LMC - VE
Purdue Road School
March 2019

Speakers:
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Patrick Martens, P.E., Bridge Preservation and Inspection Services

Moderator:
Sean Porter, P.E., Parsons
Road Map

PM: Patrick Martens, P.E.
EL: Edward M. Liberati, P.E.
BS: Bobby Steele
Latex Emulsion

- Suspension of tiny styrene-butadiene polymer particles in water (typically about 50% polymer solids).
- Styrene-butadiene polymers are hydrophobic (excellent water resistance).
- During hydration water is being used up - polymers left behind and adhere to mix components and substrate.
- Polymer particles coalesce or fuse together to form a highly waterproof polymer film.
- Latex acts as water reducer.
Latex Modified Concrete vs. LMC-VE

- LMC utilizes portland cement.
- LMC –VE uses Calcium Sulfoaluminate cement to produce an accelerated mix.
- Other components very similar.
Latex Modified Concrete Types

➔ Regular Mix Type 1 or 2 Cement:
  ● 4 day cure => 2 days wet / 2 days dry

➔ High Early Strength Mix Type III Cement:
  ● 2 day cure => 1 day wet / 1 day dry

➔ LMC-VE Mix with CTS Rapid Set Cement:
  ● 3 hour cure => 3 hours wet
Why use Latex Modified Concrete?

➔ Designed specifically as a concrete overlay for bridge decks.
➔ Provides increased durability, bondability and flexibility to concrete.
➔ Withstood test of time.
Latex Requirements

➔ Do not allow latex to freeze.
➔ Store between 50 and 85 degrees in insulated tanks.
➔ Keep out of direct sunlight.
➔ Mechanically cool, if necessary, in hot temperatures.
➔ Do not combine different brands of latex.
AGGREGATES
Citric Acid

→ Serves as retarder
→ Introduced where water and latex enter
<table>
<thead>
<tr>
<th>LMC</th>
<th>LMC-VE</th>
</tr>
</thead>
<tbody>
<tr>
<td>658 LBs Type 1</td>
<td>658 LBs <strong>Rapid Set</strong></td>
</tr>
<tr>
<td>0.30 to 0.40</td>
<td>0.42</td>
</tr>
<tr>
<td>1470-1785 LBs</td>
<td>1470-1785 LBs</td>
</tr>
<tr>
<td>1456-1176 LBs</td>
<td>1456-1176 LBs</td>
</tr>
<tr>
<td>24.5 Gal</td>
<td>24.5 Gal</td>
</tr>
<tr>
<td>18 Gal</td>
<td>18 Gal</td>
</tr>
<tr>
<td>3” - 7”</td>
<td><strong>6” - 10”</strong></td>
</tr>
<tr>
<td>0% - 7%</td>
<td>0% - 7%</td>
</tr>
<tr>
<td>4000 psi - 7 Day</td>
<td>3000 psi - 3 Hrs</td>
</tr>
<tr>
<td>Cement</td>
<td>Water</td>
</tr>
<tr>
<td>W/C Ratio</td>
<td>Slump</td>
</tr>
<tr>
<td>FA</td>
<td>Compressive</td>
</tr>
<tr>
<td>CA</td>
<td>Air</td>
</tr>
<tr>
<td>Latex</td>
<td>5000 psi - 24 Hrs</td>
</tr>
<tr>
<td>Water</td>
<td>6500 psi - 28 day</td>
</tr>
<tr>
<td>Material Sources</td>
<td>Mix Design</td>
</tr>
<tr>
<td>-------------------------------------------------------</td>
<td>--------------------------------</td>
</tr>
<tr>
<td>→ Cement, CTS – Rapid Set</td>
<td>658 lbs.</td>
</tr>
<tr>
<td>→ Citric Admix</td>
<td>1/4% - 1% by weight / bag</td>
</tr>
<tr>
<td>→ Concrete Sand, Spray SD &amp; GR</td>
<td>1600 lbs.</td>
</tr>
<tr>
<td>→ #11 Washed Limestone, US AGG</td>
<td>1300 lbs.</td>
</tr>
<tr>
<td>→ Latex, Trinseo Mod A</td>
<td>208 lbs. (24.5 Gals)</td>
</tr>
<tr>
<td>→ Water, city</td>
<td>155 lbs.</td>
</tr>
<tr>
<td>→ Air</td>
<td>Est. @ 5%</td>
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</tbody>
</table>
TESTING

