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FHWA

"COST EFFECTIVE ALTERNATIVE METHODS FOR STEEL BRIDGE PAINT SYSTEM MAINTENANCE"

CONTRACT NO. DTFH61-97-C-00026

REPORT IV:
THE USE OF RAPID DEPLOYMENT℠ IN THE REMOVAL OF LEAD-BASED PAINT

WRITTEN FOR THE FEDERAL HIGHWAY ADMINISTRATION
BY: CORRPRO COMPANIES INC.
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TECHNOLOGY INTRODUCTION

On many highway overpasses, bridge painting is an inconvenience to the travelling public as well as a safety hazard. Therefore, a concept called "Rapid Deployment℠" has been developed to reduce these inconveniences and hazards. The main objective of the concept is to mobilize all equipment to the site, blast and paint, and incrementally demobilize all equipment from the site; all in one over-night working shift. Generally, Rapid Deployment℠ would be used on highway overpasses where the structural steel is easily accessible, using a lift truck or other form of mobile modular containment, from the roadway below. Rapid Deployment℠ requires a significant array of equipment that is in good condition and a knowledgeable contractor with skilled workers.

The Rapid Deployment℠ method utilized a Recyclable Steel Grit Rig[1], a truck for the paint equipment, modular containment, a dust collector, and an air compressor. All of these pieces of equipment must remain mobile, either self-propelled or connected to a truck.

TECHNOLOGY OBSERVATION

The Ohio Department of Transportation specified Rapid Deployment℠ for the coating system rehabilitation of two overpass bridges over Interstate 77 in Canton, Ohio. The bridges included in the project were the on-ramp from US 30 east and the off-ramp to US 30 west. The coating system was severely deteriorated on the fascia beams and bottom flanges and included red lead primer.

The contractor that performed the work was North Star Painting Company, Inc. of Youngstown, Ohio. The crew consisted of two blasters/painters, one machine operator, a QC person/helper, and a foreman. The contractor was allowed to mobilize onto I-77 at 7:00 PM to take one lane plus one shoulder if necessary, and had to re-open the roadway by 5:00 AM. Due to these time constraints, work had to be done in an orderly, well planned fashion. Each night's work, or each mobilization, consisted of blasting and painting ~900 ft^2. A timeline, which depicts one night's work and inspection points (one mobilization), is shown in Figure 4 in Appendix A.

The contractor began the night's work by setting up traffic control devices followed by the mobilization of the work platform, an ARK® Overpass Master, towed by a large box truck that housed the paint equipment. This platform consisted of two standard 8.5 ft by 20 ft ARK modules connected lengthwise and mounted on a trailer. Wings on the top of the platform opened to give a working platform width of approximately 12 ft. The workable platform was 12' x 40' which corresponds to ~900 ft^2 of accessible surface. The platform could be raised into place using pneumatic pistons located at each corner. The trailer contained a generator and eight halogen lights that provided ample visibility inside the containment. A large diameter vacuum hose was connected to one end of the platform for dust collection and a smaller diameter vacuum hose was connected to the

[1] For more information on Recyclable Steel Grit, see "Cost Effective Alternative Methods for Steel Bridge Paint System Maintenance", Report V

other end for abrasive collection. The spent abrasive was transported to the vacuum hose by an auger system below the grated floor of the platform.

The dust collector was then mobilized to the work zone, towed by a truck, and connected to the platform via the large vacuum hose. The dust collector used was an ETI Cyclone 40 DC. The next piece of equipment mobilized to the work zone was the recyclable steel grit (RSG) rig, manufactured by KEY Abrasive. This RSG rig was mounted on a trailer and towed by a truck. It was able to support up to six blasters simultaneously, though only two were used for this application. The next piece of equipment to be brought to the work zone was a Sullair Compressor capable of providing 1300 CFM air at 150 psi, towed by a pickup truck. Figure 5 in Appendix A illustrates how the Rapid Deployment℠ equipment is set up during the working shift. It is important to note that all equipment must remain mobile for this methodology to be effective.

During mobilization of equipment, containment bulkheads were set up around the platform and tarps were hung. During the site visit, the containment enclosed approximately 40 feet by 16 feet to include one 12 ft wide lane plus a 4 ft wide shoulder. After containment and staging erection, the edges of the bottom flanges were radiused using power disc sanders.

