Research Report
KTC-00-10

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EXPERIMENTAL MAINTENANCE PAINTING ON THE I-64 RIVERSIDE EXPRESSWAY IN LOUISVILLE

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In cooperation with

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16. Abstract

The Riverside Parkway comprises some 3.2 miles of elevated steel (plate-girder) in downtown Louisville having approximately 24,054 tons of steel. The structures had existing coatings that contained lead. The project posed significant operational and public safety and operational constraints due to close proximity of the structures with residences and businesses along the entire route. In 1996, the KYTC Paint Team developed experimental specifications to re-paint the Parkway by overcoating. Surface preparation procedures included 3,000-psi pressure washing and power-tool cleaning. Containment enclosures were employed throughout the project and hazardous wastes were collected and disposed of. The Parkway spans were painted with a brushed-on spot coat and full brushed-on intermediate coat of aluminum-pigmented moisture cure polyurethane primer and rolled or spray-applied topcoat of high-gloss acrylic polyurethane. The project was let at a cost of about $\$1.20/ft^2$. The painting project began in September 1996 and was successfully completed in June 1998. A follow-up inspection in June 1999 revealed that the project was performing exceeding well despite its low cost.

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EXECUTIVE SUMMARY

The I-64 Riverside Parkway runs approximately 5.5 miles between the I-65 John F. Kennedy and the I-64 Sherman Minton Bridges in downtown Louisville, KY. The Riverside Parkway has approximately 3.2 miles of elevated steel deck-girder structures in 14 spans weighing 24,054 tons (Appendix A). The Parkway was constructed in the early- to mid-1970s. Most of those structures had not been re-painted prior to 1996.

In 1995, the KYTC Paint Team began work on preparing special notes for the maintenance painting of the Parkway structures. Preliminary inspections of those structures revealed the existing paint contained lead. Most of the existing paint was in relatively good condition with erosion due to weathering. Extensive corrosion was observed on steel under open deck joints in spans 1 and 2. The existing paint on span 14, which had been previously overcoated, was in poor condition and was disbonding throughout the span.

Due to the close proximity of the Parkway with residences and business along the entire route, the project posed significant operational and public safety constraints. To minimize the potential for conflicts with adjacent landowners and businesses, the Paint Team sought close cooperation from District 5 officials. Plans were made prior to the contract letting to address contractor access requirements to those structures. Overcoating was selected for painting the structures to minimize the potential for environmental problems.

On the east end of the project, much improvement and development was taking place along the riverfront, various municipal groups were interested in the color used for the project. Over several months, KYTC and Kentucky Transportation Center (KTC) personnel applied 25 paint test patches of various colors for selection by the local groups. Eventually, those groups selected a beige color for the Parkway paint.

Painting of the Parkway was designated as an experimental project. Some elements of previous overcoating projects were incorporated into the special notes. Incremental changes were made to the surface preparation procedures including the use of pressure washing at 3,000 psi (with spinner tips) and the requirement for power tool cleaning using tools with vacuum shrouds. The wastewater from the project was to be filtered through 85 percent windscreens to remove lead chips. Debris generated by the power tools was to be collected. All paint-related debris was considered to be hazardous waste and it was to be handled and disposed of according to applicable environmental regulations.

A quality control/quality assurance (QC/QA) procedure was employed for this project. The contractor was required to employ a full-time QC person to perform 100 percent inspection of the completed work. KYTC inspectors performed random QA audits at each site. The spans were divided into control areas and each phase of work (washing, mechanical surface preparation, spot priming, full priming and top coating) had to be approved by the KYTC QA inspector before the next phase of work could begin in that control area.

The Paint Team decided to use a polyurethane paint system successfully employed on previous projects. The coatings system consisted of an aluminum-pigmented moisture cure polyurethane (MCU) primer applied by brushing as a spot coat (over areas where the original coating was not intact), followed by a brushed-on coat of the MCU primer and a topcoat of high-gloss two component acrylic aliphatic polyurethane applied by either brushing, rolling or spraying. Special notes for the system were revised to better regulate its composition and to facilitate acceptance testing by the Division of Materials.

The project featured a mandatory full day pre-bid meeting for prospective contractors. The meeting included a review of the contract specifications and special notes by KYTC officials and walkover of the complete project. Only attending contractors were permitted to bid on the project.

The project was awarded for a total bid of was $4,171,761. This was later increased slightly due to several change orders initiated by KYDOH. The total area of steel was estimated to be about 3.4 million ft^2. That yielded a unit cost for the project of approximately $1.20/$ft^2$. The low bid of the performing contractor was not an abnormality. The next lowest bid was only $600,000 (16 %) higher and four bids were received that would have provided unit costs at or below $2.00/$ft^2$. From its onset in 1996 to its completion in 1998, it was one of the largest highway painting projects in the U.S.

The contractor began work on the project in September 1996. When colder temperatures were encountered in October, the contractor experienced a problem with paint blistering in the MCU primer. Short-term attempts to remedy the problem were unsuccessful and project was halted for the winter. During that time, KYTC, KTC and the paint manufacturer worked to resolve the blistering problem. Some 20 different paint formulations were applied under similar conditions to those resulting in blistering. A solution to the problem was identified, and after the contractor resumed his work in April 1997, the revised MCU primer performed properly.

Work progressed satisfactorily throughout 1997. At many locations, the contractor completely enclosed the structures with containment tarpaulins to allow him to spray on the topcoat without overspray damage to neighboring property or to prevent dust contamination of wet paint in the riverfront development area. He used elevated and ground level containment to enclose the work areas. The contractor placed the 85 percent windscreens below the work to filter wastewater and capture paint debris.

On spans 4-8 that formed the 9th Street interchange, the contractor used night painting off of man lifts without resorting to full containment. At those locations, he draped the windscreen on the ground to filter the wastewater and applied all coats of paint by brushing. That portion of the work was completed successfully. The contractor used a similar approach on the portion of span 4 that crossed over I 64 as part of the 9th Street interchange and on the west end of span 14. Much of that work was conducted during the daytime on weekends.

Throughout the project, the contractor worked successfully with District 5 officials to schedule and complete work without undue interference with businesses and agencies using land under and adjacent to the Parkway. The contractor also had to coordinate his work with four other contractors working on or adjacent to the Parkway. No problems occurred related to the contractor's access to his work sites.

The work was completed in June 1998. The KYTC Central Office Division of Construction inspector worked closely with the contractor during final inspections of each span. Often, the contractor would assign a painter to accompany the inspector on his final inspection and touch-up missed or deficient spots. This cooperation facilitated the completion of work. A final project walk-through revealed that the drainage troughs on spans 1 and 2 were filling with debris and subsequently leaking water that washed through the open deck joints (finger dams) onto the steel. That was resulting in rust staining from the joint steel work and corrosion of the steel under the deck joints. At other locations, the project appeared to be in excellent condition.

In June 1999, KTC personnel conducted a follow-on inspection of the entire project (Appendix B). The problems at the open deck joints in spans 1 and 2 persisted and worsened. At other deck joint locations where modular joints were present, rust staining and corrosion were

less apparent. Other defects were usually minor in scope. They included rust staining and corrosion at rockers and bearing plates, spot rusting along the flange edges of beams and cross bracing, and isolated spots lacking top coats (usually bolt heads and cross bracing). Disbonding had occurred at only one location over a railroad crossing where diesel fume deposits were present. That area was very small.

The great bulk of the paintwork on this large project was in excellent condition. The gloss retention and general appearance were very good and the color of the structures was in harmony with the environs. Many years of useful service are expected for this project. It represents an outstanding value to the Kentucky Transportation Cabinet and the taxpayers of Kentucky.

TABLE OF CONTENTS

LIST OF FIGURES

BACKGROUND

The Riverside Parkway runs approximately 5.5 miles carrying I 64 from just west of the John F. Kennedy (I-65) Bridge to the main span of the Sherman Minton (I-64) Bridge that crosses the Ohio River west of downtown Louisville. It contains some 3.2 miles of elevated steel (rolled-beam and plate-girder) structures (Appendix A). The Parkway was constructed in the early- to mid-1970s containing approximately 24,054 tons of steel. Prior to 1996, most of those structures had not been re-painted since their original construction. The original paint system used on all of the steel consisted of one coat of red-lead primer applied over mill scale followed by two coats of aluminum-pigmented alkyd. A leafing aluminum pigment was used in the intermediate coat and a non-leafing aluminum pigment in the topcoat. Span 14, at the west end of the project, had been overcoated in 1980 with one coat of red-lead primer and one coat of a gray-alkyd topcoat that contained some lead pigment.

Over the years, the Parkway coatings had deteriorated to the point that the structures required maintenance painting. In 1995, the Kentucky Department of Highways (KYTC) Division of Operations personnel began to focus efforts on maintenance painting of the Parkway by overcoating. This was to be the largest maintenance-painting project ever attempted by KYTC. Previous experimental overcoating projects conducted between 1991 and 1995 had provided incremental process and specification improvements. Paint Team members were confident that this large project could be performed successfully. However, careful planning was necessary to avoid problems posed by the existing paint, traffic, and nearby private and publicly owned facilities.

INITIAL FIELD INSPECTIONS

The KYTC Paint Team conducted a series of preliminary inspections to assess the structures and identify non-KYTC facilities under and adjacent to them to determine the scope of work necessary for this maintenance painting project. Those inspections of the Parkway were conducted in 1995. The inspections consisted of ground-level walkovers using binoculars to obtain close views of the structures.

The condition of the existing paint varied significantly throughout the project. On most of the spans, the paint was in good condition with a slight amount of rust, usually observed in the bearing areas (Figures 1, 2). Structures on spans at the east end of the Parkway had pin-and-hanger connections with open deck joints. Floor beams under those joints had extensive corrosion around the lower flanges (Figure 3). Otherwise, the paint on those spans was in good condition. On a short section of span 9, the aluminum topcoats were disbonding from the primer (Figure 4). Span 13 appeared to possess some incipient rust bloom on many of its structural elements (Figure 5). The paint on span 14 was disbonding extensively throughout its structures with some rust evident on the exposed mill scale (Figure 6).

