Use of Fibers in Concrete Overlays at MnROAD

NCC Fall Meeting
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Minnesota Department of Transportation

Office of Materials and Road Research
Why Use Fibers in Thin Concrete Overlays?

- Increased toughness
  - Hold fatigue cracks together
  - Reduce maintenance frequency

- Improved joint load transfer capacity (?)
  - Serve as “dowel bars” in very thin slabs (?)
MnROAD 2013 Construction (June)

- Cells 160-163: Fiber-reinforced bonded concrete overlay of asphalt (whitetopping)
  - 4” FRC over 7” existing HMA (milled)
  - 5” FRC over 6” existing HMA (milled)
  - Sealed vs unsealed joints

- Cells 140, 240: Ultra-thin FRC unbonded concrete overlay of concrete
  - 3” FRC over 7” existing PCC
  - Fabric interlayer (2 thicknesses)
FRC Specifications

Cells 140/240 and 160-163 Pavement Mix Design shall comply with the following:

Provide a mix design meeting the following requirements:

(1) Grade A paving concrete placed at a water/cement ratio not greater than 0.42.

(2) Provide a fine aggregate gradation complying with Table 3126-3.

(3) Provide a CA-50 coarse aggregate gradation complying with the requirements of Table 3137-4 for Cell 40.

(4) Provide a CA-35 coarse aggregate gradation complying with the requirements of Table 3137-4 for Cells 60-63.

(5) Provide fiber-reinforced concrete utilizing structural macro fibers which require approval by the Engineer in conjunction with the Concrete Engineer prior to use. A minimum concrete residual strength of 120 psi according to ASTM C1609 is required.
Fiber Reinforced Concrete

Performance-based specification (120 psi residual strength)

ASTM C1609: Standard Test Method for Flexural Performance of Fiber-Reinforced Concrete (Using Beam With Third-Point Loading)
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Element Materials Technology, June 5, 2013
Fiber Reinforced Concrete

*Performance-based specification (120 psi residual strength)*

*ASTM C1609: Standard Test Method for Flexural Performance of Fiber-Reinforced Concrete (Using Beam With Third-Point Loading)*

6.5 lbs/yd³ Propex structural fibers

<table>
<thead>
<tr>
<th>Sample ID</th>
<th>( f_{150} ) (psi)</th>
<th>Mix 1F (Cell 160-163)</th>
<th>Mix 2F (Cells 140/240)</th>
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<tbody>
<tr>
<td>1A</td>
<td>145</td>
<td>105</td>
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<tr>
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MnROAD Cells 160-163

Fiber Reinforced Concrete Overlay of Asphalt (Whitetopping)

5” FRC
6’x6’, 6.5 lbs/yd³ Propex
Sealed/unseal jts

6” HMA

Silty/Clay

4” FRC
6’x6’, 6.5 lbs/yd³ Propex
Sealed/unseal jts

7” HMA

Silty/Clay
MnROAD Cells 140 & 240

Ultra-thin Fiber Reinforced Concrete Overlay of Existing Concrete Pavement

- 3” FRC
  - 6’x6’ panels, 6.5 lb/yd³ Propex
- Fabric interlayer (std and thin)
- Var thickness PCC
  - 5.5-7” design (1993)
- 5” Class 5 Sp (1993)
- Silty/Clay
MnROAD Cells 140 & 240

Nonwoven Geotextile Fabric Interlayer (white)

Used glue to secure standard/thin fabric to existing concrete

Fabric manufactured by Propex
MnROAD Cells 140 & 240
MnROAD Cells 140 & 240

Fiber Optic Sensors

Partnership with Missouri University of Science and Technology and NDSU
Questions??????