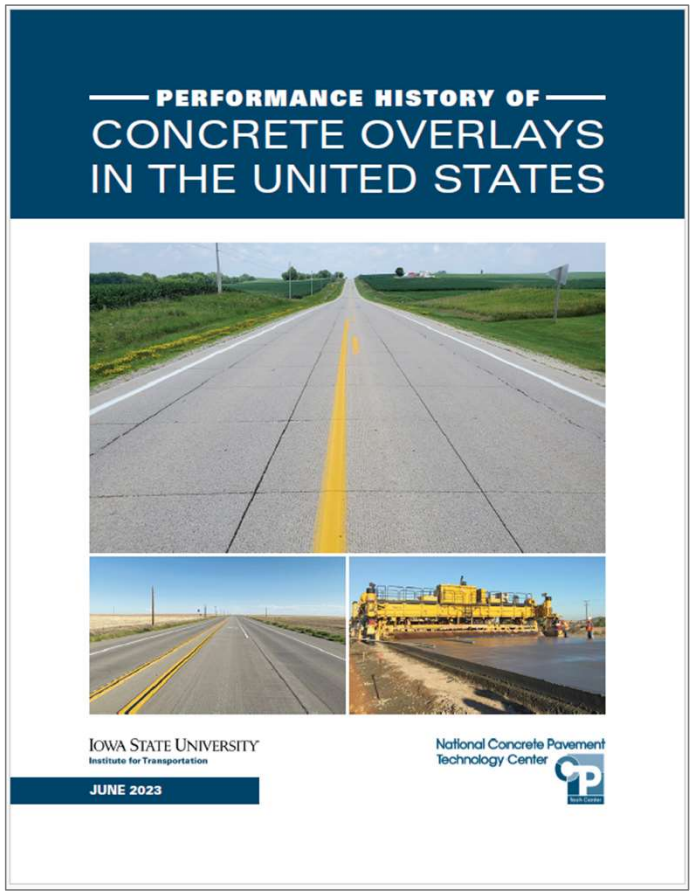
What Are We There For?

- To help you…
  - Make great concrete pavements
  - Solve problems
  - Try out new ideas



Publications



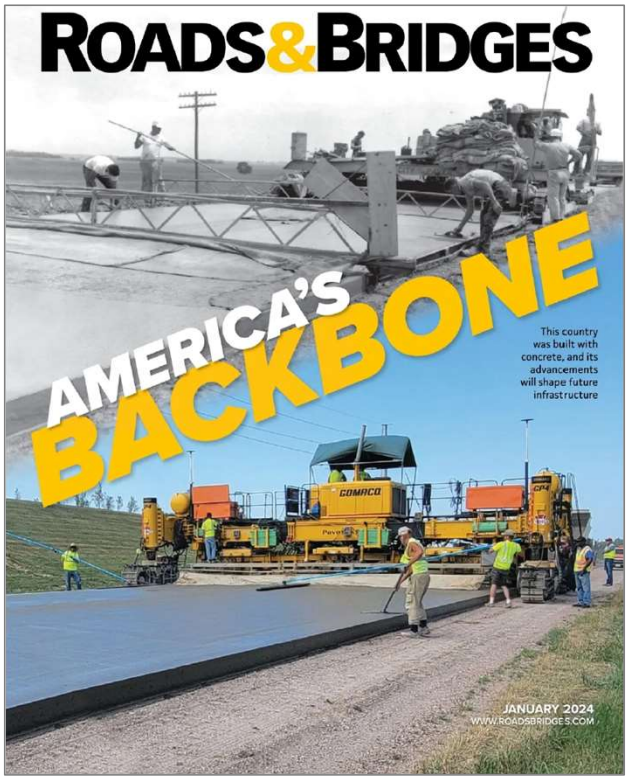


Publications

Tech Briefs

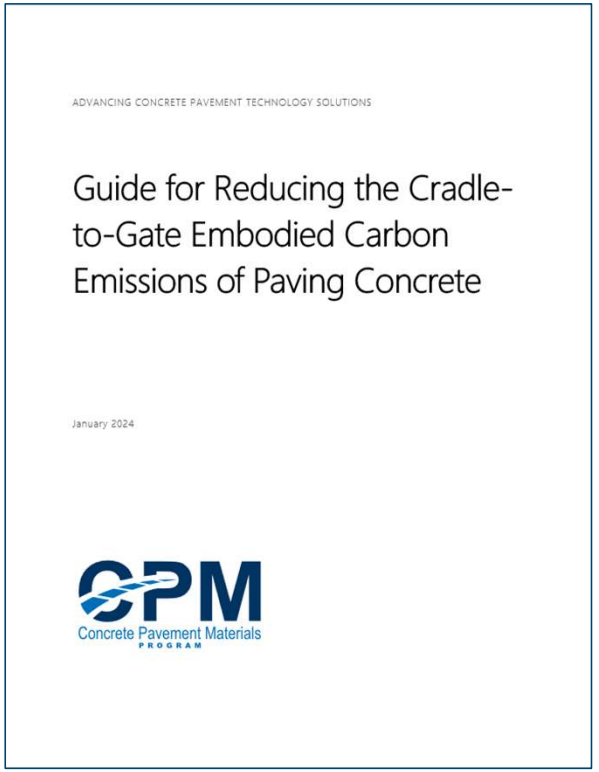
- Revisiting Concrete Scaling
- Climate Change, Resilience, and Concrete Pavements