A variety of tests were performed to assess the existing paint. Scratch gage (ASTM D-4138), tape adhesion (ASTM D-3359), pull-off strength (ASTM D-4541), and surface chloride (Scat) tests were performed to measure coating thickness, brittleness, bonding strength, and soluble salt content respectively (Figure 7). On the exterior surfaces of several spans, the aluminum alkyd topcoat was found to be thinner than topcoats at interior locations. That was probably due to weathering of the alkyd paint on surfaces directly exposed to the elements.

Where the topcoat had extensively weathered, less than 1-mil (.001inch) thickness remained. On span 13, it was determined that only one coat of aluminum paint had been applied over the primer. At most locations, the aluminum topcoat was typically 2 to 3 mils thick. Throughout the Parkway, the red-lead primer thickness measurements varied from 2 to 7 mils.

X-cut and crosscut (at 5-mm spacing) tape-adhesion tests were performed on the existing paint. On Span 14, the overcoated paint was very brittle, providing 0A and 0B readings, respectively, for the two types of adhesion tests. The tape-adhesion results varied over the other spans tests. The test results were typically low (1 to 2 A or B) at locations with thin topcoats. They were higher (4 to 5 A or B) at locations where the existing coatings were in good condition.

Pull-off test results ranging from 50 to 200 psi were obtained at locations exhibiting thin topcoats or disbonding. Failures at those locations were typically adhesive between the topcoat and the primer, or cohesive in the primer. At locations where the existing coating remained in good condition, the test values ranged from 200 to 700 psi. At those sites test failures were primarily cohesive in the red-lead primer or adhesive between a primer and the alkyd intermediate coat. The highest test values were obtained from adhesive failures between the primer and the mill scale.

Scat tests produced only trace levels of chlorides of the paint surfaces, even at locations under open or leaking deck joints. The limited amount of corrosion at those locations indicated that chloride contamination was not an issue on most of the spans.

A portion of the off ramp from I 64 onto 3rd Street is periodically underwater when the Ohio River rises to its higher stages. An oily scum had been deposited by the floodwater on the ramp steel near ground level (Figure 8). At other locations along the Parkway, diesel fumes had deposited on beams in spans that passed over roads and railroad tracks (Figure 9). Those built-up oily deposits could result in poor paint adhesion if they were not completely removed. Such deposits were significant at locations where the Parkway crossed over railroad tracks and at the intersection of River Road and 3rd Street.

The inspections and test results were typical for other bridges previously overcoated by KYTC. While the coatings used by KYTC worked well over poorly bonded existing paint, the consequences of premature coating failure on this highly visible project provided little tolerance for such events. Surface cleaning (i.e., pressure washing and mechanical surface preparation) operations would need to provide good substrates for overcoating to preclude the possibilities of early coating failures.

WORKSITE CONDITIONS

Several situations were observed that complicated the Parkway painting operations. Portions of the elevated spans traversed city streets necessitating traffic control during painting. Numerous businesses, a Coast Guard station, a public golf course, and several municipal parking lots were located under or immediately adjacent to the various Parkway spans. To accommodate painting operations, public access to KYTC right-of-ways under the structures was temporarily suspended or restricted.

KYTC District 5 officials were enlisted to identify the various landowners/users impacted by the painting operations and inform them as to when and how long closures/access restrictions would be enforced. Contractor progress along the project was subjected to variances from his established timetable. District officials constantly needed to be informed of contractor's current

progress of work and future intentions in order to properly alert impacted businesses and municipal agencies in a timely manner.

Near the center of the project, span 4 (the off ramp from I 64 westbound to 9th Street) crossed over the mainline I-64 structures. At the west end of span 14, connecting to the double-decked Sherman Minton Bridge over the Ohio River, the westbound on ramp crossed over the eastbound off ramp. At both locations, lane restrictions were necessary on the underlying mainline I-64 roadway to permit painting operations. The closure of interstate lanes was restricted to periods of low traffic to prevent undue inconvenience to motorists. Also, the 9th Street exit ramp was closed during portions of the ramp-painting operations. The decision was made to limit those painting operations to weekends when I 64 experienced lower traffic volumes. Contractor access to city streets running under the Parkway was limited to non-peak traffic hours (middays and evenings during the working week). Access was limited in the portions of spans 12 and 13 that crossed railroad tracks. Railway flagmen were required when the contractor was working directly over the tracks.

Several unrelated road construction projects were in progress that could affect the Parkway painting operations. A contractor was retrofitting the pin-and-hanger connections on some of the Parkway structures for KYTC. Another contractor was installing a new on-ramp from River Road to the eastbound lanes of I 64 at 1st Street. Both of those projects had priority over the painting operations. At span 14, a contractor was conducting deck work on the Sherman Minton Bridge for the Indiana Department of Transportation. That contractor's traffic control had to be coordinated with the KYTC painting contractor's work and his traffic-control. A significant amount of renovation/beautification work was occurring on a park adjacent to the east end of the Parkway. Most of that work was being conducted adjacent to and directly under spans 1 and 2. An extensive amount of grading work was being conducted in that area. Large clouds of dust were being generated that could negatively impact the painting operations. That contractor had to suppress his dust generation and the painting contractor had to take steps to preclude dust-related problems.

The close proximity of the Parkway structures to homes, schools, businesses, parking lots, etc. posed additional concerns. Potential problems existed if hazardous wastes generated during the work were accidentally released into the environment. Also, there was significant potential for paint-overspray damage to public and private properties. Steps were needed to reduce the potential for such harmful releases into the environment.

SPECIFICATION DEVELOPMENT

KYTC employs overcoating, painting over existing coatings, to minimize environmental problems and to limit bridge maintenance painting costs. Since 1991, KYTC has conducted an on-going series of overcoating research projects with the Kentucky Transportation Center (KTC) at the University of Kentucky. That work is intended to develop and improve upon KYTC overcoating practices. Prior to this project, about 50 KYTC bridges had been overcoated using a variety of paint systems and overcoating procedures. Overcoating research projects were conducted to identify effective coatings, economic painting practices, and environmentally compliant operating procedures.

A multi-disciplinary group, the KYTC Paint Team, was formed shortly before this project to assist and advise the KYTC on maintenance-painting operations. The Paint Team consists of

personnel from the Divisions of Construction, Operations, Materials and Environmental Analysis, and KTC researchers. The primary duties of the Paint Team include: assisting in the development of project special notes, development of materials specifications, developing new cleaning and application specifications, monitoring construction and performance of experimental KYTC maintenance-painting operations, assurance of compliance with environmental regulations, and supervision of research related to maintenance-painting issues.

The Paint Team selected overcoating of the Riverside Parkway structures to minimize the amount of hazardous wastes generated and limit the potential for worker and public exposure to those wastes. Prior to this project, they had adopted a fundamental approach to overcoating based upon a series of successful experimental projects. The Paint Team saw opportunities for further improvements and decided to implement them in the Parkway project. Due to the high visibility of this project, they met frequently to prepare specifications that would address both painting and site-specific issues. Improved material (coatings) specifications, cleaning procedures, QC/QA requirements, and containment/waste disposal procedures were developed and the project was classified as experimental. Most of the new specifications constituted measured advancements over previous ones. This incremental improvement approach minimized the possibility that any revised procedures would provide unsuccessful projects.

Surface Cleaning

Pressure washing is normally specified on KYTC overcoating projects to remove dirt, chalked paint, oil, etc. As specified by KYTC, it also acts as a proof test to remove weakly bonded existing paint. To achieve the desired cleaning/proof testing, a washing pressure of 3,000 psi was specified (measured at the wand) with a 12-inch maximum separation between the wand nozzle and the work piece. To promote an aggressive cleaning action during pressure washing, the contractor was required to use rotating columnar spray nozzles (i.e. 0^{o} spinner tips). To preclude contamination of washed substrates, he was required to use potable water as the washing medium. The specifications also provided for the use of other cleaning methods including steam cleaning and solvent wiping that the contractor could employ to remove oil and diesel-smoke deposits. The washed surface was accepted when all visible dirt, chalk paint, oil, grease, diesel fumes, diesel smoke, tar, road salt, bird contamination, and other foreign material were removed.

All of the spans were over land. The filtered wastewater discharged onto the ground would be classified as hazardous only if it exceeded the EPA regulatory threshold of 5 PPM as determined by the Toxicity Characteristic Leaching Procedure (TCLP) test. Several other parties who had employed similar washing procedures on lead-based paints, provided KYTC with TCLP test data on both filtered and unfiltered wastewater. Those test results were well below the regulatory threshold for the wastewater to be classified as hazardous. The bulk of pressure washing on this project was conducted on the existing aluminum-pigmented alkyd topcoats. It was assumed that very little lead-based paint would be disturbed except on span 14. Pressure washing would generate some paint chips, but those would be captured in porous 85 percent containment screens that were to be draped under the structures. As a consequence, there was little concern about wastewater-generated hazardous waste discharges.

Mechanical Surface Preparation

Prior to other mechanical surface preparation, all stratified (pack) rust was removed. Mechanical surface preparation (hand or power tool cleaning) was specified to treat surfaces that did not possess adherent paint after washing. Power tool cleaning was performed in accordance with Steel Structures Painting Council (SSPC) SP-3. In areas of limited access, hand tool cleaning was performed in accordance with SSPC SP-2. Little lead-based paint debris was generated by that operation as most of the existing paint was intact and, in most spans, the corrosion was localized thereby limiting the use of tools for paint removal. The specification required vacuum-shrouds on tools used for mechanical surface preparation. Any paint debris generated by that process was to be contained by the shrouds and drawn through hoses into vacuum systems for collection and eventual disposal. The specification of vacuum shrouds precluded the need for complete containment of structures receiving mechanical surface preparation. Mechanical surface preparation was not allowed until 24 hours after pressure washing to ensure that it would be performed on dry substrates. Painting was permitted immediately after mechanical surface preparation.

Coatings Systems and Application

The coatings system used for this project consisted of an aluminum-pigmented moisture cure polyurethane (MCU) primer and a high-gloss acrylic aliphatic polyurethane topcoat. These coatings had been employed successfully by KYTC since 1992. In 1995, new material specifications were prepared to ensure that KYTC obtained high-quality coatings. The materials specification was revised for this project to better regulate the composition of paint provided by qualified coatings manufacturers. The MCU primer was specified as both a spot primer and a full primer.

