SCAN TEAM REPORT

NCHRP Project 20 68A, Scan 15-03

Successful Preservation Practices For Steel Bridge Coatings

Supported by the

National Cooperative Highway Research Program

Executive Summary

Coatings provide the primary corrosion protection system for steel highway bridges. There are currently approximately 610,000 highway bridges in the U.S.; approximately 180,000 of these are constructed from steel. Although steel bridges are still being built, the majority of steel bridges were constructed between 1920 and 1970. In recent years, the construction of new highway mileage has slowed and the use of concrete for construction of new bridges has increased. These factors indicate that the primary issues regarding steel bridge coatings lie with maintenance of the many existing—and aging—inventory of steel bridges. The median age of the existing inventory now exceeds 40 years, and a large percentage of coating systems protecting steel bridges have met or exceeded their useful service lives. There is currently an increasing demand for maintenance and replacement of coating systems on steel bridge structures.

Bridge painting practices have changed significantly over the past two decades. Typical, evolutionary changes in surface preparation and coatings material technology have been accelerated by environmental and health and safety regulations to produce revolutionary changes in bridge painting methodology. Specifically, the requirement to build controlled containment structures around surface-preparation and coating-removal operations and requirements for dramatic reductions in solvent content of industrial coatings have forced significant changes in painting practices. These changes have not only created cost increases of 200% to 500%, but have also made innovation a key driver for success in the bridge painting arena. According to a study by the National Association of Corrosion Engineers (NACE), "Corrosion Costs and Preventive Strategies in the United States," the annual cost of corrosion for highway bridges is estimated to be between $6.43 billion to $10.15 billion and is increasing.

Bridge painting is a cost-effective means of extending the functional performance of steel bridges. It should be in the toolkit of every state highway agency; all state highway agencies will be required to use it due to its economic impact to the taxpayer and its function viability. The applied polymeric coating (where pertinent) should serve in an aesthetic and corrosion preventive manner for an extended period of time; based on the results of this scan, at least 15 years and up to 30 years. The range is an estimate and should only be dependent on localized structure environment, not other controllable parameters such as surface preparation and application methods. Additionally, the painting work must meet regulatory requirements regarding both environmental and worker/public safety and health. The seemingly simple act of applying paint to bridge steel must accommodate all of these needs for it to be a practical solution to preventing corrosion.

The scan team identified several factors that would result in premature coatings failure (singly or in combination with others), including:

- Inadequate surface preparation or coating application
- Residual surface contamination
- Incorrect coating thickness

- Improper environmental conditions for application
- Incorrect mixing or agitation
- Inadequate/incorrect coatings/materials
- Extreme exposure conditions
- Inadequate inspections
- Inadequate qualified contractors
- Inadequate specifications

The scan team's observations from the workshop to mitigate premature coating failures are:

1. Agency Funding Levels
    - Dedicated bridge painting funds – utilize algorithms incorporating biannual inspections data, etc., to determine appropriations
2. Evaluation Practices for In-Situ Coatings Prior to Recoating
    - Inspection elements – database containing element-specific conditions
    - Agency-developed elements – ranking system and cataloguing method
3. Surface Preparation
    - Removal/application techniques
        - Crevice sealers
        - New technology – laser coating removal
        - Cable painting/removal techniques – Golden Gate Bridge, Highway and Transportation District
    - Removal of pack rust
        - Ultra-high-pressure washing
        - Soak pack rust and apply heat to remove
4. Coating Option Decision Making
    - Better use of innovative coatings
        - Ultra-weatherable coatings – fluoropolymers, microcapsules, and smart release of corrosion inhibitor
        - Thermal spray
        - Un-top-coated inorganic zinc (IOZ)
5. Use of Performance-Based Contracts (i.e., Warranties)

- Warranties – bonding amount withheld, short terms not to exceed three years, and inspection prior to expiration; issues with implementing warranties on railroad bridges

6. Performance Evaluation of Coatings
   - Modify national test protocols to be appropriate for additional coating types
   - Incorporate colorimetry into national test protocols
7. Specifications for Coating Systems (including removal and replacement, overcoating, and spot/zone coating)
   - Specification improvements
     - Paint beam ends – weathering steel
     - Incorporate hold points for inspection
     - Full-time inspection
     - In-house paint team
     - Shop coating using IOZ for better service life
     - SSPC-SP 10 or better for paint removal
     - Eliminate mist coats – difficult to inspect
     - Priming faying surfaces
   - Stripe coating
     - Use edge-retentive coating – use contrasting colors for the stripe coat for inspection; specify which coats to be striped
   - Structure prioritization – use spot coating
   - Bridge washing – remove surface contaminants like chlorides
   - Bridge debris cleaning (removing debris from deck drains and increasing drain size); raptors to keep pigeons away from bridges
8. Quality Assurance Coating Inspection Requirements
   - Specify SSPC Bridge Coating Inspector (BCI) Program[1] and NACE for inspectors and consultants with 100% inspection required on paint projects
9. Quality Control Inspection Qualifications and Contractor Qualifications
   - Specify SSPC BCI and NACE for inspectors and consultants with 100% inspection

1 Bridge Coating Inspector (BCI) Program, The Society for Protective Coatings, http://archive.sspc.org/bridge-coating-inspector-program-bci

required on paint projects

10. Agency Commitment to Supporting Future Preservation of Coatings
    - Tracking project coating information – bridge ID/tagging/radio-frequency identification (RFID)
    - Communication
        - Paint success/failure
        - Publications
        - Memberships/training
        - Agency-controlled (i.e., membership) blogs
    - Joint Elimination (when possible)
    - Waste Disposal – specify as hazardous unless proved otherwise

Potential implementation activities that CTC & Associates[2] will be assisting the team are in writing articles for publication in coatings publications, like *CoatingsPro Magazine, Modern Steel Construction, Journal of Protective Coatings & Linings* (PaintSquare), *Durability + Design*[3], and others.

Many AASHTO committees and subcommittees, like TSP 2, Subcommittee on Bridges and Structures Technical Committees 9 and 18, and the Subcommittee on Maintenance; the North East Protective Coating Committee; and the National Steel Bridge Alliance, were identified for presenting domestic scan results. Many national conferences (e.g., The Society for Protective Coatings, the National Association of Corrosion Engineers, and the Transportation Research Board) were also identified to reach a wide audience.

2 CTC & Associates LLC, http://ctcandassociates.com/

3 Durability + Design, Technology Publishing Co., http://www.durabilityanddesign.com/