Magazine Articles



Publications

- On the way…
  - Recommended Practice for Quality Assurance of Portland Cement Concrete
  - Overlay repairs
  - Achieving and measuring the foundations that meet design support requirements
  - Overview of LC3, Blended Cements and Alternative Supplementary Cementitious Materials



Videos


Concrete Overlays
IOWA STATE UNIVERSITY
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National Concrete Pavement
Technology Center
03:28


Reclaimed Fly Ash
In Highway Infrastructure
04:38

AASHTO

- T 413 Maturity for pavements – new method
- T 395 SAM - precision and bias
- T 358 and T 402 Resistivities - precision and bias
- T 403 VKelly – full standard

Tech Support

- 180 contacts spread across agency, industry and academia

Admixture question	Overlay on faulted concrete
Albedo testing	PLC
ASR	Preservation
Buckling	Proportioning tool
Curing	Rain
Early opening	Recycling info
EPDs	Roundabout jointing
Fabric interlayer	Sawing specifications
Failed patches	Scaling
Fiber-reinforced concrete	Shrinkage
Geotextile	Slab cracking
Hail damage	Spalling
Heavy truck design	Specification
Heritiage repair	Surface sealers
Low Air	Trails

Tech Tuesday Webinars

Date	Topic	Attendees	Countries
11/14/2023	Low carbon Concrete	237	11
10/10/2023	Cold weather	350	5
9/12/2023	Smoothness	320	5
8/8/2023	Performance cements	176	9
7/18/2023	Stabilization	315	13
6/13/2023	LCCA	370	15
5/9/2023	Preservation	416	11
4/25/2023	FAA Specifications	385	13
3/14/2023	P3C	287	5

Tech Tuesday Webinars

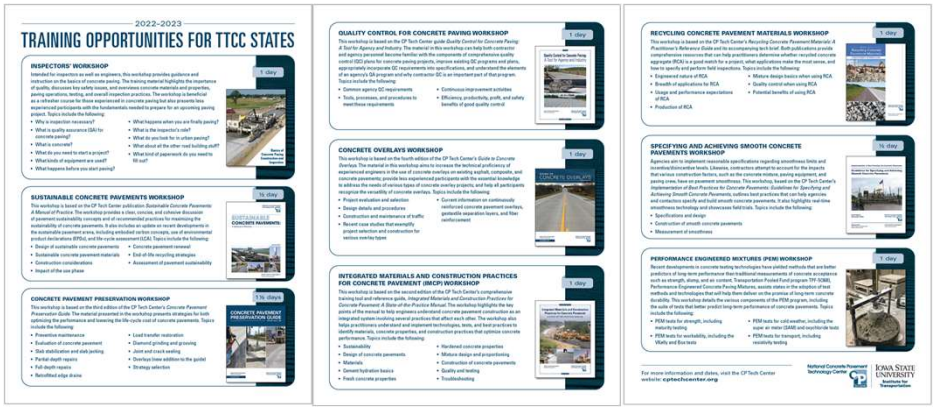
- Future ideas
  - Low carbon AASHTO guide
  - Pavement foundations
  - Ultra-smooth concrete
  - Roundabouts
  - Jointing
  - Dowels - Best practices
  - Construction while maintaining traffic
  - CPR for thin overlays
  - Authority of the Engineer
  - Engineering Ethics..

Lunch and Learn Program

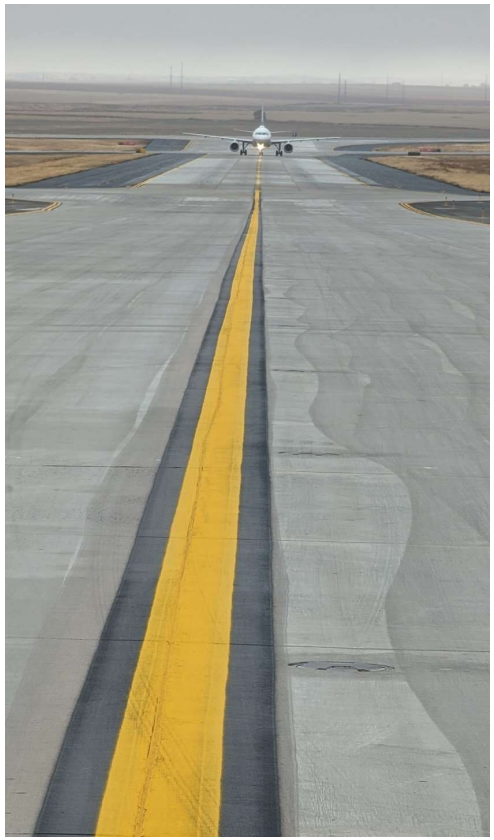
- Concrete Roundabout Design and Construction
  - Thursday, February 1 — Cedar Rapids
  - Friday, February 2 — Ankeny
  - Friday, February 16 — Iowa City
  - Wednesday, February 28 — Council Bluffs
  - Thursday, February 29 — Waterloo
  - Friday, March 1 — Davenport

