

BENJAMIN FRANKLIN BRIDGE PAINTING PROJECT

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Abstract: This paper identifies the unique steps taken to safely remove lead based paint from a major highway/commuter railroad bridge connecting Philadelphia, Pennsylvania with Camden, New Jersey, followed by the application of a new long lasting protective coating system. The paper addresses project phasing by the owner and coordination with the commuter train to keep costs down and to minimize inconvenience to the public. Project innovations in equipment and accessibility are presented together with a significant partnering effort undertaken by the owner, contractor and engineering/inspection firm. Steps taken to protect the workers and the public during lead paint removal are discussed.

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Project Overview

The Delaware River Port Authority (DRPA) is a bi state agency that is responsible for the operation and maintenance of four major river crossing bridges between Pennsylvania and New Jersey in the Philadelphia area (Benjamin Franklin Bridge, Walt Whitman Bridge, Betsy Ross Bridge, and Commodore Barry Bridge).

The Benjamin Franklin Bridge, constructed in 1926, is a 7,500 foot long suspension bridge with 5 million square feet of paintable surface. It carries 7 lanes of traffic and commuter railroad tracks on the outboard sides of the bridge. The bridge was repainted approximately 10 times since it was constructed. Most of the coating work was accomplished using lead based oil and alkyd systems, and the mill scale was never removed.

In 1998, the DRPA commissioned a study to determine if the existing coating system could be salvaged or if it had to be replaced in order to achieve 25 years of protection with limited maintenance painting during that time. The study concluded that the bridge was in need of painting for both corrosion protection and aesthetics, and that the existing coating could not be salvaged. Corrosion and deteriorated coatings were visible on 15 to 20% of the overall surface with some members exhibiting as much as 50% coating detachment. The coatings were as heavy as 50 mils and the adhesion, when tested using a knife, was poor. Forced failure of the coating typically occurred to the steel substrate or within the lead primer. Lead content of the paint was up to 40%.

Based on the analysis provided in the report, the DRPA initiated a five phase, eight (8) year project for painting the bridge. The phases were awarded as separate contracts. The phases and successful contractors for each are as follows:

- Phase 1 - Camden Approach Truss Spans (2000 to 2001) - Jupiter Contracting Company
- Phase 2 - Camden Approach Girder Spans (2001 to 2002) - Jupiter Contracting Company
- Phase 3 - Camden and Philadelphia Towers (2002 to 2003) - The Aulson Company, Inc.
- Phase 4 - Suspension Spans (2003 - 2005) - Corcon Inc.
- Phase 5 - Philadelphia Approach Spans (scheduled for 2006 to 2007)

The work performed under Phase 4 of the project is the subject of this paper. The scope of the project included total removal of existing lead-based coatings, rust, and mill scale to an SSPC-SP 10, Near White finish and the application of a three coat organic (epoxy) zinc/epoxy/urethane system to a total dry film thickness range of 8 to 14 mils (200 to 350 microns). Stripe coats of both the primer and finish coats were required, with additional coating thickness allowed in the stripe coat areas - 11 to 20 mils total (275 to 500 microns). Phase 4 work began September 23, 2003, starting with site work, issuance of final submittals, and yard preparation. Blast cleaning and coating work began in April 2004.

Owner Phasing of Work

Phasing of the work over an eight (8) year period into five different projects was instrumental to budgeting a project of this size and complexity.

The DRPA's phased approach allowed for a greater number of contractors to bid than would have been possible if the work was let as a single project. At the same time, each phase was large enough to attract the attention of a number of contractors who had the resources and experience to handle projects of this size and complexity. Experience requirements were further defined by requiring SSPC QP1 and QP2 certifications.

From the technical aspects of the project, phasing also allowed lessons learned from one phase to be rolled into the next phase, leading to continual improvement.

Public and Regulator Participation

DRPA was very sensitive to the opinions of the public years before the Phase 1 contractor mobilized. When the design stage was in its infancy, focus group meetings were held with the community to discuss the general plans for the project and to better understand public concerns.

During the initial design of each phase, Town Meetings were held with the public at large to describe the project and the controls that were in place. Feedback from the meetings was considered throughout the remainder of the design phase. Arrangements were also made for the media to cover the events.