Spot priming (2-3 mils DFT) was performed over portions of steel that had received mechanical surface preparation or that possessed exposed mill scale. Spot priming was intended to form a continuous paint substrate (along with the adherent existing paint) for succeeding coats of paint and to provide corrosion protection equivalent to the adhering alkyd paint. Following spot priming, a full prime coat (2-3 mils DFT) was to be applied to provide additional corrosion and weathering protection. Spot and full prime coats were to be applied directly over cleaned substrates. Brush application was specified to ensure that the primers would be thoroughly worked into those substrates, filling any cavities and penetrating any loose edges in the existing paint. That would help prevent premature disbonding of the new paint. The topcoat was to be applied over the fully primed substrate. As a good, continuous substrate would be present, the contractor could elect to apply the topcoat by brushing, rolling or spraying. If he chose to spray the topcoat, he was required to completely contain his work to prevent overspray damage.

Selection of the topcoat color became an involved process. The KYTC Paint Team initially planned to specify a dark color for the topcoat due to concerns about rust staining on steel under open deck joints. However, several civic groups active in revitalizing the riverfront interceded and gained authority to select the topcoat color. The Paint Team applied 25 paint test patches on the 3rd Street off ramp using various colors before the municipal groups agreed upon light beige as the topcoat color (Figure 10). Eventually, they selected a light beige color that was used throughout the project.

Materials

A list of coatings manufacturers qualified to provide KYTC-specification paint was provided to bidding contractors along with the specifications. Those manufacturers had submitted qualification samples that were extensively tested by the KYTC Division of Materials. All paint sent to the job site was to be subjected to acceptance testing on a per-lot basis from random samples taken by KYTC personnel. Paint samples were to be tested and approved by the Division of Materials within 10 days of sampling.

Quality in Workmanship

A quality control/quality assurance (QC/QA) approach to inspection was employed by KYTC to obtain a satisfactory project. Structures were divided into pre-defined areas that limited the extent of the contractor work (control areas). The work was divided into specific tasks (washing, mechanical surface preparation, spot priming, full priming, and topcoating). Only one task could be performed in a control area at a time. That task was not considered complete until QC/QA inspections indicated that the work was acceptable. Then, the contractor was permitted to address the succeeding task.

The contractor was required to employ a full-time QC inspector. That individual was assigned to examine all work in a control area after it was completed and have any corrective work performed. After the QC inspector deemed the work satisfactory, a KYTC QA inspector would re-examine a portion of the work. If the QA inspector considered it acceptable, he would notify the QC inspector and sign-off his acceptance in a logbook maintained by the QC inspector. The QC inspector would inform the contractor's foreman that the next task could be performed in that control area. Rejected work would need to be corrected to the satisfaction of the QA inspector. Resolution of any disputes between the two inspectors was to be handled by the KYTC resident engineer assigned to the project.

Prior to the onset of work, the contractor was required to apply a test patch incorporating the equipment, coatings and procedures specified for the project. KYTC personnel and the contractor's personnel attended the test to confirm that it was conducted properly and to ensure that all parties comprehended the level of quality in cleaning and painting expected on the project. The test patch area was to be covered with plastic sheet and retained as a reference standard until the project was completed.

Pre-Bid Meeting

Painting contractors wishing to bid on the project were required to participate in a pre-bid meeting. The meeting was held in the KYTC District 5 office in Louisville several weeks prior to the bid opening. Attendees included contractors, KYTC District 5 officials associated with the project, and the Paint Team. Paint Team members reviewed the project specifications in detail and answered the contractors' questions. District 5 officials discussed scheduling requirements for accessing each of the spans. Thereafter, the group was taken to all of the spans to review the condition of the structures and to observe the non-KYTC facilities and activities under and adjacent to the KYTC Parkway rights-of-way (Figure 11). The prospective contractors were required to sign a form that showed they had attended the meeting at the District 5 office and had

also participated in the field review. Contractors not signing the form were not allowed to bid on the project.

Environmental Protection and Worker Safety

General requirements were provided for environmental and worker safety regulations. The contractor was required to contain all areas washed or receiving mechanical surface preparation with 85% containment screens. The screens were to be positioned to trap all falling solid debris. Debris was to be cleaned from the screens daily and when the screens were repositioned. The contractor was responsible for collecting, storing, transporting, and disposing of any waste generated in accordance with applicable regulations.

KYTC provided a secured hazardous waste storage location on its property adjacent to the 9th Street interchange in downtown Louisville. The Kentucky Natural Resources Cabinet, Division of Waste Management allowed the contractor to transport hazardous wastes generated along the project to that storage area. At the onset of the project, KYTC applied for a large-quantity waste generator permit. The contractor was required to dispose of all hazardous wastes within 90 days of generation. He was required to provide KYTC with all manifests related to hazardous waste transport and disposal.

PROJECT BIDS

The bid opening was on August 23, 1996 at the State Office Building in Frankfort. There were eight bids received on the project ranging from $4,171,761 to $8,194,000. The lowest bid was $682,991 lower than the next lowest bid. A rough estimate of the original surface area of steel to be painted was about 3,500,000 ft^2 based upon the tons of steel and an estimated area of 145 ft^2/ton of light steel. That resulted in an estimated unit cost of about $1.20/$ft^2$. That was one of the lowest bridge painting costs obtained by any state highway agency during the mid-1990s. The final project cost was slightly higher due to some extra work requested by KYTC. A portion of the work was subsequently subcontracted to a second firm. That cost generally conformed to KYTC painting costs during the mid-1990s. Due to the size of the Parkway, this was probably the largest project that ever would be let by KYTC.

PROJECT PAINTING ACTIVITIES

Painting Operations in 1996

Shortly after the contract was awarded, KYTC District 5 officials and the Paint Team held a pre-construction meeting with the contractor's representatives in Louisville. The contractor's representatives and KYTC District 5 personnel directly assigned to the project were introduced. KYTC general contracting requirements were reviewed. The contractor opted for formal partnering with KYTC. The two parties agreed upon monthly partnering meetings to resolve problems and discuss project progress and scheduling (Figure 12). KYTC officials were provided with an initial schedule for work through the end of 1996. Plans were made to perform a test patch as soon as the contractor had mobilized. KYTC Division of Construction

representatives offered to perform final inspections on each span after the KYTC QA inspectors indicated the work was complete. After final inspections and any corrective work on a span, that portion of the project would officially be completed. The contractor would be paid based upon the total project bid and the percentage of total tonnage of steel painted in a completed span.

Due to late start-up of this project (KYTC requires that all maintenance-painting operations cease by November 15), the contractor planned to paint only one span in 1996. Initial painting work began in September 1996 on span 13 (2,662 feet of plate-girder structures/2,479 tons of steel) in the West portion of the project. The contractor elected to employ total containment at that location (Figure 13). With total containment, he was allowed to use conventional tools for mechanical surface preparation with respirators for worker protection. He was also able to spray on the topcoat. Close inspection of the structural steel on span 13 revealed that the structures possessed very little corrosion. The existing aluminum alkyd topcoat had completely weathered away in spots exposing red-lead primer, which was mistakenly believed to be rust based upon the preliminary inspections. As a consequence, very little mechanical surface preparation was necessary on that span.

The paint test patch was applied shortly after the contractor began erecting his containment in September 1996 (Figure 14).

The painting operation progressed satisfactorily until late October when ambient temperatures dipped below 50^{o} F. Thereafter, blistering was encountered in the aluminum-pigmented moisture cure primer. Immediately after application, the drying primer would appear to be satisfactory. However, after curing overnight, workers would detect the paint blisters (Figures 15,16). Attempts to eliminate the problem proved unsuccessful. The contractor had to scrape off the blisters and perform touch-up repairs. Frequently, the spot repairs would also blister. This slowed his progress. Lacking a ready solution to the problem, KYTC officials and the contractor agreed to terminate painting at the end of October. By then, most of Span 13 had been painted. The Paint Team took steps to resolve the problem prior to the onset of the next painting season (April 1, 1997).

Preliminary attempts to resolve the problem centered on the composition of the moisture cure paint. No blistering was experienced with the two-component topcoat paint. Working with the coatings manufacturer and the resin supplier, various modified paint samples were prepared; primarily using the specified paint system with different solvents. Paint test patches were applied with the modified primers under ambient conditions similar to those associated with the blistering problem (Figures 17, 18). Patches of the original primer were also applied concurrently with those test samples to ensure that the ambient test conditions would cause blistering.

Some 20 modified primers were tested. Follow-up inspections identified patches that did not blister. A different solvent used in those successful paint samples was identified as the solution to the problem. The solution was found prior to the onset of the 1997 painting season. After the modified paint was employed using the new solvent, no major paint problems were encountered throughout the remaining work on the project.

Painting Operations in 1997 and 1998

Painting operations resumed in April 1997, with the completion of work on span 13 (Figures 19,20). One problem encountered during this period related to cleaning and painting in the narrow gaps between back-to back angles (Figure 21) Thereafter, it progressed satisfactorily. The contractor coordinated his scheduling with the District 5 officials to facilitate the previously

agreed upon evacuation of areas under the Parkway. The contractor went into those areas when he was scheduled and left within his projected timeframes. As a result, there were no complaints from firms and municipal agencies that normally occupied those areas. Coordination with the other contractors working on and about the Parkway also posed few problems. The contractor was able to interface his painting activities on span 14 with the contractor working on the deck of the Sherman Minton Bridge for Indiana DOT.

The contractor began to employ a larger paint crew early that summer. He conducted concurrent paint operations on several spans and expanded his working hours into evening and late-night shifts by employing portable light towers. The added work placed a strain on KYTC inspection resources. KYTC had two qualified paint inspectors in District 5, but one of them was also inspecting on several other KYTC painting projects. Two other KYTC districts were able to loan qualified paint inspectors. Other districts had capable inspectors, but they were unavailable.

