IOWA DOT Slide Bridge with MCE & Pavix

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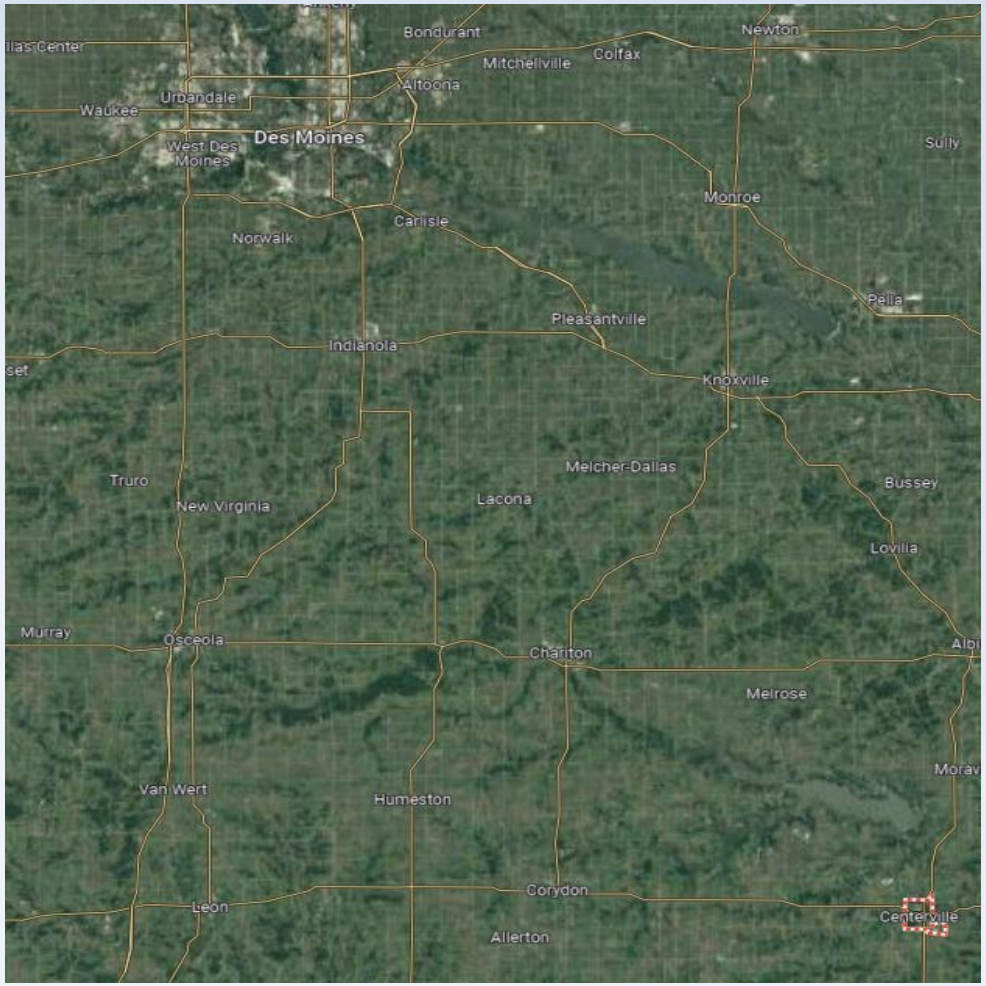
Outline

- Background
- Trial batching
- Concrete results
- Construction
- Conclusions
- Questions

Background

- Iowa Hwy 5
  - Centerville, IA
  - Lateral slide bridge
  - Deck placed August 4, 2023