During the design of each phase, separate meetings were held with local and state regulators (both Pennsylvania and New Jersey), to discuss the plans for public and environmental protection. Comments were addressed and the regulatory community was very appreciative that their issues were resolved before the work began. They were also pleased that they knew the specifics of the project and the containment/monitoring steps that would be taken. This helped them to prepare in advance for questions that their respective departments might receive.

Partnering - Owner, Contractor, Consultant

The success of a project is greatly influenced by the cooperation that exists between key participants. The success in all phases of this project was due to the direct and open interaction between the owner, contractors, and consultant.

The consultant, Urban Engineers, Inc. (Philadelphia, PA) and its sub consultant KTA-Tator, Inc. (Pittsburgh, PA), supported the implementation of the contractor's painting plan on behalf of DRPA. Weekly and daily meetings between the parties also offered a venue for quick responses to various field conditions. If necessary, adjustments were made within hours.

Partnering is a term that is often misused, or is a concept that achieves mixed rates of success. In this project the DRPA supported, encouraged and demanded cooperation between all parties, and their mandate paid off. Everyone worked together for the common good of the project, and both the quality of the work and work progress were maximized.

Project Planning

A project-specific plan was developed by the Phase 4 contractor at the time of bidding. The plan was extensively reviewed with supervisors and foremen, and man-days and crew days were applied to each activity. The figures were then applied to an estimating program and the bid developed.

The same written plan that was generated at the beginning of the bidding process was followed throughout the project. Field changes, when needed, were made to increase efficiency, improve on safety, or to enhance the quality of the finished product, but the overall plan served as the roadmap for controlling the project.

The plan divided the Phase 4 work on the suspended spans into four quadrants: North side from New Jersey end to the middle of the span, South side from New Jersey end to the middle of the span, North side from Pennsylvania end to the middle of the span, and South side from Pennsylvania end to the middle of the span. This proved to be an effective and logical approach to the project based on project constraints associated with staging locations and the availability of temporary lane closures.

Containment System

A stiffening truss extends above the roadway along both sides of the bridge. Pedestrian walkways supported by umbrella columns are located adjacent to the stiffening truss on both sides of the bridge, and floor beams and stringers support the orthotropic deck.

Only sixteen inches separate the umbrella columns from the parapet wall located at the outer edge of the outside lanes. In order to minimize disruption to the traveling public to the greatest extent possible, all lanes had to be kept open to traffic, with the exception of temporary short-term (e.g., 10AM to 2PM) closures. A commuter railroad runs along the outside of the stiffening truss, and under the pedestrian walkways, on both sides of the bridge. The train operates approximately three feet from the umbrella columns used to support the walkways. Similar to the roadway, the trains could not be stopped, with the exception of periodic weekend outages that had to be scheduled in advance.

In order to avoid harm to the traveling public and to maximize production, it was necessary to design a solid impenetrable containment system that could remain in place under the stress created by continual auto, truck, and train traffic, in addition to the winds following the river. The containment would also have to withstand direct impact from abrasive when cleaning steel that was only a few inches away. The containment had to function with minimal down time due to maintenance so that production could continue unimpeded.

The contractor addressed these demands by designing a novel system for the containment sidewalls facing both the automobile and train traffic. The walls were built from solid steel deck sheets that were bolted in place to a specially designed framing system. Conventional tarpaulin materials were only used to enclose the top and sides where blasting was at a greater distance from the materials and not adjacent to the trains or traffic.

The containment used for the floor beneath the stringers and floor beams was a patented system consisting of sheets of corrugated steel that are fastened together to create a seamless platform. The platform provided safe secure access to all points beneath the

bridge, again maximizing productivity and minimizing downtime due to containment problems. The sidewalls were again constructed of traditional tarpaulin materials.

The containment system met the specified Class 1A requirements of SSPC Guide 6 “Guide for Containing Debris Generated During Paint Removal Operations.” Most importantly, not only did the containment and ventilation system (described in next section) meet the requirements at the time of design, it continued to meet the requirements during use.