The contractor did not use total containment on spans 4-8 (the 9th Street interchange ramps) in the downtown area. Instead, he resorted to night operations using draped containment screens to filter the wastewater while his men worked off of man-lifts. As those spans did not possess open deck joints, the existing paint was in very good condition and little, if any, mechanical surface preparation was required. The contractor performed all painting in those areas by brushing and/or rolling to prevent paint misting/property damage. Ground tarps were used to prevent paint splatter from damaging the pavement under the areas being painted. No overspray damage resulted from those painting operations. The contractor's work in this area did not interfere with the parking lots in those areas, as they were closed at night.

Work on the span 4 off ramp at 9th Street and the span 14 on ramp onto the Sherman Minton Bridge, where they traversed mainline I 64 and the Sherman Minton Bridge off ramp, respectively, were performed on weekends during daytime hours as mandated in the specifications. The traffic volumes were relatively low at those times and motorists using I 64 did not experience any delays.

Riverfront development work ran under and around span 1 (2,073 feet of plate-girder structures/3,458tons of steel). Span 2 (2,745 feet of plate-girder structures/3,838 tons of steel) was contiguous with span 1. A portion of River Road running under span 2 was closed for re-construction of the 1st Street on-ramp. At those locations, the 85 percent containment screen was placed on the ground to filter the wash water and catch all paint chips generated during pressure washing (Figures 22-24). Workers used man-lifts to access the elevated steel. Paint chips generated during washing were captured on the grounded screens and collected daily by vacuuming (Figure 25).

After the steel was washed, impermeable tarps were suspended to form large containment enclosures for mechanical surface preparation and spray painting of the topcoat (Figure 26). It also prevented the adherence of dust, generated by the riverfront development work, on the wet paint. A vacuum truck was employed to provide a negative pressure in the containment enclosure during spray painting of the topcoat (Figure 27). The containment enclosure incorporated the full width (approximately 50 feet wide) of the Parkway along span 1 and one-half of the width (approximately 50 feet wide) along span 2. The containment enclosures used in that those locations varied in length from 200 to 400 feet. The containment enclosure was moved along the Parkway to 3rd Street where an underlying road remained open to traffic. On that segment of span 2, one-half of the underlying road was closed at night to permit work on elevated steel.

During the work on spans 1 and 2, severe corrosion was observed on the lower portions of floor beams located under the open deck joints that was more severe than observed in the

1995 walkover inspections conducted at ground level. In several cases, corrosion had created holes in the floor beam webs (Figure 28). Extensive mechanical surface preparation was required at those locations, slowing the progress of work (Figure 29). The other mainline spans did not possess open deck joints and, as a consequence, had much less corrosion.

Painters working on spans 1 and 2 used man-lifts to access the elevated steel. Brushing and rolling were used to apply the paint in a portion of span 2, away from the riverfront development work, that was not totally contained (Figures 30,31). Drop cloths were used in that area to prevent damage to municipal property from paint splatter. In span 1, the contractor assisted KYTC personnel with an experimental application of a micaceous iron ore pigmented MCU intermediate coating. That coating was applied experimentally on several panels (Figure 32). The contractor also supplied man lifts and personnel to test high-pressure water jetting (20,000 to 40,000 psi) in span 3.

The painting work on the remaining spans progressed as planned. Where practical, the contractor used containment enclosures that ran from the barrier walls of the elevated spans to the ground. At other locations, he used elevated containment. The latter included portions of span 14 over a municipal golf course (Figure 33).

The contractor used brushing to apply the spot prime and intermediate coats of the MCU aluminum primer and spraying of the polyurethane topcoat (Figures 34-36). Typically, he used the containment structures to permit spraying the topcoat. However, he used brushing for the topcoat on spans 2 and 3 where it was difficult to employ containment and, as noted, in spans 4-8 where containment was not employed.

The QC/QA inspection procedure worked well. The contractor employed a QC person to inspect the completed work in a control area (Figure 37). In addition, he furnished his painters with tooth gages to inspect the wet film thickness as they were painting (Figure 38). The KYTC inspector performed the follow-on QA inspection in the control area. When a span, or a major portion of a span was completed, Division of Construction personnel followed with a final inspection. Once any touch-up needed work was performed, the contractor was paid. To facilitate the work, the Division of Construction inspector periodically traversed the accessible spans in a manlift with a painter to affect minor repairs as the final inspection progressed (Figure 39). That high level of cooperation speeded the completion of the work throughout the project.

The containment enclosures proved effective in containing generated wastes and overspray. The only paint damage to private property occurred in span 2 when painters attempted to brush the topcoat on the 3rd Street off ramp without using a containment enclosure. High winds carried some paint onto cars in a nearby parking lot.

The hazardous waste collection and storage operation was equally uneventful. Only twenty-one 55-gallon barrels of hazardous wastes (paint debris mixed with rust) were generated during the entire project (Figure 40). The only problem that occurred was related to the failure of the contractor to dispose of some of the wastes within the 90-day interval mandated for large-quantity generators.

The project was officially completed in June 1998 with painting of span 14. The project had exceeded its scheduled completion date of October 30, 1997. The contractor was excused from liquidated damages due to the delay caused by the aforementioned paint-blistering problem.

Despite being an overcoating project, the completed work had an excellent appearance. In part, that is attributable to the high-gloss topcoat. After the project was finished, the coating manufacturer subjected a sample of the production paint to an accelerated weathering test

(Weatherometer B). The coating gave a 60^{o}-reflectivity reading of 70 percent after 3,000 hours of exposure. The beige color possessed a consistence appearance throughout the project.

PARTNERING

The KYTC Standard Specifications allow for partnering (formal or informal) on KYTC projects. I-64 Riverside Parkway specification had partnering between KYTC and the contractor to resolve any issues relating to maintenance operations. At the onset of the project, the contractor and KYTC officials agreed upon formal partnering. The initial partnering meeting was held on October 11, 1996. During the course of the project, partnering meetings were held on regular monthly intervals. Due to the previously discussed site conditions for the project and other unanticipated events that occurred during the normal progress of work, many potentially contentious issues existed for this project. The spirit and the function of partnership, which existed on this project, permitted addressing and resolving of most issues before they became problems. Some of the issues that were resolved included adjustment of dew point restrictions for painting operations, coating thickness adjustment, containment measures, and cleaning in hard-to-access areas.

LABORATORY PAINT TESTS

In recent years, Paint Team sought to obtain timelier coating performance test results and to eliminate the test variables encountered on experimental overcoating projects. They also wanted to investigate a number of different coatings. As part of this research effort, KYTC and KTC personnel undertook accelerated performance tests of overcoating systems in the laboratory. The coatings systems tested were: 1) proprietary, 2) KYTC experimental formulations, and KYTC standard (used as the control or reference standard). Those tests served to provide insight into the suitability of the KYTC standard coating system used on this project and to provide guidance for future experimental bridge overcoating projects.

Flat hot-rolled steel panels measuring 6 inches by 4 inches by 3/16-inch thick were obtained from a single supplier to ensure consistency. They were provided with a rusted surface meeting the SSPC Grade D visual rust finish per SSPC-VIS 1. The panels were stamped on one side with consecutive numbers to facilitate identification and correlation with specific coatings systems.

Two manufacturers supplied coatings systems for the tests. One manufacturer provided 6 coatings systems including the KYTC standard system use as a control for the tests. The other manufacturer provided 5 coatings systems. KYTC Division of Materials personnel sampled the coatings and performed laboratory tests to assure the coatings conformed to manufacturer and/or KYTC specifications.

The test design was impacted by the capacities of the KTC test equipment. To achieve high confidence in the test results, each experimental coating system was applied to fifteen coupons. Any coupons with application flaws were discarded and 10 specimens of each coatings system were tested. Based upon capacities of the KTC test equipment, the tests consisted of two sequential runs of 6 coatings systems each. The KYTC standard control system was used in each run.

The coatings were applied at the plant of one coatings manufacturer and at a paint booth at the University of Kentucky Physical Plant (Figure 41).

Prior to application, measurements were taken of environmental conditions to ensure conformity with manufacturers' requirements. A prime coat was applied to both faces of the panels. Thereafter, only the test side of the panels received additional coats of paint. All coats of paint were applied by brushing with a 24-hour curing period between coats. During painting, frequent wet film measurements were taken using tooth gages to obtain dry-film coating thickness within manufacturers' requirements.

The painted panels were cured for 30-35 days prior to the onset of laboratory testing. Just prior to testing, the coupons were photographed and a 2-inch scribe mark was placed near one 6-inch edge of the panels using a 1X Tooke cutter (Figure 42). The Tooke gage was used for preliminary dry-film thickness measurement of each coat of paint. For all coated panels used in the tests, the coatings thicknesses had to conform to the manufacturers' specifications. For all coated panels used in the tests, the coating thicknesses had to lay within manufacturers specifications as provided in product data sheets. Measurements were taken of the initial gloss using a 60^{o} gloss meter in conformance with ASTM D-523. The laboratory performance tests incorporated accelerated weathering (cyclic light/water), cyclic corrosion (Prohesion) and cyclic freezing & thawing in controlled environmental test chambers

The QUV light condensation chamber was used for the accelerated weathering test. Normal tap water was used in this test. A test cycle consisted of a four-hour UV exposure cycle with UVA-340 lamps set at normal irradiance at 60^{o} C alternated with a four-hour condensation cycle at 50^{o} C (Figure 43). All paint test series began with the QUV tests.

The cyclic corrosion tests were performed in a Prohesion test chamber (Figure 44). The test employed an electrolyte solution of deionized water, 0.05% sodium chloride, and 0.035% ammonium sulfate. The Prohesion cycle consisted of a one-hour fog application of the electrolyte followed by a one-hour dry off period. This was the second test method applied in a test series.

KYTC and KTC jointly developed the cyclic freeze-thaw test. A freeze-thaw chamber with humidity control was employed for this test (Figure 45). Hourly temperature data from KYTC bridges indicated that they experienced about 60 freeze-thaw cycles annually. However, the average temperature range of those cycles varied from about 3^{o} C to -3^{o} C. Freezing of coatings in a water-saturated condition was possible. To approximate this exposure, the freeze-thaw cycle test consisted of a one-hour exposure at 3^{o} C and 90 % relative humidity followed by a one-hour ramp down of the temperature to -3^{o} C and 0 % humidity. Those conditions were maintained for one hour followed by a one-hour ramp up to 3^{o} C and 90 % humidity and a repeat of the test cycle. This was the third test in the test series.

