

Performance Centered Concrete Construction

Life After PEM

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The Goal



How do we ensure
that we get it?

The Process

- Pay attention to:
 - The design
 - Foundation
 - Thickness
 - Details
 - The mixture
 - PEM
 - The construction
 - P3C
 - The maintenance
 - Later



PEM Philosophy

- What do we want from a mixture?
- How do we produce it?
- How do we know its good?



The Critical (Mixture) Properties

- Transport
- Cold weather
- Strength
- Aggregates
- Shrinkage

- Workability



5

Where Next?

- We have the perfect mixture in the truck...

- What happens after it leaves the plant
 - Transporting
 - Adding water / chemicals
 - Spreading
 - Vibrating
 - Curing
 - Sawing
 - Waiting



6

Where to test?

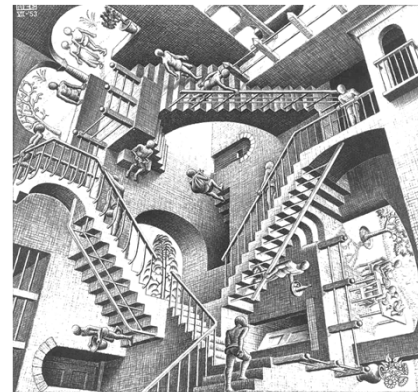
- In the lab before construction
 - Is it representative?
- At point of delivery
 - Doesn't pick up what happens in the paver
 - Variability
 - Response time
- Behind the paver
 - Maybe (not)
- Later
 - Acceptance



7

A 4-Dimensional Problem

- The properties
- What affects them?
- How do we measure them?
- When?



8

In the Lab

- Design the mixture for the materials available
- Check that it meets performance requirements
- Check constructability
- Assess sensitivity to normal variations
- Develop plans to react to changes

PEM – The mixture

- Transport
- Cold weather
- Strength
- Aggregates
- Shrinkage
- Workability



9

At the batch plant

- Water content
 - w/cm
 - Workability
- Measurement?
- And everything else



10

At point of delivery

- To confirm that the mixture delivered is that which was approved
 - Water
 - Air

- Acceptance samples (ideal curing)
 - (Workability)
 - Resistivity
 - Strength



11

Behind the paver

- To flag effects of paving activities
 - Placing
 - Spreading
 - Vibrating

- Segregation
- Consolidation
- Smoothness



12

Later

- To flag effects of finishing activities
 - Finishing
 - Curing
 - Sawing

- Texture
- Smoothness
- Surface durability



13

The (Slab) Properties

- Consolidation
- Segregation
- Cracking
- Skid resistance
- Smoothness



14

Mixture – Affected by...

	Transport	Strength	Cold weather	Aggregates	Shrinkage	Workability
Lab	w/cm, Binder	w/cm	AVS, SCM	Mineralogy, SCM	Paste content	Water, WRA
In front	w/cm, Binder	w/cm	AVS	-	-	Water, WRA
Behind	-	-	AVS	-	-	-
Later	-	-	-	-	-	-

15

Mixture – Indicated by...

	Transport	Strength	Cold weather	Aggregates	Shrinkage	Workability
Lab	Resist	Comp / Flex - w/cm	SAM, Pot, SCM	R80	Paste content	Vkelly, Box
In front	Resist, w/cm	Comp / Flex - w/cm	SAM, Pot	-	Paste content	Slump
Behind	Water and air					
Later						

16

The Slab – Affected by...

	Consolidation	Segregation	Cracking	Skid Resistance	Smoothness
Lab	Workability	Workability	Shrinkage	-	Paste content
In front	Workability	-	-	-	-
Behind	Vibration	Vibration	Curing	Texture	Speed / vibration
Later	-	-	Sawing	-	-

17

The Slab – Indicated by...

	Consolidation	Segregation	Cracking	Skid Resistance	Smoothness
Lab	Ruler, Float	Eye	Paste content	-	Proportions
In front	-	Need	-	-	-
Behind	Need	Need	Need	Need	RTS
Later	-	-	UPV, MIRA	-	Many

18

Finishability / Segregation



19

Real Time Smoothness



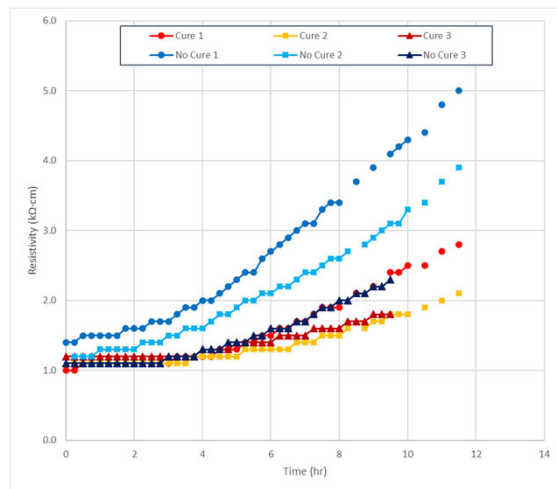
20

Texture

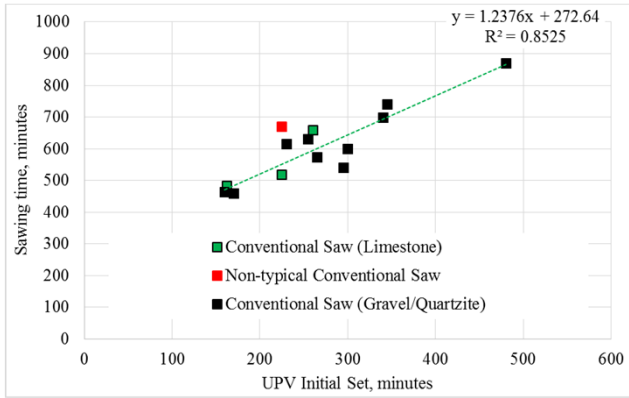


21

Behind the Paver



Saw Timing

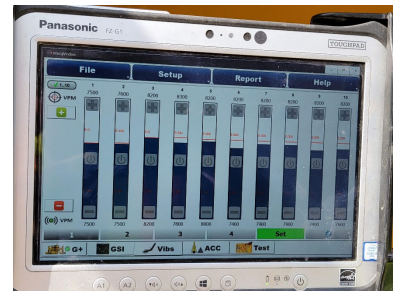


Joint Activation



P3C

- Goals:
 - Continue to assist state agencies on specification improvements
 - Continue to offer training
 - Investigate tools to monitor the mixture through the paving process
 - Investigate feedback loop approaches



25

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Sustainable Performance Engineered Concrete

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General Information Solicitation Number: 1582 Status: Solicitation posted Date Posted: Jul 08, 2022 Last Updated: Aug 01, 2022 Solicitation Expires: Jul 08, 2023 Partners: ID, MO, PADOT Lead Organization: Iowa Department of Transportation	Financial Summary Commitment Start Year: 2023 Commitment End Year: 2027 100% SP&R Approval: Not Requested Commitments Required: \$500,000.00 Commitments Received: \$300,000.00
Contact Information Lead Study Contact(s): Kyle Clute Kyle.Clute@iowadot.us Study Champion(s): Todd Hanson todd.hanson@iowadot.us	

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26



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