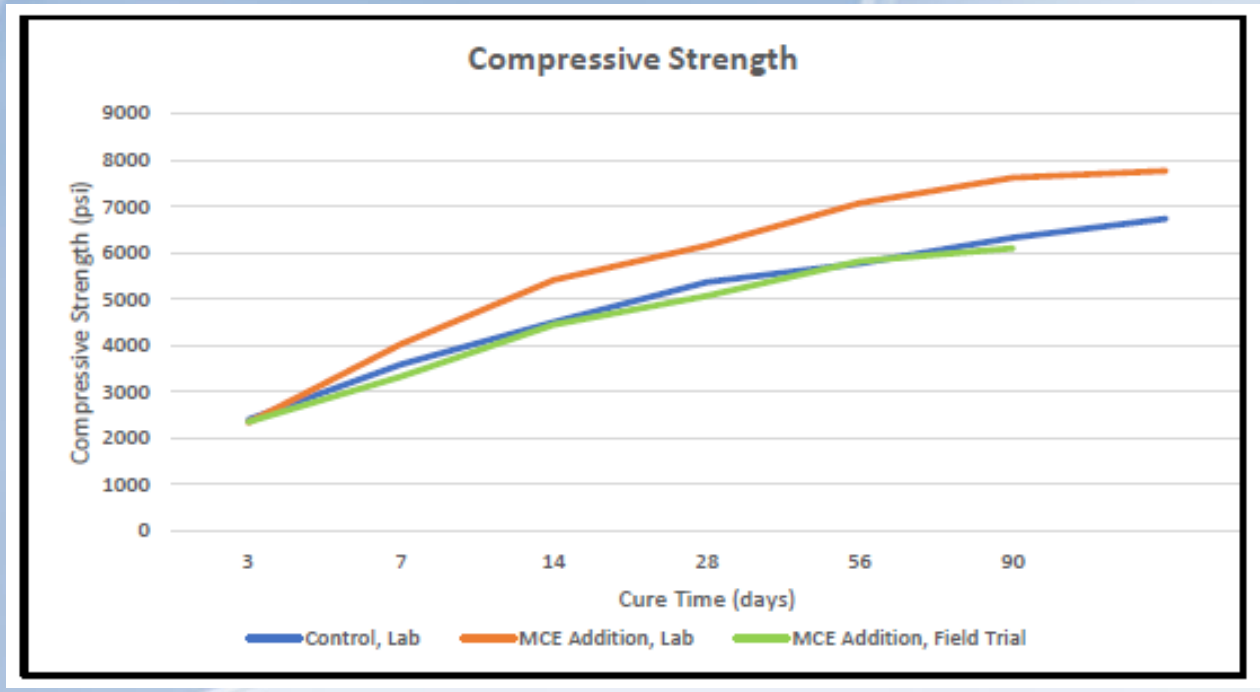
Trial Batching

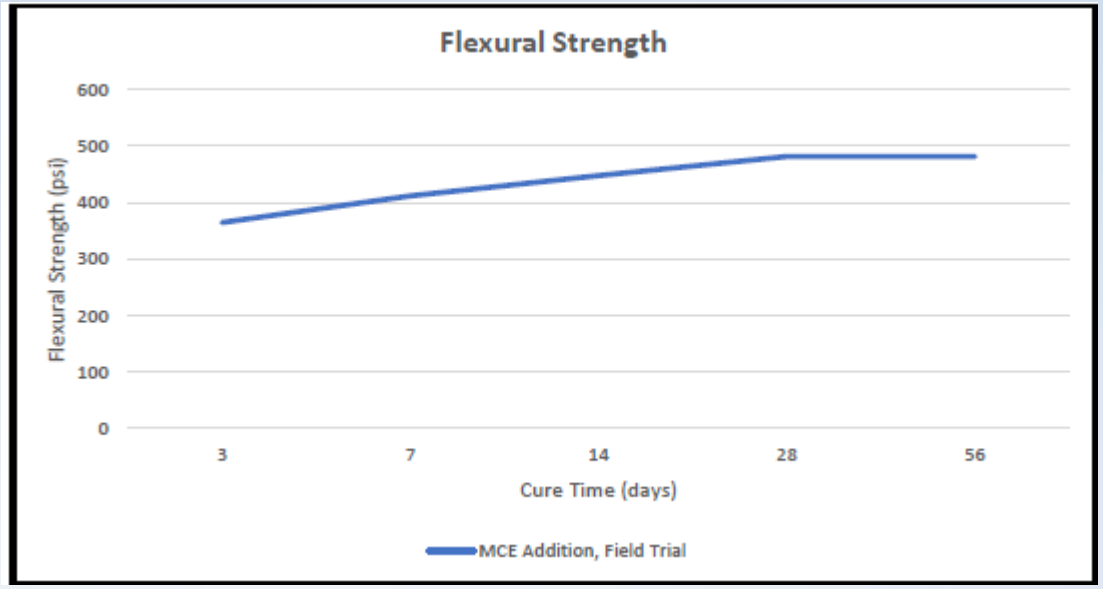
- Construction Materials Testing (CMT)
  - Compressive, flexural, and tensile strength, permeability and drying shrinkage
- Iowa DOT
  - Hardened air content and Nordtest 492
- Ideal Ready Mix Co., Inc. (Centerville, IA Plant)
  - Placed trial slabs on May 10, 2023
  - Iowa DOT C-4WR-C CL3

