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!

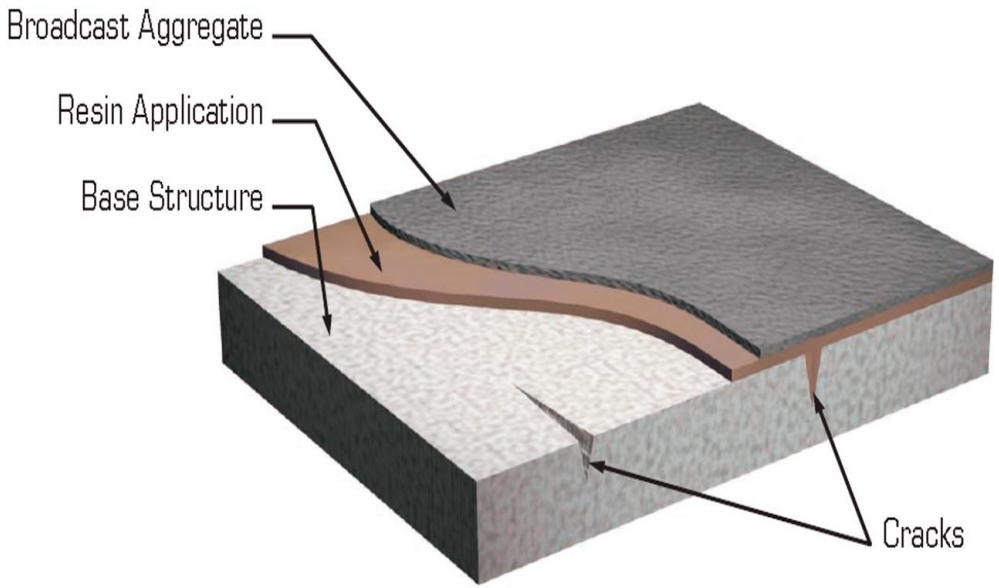
Right Time!

Polymer Overlays: Decks

Polymer Overlays: Pavements

Polymer Bridge Overlays

- ✓ Preservation → Seal
- ✓ Safety → Friction



State Experience

STATE	YEARS
Illinois	8
Indiana	7
Kansas	15
Kansas Turnpike*	4
Michigan*	15
South Dakota	18
Virginia	25

*** Install >50,000 sf/yr with state maintenance crews**

Polymer Overlay Binder Resins

- Epoxy
- Modified Epoxies
- Methyl Methacrylate's (MMA’s)
- Polyester

Key Polymer Binder Properties

- Compressive strength
- Flexural modulus
- Elongation
- Viscosity
- Temperature limitations
- Cure time
- Required mixing and installation equipment

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) ***Resistance to polish***
- Durability ***Resistance to degradation***
- Consistent Gradation (#8 critical sieve)
- Angular
- Clean (washed)

Selecting Aggregate

- Flint/Chert >6 Mohs ~$200/ bag
- Granite 6 Mohs ~$300/bag
- Basalt 7 Mohs ~$400/bag
- Bauxite ~8.5 Mohs ~$1,000/ bag

Candidate Selection

- Overall Bridge Condition
  - >6 (min condition index 6-7)
  - “Right Bridge”/”Right Time” (when?...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 and quality
- 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)

  ~10-ozs of epoxy per SF!
- 3-lbs aggregate/sf
- 10 Yrs – 15 yrs (>30,000 ADT)

*** Epoxy & Aggregate - excludes shot blasting & traffic control**

Application Temp and Curing Time

Polymer Resin	Temp limit	Curing time@70°F
Epoxy	50°-100°F	2-4 hours
Polysulfide Epoxy	50°-100°F	3-4 hours
Methyl Methacrylate's	14°-100°F	1 hour
Polyester	40°-100°F	2 hours

Safety and Environment Issues

Safety, Storage & Handling

- Do not store materials in extremely 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)

- http://www.sddot.com/transportation/bridges/reference/Default.aspx