Abrasive blasting began between 8:30 PM and 9:30 PM, depending on whether or not bulkheads were previously put in place, lasting ~2 ½ hours. The blast achieved was the specified SSPC SP-10 Near White Metal Blast. After inspection, primer was mixed and applied using an airless spray unit. The primer was Sherwin Williams Corothane® I zinc filled moisture-cure urethane with a cure accelerant added during mixing. Dry time to recoat was one hour. This was followed by a brushed/rolled stripe coat of the Corothane® I with a cure accelerant added during mixing. After a one-hour dry time for the stripe coat, Sherwin Williams Acrolon™ 218 Rapid Deployment™ Polyurethane was applied at 4.0-6.0 mils dry film thickness using an airless spray unit. This coating was a two component aliphatic polyurethane. The topcoat did not need to dry rapidly since it was the last coat to be applied.

During coating application, some of the equipment was removed from the site to the contractor's storage yard. First removed was the dust collector, during the application of the primer or stripe coat. Next removed was the RSG unit during stripe coat cure or topcoat application. After the final coat was applied, the crew began to remove the containment and touchup any areas that were damaged during the containment removal. Upon completion of touchups and containment removal, the crew re-opened the lane and removed the air compressor and ARK Overpass Master from the site. The lane was re-opened by ~5:00 AM or earlier each day.

RESULTS AND DISCUSSION

Data was collected for this project over four working shifts. According to the data collected, the contractor achieved an average abrasive blasting productivity of ~171 ft^2/hour using Recyclable Steel Grit. The average productivity for application of the

primer and topcoat was ~1,000 ft^2/hour. The painters were able to apply a stripe coat to all edges and bolts of the primed surface in ~½ hour. The productivity rates observed during the site visit are shown in the following table.

Table 1. Productivity Data From Site Visit

Date	Area Completed (ft^2)	Blast Productivity (ft^2/man-hr)	Stripe Coat Productivity (ft^2/man-hr)	Top Coat Productivity (ft^2/man-hr)	Total Time (hours)
9/12/99	926.5	213.8	926.5	926.5	9
9/14/99	926.5	179.3	1111.8	958.4	10
9/16/99	857.3	151.3	1512.8	1094.3	9
9/17/99	857.3	140.9	1285.9	779.3	9.75

In the context of Rapid Deployment[SM], productivity rates of individual steps are not as important as the fact that one mobilization be completed each night. With this in mind, it was demonstrated that at least 900 ft^2 could be prepared and a full coating system be applied in one night. With increased staging area and additional blasters, it would be possible to accomplish blasting and painting on a larger area during one mobilization.

The total surface area of the two overpass structures was 16,881.90 square feet. To finish the project, the contractor required 17 days. This equates to a daily production rate of 993 ft^2/day. If another crew of blasters/painters were to work from an additional ARK platform, time to perform the work could be cut in half, reducing inconvenience to the public and reducing costs.

Notable advantages of Rapid Deployment[SM] are that only a small crew is needed to perform the work. Due to the relatively small area being blasted and painted each night, two blasters/painters can accomplish all stages of work in the allotted time. Since work is accomplished at night, inconvenience to the travelling public is greatly reduced. In addition, when a second crew is added, the length of time needed to perform the work is also reduced.

Each mobilization results in a section of finished product. This not only allows one to easily gauge progress, but also may have a positive influence on public opinion of the project. One last notable advantage is that Rapid Deployment[SM] closes only one lane each night, once again reducing inconvenience to the travelling public.

As with any method for bridge painting, Rapid Deployment[SM] also has its disadvantages. Due to the specialized equipment needed, there is a large initial capitol investment. Many contractors do not have all of this specialized equipment and may be wary of purchasing it because of the high initial investment.

Since all coats of paint need to be applied in one night, cure times can be a problem. Although an accelerant is added to the paint, cure time is still at least one hour. During these times, the crew takes its breaks.

When the night's work is finally finished and the containment is removed, the topcoat is still wet. Because of this, the topcoat can be easily marked and damaged requiring touch ups to be performed during demobilization. Other concerns include susceptibility to imbedment of road debris and risks of changing weather conditions impacting the cure of the coating system.