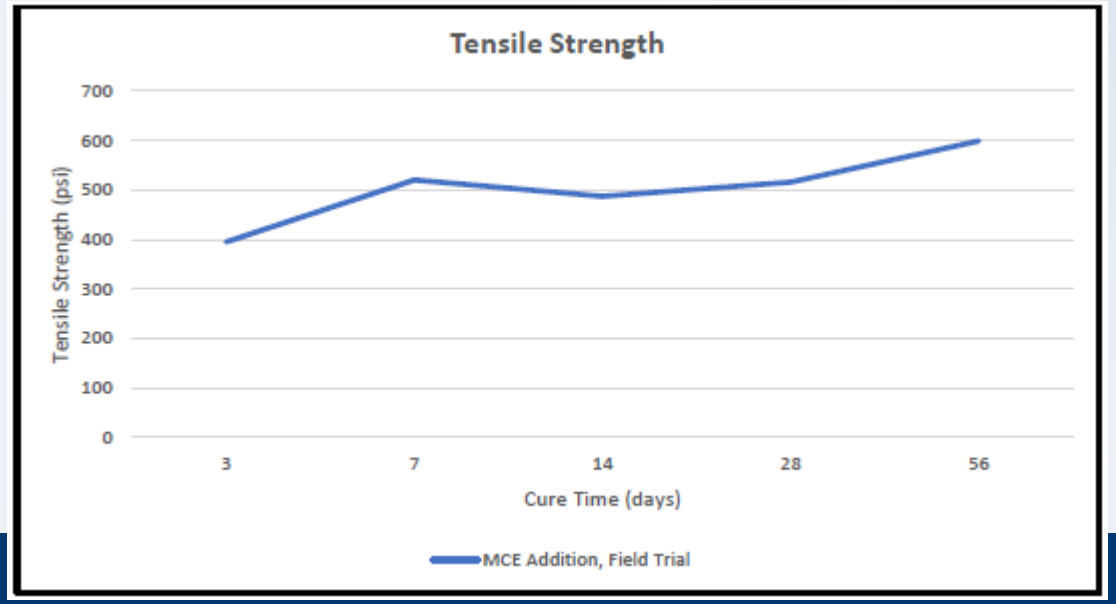
Mixture Proportions

• Type IL Cement	470 pcy
• Fly ash	117 pcy
• w/cm	0.42
• Coarse aggregate	1424 pcy
• Sand	1516 pcy
• WR	Adjusted for site conditions
• MCD dosage rate	147 fl oz per cuyd
	“target 2% cementitious weight

Concrete Results







Water Permeability

- Army Corps of Engineers Method
  - CRD-C48-92 @ 200 psi pressure
  - Very stringent test

Permeability Comparison		
Sample Designation	Age at Time of Testing	Coefficient of Permeability (cm/sec)
Control	28	6.65×10^{-7}
MCE (Lab sample)	28	3.58×10^{-12}
MCE (Field Trial 1)	28	3.01×10^{-11}
MCE (Field Trial 2)	28	2.28×10^{-11}
MCE (Field Trial 3)	28	2.61×10^{-11}

Chloride Penetration

- Iowa DOT
  - Nordtest 492
  - Measures chloride migration coefficient from non-steady-state migration

Test Results

The depth of penetration is measured and the non-steady state, chloride migration coefficient (Dnssm) is calculated. Results are shown in the table below.