Samples were exposed for one-week periods (168 hours) and then shifted to another test chamber for each succeeding test. The tests were stopped at 6-week intervals (1,008 hours) to examine the specimens and take necessary measurements and photographs (Figure 46). Measurements were taken of gloss (per ASTM D-523), blistering (per ASTM D-714), scribe undercutting (per ASTM D-1654), and rust-through (per ASTM D-610).

The tests were run for seven 6-week intervals or 7,056 hours (Figure 47). In part, the extended duration of those tests was due to the desire of KYTC and KTC personnel to gain familiarity with the procedure. No endpoints for coatings failure were established.

As the KYTC control system was the accepted standard for acceptable performance, the test results of the other paint systems were normalized (referenced) to the performance of the control system (Figure 48).

SHORT-TERM PERFORMANCE

Inspections conducted in June 1998 (after one winter of exposure for most of the spans) revealed that most of the overcoating project was performing excellently. The only locations showing significant early deterioration were at the floor beams under the open deck joints in Spans 1 and 2 (Figures 49, 50). The rigid troughs and drains at those locations had filled with debris to the extent that some debris had spilled onto the lower flanges of the floor beams (Figure 49). Minor corrosion was evident on the floor beams and rust stains were present from corroding steel in the deck joints. Employment of a darker paint (suggested by the Paint Team) would have masked the rusting and rust staining. In reality, that problem is related to the type of deck joint employed and, fundamentally, is not a painting problem. KYTC opted to increase cleaning of the trough/drain systems, but that may not offset the problems posed by the open deck joints. Some diesel fumes were observed on the steel at the 3rd Street/River Road intersection and under the railroad tracks. The fumes and rust staining observed on spans 1 and 2 were highlighted by the beige paint. A darker color would have masked those flaws better.

On May 27, and June 2, 1999, KTC personnel made detailed inspections of all spans of the Riverside Parkway. The bulk of paint was found to be in good condition. There was some minor rusting at deck joints, bearing areas, and edges of flanges. Rusting of open deck joints in Spans 1 and 2 had produced readily observable staining on the overcoat on the fascia beams and deterioration of the paint at locations directly under the joints on interior beams and other bridge steel. The overcoating project did not address deck joints and while the staining gives a negative appearance, it does not reflect on the performance of the overcoating project. A span-by-span summary of the 1999 survey findings are documented in Appendix B

SUMMARY

The I-64 Riverside Parkway project exemplifies the remarkable cost benefits obtainable by the proper application of overcoating. A large quantity of steel was painted for an extremely low initial cost. Based upon the performance of the original alkyd coating, it is likely that the bulk of the overcoating paint will last for 15-20 years. A complete removal/containment project would have to last a minimum of three to four times longer than that to be as effective on a life-cycle basis!

The size of the project and its proximity to many firms, houses, and municipal operations posed the potential for many operational and environmental incidents. That none occurred relates, in part, to good initial planning by the Paint Team and District 5 officials. The paint contractor also deserves much credit for making a complicated project progress, problem free. The KYTC inspectors worked long hours to help the project progress. They deserve credit for the high quality of the project, as does the contractor.

This project is an outstanding value to both Kentucky Transportation Cabinet and to Kentucky taxpayers. It will provide many years of service while maintaining its esthetic appearance

Since this project was completed, the Paint Team has made six major changes to the KYTC overcoating procedures. Those include the addition of a non-woven geotextile fabric to better filter the wastewater, an increase in washing pressure to 5-7,000 psi, the use of SSPC Visual Standard SP3 for inspecting power-tool cleaned surfaces, requiring power- tool cleaning to the SP11 standard, the requirement for KYTC and contractor inspectors to have Kentucky Qualified Bridge Coatings Inspection Technician Training, and the use of a micaceous iron oxide MCU intermediate coating that may be more contractor-friendly than the KYTC aluminum pigmented primer.

The KYTC Paint Team will employ additional experimental features on other major KYTC projects scheduled for spring 2000. As with the Riverside Parkway project, those features will be investigated in an on-going effort by KYTC to maintain low overcoating costs and provide better performing projects.

FIGURES

Figure 1. The existing coating on span 2 in 1995.

Figure 2. The existing coating on span 3 in 1995.

Figure 3. Corrosion at an open deck joint in span 1 in 1995.

Figure 4. Existing aluminum alkyd disbonding on span 9 in 1995.

Figure 5. Span 13 showing weathering of aluminum alkyd exposed red lead primer in 1995.

Figure 6. Span 14 showing extensive disbonding of existing coating in 1995.

Figure 7. Pull-off and tape adhesion testing of existing paint on span 13.

Figure 8. Oil deposits on the 3rd Street off ramp.

Figure 9. Diesel fumes on span 13 railroad overpass.

Figure 10. Color patches on the 3rd Street off ramp.

Figure 11. Pre-bid meeting in 1996.

Figure 12. Monthly partnering meeting held at the District 5 offices in 1997.

Figure 13. Elevated containment on span 13 in 1996.

Figure 14. Application of the test patch on span 13 in September 1996.

Figure 15. Blistering encountered in MCU aluminum primer in 1996.

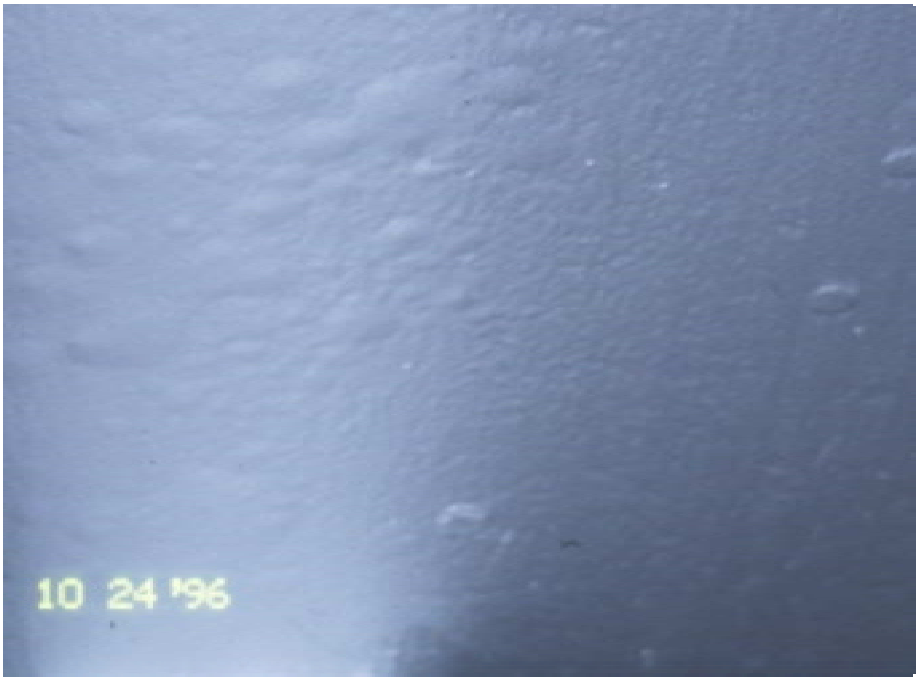

Figure 16. A closer view of the blisters in the MCU aluminum primer.

Figure 17. A test patch where an experimental paint blistered.

Figure 18. A test patch where an experimental paint did not blister.

Figure 19. Ground level containment used in painting span 13 in 1997.

Figure 20. Elevated containment on span 13 adjacent to a trailer park.

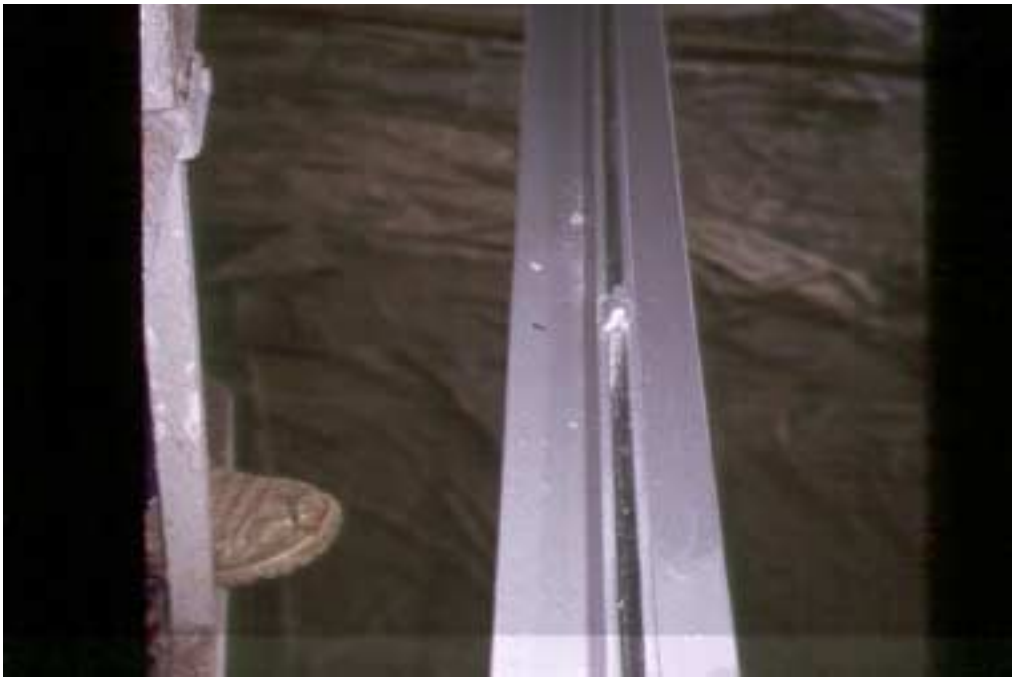

Figure 21. Back-to-back angles that posed both cleaning and painting problems in span 13.

Figure 22. Pressure washing on span 1 in 1997.

Figure 23. Pressure washers used on span 1 in 1997.