TTCC Workshops

• Bridge Deck Curing	Utah
• Concrete Preservation	Idaho
• Inspector’s	North Dakota, South Dakota, Alabama
• Quality Control Workshop	Illinois Tollway, Texas
• PEM & IMCP	West Virginia
• Concrete Preservation	Pennsylvania
• Concrete Roundabouts	Minnesota
• Concrete Overlays	Wisconsin
• Recycled Concrete Aggregates	Colorado



Cool Places!



Cool Places!

FHWA Coop

- Tasks completed

Task	Deliverable
Fly Ash Tech Brief	Tech Brief
Fly Ash PowerPoint	PowerPoint
Use of RCA in Concrete Mixtures Tech Brief	Tech Brief
QC Manual (QC control charts in appendix)	Manual
PEM testing one pagers	One page summaries
Precision & Bias testing for SAM	Summary report
AASHTO P&B statement for SAM	AASHTO P&B statement
AASHTO P&B statement on resistivity	AASHTO P&B statement
Update Preservation Guide &PPT	Guide
Update Overlay Guide	Guide
History of Overlays	Tech Summary
Precast PPT (for Concrete P&M TFG)	PPT
Fly Ash PPT (for Concrete P&M TFG)	PPT
Fly ash video	video
Overlay video	video
CPMTFG	meeting/notes
CPMTFG	2 additional meetings/notes

Communication dev CPM program	Branding - CPM
Concrete Overlays: Value Proposition	Tech Summary
Concrete Overlays: Proven Technology	Tech Summary
Optimizing Opening	Tech Summary
Optimizing Opening	PPT
Tech Brief: Resources for Selection, Design, and Construction of Concrete Overlays	Tech Brief
EDC-6 Six one-pagers	One page summaries
EDC-6 Case study: Alabama, Delaware, Florida, Arkansas, Virginia, Illinois, Iowa, Missouri	Case Studies
EDC-6 Case study: Kansas, Oregon	Case Studies
PPT: A solution for extending the life of an existing pavement investment	PowerPoint
Review of TOPS workshop & attend California	Review
Pavement Maturity	AASHTO test method
Non-contact Accoustic Array	report

FHWA Coop

- Tasks still due by Dec 24

Construction Byproducts Tech Brief	Tech Brief
Use of Industrial Waste Byproducts Tech Brief	Tech Brief
Foundations Design Tech Brief	Tech Brief
Concrete Pavement Foundation Verification Demonstrations	3 demos. Project case history/ Tech Briefs
Case Studies on Long Lasting Pavements built using PLCs	2 Case Studies
Overview of LC3 & Other Blended Cements	Tech Summary & PPT
Alternative SCMs	Tech Brief & PPT
QC Tech Brief 1: QC Plans for Concrete Paving	Tech Brief
QC Tech brief 2: QC for Concrete Paving with PEM	Tech Brief
QC Tech brief 3: QC Tools for Concrete Paving	Tech Brief
QC Tech brief 4:Agency Approaches to QC for Concrete Paving	Tech Brief
QC Workshops & presentations	
P&B testing for resistivity	testing
P&B report on resistivity testing	Summary report
P&B testing BOX and Vkelly	testing
P&B report on Box and Vkelly testing	Summary report
AASHTO P&B statement on Box	AASHTO statement
AASHTO P&B statement on VKelly	AASHTO statement
PEM model spec language	Summary report

PEM model spec language	Summary report
Carbon Footprint Evolution	Report
Guide for Reduced Embodied Carbon	AASHTO guide
PEM Implementation	Update R101 Successes web page
PEM Workshops/presentation	
Standarized LCA for Pavements	White paper
CaOXY Evaluation	Tech Brief
P3C	ETG meeting
Concrete for Other than States	6 case studies How to Guide for non-state agencies
Truck Corridors	White concept paper Case study and PPT
Resilience strategies: Challenges & Case study on changes	2 Tech Briefs
Preservation Workshops/webinars	
Overlay Workshops/webinars	
Concrete Overlay Repairs	Tech Brief and PPT
Technical Assistance	
Webinars	
Workshops on Overlays	
CPMTFG	1 more meeting
Shrinkage	Summit & notes
Task force group meetings	3 groups: subjects TBD