Sample Name	Dnssm, m^2/s
MCE1	17.314×10^{-12}
MCE2	17.921×10^{-12}
MCE-Pavix1	14.899×10^{-12}
MCE-Pavix2	14.202×10^{-12}
Control1	24.061×10^{-12}
Control2	24.923×10^{-12}

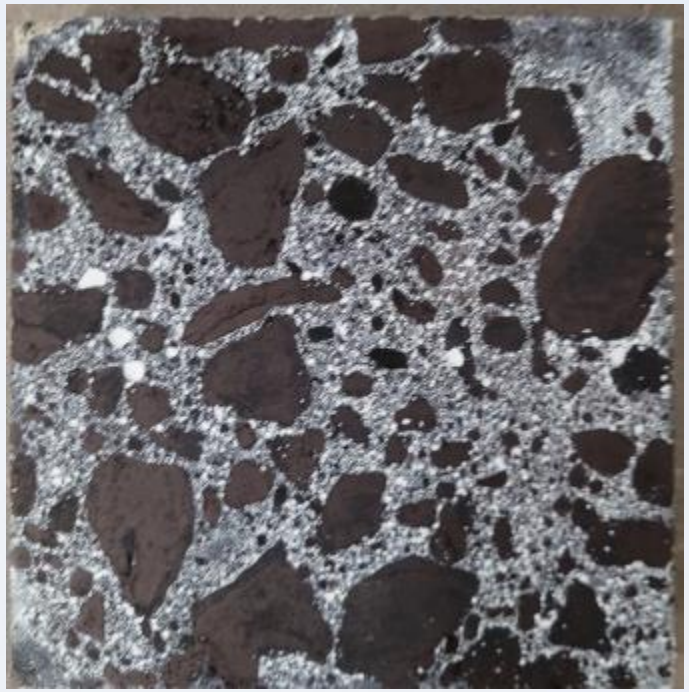
Summary

Based on the results, adding MCE internal admixture to the C-4WR-C20 mix represents approximately a 28% decrease in the non-steady state, chloride migration coefficient, Dnssm $x10^{-12}$ m^2/s, over the control mix without MCE. When Pavix CCC100 is applied to the surface prior to testing samples containing MCE, there is approximately a 40% decrease in the non-steady state, chloride migration coefficient, Dnssm $x10^{-12}$ m^2/s, over the control mix without MCE.

