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INDOT Division of Materials & Tests

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## Topics:

1. Spec Updates
2. Strength Sensors
3. Overlay bonding
4. Cement
5. 2025 E5 memorandum
6. Research update / Microspheres



# Specification Changes

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## Silica Fume Dosing

(RSP 901-M-065, effective 12-1-23)

### **901.04 Silica Fume Used as a Pozzolanic Mineral Admixture**

#### **(a) General**

Silica fume will be accepted from one of the suppliers on the QPL of Pozzolan Sources. Silica fume from more than one of these suppliers shall not be mixed or used alternatively in the same construction unless authorized in writing. *Repulpable bags, shreddable bags, or any other type of bags or packaging shall not be incorporated into the concrete mixture.* Silica fume will be subject to random assurance sampling and testing by the Department. Failure of the random samples to meet the specified requirements will be cause for removal of the silica fume supplier from the QPL.



# Silica Fume

Large SFMC popout in full depth deck (2 years old)



Silica ball in deck



Silica balls in overlay w/ bag fragments



Silica balls/pops in new overlay



Silica balls/pops in new overlay revealed after mill

# Specification Changes

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## Pozzolans in Moment Slabs (RSP 706-B-324, effective 6-1-24)

*The concrete mix design for reinforced concrete moment slabs shall be QC/QA ~~PCCP in accordance with 501 or PCCP in accordance with 502~~ and shall include one or more pozzolans in accordance with the proportioning in 501.05.*



# Specification Changes

## Lean Concrete Base

(RSP 309-R-793, effective 6-1-25)

Key points:

- Not conventional concrete
- Strength is from aggregate interlock
- Air content is for flow
- Plastic sheeting is critical for separation
- Paste strength of LCB is not critical for placement of the patch over the LCB



# Specification Changes

## Pending change

### Aggregate correction factor for air content (AASHTO T-152)

- The Div of Materials and Tests conducted in-house research in 2023 and 2024
- Phase 1 - 2023
  - CA absorption, haul time, moisture condition (oven dry, SSD, moist, & vac. saturation)
- Phase 2 - 2024
  - Freeze thaw durability at air contents 3%, 5%, and 7%.
- Proposal is to use gross air with fixed correction factor based on coarse agg absorption

Aggregate Correction Factor (505.01e)	
Absorption of Coarse Aggregate, %	Aggregate Correction Factor, %
$\leq 4.00$	0.0
$4.01 \leq 4.50$	0.5
$> 4.50$	1.0

# Specification Changes

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## Pending change

### Volumetric Mixer Specification

- Developing
  - Specifications (502, 506, 508, 702, 722)
  - Program requirements (new ITM-409)
  - Qualified list



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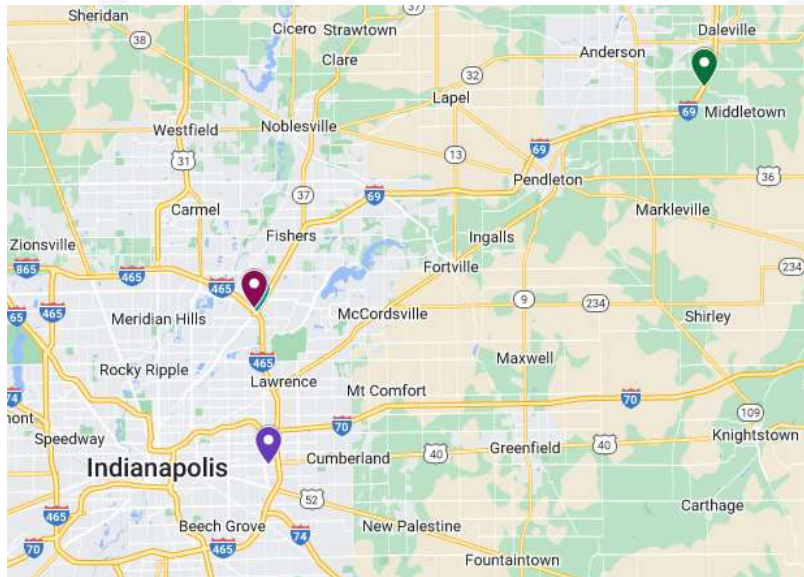
# Resonance Strength Meter (Rebel Sensor by Wavelogix)

