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News from the Repair, Evaluation, Maintenance, and Rehabilitation Research Program

Rehabilitation of Concrete Structure and Steel Sector Gates at the Court Street Dam in Rochester, New York

By William R. Miles, Bergmann Associates

During the past 10 years, many of the hydraulic structures on the Erie Barge Canal in upstate New York have undergone significant rehabilitation, first under the direction of the New York State Department of Transportation Waterways Maintenance and more recently under the direction of the New York State Thruway Authority (NYSTA). The required repairs are often quite extensive because of steel corrosion and damage from cycles of freezing and thawing. One of these historically significant facilities is the Court Street Dam on the Genesee River in Rochester, NY. In early 1996, the second phase of a three-phase rehabilitation program for this facility was completed. This phase included installation of precast-stay-in-place concrete panels and extensive sector-gate repairs.

The Court Street Dam functions as a water-control structure for the lower Genesee River to regulate water levels in the nearby Erie Barge Canal during navigation season and to furnish water for the Rochester Gas and Electric hydroelectric plant at the west end of the dam. Constructed in two phases in 1917 and 1926, the facility consists of four sector gates, separated by two concrete operating piers and a center mass-concrete pier and bounded by two concrete abutments (Figures 1 and 2). The sector gates are pie-shaped and hinged at their downstream end; they float up into position under hydraulic pressure. Through a series of interior valves and weir tubes located in the operating piers, the internal hydraulic pressures can be increased to lift the gates for water retention or can be decreased to lower the gates to release water downriver. This type of gate was first built in the Chicago area for a facility on the Chicago Drainage Canal at Lockport, IL. The original design has been credited to Mr. E.L. Cooley (Cooman 1927), and it is believed there are only a couple of other similar facilities in this country.

In 1993, Bergmann Associates, a 200-employee consulting engineering and architectural firm headquartered in Rochester, NY, was contracted by the NYSTA to provide additional in-depth inspections

Figure 1. View of Court Street Dam from downstream

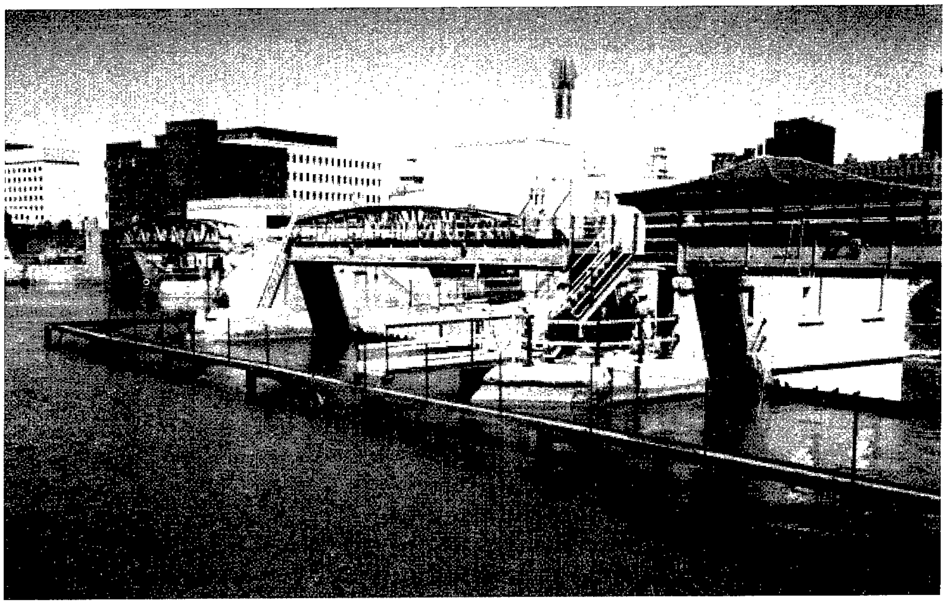

Figure 2. Upstream view of Court Street Dam during cofferdam installation

of all structural and mechanical components of the dam and to design, detail, and prepare construction documents. As Phase II of the overall rehabilitation of this facility, the work included extensive structural, mechanical, and safety repairs for each of the four sector gates, piers, abutments, and access bridges above the gates (Figure 3).

