PRESERVING DECKS WITH POLYMER RESINS
Bridge Preservation:

“Actions or strategies that prevent, delay or reduce deterioration of bridges or bridge elements, restore the function of existing bridges, keep bridges in good condition and extend their life. Preservation actions may be preventive or condition-driven.”

FHWA BPETG

Right Treatment!

Right Bridge!

Right Time!
Polymer Resin Overlays

- Bridge Decks – since 1980’s
- Pavements – since 2008
Polymer Overlays: Pavements

High Friction Surface Treatment
• Friction (safety improvement=>T&S)
• Single-course w/hard & durable aggregate)
• Test Projects/STIP KY,TN,WV, others?
Polymer Overlays: Decks

Polymer Bridge Deck Overlays
- Seal & Friction
- Double-course
Polymer Bridge Overlays:

✔ Preservation → Seal Deck

✔ Safety → Provide Friction

repeated for second application
## State Experience

<table>
<thead>
<tr>
<th>STATE</th>
<th>YEARS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Illinois</td>
<td>9</td>
</tr>
<tr>
<td>Indiana</td>
<td>8</td>
</tr>
<tr>
<td>Kansas</td>
<td>15</td>
</tr>
<tr>
<td>Kansas Turnpike*</td>
<td>4</td>
</tr>
<tr>
<td>Michigan*</td>
<td>14</td>
</tr>
<tr>
<td>South Dakota</td>
<td>18</td>
</tr>
<tr>
<td>Virginia</td>
<td>&gt;25</td>
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</tbody>
</table>

* Install >50,000 sf/yr. with agency maintenance crews
Polymer Overlay Binders

- Epoxy
- Modified Epoxies
- Methyl Methacrylate's (MMA’s)
- Polyester
Key Polymer Binder Properties

- Compressive strength
- Flexural modulus
- Elongation
- Viscosity
- Temperature limitations
- Cure time
Epoxy - ‘Commodity Grade’

- >30 years in the US for decks
- Two parts:
  - Epoxide - Part A
  - Hardener – Part B
- Mixed in equal parts
- Polymerization begins – heat
- Cure time 2-4 hours
Modified Epoxies

- Same base epoxy components
- Chemicals added to *epoxide* (Part A) to enhance physical properties:
  - Polysulfide
  - Urethane
- Mix ratio varies (1:1, 2:1)
- Benefits:
  - Maintain modulus of elasticity & tensile elongation over wider temperature range
  - UV resistance
Methyl Methacrylate (MMA)

- 30 years in US for bridge decks
- Two parts:
  - Resin - liquid
  - Hardener – powder
- 1-Gallon resin: 1 – 5 oz. hardener
- Requires primer
- Wide temperature range (14°-90°F)
- Rapid Cure time 1 hour
- Mostly *slurry-form* due to low viscosity
- Thicker application rates
Polyester Resin

- Caltrans in 1970’s
- Two parts:
  - Resin - liquid
  - Hardener – liquid
- Requires primer
- Wide temperature ranges
- Cure time - 2-hrs
- 2 types:
  - Bridge deck overlay binder
  - Polyester concrete (¾ - 12-in)
Selecting Aggregate

- Hardness (>6 Mohs)  \textit{Resistance to polish}
- Durability  \textit{Resistance to degradation}
- Consistent Gradation (#8 critical sieve)
- Angular
- Clean (washed)
Selecting Aggregate

- Flint/Chert  >6.0 Mohs  ~$200/bag
- Granite  6.0 Mohs  ~$300/bag
- Basalt  7.0 Mohs  ~$400/bag
- Bauxite  ~8.5 Mohs  ~$700/bag

Super Sacks (3,000 lbs.)
Candidate Selection

- Overall Bridge Condition
  - >6 (min condition index 6-7)
  - “Right Bridge”/“Right Time”? (scoped, let, install?)
  - Good concrete strength (pull off test)
  - Some repairs ok (spall, patching, cracking)
  - Recent survey (chain, rod, GPR, thermal imaging)

- Tining
  - Depth
    - Shot blasting & plane
    - Tining can affect polymer yields

- Roughness and Ride Quality – Right Treatment?
Epoxy Polymer Overlay

- $1.60 - $2.25/ sq ft (materials only*)
- $3.30 - $5.00/ sq ft (contractor installed)
- 3/8-inch (nominal thickness)
- 0.075 gallons/sf (epoxy)
  - 1st Course (40 sf/gallon)
  - 2nd Course (20 sf/gallon)
- ~3-lbs aggregate/sf
- 7 – 10 Yrs. (>30,000 ADT)

* Binder & Aggregate - excludes shot blasting, labor & traffic control

~10-ozs of epoxy per SF!
Pull-Off Testing

Coring

Type I break in concrete
>250 psi
## Application Temp and Curing Time

<table>
<thead>
<tr>
<th>Polymer Resin</th>
<th>Temp limit</th>
<th>Curing time@70°F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Epoxy</td>
<td>50°-100°F</td>
<td>2-4 hours</td>
</tr>
<tr>
<td>Modified Epoxy</td>
<td>50°-100°F</td>
<td>2-4 hours</td>
</tr>
<tr>
<td>Methyl Methacrylate</td>
<td>14°-100°F</td>
<td>1 hour</td>
</tr>
<tr>
<td>Polyester</td>
<td>40°-100°F</td>
<td>2 hours</td>
</tr>
</tbody>
</table>
Safety and Environment Issues

Safety
- Do not store materials at high temperatures
- Have copies of manufacturers MSDS on job site
- Review proper mixing procedures
- Supply recommended personal protective equipment

Environmental
- Read MSDS for any VOC and hazardous chemicals
- Prevent spills or discharge thru joints or drains
- Proper disposal of unused resins and powders
- Proper disposal of empty drums and containers
Right Treatment?

- What existing problem needs to be corrected?
- Application method appropriate for specific project?
- Application temperatures requirements?
- Curing time...return to traffic?
- Installation equipment requirements?
- Life cycle cost?
Handy References

Polymer Overlays

- AASHTO Task Force 34 (TF-34-01)
- ACI 503R-93 (Use of Epoxy with Concrete)
- ACI 548.9-08 (Epoxy Slurry)
- ASTM 1583-04 (Pull-off Method)
- ASTM D4263 per TF-34 (2-hr Moisture Test)

‘Inspector Training Video’ (South Dakota DOT)
Thank You!

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