Field demos	2 field demos on PEM
Project Streamlining/Acceleration	Tech Summary
EDC-6 Case study: Colorado	Case Studies
Iowa Case Study	Report
Pavement Maturity	PPT for presentations
Maintenance of Traffic	3 case studies Decision Tree Tech Brief/PPT
Real Time Smoothness: 6 demo projects	Construction reports
Real Time Smoothness: 2 more demos	Const reports State of practice and value prop
Air Void Measurement Device SWAM	Report

FHWA Coop

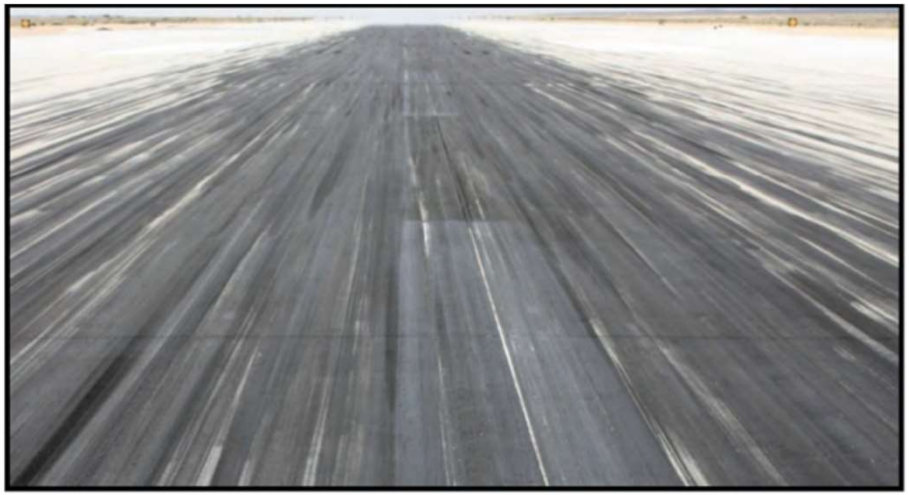
- Instant Air Meter
  - Test takes seconds
  - Can run on a pile of concrete

  - * Needs work

FAA Coop

Underway

- ASR
- PEM
- Rapid repair
- Quality
- Rubber removal
- Diamond grinding
- Thin airfield concrete pavements
- Paving continuity



FAA Coop

In preparation

- Resilience
- Acceptance criteria
- Load transfer and dowels

To come

- Heat resilience
- Shrinkage and design
- ASR field site

ACPTP
Airport Concrete Pavement Technology Program

FAA Coop

- Workshops
  - Mankato, MN
  - Indianapolis, IN
  - Denver, CO
  - Hershey, PA
- Tech Briefs
  - Reduced carbon
  - New materials

Research

- Performance Centered Concrete Construction (P3C)

What should be measured on site?

- Workability
- w/cm
- Air
- Segregation
- Consolidation
- Thickness
- Finish
- Smoothness
- Curing
- Saw Time
- Joint Activation
- Opening

Why?
When?
How?

Research

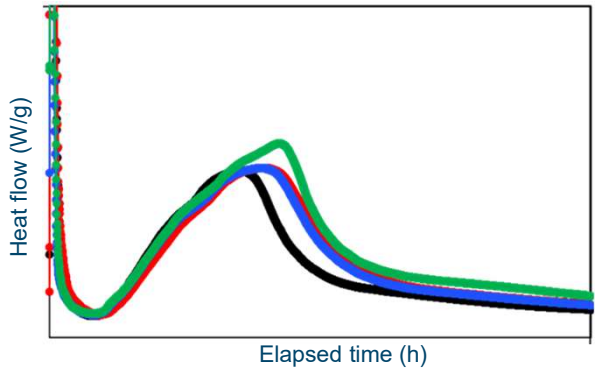
- VKelly
  - Make the test more user friendly and portable
  - Understand the science behind the method
  - Guide mixture proportioning and field operations
  - Broaden the applicability to include structural and pumping mixtures

Research

- Vibration
- Evaluate Effects of Vibration on Various Concrete Mixtures
- Effect of Vibrator variables
- Improved Vibrator Monitors
- Field Demonstration