➔ Air
➔ Slump
➔ Cylinders (3600 psi in 3 hours for I-65 job)
➔ Yield verification (1/4 yard box)
Important Criteria to Consider with Overlay

➔ Strength
➔ Flexibility
➔ Resistance to Crack Propagation
➔ Adhesion / Bond
➔ Permeability
➔ Durability / Abrasion Resistance
➔ Construction Practices - Placement
Bond Strength in:

➔ Mechanical bond – hydrodemolition surface preparation
➔ Chemical bond – styrene butadiene serves as excellent adhesive

Other Keys to Bond Strength:

➔ CLEAN SURFACE
➔ HIGHLY ROUGHENED SURFACE
➔ FREE OF EXCESS WATER AT BOND INTERFACE
➔ NO MICRO-FRACTURES IN SUBSTRATE
Placement of Latex Modified Concrete

**GETTING STARTED**

- Pre-Pour Meeting
- Weather Conditions
- Set up and Dry Run Machine
- Site Access
- Evaporation Rate
- Logistics for Placement
- Crew Size
- **Deck Saturation**
- Grouting
- Testing

**DURING THE POUR**

- Start of Pour Adjustments
- Consistent Mix
- **Removal of Standing Water on Deck**
- Consolidation of mix – vibrators
- Proper Finishing of Rollers and Sealing of Surface
- Foggers
- Pace of Pour
- What is happening behind rollers?
- **Curing with Wet Burlap and Cover with Plastic**
- Keeping Operations Close Together
Top Notch Inspection Team
## LMC-VE Bridge Overlay Projects – Indiana

<table>
<thead>
<tr>
<th>Year</th>
<th>CY</th>
<th>Contract</th>
<th>Contractor</th>
<th>Project Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>1999</td>
<td>80</td>
<td>R-23890</td>
<td>PIONEER</td>
<td>STUEBEN CO. I-69 - Patch</td>
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<tr>
<td>2000</td>
<td>50</td>
<td>B-25467</td>
<td>SCHUTT-LOOKA</td>
<td>INDPLS., FLETCHER RAMP – O/L</td>
</tr>
<tr>
<td>2000</td>
<td>50</td>
<td>B-25467</td>
<td>SCHUTT-LOOKA</td>
<td>INDPLS., FLETCHER RAMP – O/L</td>
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<tr>
<td>2000</td>
<td>15</td>
<td>R-24327</td>
<td>WALSH</td>
<td>INDPLS., I-65 - patch</td>
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<tr>
<td>2001</td>
<td>20</td>
<td>B-24327</td>
<td>WALSH</td>
<td>INDPLS., I-65 - patch</td>
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<tr>
<td>2001</td>
<td>60</td>
<td>B-24470</td>
<td>SCHUTT-LOOKA</td>
<td>BOONE CO., NW I-465 – O/L</td>
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<tr>
<td>2002</td>
<td>76</td>
<td>R-25253</td>
<td>GOHMANN</td>
<td>CLARK-SCTT COS., I-65 N. – O/L</td>
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<tr>
<td>2009</td>
<td>257</td>
<td>IN</td>
<td>AMERICAN</td>
<td>MORGAN CO., SR39 – O/L</td>
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<tr>
<td>2018</td>
<td>600</td>
<td>B-38681</td>
<td>AMERICAN</td>
<td>MARION CO., I465 W. OF 31</td>
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<tr>
<td>2018</td>
<td>110</td>
<td>R-28940-A</td>
<td>E&amp;B</td>
<td>Bartholomew CO., I-65 MP 65.5</td>
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<tr>
<td>2018</td>
<td>290</td>
<td>B-38683-A</td>
<td>Milestone</td>
<td>Wayne CO., I-70 ov/ US 40</td>
</tr>
</tbody>
</table>
Indiana is a leader in Concrete Overlays

