



Fiber Reinforced Concrete Overlays

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Fiber Reinforced Concrete – Overlays

Michigan Concrete Association
Winter Conference 2019 – Plymouth, MI

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Overlay competition: Concrete vs. Asphalt

Regardless of method, goals remain the same:

- Thinner is better
- Cost is critical
- Time-until-use is important
- Long-term durability & rideability are both important

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Common Overlay Failure Modes

- Panel corner crack-offs
- Mid-panel cracking due to excess fatigue limits
- Joint-failure and loss of aggregate interlock causing slab separation
- Cracking of curled joints

Each of these issues can be diminished with the use of the right fiber @ the right dosage.

FRC OVERLAY PROJECTS

FORTA 
CONCRETE FIBER

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Georgia DOT Bridge Deck Overlay RINGGOLD, GA - 2001



Georgia DOT Bridge Deck Overlay

FORTA-FERRO®

- Scarified 3.5" concrete surface, cement-slurry bonding agent
- 5.0 lb/cu yd FORTA-FERRO® macro fiber

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Hawaii DOT Bridge Deck Overlay OAHU, HI - 2009



Hawaii DOT Bridge Deck Overlay

FORTA-FERRO®

- HPC- High Performance Concrete deck mix
- FORTA macro/micro blend at 7.5 lb/cu yd



Park Street Overlay
OAK HARBOR, OH - 2011



Park Street Overlay

FORTA-FERRO®

- 1" HMA interlay over deteriorated concrete
- 4" thick with 4' x 4' joints
- 4.0 lb/cu yd FORTA-FERRO® macro fiber



- To this point, fibers were used in overlays to improve concrete toughness and reduce cracking
- Most current overlay design programs do not consider fiber contributions re: fatigue
- Louisiana DOT 2015 research: *"Evaluation of the Fatigue and Toughness of Fiber-Reinforced Concrete for Use as a New Highway Pavement Design"*, Dr. J. Kevern, Dr. T. Rupnow
- Based on this and other research, fibers for overlays became focused on thickness and joint-spacing.

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Brookshire Park Overlay THORTON, CO - 2017



Brookshire Park Overlay

FORTA-FERRO®

- Deteriorated 5" thick asphalt parking lot for cars and 1-ton service truck traffic
- 27,000 sq ft, 250 cu yds, 4,000 psi
- Overlay only 3" thick, with 5' x 5' sawcut panels
- City engineers used a 30-year life-cycle cost analysis to arrive at a \$30,000 savings for a thin concrete overlay
- 4.0 lb/cu yd FORTA-FERRO® macro fiber

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MnROAD ALBERTVILLE, MN - 2017

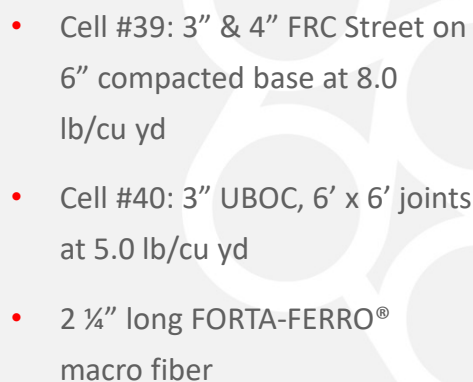


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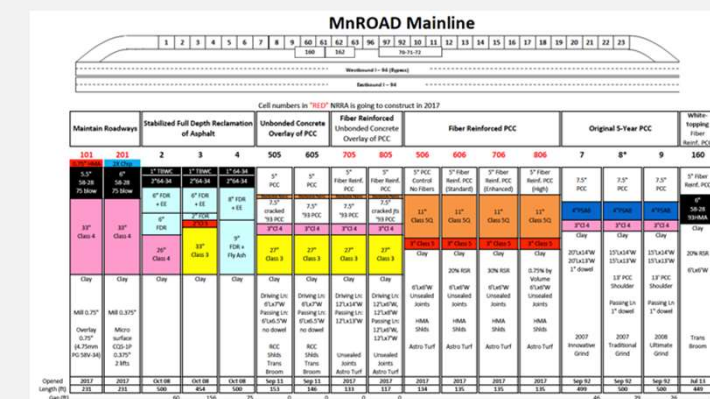
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- Cold-weather pavement test facility
- 3.5 miles of mainline roadway on I-94
- 3.5 miles of by-pass roadway beside I-94
- 2.5 miles of low-volume loop road