ECONOMIC DISCUSSION

The economic discussion of Rapid Deployment[SM] for maintenance painting of steel bridges needs to be focused differently than 'conventional' blasting and painting procedures. Since all work in a given area must be accomplished in one move of the staging platform in a relatively small amount of time, costs need to be analyzed somewhat differently. Keeping all things the same, i.e. crew size, blast equipment, paint equipment, surface cleanliness required, we are able to isolate and analyze the cost savings associated with the Rapid Deployment[SM] method of operation versus the 'conventional' method of operation. Rapid Deployment[SM] utilizes manageable areas of a structure using recyclable steel grit to remove the deteriorated coating system and apply all coats of the new coating system in one working shift, approximately 10 hours. 'Conventional' operation entails abrasive blasting using Recyclable Steel Grit and application of primer to "hold" the blast. When the entire bridge (or span) is blasted and primed, the remaining coats are then applied.

For this FHWA study, a cost model was built which estimates the entire cost of a project taking into consideration, among other issues, mobilization, profit and insurance. This model has previously been used to estimate the costs of using various technologies for bridge paint system maintenance and has been modified to estimate these costs using Rapid Deployment[SM]. The model will be used to compare the Rapid Deployment[SM] method of bridge painting to conventional bridge painting.

The Rapid Deployment[SM] process is specifically targeted at highway overpasses. Since separate, repetitive lane closures for blasting, priming, midcoat, and topcoat are not necessary, Rapid Deployment[SM] lends itself to quick turnaround for a project that can otherwise cause major traffic problems if done conventionally. The paintable area of an overpass bridge can measure up to 50,000 ft^2. Square footage is an input in the cost model and was varied from 5,000 ft^2 to 50,000 ft^2. As figure 1 shows, the resulting costs were \$7.21/ft^2-\$3.26/ft^2 for Rapid Deployment[SM] and \$9.77/ft^2-\$3.02/ft^2 to conduct the same work under conventional operations

Another variable in the cost model is the number of workers. During the site visit, only one crew worked per night. With another ARK Overpass Master, another crew of blasters/painters could work along with the same support crew of one foreman, one machine operator, and one helper. The only additional equipment needed is another ARK platform, and additional airless spray units. After changing these variables, the costs to perform maintenance on overpasses ranging from 5,000 ft^2 to 50,000 ft^2 are \$8.19/ft^2-\$2.45/ft^2 for Rapid Deployment[SM] and \$12.34/ft^2-\$2.75/ft^2 for conventional operations, shown in Figure 2.

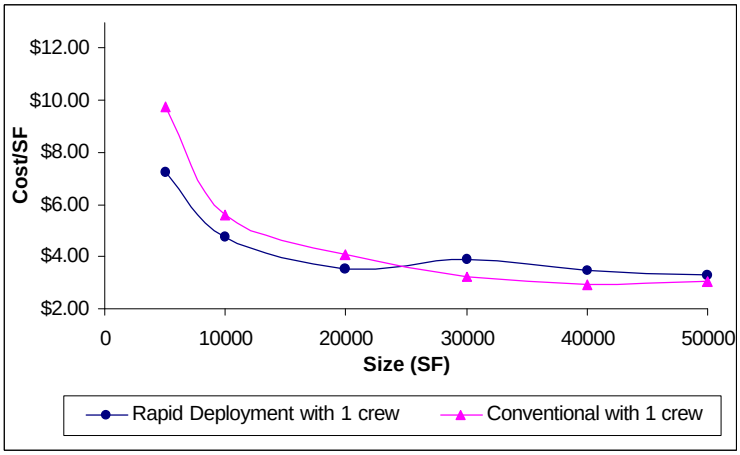

Figure 1. Rapid Deployment[SM] vs. conventional operations using one crew

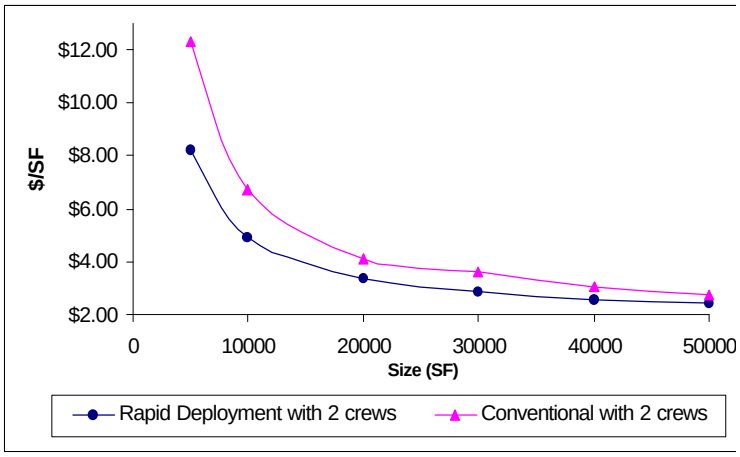

Figure 2. Rapid Deployment[SM] vs. conventional operations using two crews

Figure 3 compares Rapid Deployment[SM] costs using one and two crews. It can be seen that using two crews is more cost effective on bridges greater than 15,000 ft^2. Using two crews decreases the required time for Rapid Deployment[SM] by half whereas using two crews for conventional operations decreases the time required by only a few days.