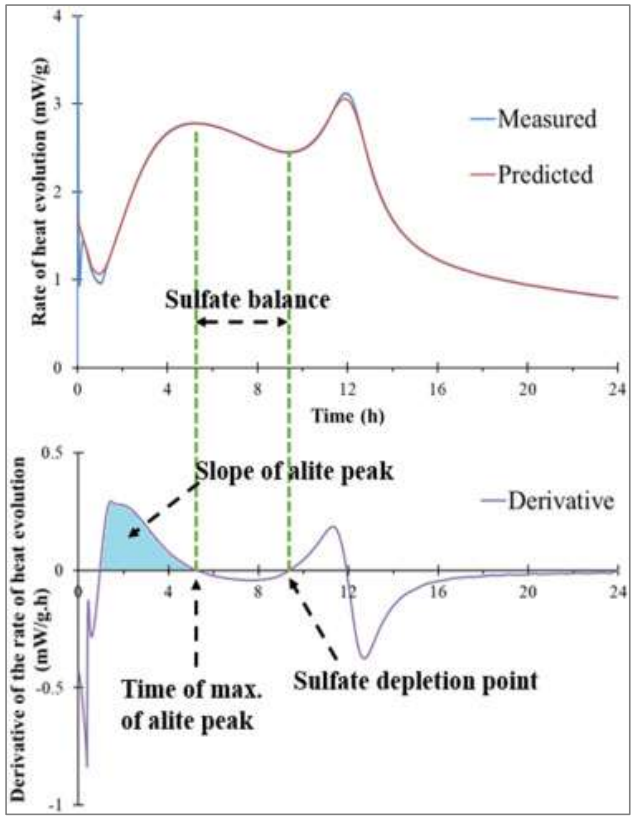
Research

- Super Absorbent Polymers for internal curing
  - How to specify SAP products
  - Determine the required quantity
  - Evaluate the feasibility of dry batching with additional water
  - Assess the impact of the optimized SAP on concrete performances, including strength and durability.



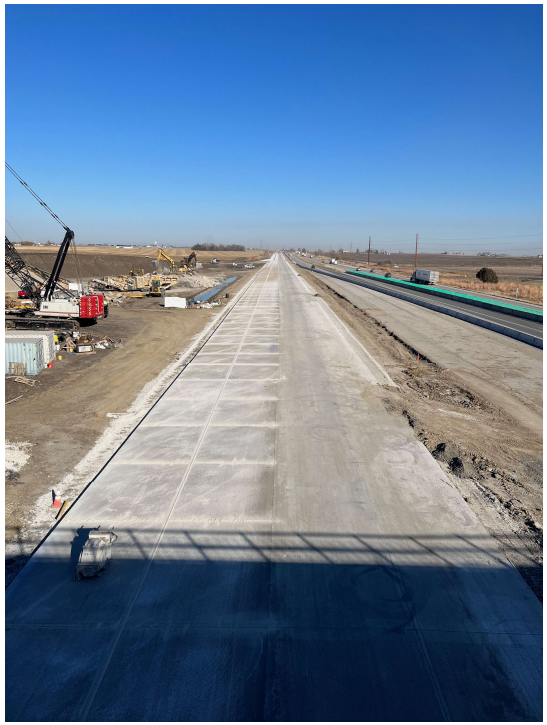
Research

- CC·I·L Cement
  - Investigate low carbon cement
  - Characterize materials
  - Optimize blends
  - Test
  - Field evaluation



Research

- Climate Challenge
  - Understand what is involved with requiring contractors to produce EPDs
  - How to use that information
  - Understand how the embodied-impacts analysis compares to a life-cycle analysis



Research

- Joint Sawing
  - Literature review
  - Survey of agencies, contractors, and sawing equipment providers to establish best practices
  - Perform a field investigation of local issues
  - Produce a guide on best practices

Research

- Fibers in overlays
  - Re-visit existing test sections
  - Make a complete assessment of performance indicators
  - Understand the contribution of fibers to concrete overlay field performance
  - Improve concrete overlay design procedures

Research Ideas

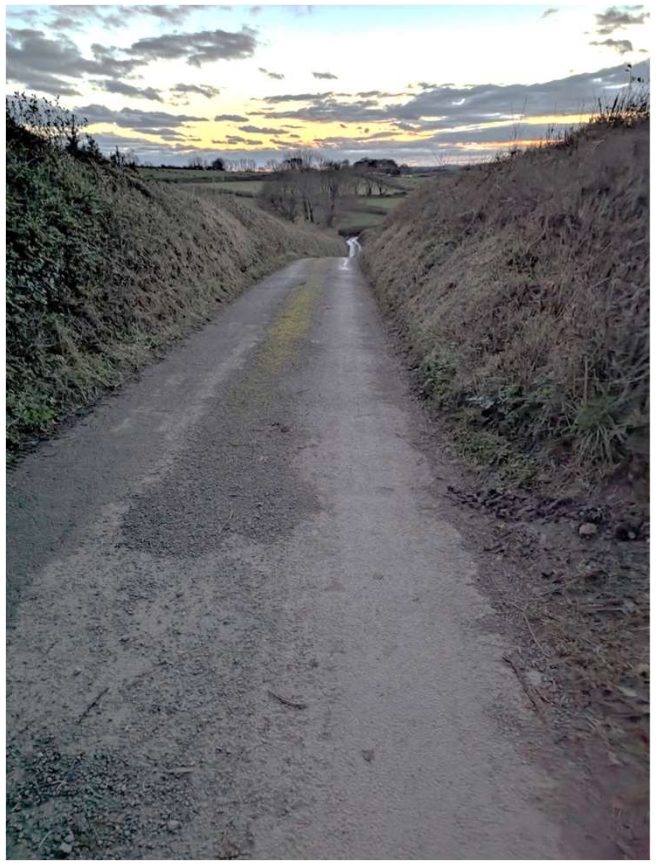
- Evaluation protocol for new cements
- Buckling
- Pumping and air
- Noise in fabric overlays