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- Cell #705-805: 5" FRC UBOC with geotextile fabric interlayer
- Cell #506-806: 5" FRC Pavement on 11" compacted base @ 5.0, 8.0, and 11.7 lb/cu yd
- 2 ¼" long FORTA-FERRO® macro fiber

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Mainline Drive – Overview of 5" FRC UBOC with geotextile fabric



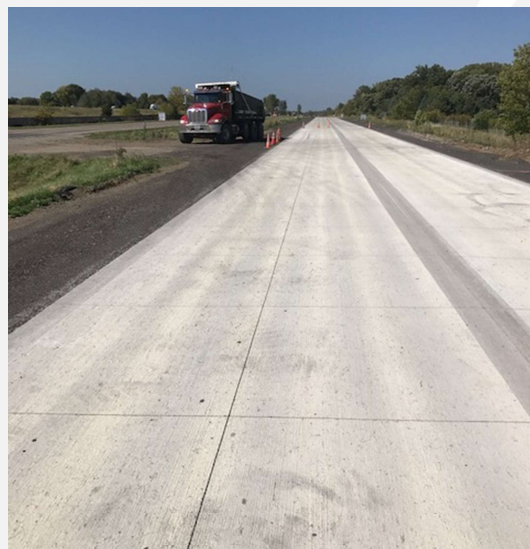
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MnROAD

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- Overview of 3" total-depth PCC pavement over 6" compacted aggregate base for city street construction.
- Accidental early loading by heavy-loaded construction trucks.
- FORTA-FERRO® macro fiber at 8.0 lb/cu yd





MnROAD

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- Premature loading of 3" FRC pavement
- Slab-edge approach panel cracks have remained tight under continued low-volume roadway ESAL's



Overview of Iowa Hwy. 105 Fiber-Overlay Project

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- Prompted, directed, and monitored by CPTech Center
- Part of 5-mile overlay project between Carpenter & St. Ansgar, IA
- Mitchell County donated 1.6 miles for FRC trial sections
- Placed in August 2017



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Existing asphalt overlay showed both deteriorated surface and reflective cracking from jointed concrete under pavement.

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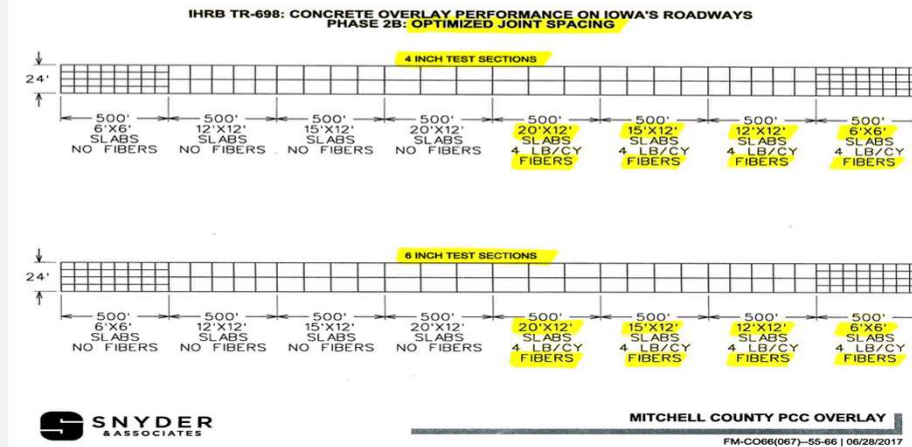


Pre-Project Road Condition Drive-Over





Iowa Hwy 105



Iowa Hwy 105

FORTA-FERRO®

- Hwy. 105 trial will provide fiber vs. plain concrete comparisons for both thickness (4" & 6") and joint-spacing (6', 12', 15', & 20')
- CPTech Center will monitor project for at least 2-years for cracks & joint activation using MIRA ultrasonic shear-wave device
- Thickness & joint-spacing are varied, while fiber dosage was constant at 4.0 lb/cu yd