## Validation 2024

- Lab Trials
  - Trial 1
  - Trial 2
- Field Trials by M&T
  - Deck/RCBA: CR 200 S over I-69
  - Deck: I-465 WB over Binford Blvd
  - Pavement: I-465 WB (north of I-69)



**Meter**



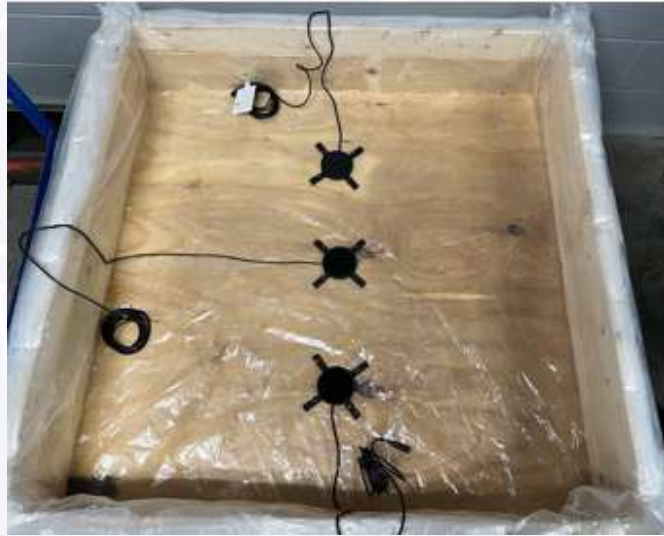
Lab Trials	Division of Materials and Tests
Deck/RCBA	CR 200 S over I-69
Deck	I-465 WB over Binford Blvd
Pavement	I-465 WB (north of I-69)



**Datalogger**

# Resonance Strength Meter

- Lab Trials



**Sensor installed in Lab Trials (slabs, beam, and cylinder)**



# Resonance Strength Meter

- Field Trials



**Sensor installed at RCBA**



**Sensor installed at Deck**



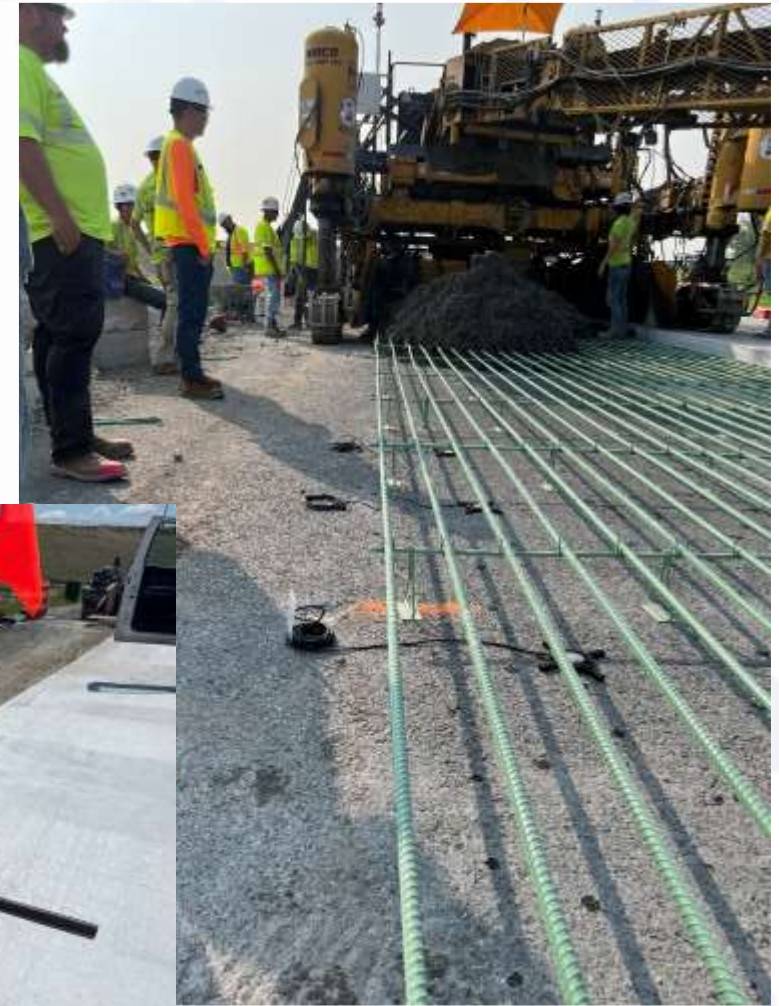
**Sensor installed in Pavement**



# Resonance Strength Meter


## Validation 2025

- Shadow testing on INDOT contracts
- Contractor installed
  - USPs for PCCP and structural concrete
  - R-38912 – Added travel lanes on I-65 in Marion County
  - Bridge deck pours in April/May