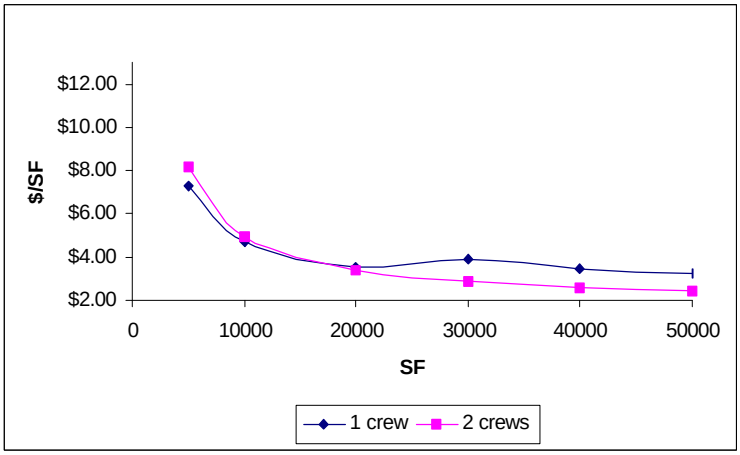

Figure 3. Rapid Deployment[SM] using one crew vs. Rapid Deployment[SM] using two crews.

CONCLUSIONS

1. To perform the work under time constraints, the contractor must be well equipped, have skilled workers, and have a strong knowledge of what it takes to perform the necessary Rapid Deployment[SM] work schedule.

2. Rapid Deployment[SM] can be strictly enforced by the State Department of Transportation since it details exactly what is required by the contractor. The specification requires that the contractor has equipment that meets certain criteria and that all work on each section is completed during one working shift (10 hours). This reduces the overall impact on traffic because the contractor is required to finish all areas started and not allowed to work at his "own pace." This ensures work is consistently performed efficiently and timely on a day-to-day basis.

3. Since the surface is primed immediately following blasting, there is little chance of loosing the specified blast condition. This method therefore reinforces good blasting and painting practices which may not be followed during conventional operations due to scheduling or time constraints.

4. Since all coats are applied in one shift and containment is not removed until after the last coat has been applied, there is little chance for surface contamination between coats. Under conventional operations, one rainy day could result in surface contamination, for example road debris and soot from diesel exhaust, that requires cleaning prior to application of the midcoat or topcoat.

5. Rapid Deployment[SM] with one blasting/painting crew (two blasters, one foreman, one helper) is most cost effective on overpasses with paintable area under ~25,000 ft^2 when compared to conventional operations.

6. Utilizing two crews (two additional blasters only) versus one crew decreases costs and makes Rapid Deployment[SM] a more viable option on overpasses with paintable area greater than ~15,000 ft^2. It is also important to note that in order for the use of two crews to be viable, the contractor must have enough future work to facilitate the additional equipment needed.

7. The authors believe the Rapid Deployment[SM] concept can significantly reduce the costs to Departments of Transportation and the negative impact to the travelling public during lead based paint removal on highway overpasses.

8. The long term performance of the two coat system with a cure accelerant versus traditional three coat systems without accelerant is as yet unknown. Since the Rapid Deployment[SM] coating system utilizes a zinc rich primer and the total system dry film thickness is the same as that of the traditional three coat system, the end product and long term performance should theoretically be the same.

9. Real time quality assurance takes on an essential role in the success of any Rapid Deployment[SM] project. Since the project is under strict time constraints, the project must be done smoothly, without mistakes, the first time through in order to be cost effective. A second mobilization to a section of the bridge will result in significant cost increases.