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Iowa Hwy 105

FORTA-FERRO®

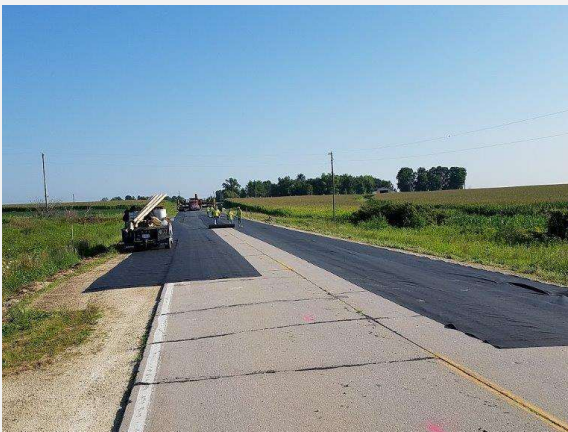
- Minimal fiber appearance on entire 0.8 mile Hwy. 105 project.
- Based on trial program, engineers will be guided towards optimum joint spacing and thickness for thin concrete overlays.
- Results will be used by Iowa city, county, and state engineers, and published on the Iowa DOT and Iowa State University websites.



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Iowa County Rd. V62
Buchanan County



Iowa County Rd. V62

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- 0.6 mile test track, plain vs. fiber
- 6" thick PCC overlay on geotextile fabric

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Iowa County Rd. V62 Buchanan County



Iowa County Rd. V62

FORTA-FERRO®

- 300 ft test sections of varied joint spacing
 - 5.5' x 5.5'
 - 11' x 12'
 - 11' x 15'
 - 11' x 20'
 - 11' x 30'
 - 11' x 40'

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Iowa County Rd. V26 Buchanan County



Iowa County Rd. V26

FORTA-FERRO®

- Macro synthetic fiber @ 4.0
lb/cu yd

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**MN Hwy 63**

Rochester to Zumbro Falls

**MN Hwy 63**

FORTA-FERRO®

- 12 ½ miles of 5" overlay on scarified asphalt
- Macro synthetic fiber at 4.0 lb/ cu yd
- 6' x 6' panels
- Forced joint activation by fully-loaded water truck at 10-12 hours

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**MN Hwy 63**

Rochester to Zumbro Falls

**MN Hwy 63**

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- Fibers unable to protect against premature loading



MN County Rd. 25
Winona County



MN County Rd. 25

FORTA-FERRO®

- Lewiston to Rollingstone, MN
- 7 Miles of 5" overlay on scarified asphalt
- 6' x 6' jointed panels
- Macro synthetic fiber @ 4.0 lb/cu yd



Fiber issues = fiber pain = hidden costs

- Slump and placement
- Surface appearance
- Addition point and process
- Mixing time
- Packaging and delivery options

Trial & choose carefully. All fibers are not created equal.



Slump & Placement



Visual slump reduced, but paver doesn't notice.

31



Surface Appearance



Fibers hide horizontally in paste surface.

FUTURE OF FRC OVERLAYS



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FRC Overlays will continue to grow... and change

- More & more design software builds in fiber values.
- Panel curling and fatigue will eventually be considered in overlay design.
- Overlay thickness & joint-spacing will change based on fiber research and real-world trials.



“What Ifs?”

- Dosages – currently at 4.0 to 5.0 lbs/cu yd
 - What if even higher dosages show promise?
- Fiber-reinforced joints – enhanced aggregate interlock.
 - What if the fiber enhancement value could affect design?
- Joint-spacing – currently at 1 to 1 ½ times the thickness.
 - What if fibers can drastically reduce or even eliminate joints?
- Fast-track overlays – current practice calls for early-strength additives.
 - What if fibers can prove high-early cohesiveness that opens pavements sooner?



To learn more about FRC Overlays...





THANK YOU