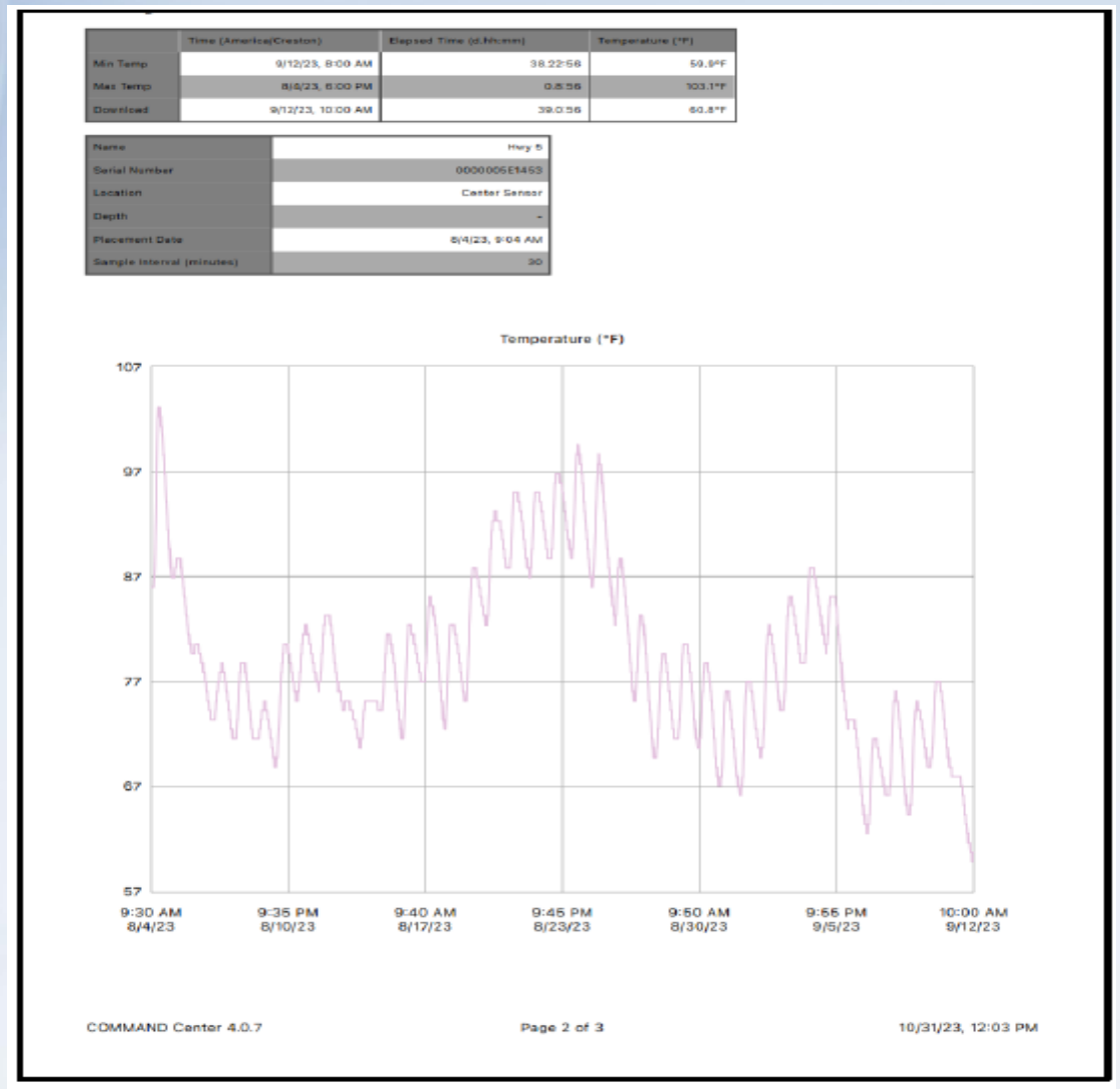
Hardened Air and Length Change

- Hardened Air Content
  - 8.74% and 8.33%
  - Spacing Factor - .082 mm
  - Specific Surface – 36-39 mm^{-1}
  - Adequate for FT protection

- Drying Shrinkage
  - 28-day – 0.013%



Maturity



	Time (America/Creston)	Elapsed Time (d.hh:mm)	Temperature (°F)
Min Temp	9/12/23, 8:00 AM	38.22:56	59.8°F
Max Temp	8/4/23, 6:00 PM	0.8:56	103.1°F
Download	9/12/23, 10:00 AM	39.0:56	60.8°F

Name	Hwy 5
Serial Number	0000005E1453
Location	Center Sensor
Depth	-
Placement Date	8/4/23, 9:04 AM
Sample Interval (minutes)	30