Figure 24. Span work area showing manlifts and position of drop cloths.

Figure 25. 85 percent drop cloths placed on the ground to collect debris.

Figure 26. Large containment employed in spans 1 and 2 in 1997.

Figure 27. Vacuum truck being used on span 1 containment enclosure.

Figure 28. Severe corrosion damage to floor beam under open deck joint in span 1.

Figure 29. Floor beam in span 1 after powertool cleaning.

Figure 30. Painter brush applying the intermediate MCU aluminum primer.

Figure 31. Painter applying the topcoat by rolling. Note the bag placed on the lamp post to protect it from dripping paint.

Figure 32. Spray application of experimental MCU primer.

Figure 33. Elevated containment used in span 14 over the golf course.

Figure 34. Spot prime coat brushed on steel after cleaning and mechanical surface preparation

Figure 35. Steel with full intermediate coat ready for topcoating.

Figure 36. Topcoated steel in containment enclosure on span 13.

Figure 37. Contractor performing QC inspection on intermediate coat using a Tooke gage.

Figure 38. The KYTC QA inspector conducting wet film tests using a tooth gage. This was done at the span 4 overpass to facilitate the inspection process due to the need for traffic control on I 64.

Figure 39. Concurrent final inspection and touch-up by the Division of Construction inspector and the contractor's painter using a self-propelled manlift.

Figure 40. The hazardous waste storage site located in a locked KYTC compound.

Figure 41. Painter applying coatings to test panels.

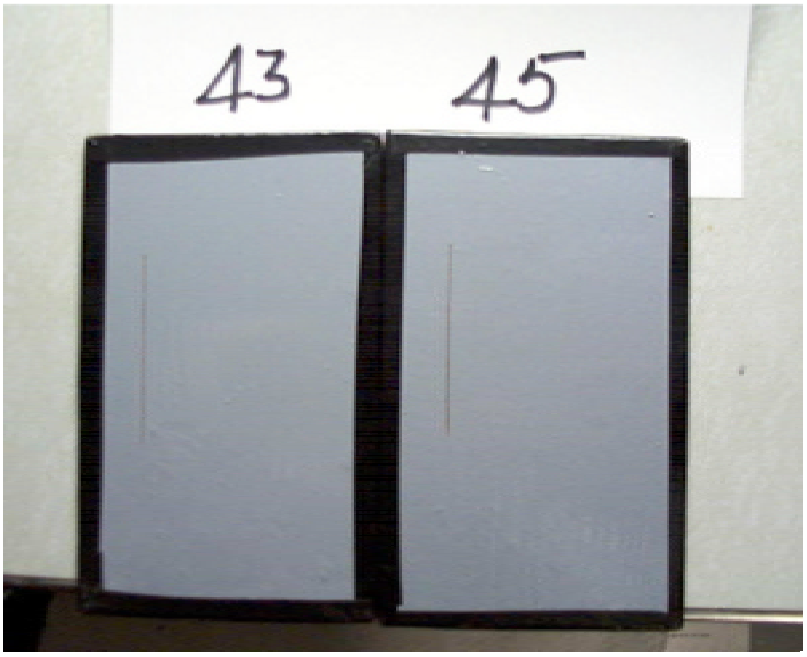

Figure 42. Coated panels with scribe marks and taped edges prior to testing.

Figure 43. Panels being removed from QUV chamber.

Figure 44. Placing painted panels in the Prohesion chamber

Figure 45. Placing panels on racks in the freeze-thaw chamber

Figure 46. Panels were evaluated after each 1,000-hr test cycle.

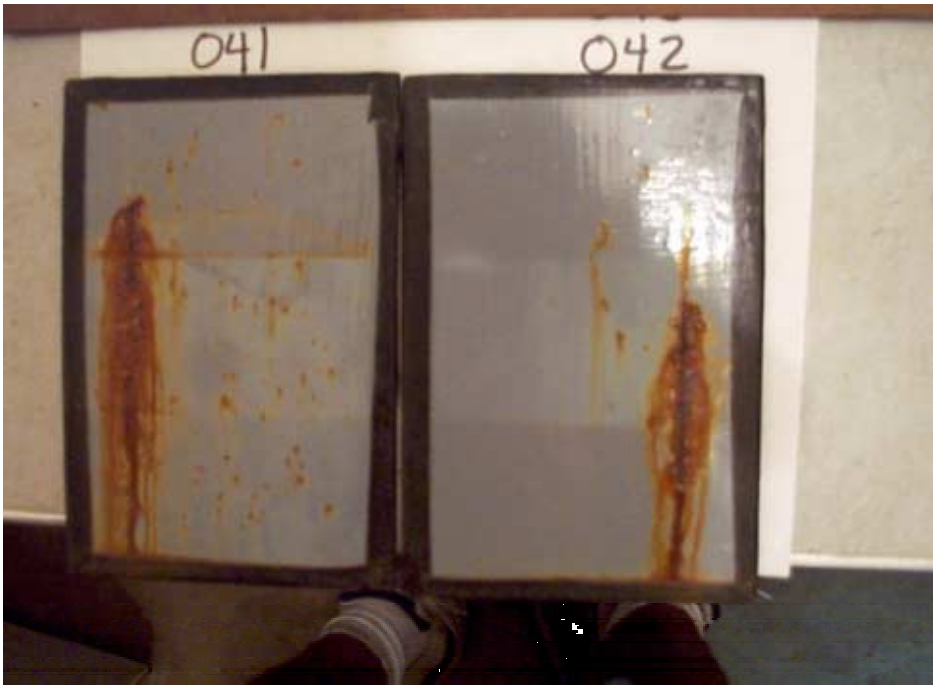

Figure 47. Typical panels after 7,056 hours testing

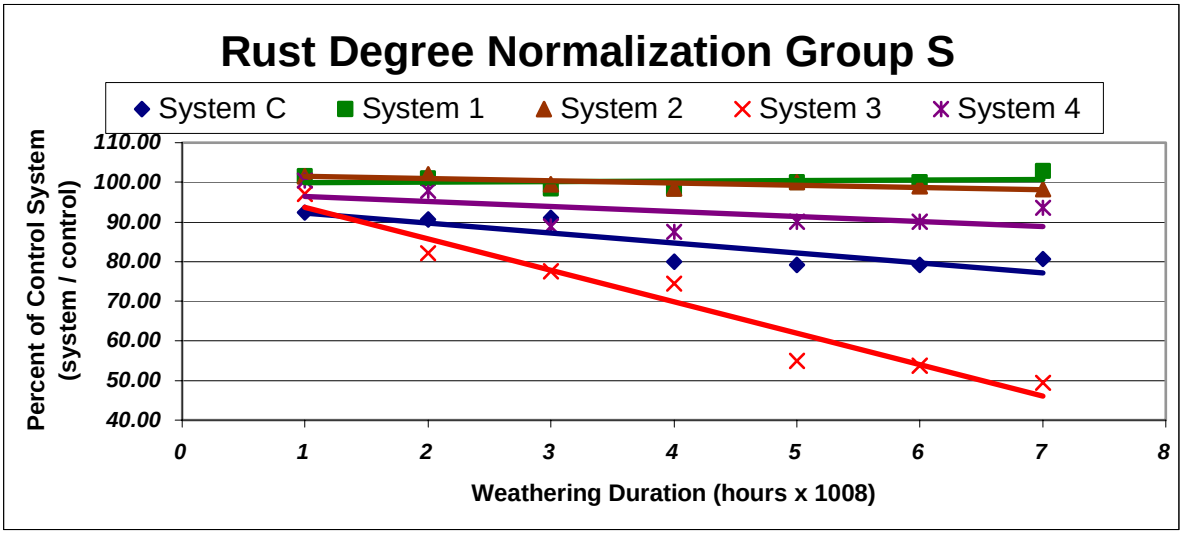

Figure 48. Average test results for each coating system are normalized to the standard system.

Figure 49. Debris build-up under open joints in span 1 observed in 1998.

Figure 50. Slight corrosion and rust staining under open deck joint in span 1 observed in 1998.