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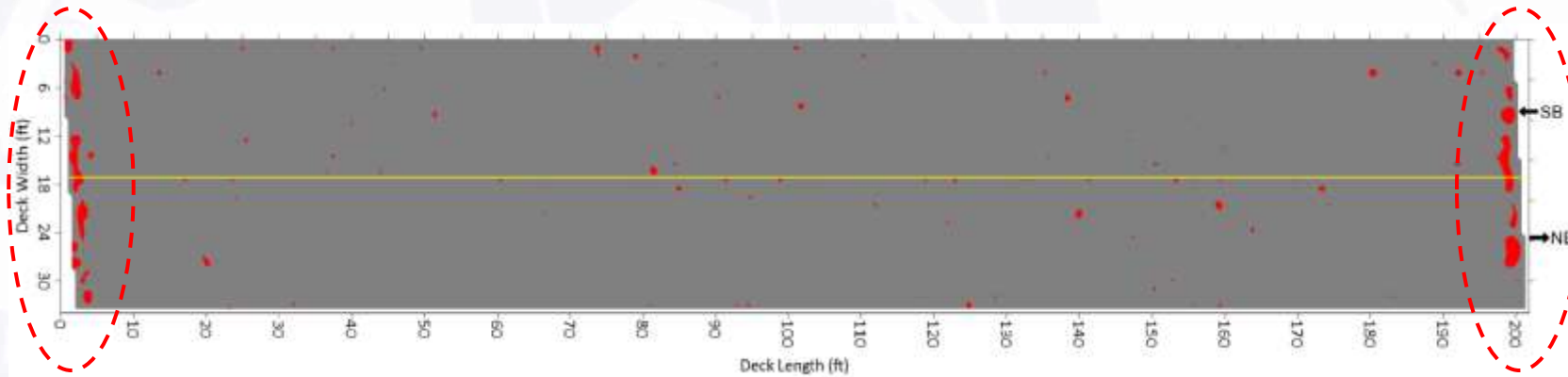
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-  3. **Overlay bonding**
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# Overlay Dam-Bonding