- 1970 – DOW Invented LMC – Placed first LMC O/L’s in Michigan
- 1974 – First INDOT LMC on I65/I70 Spaghetti Junction
- 1987 – First US Total Surface Hydro Job – Indiana Toll Road
- 1995 – DOW and CTS Cement invent LMC-VE
- 1997 – First LMC-VE Overlay in KY – I-264
- Early 2000’s – Contractors switch to LMC-VE on a few INDOT jobs
- 2003 – Replaced I65/I70 Overlays – 2nd Generation
- 2005 – First INDOT LMC-VE O/L - Martinsville
Bridge Deck Preservation Strategies

➔ 75 Year Bridge Decks
  ◆ Year 1 – Construct New Bridge Deck
  ◆ Year 25 – Place O/L #1 – Hydrodemolition
  ◆ Year 50 – Place O/L #2 – Hydrodemolition
  ◆ Year 75 – Replace Bridge Deck (Third O/L ? = 100 years)

➔ Systematic Approach – utilize bridge deck inspections.
➔ LMC Overlays are designed for 30 year service life.
Bridge Deck Preservation

It is very cost effective to attain a minimum of 75 years of service life from a bridge deck.

By placing Concrete Overlays (LMC) on Hydrodemolition prepared bridge deck surfaces before decks becomes structurally deficient, 75 years of service life or more can be achieved.

The use of Fast Track Hydrodemolition and Concrete Overlays provides an owner with an economical, long lasting and very fast bridge deck preservation method. Used for over 50 years-
LMC-VE Use in the United States

IN, NC, PA, OH, AR, AL, WV, IL, MO, TX, SC, GA, MD, LA, KY + others
TYPICAL WEEKEND SCHEDULE:

**Friday**
- 9:00 pm to 10:00 pm: Close roadway
- 10:00 pm to 12:00 am: Remove Ex. O/L
- 12:00 am: Hydrodemolition

**Saturday**
- 12:00 am to 12:00 pm: Hydrodemolition
- 12:00 pm to 12:00 am: LMC-VE O/L

**Sunday**
- 12:00 am to 4:00 am: Cure LMC-VE O/L
- 4:00 am to 12:00 pm: Cleanup work area.
- 12:00 pm to 2:00 pm: Open roadway
I-65 over Denois Creek, Bartholomew Co., IN

- Location: MM 65.5
- Project SR-28940 (I-65 DBBV Southeast Indiana Project, April 2017)
- AADT: 44,310 VPD
- Denois Creek Scope
  - Remove existing overlay
  - Surface mill and perform hydro-demolition
  - Place a variable depth latex modified concrete deck overlay
Problem

➔ Standard MOT: 3+1 traffic configuration with Temporary Crossovers

Question:

Why can’t we just close one lane in each direction on the interstate and perform the overlay? Isn’t there a concrete that can set up quick enough?

Answer:

➔ Contract did not allow
➔ IHCP did not allow
➔ No Specification
➔ RCBA needed replaced
➔ Can it be done?
➔ $$$ ... Labor, Material, Equipment
Solution

➔ Deviation from the contract
➔ Indiana Highway Congestion Policy (IHCP) EXCEPTION!
   ◆ 6 modified weekend closures - 6PM Friday to 12 noon Sunday
      **no work Saturday 12 noon to 6PM**
   ◆ 12 extended nighttime closures - 7PM Friday to 10AM Saturday +
     7PM Saturday to 10AM Sunday  NONE WERE USED!
➔ Unique Special Provision: LMC-VE
   ◆ Standard Committee Meeting Minutes (June 21, 2018)
➔ RFC Plans: August 24, 2018
Risks vs. Benefits

➔ Liquidated Damages
  ◆ $5,000 per lane mile per 15 minutes

➔ Unknowns
  ◆ Full Depth Patching
  ◆ Handchipping
  ◆ Temperature
  ◆ Cure Time

➔ Safety
  ◆ Advance Warning
  ◆ Avoid Contraflow

➔ Time
  ◆ 42 HRS x 2 Weekends
  ◆ Complete in 2018

➔ Quality
  ◆ No Temporary Striping
  ◆ Add Approach Slabs

➔ Win - Win - Win
  ◆ INDOT
  ◆ Traveling Public
  ◆ Contractor
Construction Phasing