CP Tech Focus Areas

- Sustainability
- Resilience

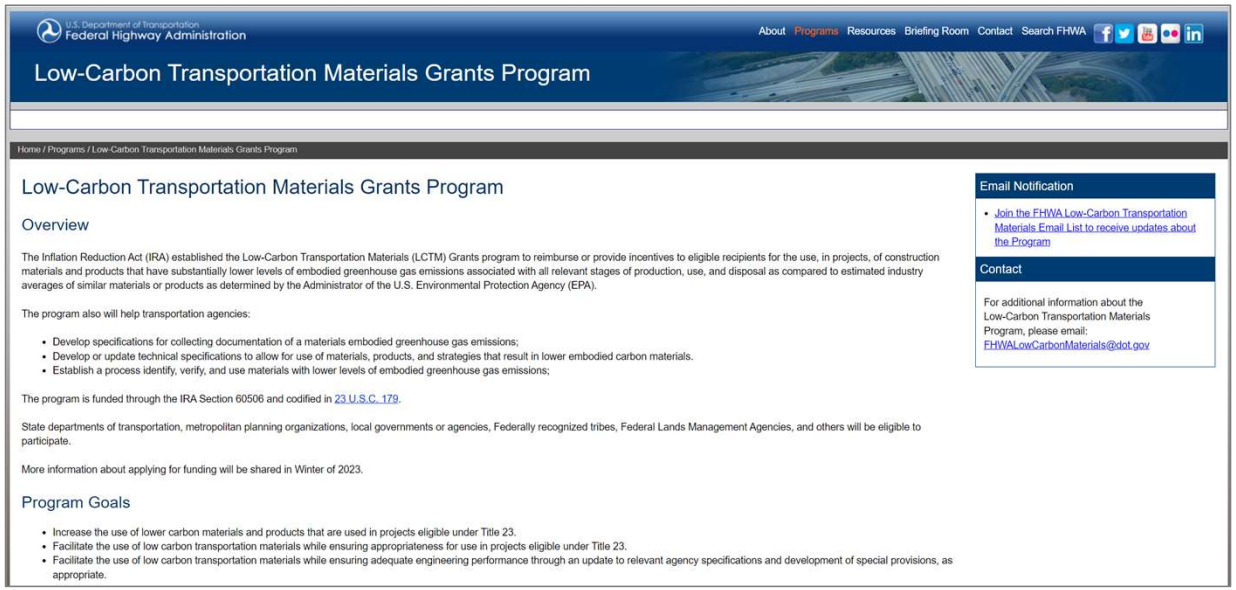
But we must not forget…

- Constructability
- Durability
- Overlays



Sustainability

- IRA Resources
- RC3 Support



U.S. Department of Transportation
Federal Highway Administration

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Low-Carbon Transportation Materials Grants Program

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Low-Carbon Transportation Materials Grants Program

Overview

The Inflation Reduction Act (IRA) established the Low-Carbon Transportation Materials (LCTM) Grants program to reimburse or provide incentives to eligible recipients for the use, in projects, of construction materials and products that have substantially lower levels of embodied greenhouse gas emissions associated with all relevant stages of production, use, and disposal as compared to estimated industry averages of similar materials or products as determined by the Administrator of the U.S. Environmental Protection Agency (EPA).

The program also will help transportation agencies:

- Develop specifications for collecting documentation of a materials embodied greenhouse gas emissions;
- Develop or update technical specifications to allow for use of materials, products, and strategies that result in lower embodied carbon materials.
- Establish a process identify, verify, and use materials with lower levels of embodied greenhouse gas emissions;

The program is funded through the IRA Section 60506 and codified in 23 U.S.C. 179.

State departments of transportation, metropolitan planning organizations, local governments or agencies, Federally recognized tribes, Federal Lands Management Agencies, and others will be eligible to participate.

More information about applying for funding will be shared in Winter of 2023.