- Impact Echo Testing

Bridge 1



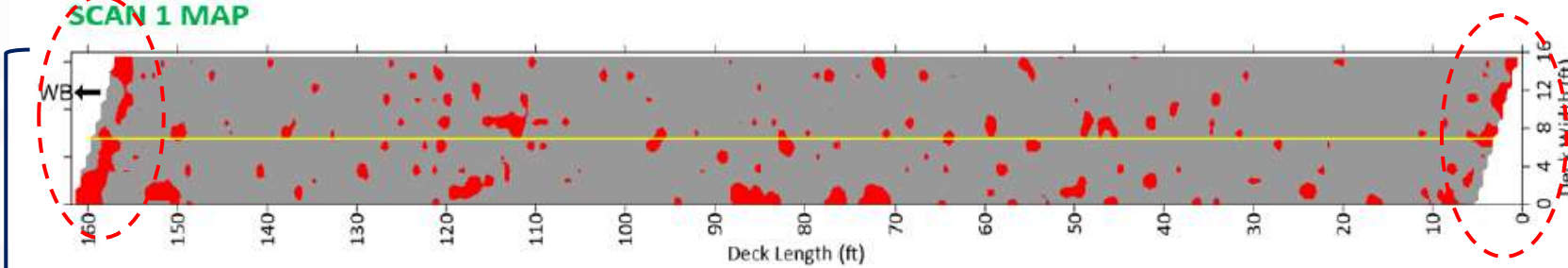
Delamination/  
Debonding



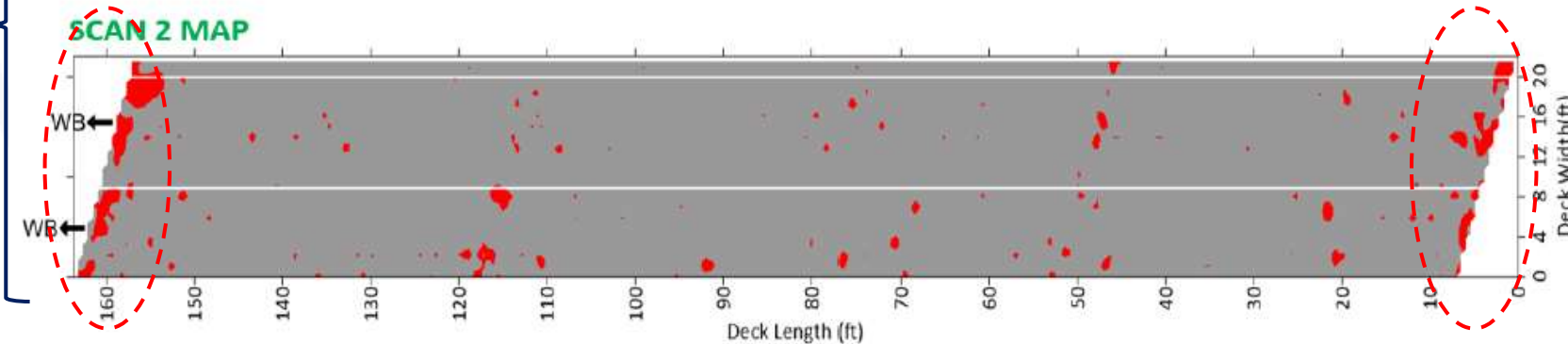
Sound Concrete

Bridge 2

SCAN 1 MAP



SCAN 2 MAP





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# Type IL Cement

- Fines problems
  - Ultrafine particles are difficult to wet
  - Migrate to the surface with excess vibration
- Chemistry problems
  - Poor aggregate-paste bonding
- Lower surface abrasion
- Slower / lower strengths
- Variability
- Construction memo 24-12



# Type II Cement

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## Mitigation

- Reduce content
  - Pozzolan replacement (e.g., slag cement)
  - Use Type 1 cement if possible
- Optimize mixes for aggregate gradation
- Avoid excessive vibration or overworking surface

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# E5 Internal Cure and E5 Liquid Fly Ash

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## 2025 Construction memo

- Reduced water/cement ratio with Type 1L mix design

The water-cementitious ratio shall be 0.42 to 0.48 *when Type 1 cement is used or 0.38 to 0.44 when Type 1L cement is used.*

- Reinforced Concrete Bridge Approaches (RCBA)
  - Moved back to application #1
  - E5 representative is not required



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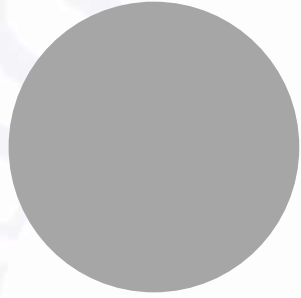
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# Research Projects

Number	Description	Principal Investigators	Start Date	Industry Reps
SPR-4718	Influence of Nanomaterials-based Admixtures on Entrained Air Void System and Freeze-Thaw (FT) Resistance of Concrete	Jan Olek Mirian Velay- Lizancos	1/1/2023	Chris Tull Dustin Hartman
SPR-4823	Systematic Study of Type 1L Cement for Mixture Optimization and Carbon Reduction	Luna Lu Yining Feng	9/1/2023	Chad Clark Devin O'Dell
SPR-4908	Potential Implications of Pore Solution Composition of Type 1L Cement on the Durability of Concrete	Jan Olek	2025	

# Microspheres



## Regular Air

Size: 10 – 1000  $\mu\text{m}$

Air content: 5 – 8%



## Microsphere

Size: 10 – 100  $\mu\text{m}$

Air content: 2%

- SPR - 4718 (P2Air 52De & Expandcell)
- Compress during freeze-thaw
- Only require 2% air by volume
  - Better distribution of small bubbles (good air)
  - Increased strength
  - Reduced porosity
  - More durable air (doesn't saturate)??
- How to test? - Pressure air test (T-152) does not work
- Trials in 2025
  - Pumpability

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# Thank You

# Questions

Michael Nelson

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