Project Innovation - Dust Collection Equipment

Permanent lane closures were not permitted on this project, and one pedestrian walkway had to remain open at all times. Barges moored at the base of the towers were permitted and staging areas were available near the anchorages, but with the suspended spans covering approximately three thousand feet, the placement of the dust collectors posed the greatest concern due to the physics of airflow.

As a result, the closed concrete sidewalk was investigated as a possible staging area for the dust collection system. A structural impact analysis of the sidewalk indicated that it could support the load, but the sidewalk was too small for typical dust collection systems. Through close work with the equipment supplier, small modular 30,000 cfm dust collectors were designed that could be placed on the sidewalks. Two dust collectors were used for each containment resulting in excellent airflow, without the high cost and inefficiency associated with long runs of ducts.

The specification also required that the dust collectors be fitted with sensors that would indicate if emissions were escaping through the exhaust stack, which would be indicative of filtration problems.

Environmental Monitoring

The project posed public and environmental challenges in addition to the proximity of the traffic. Portions of the work on the Philadelphia side were surrounded by marinas, restaurants, and clubs. It was essential that the public be protected from real or perceived exposures from the de-leading operations. Fortunately, the containment/ventilation system provided excellent negative pressure while at the same time maintaining air flow inside for worker safety. The integrity of the containment and the negative pressure were instrumental in controlling the escape of dust and debris.

In order to verify that the containment/ventilation system was performing as required, visible emissions assessments were performed by an independent safety firm working for the contractor and the consultant/inspection firm working for DRPA. Contractor workers were also vigilant for containment breaches. When an emission was observed by any of the parties, the source of the emission was located and corrected. It was well known by everyone on site, that uncorrected breaches and plumes of visible emissions could bring the project to a halt.

As an extra precaution for detecting emissions, the specification required the installation of hi-volume ambient air monitors in areas of public access. The specification required that the results be less than that allowed by the National Ambient Air Quality standards (1.5 µg/m³ as a 90-day average), adjusted to a daily allowable limit using the formulas found in SSPC Guide 6.

The visual observations and ambient air monitoring verified that the containment/ventilation system successfully controlled emissions.

Execution - Supervision & Workforce

A good workforce and good supervision are essential for the successful execution of any project. For the work of Phase 4, the painters knew the specific expectations and requirements. Expectations were communicated on a weekly basis through meetings and on a daily basis during actual production.

During this process, feedback from the painters was encouraged. Possible changes resulting from the comments were reviewed with the painters, and as appropriate, implemented in the field.

The result of this ongoing two-way communication was very little rework. The significance of this cannot be overstated. For example, every time a blast hose has to be turned on to pick up a miss, significant time is added to the job (e.g., 45 minutes or more every time the hose is turned on for touch up – even if it is on for only a single minute).

Worker protection - Safety, Blood Lead Levels

Another problem that was given serious consideration was the high lead content of the existing coating. This was one of the reasons dust collectors were developed that could be placed close to the work zone.

But even this was not enough for work of this nature when dealing with old multi-layered lead coated structures, and elevated blood lead levels were noticed in the initial stages of the project.

Communication with an independent safety consultant resulted in a changed method for testing the respirators - from qualitative to quantitative. This change was made because of concerns over the consistent and proper use of the irritant smoke as the means for testing. The change proved to be very beneficial, as in some cases, workers wearing respirators that had originally passed the qualitative smoke test failed the 20 minute quantitative computerized test.

As a result, ten different types of respirators were used on the job. The safety team tailored respirator selection to the worker and his or her task.

Using a quantitative fit testing unit resulted in safety personnel and workers using respirators with a better fit as well as an appreciation of the differences in fit among various types of masks. By the beginning of the second stage of the project (the South side from the New Jersey anchorage to the middle of the span), all employee blood lead levels were normal with no spiking of levels occurring.

The project also saw an increased emphasis on safety, training, and personal protection. At first this seemed to be costly, but in retrospect, the benefits far outweighed the cost.

Conclusion

The first four phases of the Benjamin Franklin Bridge repainting project have been a success due to the hard work and planning of all parties involved with the project. A few key elements instrumental in achieving this success were:

- Advance planning with regulators
- Community awareness
- Clear specifications
- Phased contracting
- Contractor planning and innovation
- Dedication on the part of all project participants
- Cooperation between owner, consultant, and contractors