APPENDICES

APPENDIX A - PROJECT DESCRIPTION

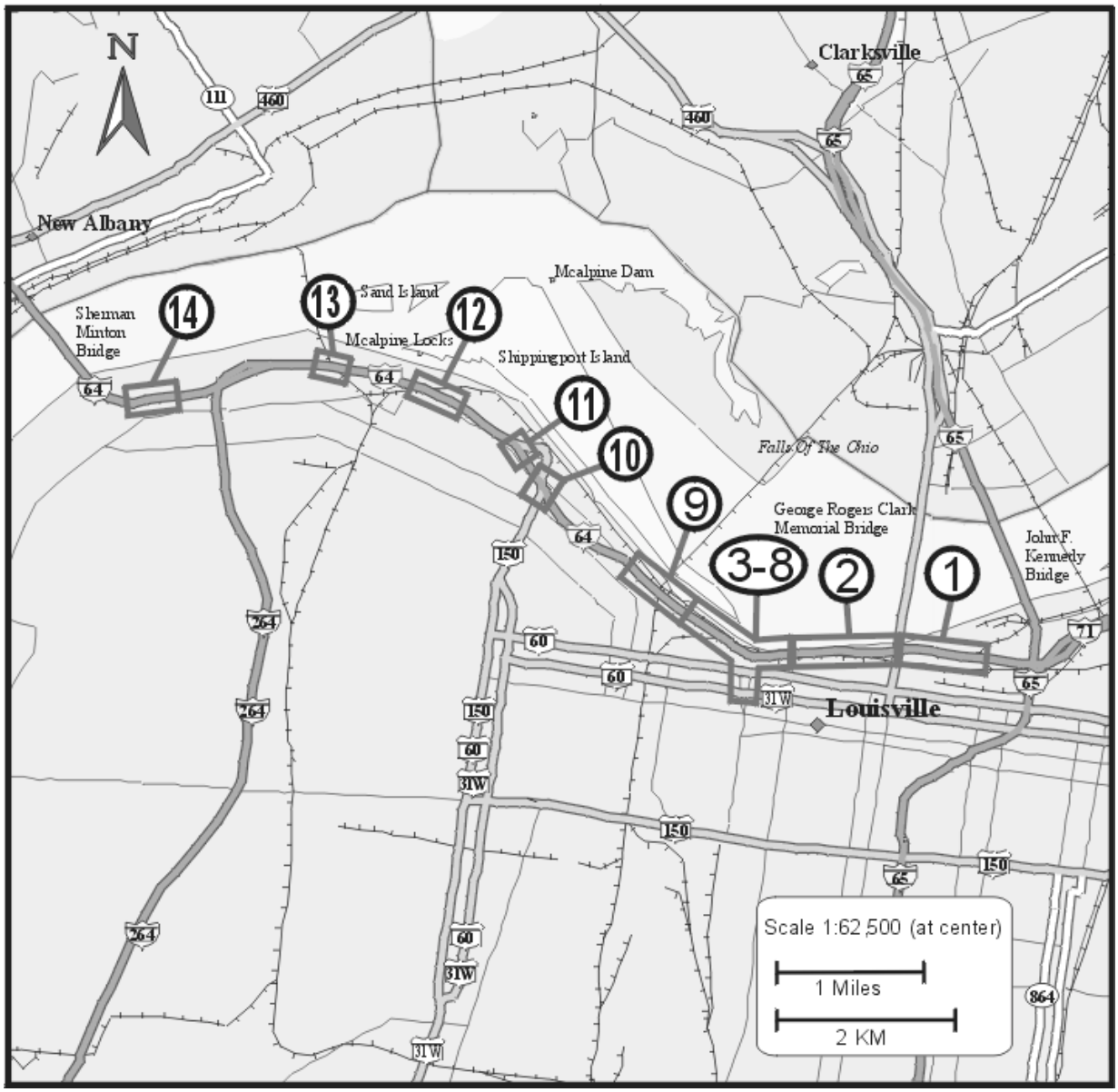

Figure 51. Location of spans along the entire Riverfront Parkway project.

Span 1. **056-0064-004.63(B142)**
Riverside Parkway
I-64 over (2nd Street East to Preston Street)

Geographic Coordinates
Latitude - 38 15.5
Longitude - 85 45.1'

Description: (Structure Length)
2073 Ft. Welded Steel Girder Spans

Tons of Steel
345

Span 2. **056-0064-004.18(B292)** **Geographic Coordinates**
Riverside Parkway Latitude - 38 15.5
I-64 over (2nd Street West to 7th Street) Longitude - 85 45.

Description: (Structure Length) **Tons of Steel**
2,745 Ft. Welded Steel Girder Spans 3838

Span 3. **056-0064-003.69(B293)** **Geographic Coordinates**
Riverside Parkway Latitude - 38 15.5
I-64 over (7th Street to 13th Street over ICRR) Longitude - 85 46.0'

Description: (Structure Length) **Tons of Steel (Spans 3 to 8)**
2,638 Ft. Welded Steel Girder Spans 5800

Span 4. **056-0064-003.88(B298)** **Geographic Coordinates**
Riverside Parkway - 9th Street Interchange Latitude - 38 15.4
Westbound I-64 Exit Ramp To 9th Street Longitude - 85 46.0'

Description: (Structure Length)
1,634 Ft. Welded Steel Girder Spans

Span 5. **056-0064-003.88(B299)** **Geographic Coordinates**
Riverside Parkway - 9th Street Interchange Latitude - 38 15.4
Ramp No. 2A (9th Street To I-64 Eastbound) Longitude - 85 46.0'

Description: (Structure Length)
370 Ft. Welded Steel Girder Spans

Span 6. **056-0064-003.82(B300)** **Geographic Coordinates**
Riverside Parkway - 9th Street Interchange Latitude - 38 15.5
On Ramp No. 1 (9th Street To I-64 Westbound) Longitude - 85 46.0'

Description: (Structure Length)
1,207 Ft. Welded Steel Girder Spans

Span 7. **056-0064-003.88(B301)** **Geographic Coordinates**
Riverside Parkway - 9th Street Interchange Latitude - 38 15.5
On Ramp No. 2 (Main Street To I-64 Eastbound) Longitude - 85 46.0'

Description: (Structure Length)
352 Ft. Welded Steel Girder Spans

Span 8. **056-0064-003.87(B302)** **Geographic Coordinates**
Riverside Parkway - 9th Street Interchange Latitude - 38 15.4
Eastbound Exit Ramp No. 3 (I-64 To 9th Street) Longitude - 85 46.0'

Span 8. Cont. **Description: (Structure Length)**
611 Ft. Welded Steel Girder Spans

Span 9. **056-0064-003.17(B285)** **Geographic Coordinates**
Riverside Parkway Latitude - 38 15.9
I-64 From 13th Street To 17th Street Longitude - 85 46.7'
Description: (Structure Length) **Tons of Steel**
2,116 Ft. Welded Steel Girder Spans 2850

Span 10. **056-0064-002.60(B282)** **Geographic Coordinates**
Riverside Parkway Latitude - 38 16.2
Mainline I-64 at 22nd Street Longitude - 85 46.9'

Description: (Structure Length) **Tons of Steel**
501 Ft. Welded Steel Girder Spans 763

Span 11. **056-0064-002.59(B281)** **Geographic Coordinates**
Riverside Parkway Latitude - 38 16.2
Eastbound I-64 Exit Ramp To 22nd Street Longitude - 85 46.9'

Description: (Structure Length) **Tons of Steel**
256 Ft. Welded Steel Girder Spans 763

Span 12. **056-0064-001.91(B283)** **Geographic Coordinates**
Riverside Parkway Latitude - 38 16.6
I-64 .4 mile East of K&IT RR Ohio River Bridge Longitude - 85 47.6'

Description: (Structure Length) **Tons of Steel**
1,020 Ft. Welded Steel Girder Spans 1028

Span 13. **056-0064-001.31(B284)** **Geographic Coordinates**
Riverside Parkway Latitude - 38 16.6
I-64 South End of K&IT RR Ohio River Bridge Longitude - 85 48.0'

Description: (Structure Length) **Tons of Steel**
2,662 Ft. Welded Steel Girder Spans 2479

Span 14. **056-0064-000.32(B161)** **Geographic Coordinates**
Louisville - St. Louis Latitude - 38 16.6
I-64 Approaches To Sherman Minton Bridge Longitude - 85 49.2'

Description: (Structure Length) **Tons of Steel**
1,760 Ft. Welded Steel Girder Spans 3075

APPENDIX B - 1999 INSPECTIONS

MAY 27, 1999

Span 1 – Painted in November 1997

The bulk of the paintwork on Span 1 was in good to excellent condition. The gloss retention is good and the beige color blends in well with the surroundings.

Minor rust was identified at bearings and below deck joints. More obvious stains from rusting in the deck joints were present on the overcoated steel below deck joints. To a casual observer these stains appear to be rusted areas in the paintwork. There was slight construction damage in the form of chipped or scuffed paint at several areas on Span 1. The damage occurred after the overcoating was completed and accepted.

Troughs under the open deck joints were not sized sufficiently wide. Stains on the overcoated steel indicate that the troughs have overflowed. Debris build-up on some flanges under the deck joints indicated that the drains also might have become clogged from material falling through the open deck joints. Some overspray of paint was observed on pier columns where the contractor sprayed the drainpipes. Conduit on a column near 2nd Street was primed but topcoat was not applied.

Figure 52. Corrosion and rust staining under a finger dam/trough assembly in span 1.

Figure 53. The east end of span 1 at the Riverfront Park in 1999.

Figure 54. Span 1 viewed from the Riverfront Park looking westward in 1999.

Span 2 – Painted in November 1997

The bulk of the paintwork on this span was in excellent condition. The gloss retention is very good.

Minimal rust was identified at bearings, pin and hanger assemblies, and floor beams. A longitudinal trough between the lanes was leaking. At west end of the structure there was leakage near the deck drain piping at locations where there is no joint at the center piers. Vehicle scrapes were observed on beams at the left end of 3rd street off ramp near boat landing were found. Paint was tight on the 3rd street exit ramp where large-scale grease deposits had been present. Corrosion and rust stain were observed on the bearing plates and rockers on the off ramp.

Some troughs under the open joints were filled with debris. That will cause accelerated deterioration of the paint in this area. Some rust and\or rust stains were also evident around the open troughs indicating that the design was faulty.

Thin spots of topcoat were observed by the pedestrian crossway near 4th Street. Spider webs and bugs at a few locations looked like spot rust.

Figure 55. Large and small modular joints in span 2 showing much less corrosion than the open finger joints on spans 1 and 2 in 1999. Note that lighting impacts the apparent color of the coatings.

Figure 56. Completed span 2 near the GALT House in 1999.

Figure 57. Debris build-up on lower flange of floorbeam below open deck joint in span 2 in 1999.

Figure 58. 3rd Street off ramp in span 2 in 1999.

Figure 59. A typical view of the paintwork at the west end at the west end of span 2 in 1999.

JUNE 2, 1999

This inspection was conducted after a hard rain.

Span 3 – Painted in November 1997

The bulk of the paintwork is excellent condition. The gloss retention is excellent throughout the span.

A modular joint site over the parking lot had slight rusting on the floor beam. Again, this was less than that occurring at the open deck joints in spans 1 and 2. A second modular joint where the road splits was in good condition because it was significant super-elevation of the roadway. The vertical curve there caused the water to flow away from joint. At the modular joints, through the location where span 6 enters I-64, floor beams and drains were in good condition with very little rusting. The bearings on the abutments at 9th street were in very good condition with no rust. Pinpoint rust was observed on the edges of the flanges at few spots. There were spots of missed topcoat and holidays on the stiffeners. Bolts on some diagonals were not top coated. There was no rust except at joints.

The condition of the paint was difficult to determine at the west end of Span 3. Span 3 ends over the cargo yard at 13th street. In the yard, there were a few small some spots including bolt heads where to topcoat had not been applied. There was a small amount of rust staining on the floor beams under the modular joints similar to the one observed in the parking lot. A drain on exterior of westbound lane was clogged with grass growing on it.

Figure 60. A modular joint in span 3 showing little signs of leakage or corrosion in 1999.