10. As other opportunities to collect data on Rapid Deployment[SM] are presented, supplemental reports will be issued.

APPENDIX A
FIGURES

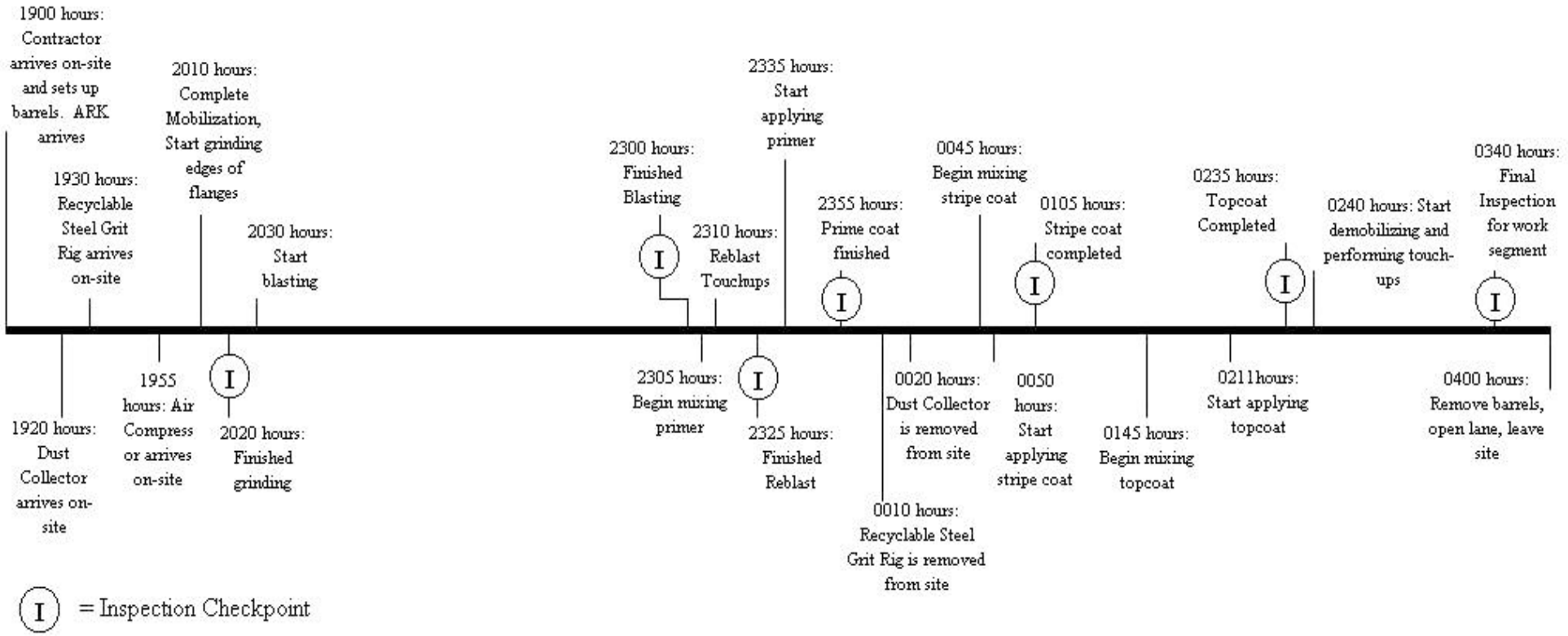

Figure 4. Example of timeline of major events for one working shift (actual shift depicted)

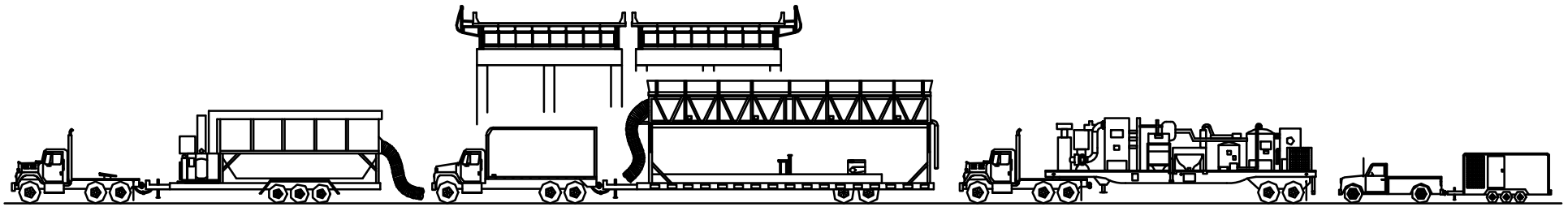

Figure 5. Schematic of the equipment involved in Rapid Deployment[SM] overpass painting.