Program Goals

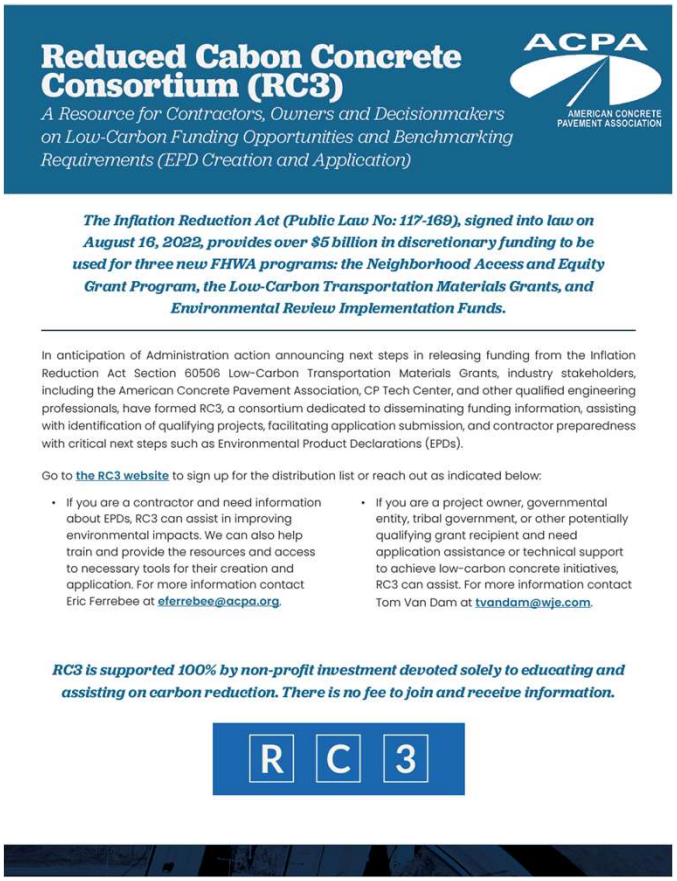
- Increase the use of lower carbon materials and products that are used in projects eligible under Title 23.
- Facilitate the use of low carbon transportation materials while ensuring appropriateness for use in projects eligible under Title 23.
- Facilitate the use of low carbon transportation materials while ensuring adequate engineering performance through an update to relevant agency specifications and development of special provisions, as appropriate.

Email Notification

- Join the FHWA Low-Carbon Transportation Materials Email List to receive updates about the Program

Contact

For additional information about the Low-Carbon Transportation Materials Program, please email: FHWALowCarbonMaterials@dot.gov



Reduced Cabon Concrete Consortium (RC3)

A Resource for Contractors, Owners and Decisionmakers on Low-Carbon Funding Opportunities and Benchmarking Requirements (EPD Creation and Application)

ACPA
AMERICAN CONCRETE PAVEMENT ASSOCIATION

The Inflation Reduction Act (Public Law No: 117-169), signed into law on August 16, 2022, provides over $5 billion in discretionary funding to be used for three new FHWA programs: the Neighborhood Access and Equity Grant Program, the Low-Carbon Transportation Materials Grants, and Environmental Review Implementation Funds.

In anticipation of Administration action announcing next steps in releasing funding from the Inflation Reduction Act Section 60506 Low-Carbon Transportation Materials Grants, industry stakeholders, including the American Concrete Pavement Association, CP Tech Center, and other qualified engineering professionals, have formed RC3, a consortium dedicated to disseminating funding information, assisting with identification of qualifying projects, facilitating application submission, and contractor preparedness with critical next steps such as Environmental Product Declarations (EPDs).

Go to **the RC3 website** to sign up for the distribution list or reach out as indicated below:

- If you are a contractor and need information about EPDs, RC3 can assist in improving environmental impacts. We can also help train and provide the resources and access to necessary tools for their creation and application. For more information contact Eric Ferrebee at **eferrebee@acpa.org**.
- If you are a project owner, governmental entity, tribal government, or other potentially qualifying grant recipient and need application assistance or technical support to achieve low-carbon concrete initiatives, RC3 can assist. For more information contact Tom Van Dam at **tvandam@wje.com**.

RC3 is supported 100% by non-profit investment devoted solely to educating and assisting on carbon reduction. There is no fee to join and receive information.

R C 3

Reducing Carbon

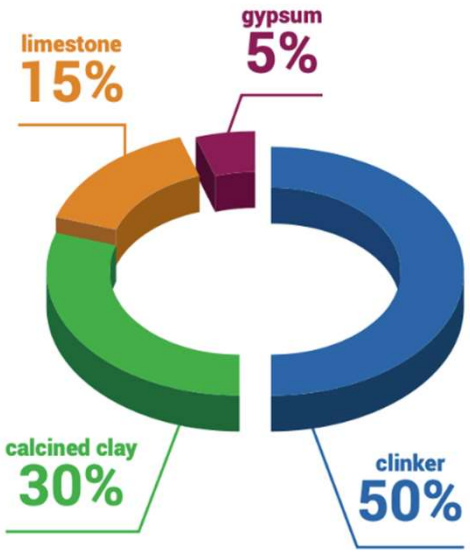
- What can we do to reduce impact?
  - Use concrete efficiently
  - Use binder efficiently
  - Use clinker efficiently
  - Reduce construction impacts
  - Reduce user fuel consumption

Portland Limestone Cements (ASTM C 595)

- Up to 15% ground limestone
- Similar performance

But Wait – There's More

- Harvested fly ash
- LC3
- 50% clinker
- Other powders



Impacts

- Sensitivity to materials variability may be changed
  - “Low cement mixtures are delicate!”
- Design assumptions may need to change
  - Shrinkage
  - Modulus of elasticity