Figure 61. Westward view from a parking lot at east end of span 3 in 1999.

Figure 62. Eastward view from west end of span 3 over cargo yard in 1999.

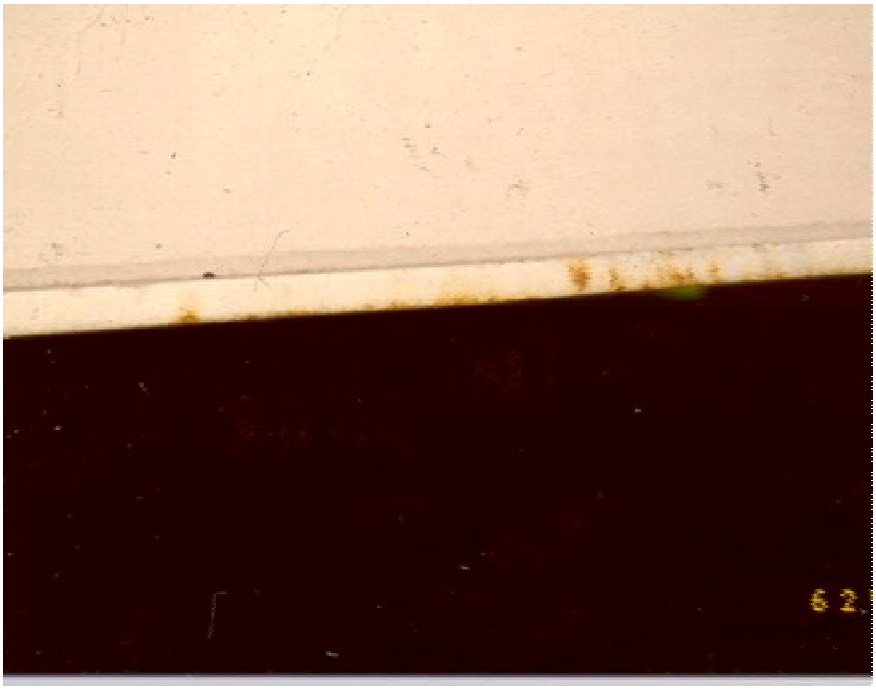

Figure 63. Rust spots observed along edges of flanges in span 3 in 1999.

Figure 64. Foliage growing out of clogged drain in span 3 in 1999.

Spans 4, 5, 6, 7, and 8 – Painted in November 1997

The bulk of paintwork was in excellent condition. The paint had good gloss retention. The rockers under all spans were in were in good condition.

Tooke gauge readings indicated 4 mils DFT of primer and 3 mils DFT of topcoat. The 9th street interchange had very little rusting at the joints. The abutment bearings at 9th street were in very good condition with no rust. Pinpoint rust and spot rusting was present on the edges of flanges at a few locations, mostly below modular joints. There were few missed spots of topcoat and few holidays on the stiffeners.

Figure 65. Paintwork on spans 4, 5, 6. and 8.

Figure 66. Span 7 from Main Street to east bound I 64 in 1999.

Figure 67. Rocker assemblies and end of span 6 at 9th Street in 1999.

Span 9 – Painted in November 1997

The bulk of the paintwork on this span was in excellent condition. The gloss retention was very good.

On one beam over the railroad tracks, there was an area about 30”x 4” where the new paint had disbonded to original coating. At that location, there was a significant amount of diesel fumes. The contractor had difficulty in removing the fumes and the disbanding is probably due to paint applied over fume-impregnated existing paint. In the same general area over tracks, there were small rust spots on bottom edge of several beam flanges. Near the 1st joint, west of railroad there was minimal rusting at the deck drain. West of railroad by the DeVoe Paint Company, a deck joint was clogged with grass growing out of the edge. At that location there was moderate staining with minimal rust. A deck joint near Fourth Industries had moderate corrosion of the underlying steel. Some holidays in the new paint were present along the span.

Tooke gage readings at the abutment near the 17th street overpass are provided in the table below. There was rust on the exterior bearing pad.

Position	**Primer**	**Topcoat**
Inside	3 mils	2 mils
Inside	6 mils	1 mil

Figure 68. Span 9 over the railroad tracks showing minor disbonding in 1999.

Figure 69. View of span 9 from the east end looking westward in 1999.

Figure 70. West end of span 9 looking eastward in 1999.

Span 10 – Painted in November 1997

The bulk of the paintwork in this span was in excellent condition. The gloss retention was very good throughout this span.

Slight rust was found under a poured joint (narrow joint) and the joint was leaking. There were rust spots on exterior where cleaning was not performed properly. There were rust stains coming through on some back-to-back angles. A small amount of rust was found on bearings and pads at east abutment. A small amount of corrosion was found on steel under two other poured joints. There were burn marks on the third beam at abutment bearings from a fire (vandals?). The bearing areas were in good condition. Tooke gauge readings taken at various locations on this span are given below.

Position	**Primer**	**Topcoat**
Interior at east abutment of west bound lane	3 mils	2 mils
South exterior beam on inside	1 mil	1.5 mils
West abutment exterior beam	3 mils	2 mils
West abutment exterior beam		2nd Primer 3 mils

Figure 71. Completed span 10 in 1999.

Span 11 – Painted in November 1997

The condition of the existing paint, overall, was very good. The gloss retention was excellent.

Rusting was found on pin and hangar joints at the west abutment. On the east abutment, there were rust spots and stains on back-to-back angle at some locations.

Position	**Primer**	**Topcoat**
West Abutment	4 mils	2 mils

Figure 72. West-facing side of completed span 11 in 1999.

Span 12 – Painted in November 1997

The bulk of the paintwork was in very good-to-excellent condition. The gloss retention was very good.

At the east end of the project, there was rust stains and corrosion on about half of the rockers and bearing plates. There was also slight corrosion on splice plates at flanges. On the first full span west of road, rust spots were found on two beams at the edge of bottom flange. There was minimal rusting at the back-to-back angles. On the second deck joint, moderate rusting was found. The drain on the fourth pier was very rusted. The deck joint on the fifth pier had rusted rockers and moderate rusting on back-to-back angles and on beams was found. The centerline longitudinal joint was leaking with minimal rust and there was medium staining on bearings and transverse steel at several piers. Transverse beams at sixth pier had minimal rust on flange edge. West abutment had rust stains with very little rust on bearings. The bulk of paint was in good condition. There were areas with missed primer on the third beam from south side. The Tooke gauge readings taken at various locations on this span are given below.

Position	**Primer**	**Topcoat**
Beam 3 on south face	3 mils	2 mils

Figure 73. Westward view of completed span 12 from east end in 1999.

Figure 74. West end of span 12 looking eastward in 1999.

Figure 75. Slight corrosion at splice plate in span 12 in 1999.

Span 13 – Painted on Various Dates: Completed in November 1997

On the east end there was rust at the deck joints and the back-to-back angles were in good condition. Near the junkyard east of railroad tracks, the east abutment bearings had some rust but the over all condition of the paint was good. There was slight rust spotting on edge of the lower flanges of several beams. There was rust on inside of north beam one on lower flange and little rusting on the edge of flanges.

On the second deck joint from the east end, there was rust on the trough, beams and cross bracing. Also there was spot rusting on center of flanges. On the second deck joint east of the railroad there was moderate rust under an open deck joint. On the first deck joint east of the railroad there was moderate rust along the joint. There was rust stain at the deck joint, just west of railroad on beam-ends and cross bearings. There were diesel stains on beams over railroad track. There was rust at all the deck joints west of the railroad. There was minor spot rusting on the edge of some beam flanges along the span. On the west segment of span 13, there was rust on a drainpipe at location where the pipe had obviously clogged. There was extensive graffiti at the west abutment. That abutment was at ground level and readily accessible to trespassers. The bearings on west abutment were rusted. Tooke gauge readings taken at various locations on west-most span are given below.

Position	**Primer**	**Topcoat**
Inside of north Beam 1	4 mils	2 mils
Beam 2	5 mils	2 mils
Beam 4	4 mils	2 mils
Drain pipe	Trace	2.5 mils
3 Beams	3 mils	1.5 mils
4 Beams	3 mils	1.5 mils
5 Beams	3 mils	1 mil
Beams from south side down	1 mil	1.5 mils

Figure 76. A clogged drain at the west segment of span 13 in 1999.

Figure 77. Corrosion and rust staining on rocker and bearing plate in span 13 in 1999.

Figure 78. Corrosion in back-to-back angles under deck joint in span 13 in 1999.

Figure 79. Westward view from the east end of span 13 in 1999.

Figure 80. West most abutment of span 13 showing extensive graffiti in 1999.

Figure 81. Completed west end of span 13 in 1999.

Span 14 – Painted in June 1998

The overall paintwork on this span is very good-to-excellent. The gloss retention is very good.

At the east end of the eastbound structure, there was one site with a spot of missed topcoat (about ½ ft^2 in area). Pinpoint rust was present on the edges of the flanges at few spots and on one cross brace. Bolts on some diagonals were not top coated. Only one bearing plate was corroding. At the east end of the westbound structure, there was slight corrosion on the bearing plates. The paint was chipped at one site from contact with a ladder.

On the portion of both structures over the golf course, the paint was in generally excellent condition. Random corrosion and rust staining were present a locations where the deck had been made continuous. The steel at those locations was severely pitted promoting rust-back. Some black material, possibly asphalt was deposited on some of the beams. Spot rusting was present along one beam of the eastbound structure at approximately the midpoint of the span. At the sixth joint of the eastbound structure, rust was present on a rocker. At the eastbound portion of west most structure, the end panels some beams and cross bracing had not been top coated. Tooke readings taken on the east end of the eastbound lane are listed below.

Position	**Primer**	**Topcoat**
Beam 2	1.5 mils	1.5 mils
Beam 3	1.5 mils	0.5 mils

Figure 82. Westward view of span 14 from the east end of structure in 1999.

Figure 83. High gloss on north bound approach to Sherman Minton on span 14 in 1999.

Figure 84. Completed east and westbound approaches of span 14 to the Sherman Minton Bridge in 1999.

Figure 85. West most segment of span 14 at the east end of the Sherman Minton Bridge in 1999.