POLYMER OVERLAYS IN KANSAS

CALVIN REED
BRIDGE MANAGEMENT ENGINEER, KANSAS DOT

FOR MIDWEST BRIDGE PRESERVATION PARTNERSHIP
NOVEMBER 12, 2013
HIGHLIGHTS

• History
• Lessons learned
• Current practices
• Where do we go from here?
HISTORY

- First polymer overlay placed in 1998 in NW Topeka
- Approximately 12,000 SF
- Several different products used
- Still in service
POLYMER OVERLAYS PLACED

• Few polymer overlays placed until 2002
• Gradual increase from 2002 to 2010
• Rapid increase since 2010
• As of 2012, approximately 5 Million sf placed
• Price has dropped as we have placed more
POLYMER OVERLAY TREND

AMOUNT PLACED (1000s SF)

WHAT HAS WORKED

• AS A PREVENTATIVE TREATMENT
  • Ideal candidate is minimal delaminations/spalls (<2%) with moderate to heavy cracking
    • Deck Element (CoRe) in condition state 1
    • Deck Cracking Smartflag in condition state 2 or 3
  • To seal cold joints (phase construction lines, new rails, etc.)
    • Standard to extend polymer overlay up face of barriers and rails

• BUNDLING BRIDGES
  • Bundle bridges by proximity (Economy of Scale)
  • If one bridge isn’t quite ready, go ahead and do it now
  • Save $$$ on Traffic Control and Mobilization costs
THE IDEAL CANDIDATE

Deck = Condition State 1
Deck Smartflag = Condition State 2
Delaminations = 1% of Top, Isolated
COLD JOINT PROTECTION
THE PROBLEMS

• CONSTRUCTION ISSUES
  • Improper surface preparation – Shotblast (ICRI Level 6-7)
  • Contamination – redo shotblast if contaminantion is found
  • Temperature – Use right product at right temperature

• PUSHING THE ENVELOPE
  • Too many delaminations in substrate
  • Active flexural cracking
FAILURES - SPALLING
FAILURES - CRACKING
APPLYING TO NEW BRIDGE DECKS

• New Policy, 2010
  • From two-course decks with 1.5” Silica Fume Overlay
  • To single-course decks with Polymer Overlay

• Problems – Late Season Deck Pours
  • What if contractor can’t get the polymer overlay placed in time?
    • 35 Day for deck curing prior to installation of Polymer Overlay
  • What to do with the deck surface through winter?
  • Cost of remobilizing and traffic control
APPLYING TO NEW BRIDGE DECKS

• The (New) New Policy – 2011
  • Polymer overlays on new decks is an option
  • Mostly used for high ADT (>8,000 vpd) corridors
  • Can be used in other places at discretion of designer with input from Field Engineers
  • For the most part, Polymer Overlays will be applied as a maintenance/preservation item
WHAT’S NEXT?

• New Bridge Decks – Optimize Placement Time
  • Would more cure time help bond?
  • Can we reduce cure time without sacrificing quality?
  • Is there another way we can measure deck readiness other than time after cure?

• KTRAN Project KSU-13-03 (Kansas State University)
  “Sustainable and Durable Bridge Decks (Phase I)”
KTRAN-13-03

- Using standard pull-off test to measure bond
- Commercial moisture meter to measure moisture
- Parameters
  - 3 concrete mixes
  - 3 wet curing temperatures
  - 4 dry curing time periods
  - 5 epoxies
  - 8 tests for each combination
  - Equals 1440 pull off tests!
## TEST MATRIX

<table>
<thead>
<tr>
<th>Concrete Type</th>
<th>Wet Cure @ 100% RH</th>
<th>Days for Dry Cure @ 73F, 50% RH</th>
<th>Epoxy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control w/c = .5</td>
<td>40°F</td>
<td>3</td>
<td>Product (1)</td>
</tr>
<tr>
<td>Low-Cracking</td>
<td>73°F</td>
<td>7</td>
<td>Product (2)</td>
</tr>
<tr>
<td>Fly Ash Modified</td>
<td>100°F</td>
<td>14</td>
<td>Product (3)</td>
</tr>
</tbody>
</table>

*Epoxy Types: Product (1), Product (2), Product (3), Product (4), Product (5)*
FAILURE TYPES

- **Type 1** – Failure in the concrete at a depth greater than or equal to ¼ inch over more than 50% of the test area.
- **Type 2** – Failure in the concrete at a depth less than ¼ inch over more than 50% of test area.
- **Type 3** – Separation of the polymer overlay from the concrete surface.
- **Type 4** – Failure within the polymer overlay.
- **Type 5** – Failure of the test adhesive.
SAMPLE RESULTS

BOND STRENGTH vs DRY CURE TIME

Pull-off (psi) vs Cure Time (Days)
**MOISTURE RESULTS**

**Moisture vs Time**

Moisture decreases only slightly between 3 day and 21 day dry cure times.
PRELIMINARY CONCLUSIONS

• Bond does increase with curing time
• Moisture content may not be the only factor
• More definitive answers to come

• Next Phase of Research – optimizing the replacement of polymer overlays
QUESTIONS?