Construction

Construction

Construction

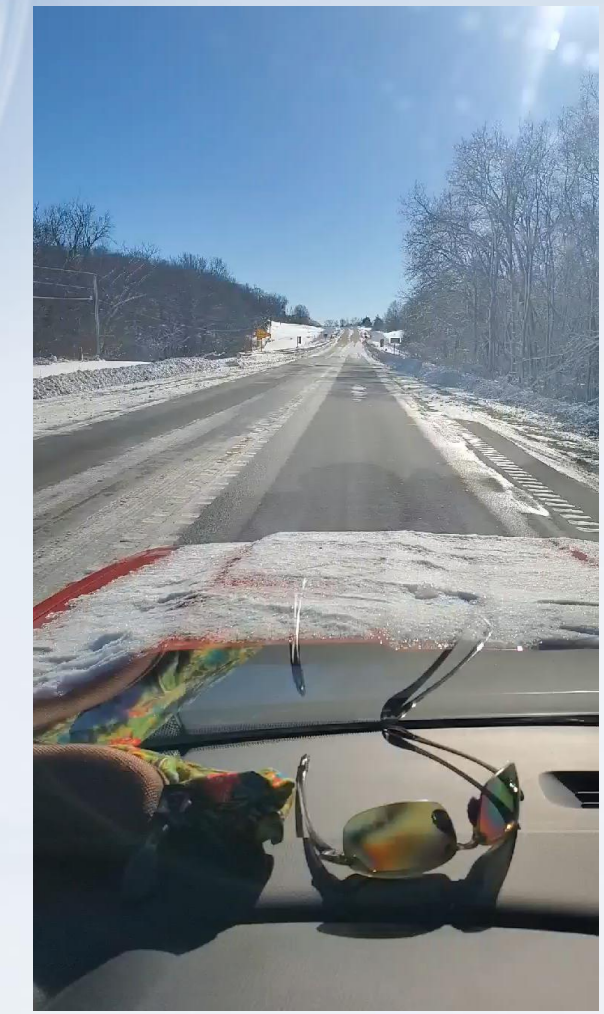
Construction Notes

- Waiver to allow 6” slump
- 9 cuyd trucks
- 270 cuyd of pumped concrete
- Pump operator noted significantly lower pump pressures
- No segregation
- Finishing crew liked the MCE concrete
- 7-day wet curing

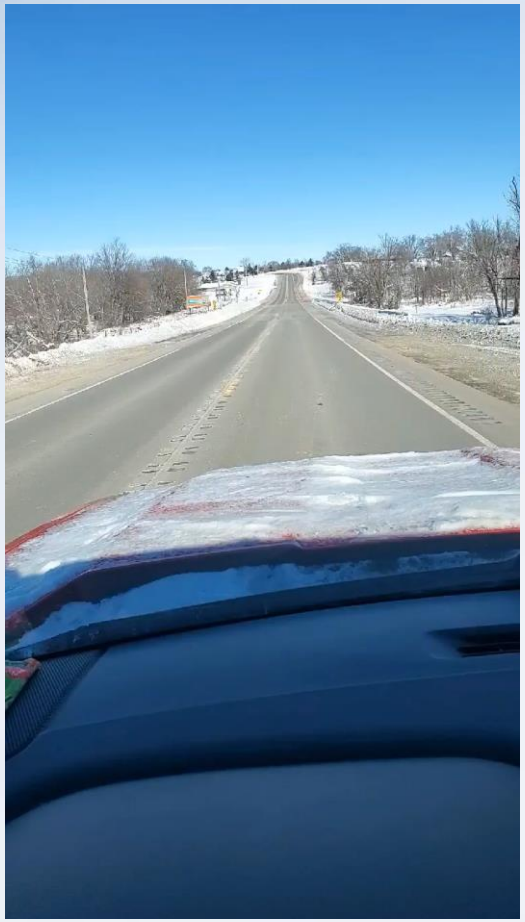
Construction Notes

- Negatives of Type IL cement usage seemed to be mitigated by incorporation of MCE
- Deck was inspected after burlap removal prior to sliding in place
  - No surface cracking or initial distress
- Deck reinspected after the slide
  - No surface distress
- ½ deck was sprayed with Pavix CC100
- Long term monitoring by Iowa DOT and others

Post Construction – Ice Adhesion



Post Construction – Ice Adhesion



Conclusions and Recommendations

- MCE improved performance of fresh and hardened concrete
- Notably improved permeability characteristics
  - Excellent for protection from deicing salt applications, etc.
- Significant reduction in ice adhesion for bridge with MCE and Pavix

Questions