DENOIS CREEK BRIDGES
MILE MARKER 65.61

Fast Lane Approaches
20'-6" x 20'-6"
July 27-29

Slow Lane Approaches
20'-6" x 19'-0"
August 3-5

Slow Lane Overlay
93'-2" x 19'-0"
August 24-26

Fast Lane Overlay
93'-2" x 20'-6"
September 14-16
Construction Phasing

PHASE I
August 24-26

PHASE II
September 14-16
## Schedule

- **4 crew shifts**
  - 5PM - 2AM
  - 1AM - 12PM
  - 6PM - 3AM
  - 2AM - 8AM

### Work Schedule

<table>
<thead>
<tr>
<th></th>
<th>Friday</th>
<th>Saturday</th>
<th>Sunday</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shut Down Lane</td>
<td>1-22</td>
<td>1-22</td>
<td>1-22</td>
</tr>
<tr>
<td>Install Barrier Wall</td>
<td>19-24</td>
<td>19-24</td>
<td>19-24</td>
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<tr>
<td>Milling</td>
<td>4-8</td>
<td>4-8</td>
<td>4-8</td>
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<tr>
<td>Hydrodemolition</td>
<td>10-16</td>
<td>10-16</td>
<td>10-16</td>
</tr>
<tr>
<td>Water Control</td>
<td>18-22</td>
<td>18-22</td>
<td>18-22</td>
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<tr>
<td>Handchipping</td>
<td>13-17</td>
<td>13-17</td>
<td>13-17</td>
</tr>
<tr>
<td>Setup Screed Machine</td>
<td>11-12</td>
<td>11-12</td>
<td>11-12</td>
</tr>
<tr>
<td>Dry Run</td>
<td>6-7</td>
<td>6-7</td>
<td>6-7</td>
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<tr>
<td>Water Blasting / Cover</td>
<td>14-15</td>
<td>14-15</td>
<td>14-15</td>
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<tr>
<td>Pour Overlay</td>
<td>3-5</td>
<td>3-5</td>
<td>3-5</td>
</tr>
<tr>
<td>Cure Overlay</td>
<td>17-18</td>
<td>17-18</td>
<td>17-18</td>
</tr>
<tr>
<td>Remove Screeds</td>
<td>5-9</td>
<td>5-9</td>
<td>5-9</td>
</tr>
<tr>
<td>Cleanup / DEMOB</td>
<td>19-22</td>
<td>19-22</td>
<td>19-22</td>
</tr>
<tr>
<td>Open Roadway</td>
<td>16-17</td>
<td>16-17</td>
<td>16-17</td>
</tr>
</tbody>
</table>
Coordination

- Subcontractors
  - Cutting/Saw
  - Milling
  - Hydrodemolition
  - Water Control
  - Water Blasting

- Trucking
  - Mobilizing Equipment
  - Tri-axles
  - Water Trucks

- Suppliers
  - Concrete (LMC-VE)
  - Donuts
  - White Castle
Results

Safety:

➔ No accidents recorded within shutdown during weekends
➔ No accidents due to queuing recorded during weekend shutdowns

Time:

➔ Conventional Method 4-5 months of traffic switches
➔ 6 Weekend Shutdowns Friday 6PM - Sunday 12PM
  ◆ 2 Wknds - Approaches
  ◆ 2 Wknds - Bridge Deck Overlay
  ◆ 2 Wknds - Full Depth roadway patching
➔ Roadway was opened early on 4 weekends
➔ Completed in 2018 vs. 2020

Quality:

➔ Approaches were added to the contract
Resources

➡️ Standard Committee Meeting Minutes (June 21, 2018)
➡️ Design Memorandum 18-17 (Aug. 8, 2018)
➡️ RSP 722-B-307 Concrete Bridge Deck Overlays (Dec. 1, 2018)
  ◆ LMC & SFMC Overlays
  ◆ LMC-VE Overlay
  ◆ Transverse Grooving
  ◆ Bridge Deck Overlay Budget