Impacts

Properties will change

- Setting time
- Bleed
- Strength development

Construction practices may need to change

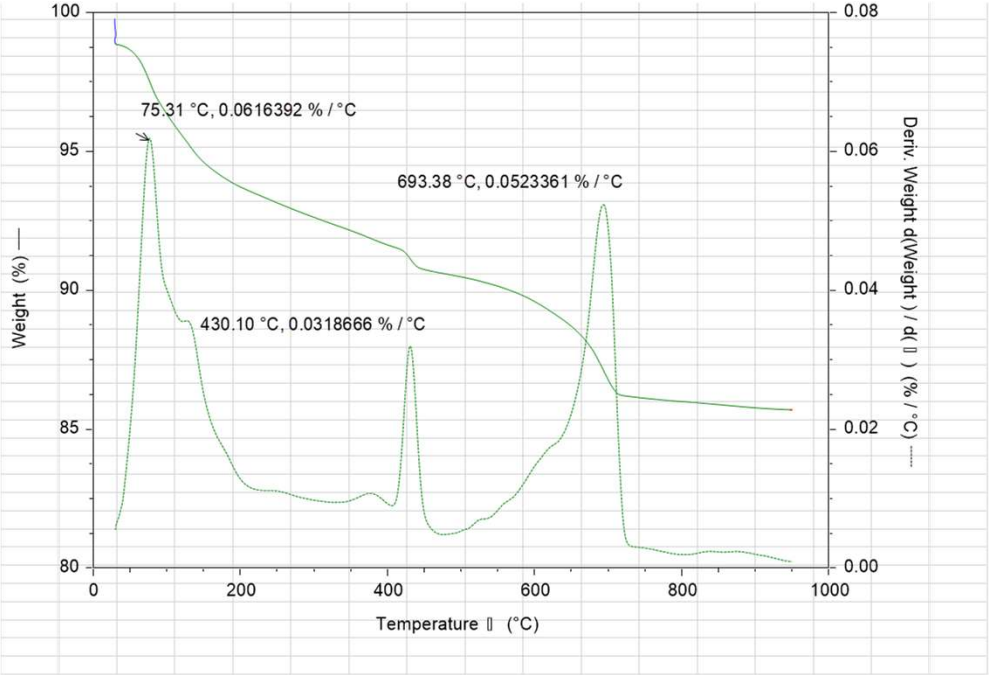
- Finishing
- Curing
- Sawing

Impacts

- Costs of trials
- Costs of slower construction
- Costs of changing risks
- Are the current specs appropriate?

I have to know what's in it

- How good is your chemistry?



Or…I have to know what it does

- But what?
  - Are we specifying the right things for cements?
    - Set time
    - Strength gain
    - HOH
    - Sulfate expansion
    - Autoclave
    - Air
  - Is anything missing?
    - Permeability
    - Shrinkage
  - Or do we worry about the concrete?

TABLE 1 Standard Physical Requirements

Cement Type	Applicable Test Method	GU	HE	MS	HS	MH	LH
Fineness	C204, and C430 or C1891	A	A	A	A	A	A
Autoclave length change, max, %	C151/C151M	0.80	0.80	0.80	0.80	0.80	0.80
Time of setting, Vicat test[B]	C191						
Initial, not less than, minutes		45	45	45	45	45	45
Initial, not more than, minutes		420	420	420	420	420	420
Air content of mortar volume, max, %[C]	C185	12	12	12	12	12	12
Compressive strength minimum, MPa [psi][D]	C109/C109M						
1 day		...	12.0 [1740]	...	...	...	...
3 days		13.0 [1890]	24.0 [3480]	11.0 [1600]	11.0 [1600]	5.0 [725]	...
7 days		20.0 [2900]	...	18.0 [2610]	18.0 [2610]	11.0 [1600]	11.0 [1600]
28 days		28.0 [4060]	...	...	25.0 [3620]	...	21.0 [3050]
Heat of hydration, max, kJ/kg [cal/g]	C1702						
3 days		...	...	...	...	335 [80]	200 [50]
7 days		...	...	...	...	...	225 [55]
Mortar bar expansion	C1038/C1038M						
14 days, % max		0.020	0.020	0.020	0.020	0.020	0.020
Sulfate expansion (sulfate resistance)[E]	C1012/C1012M						
6 months, max, %		...	...	0.10	0.05	...	...
1 year, max, %		...	...	...	0.10	...	...
Optional Physical Requirements							
Option A—Air entraining[C,F]	C185						
Air content of mortar, vol %							
max		22	22	22	22	22	22
min		16	16	16	16	16	16
Option R—Low reactivity with alkali-silica-reactive aggregates[G]	C227						
Expansion at							
14 days, max, %		0.020	0.020	0.020	0.020	0.020	0.020
56 days, max, %		0.060	0.060	0.060	0.060	0.060	0.060
Early stiffening, final penetration, min,%	C451	50	50	50	50	50	50
Compressive strength,[D] 28 days, min, MPa	C109/C109M	...	...	28.0	...	22.0	...

Where next?

- Learning and thinking required
- Target the properties you need
- Do those trial batches
- Stay away from the cliff edge

- Enjoy the adventure!

- Help is available…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