Although there were many unique aspects of the Phase II design and reconstruction for the Court Street Dam, this article will focus primarily on two of the more interesting components: the use of precast concrete panels to resurface pier and abutment wall surfaces and the structural repair of the sector gates themselves.

Precast Concrete Panels

The use of precast concrete panels as a stay-in-place forming system and a very high-quality surface replacement option for lock and dam concrete structures has grown significantly in the 1990's, especially in New York State. The details of this system are described in Technical Report REMR-CS-41 (Miles 1993) for the Federal Lock at Troy, NY, and in Technical Report REMR-CS-49 (McDonald and Curtis 1995) for a wide variety of Civil Works applications. This system has now replaced the use of conventional cast-in-place concrete and shotcrete resurfacing for many waterways rehabilitation projects.

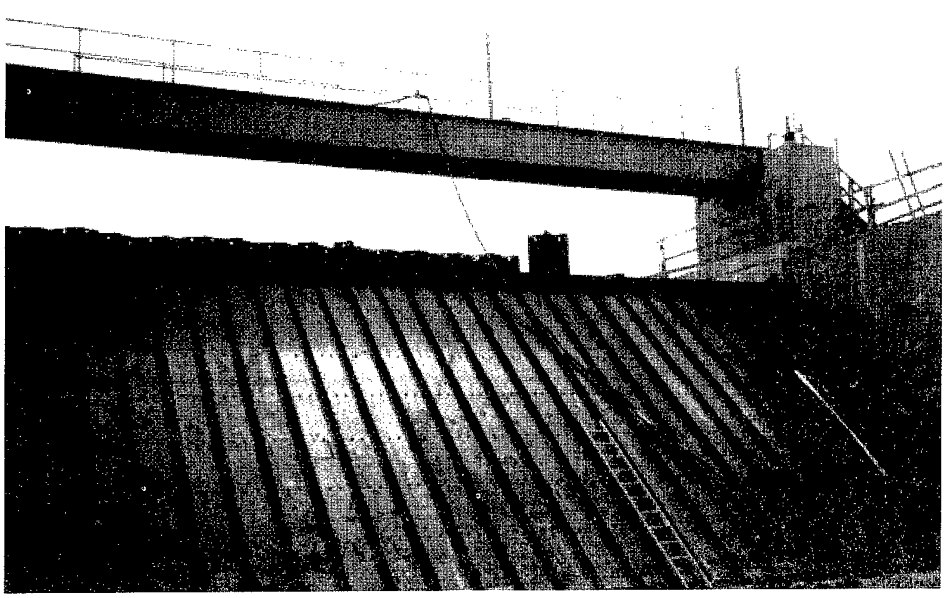

Figure 3. Rehabilitation Gate No. 2, new access bridge, and center pier with precast panels

Compared to cast-in-place concrete, precasting offers a number of advantages including minimal cracking, durability, improved abrasion and impact resistance, speed of construction, easier winter installation (limited heating), improved facility appearance, and reduced maintenance cost, all at a very similar initial cost.

Precast panels at the Court Street Dam were designed and detailed for the two operating piers, the center pier, and the west abutment. The panels extended from elevation 505 on the upstream faces of all units (about 2 to 3 ft below low-water levels) and from the sill slab on the downstream side of the center pier up to between 12 and 18 in. from the top of the unit, to allow for a new cast-in-place cap. There were a total of 36 panels at the four unit locations. The typical panels were 7 in. thick and were of variable surface dimensions, many of which were trapezoidal in configuration with widths up to 11 ft-10 in. and lengths up to 20 ft-8 in. See Figure 4 for a typical precast repair detail.

The typical panel installation required (a) a minimum removal of 12 in. of existing surface concrete (primarily using small impact hammers), (b) No. 6 reinforcement anchor dowels at a 2- to 4-ft spacing and a minimum 18-in. embedment, (c) a minimum of 5 in. of 4,000-psi infill concrete with 1/2-in.-maximum coarse aggregate, (d) she-bolt form anchors at a 4-ft-maximum spacing for construction phase tiebacks, and (e) completely sealed joints.

Specialty panels were provided for trash-gate recesses at the two operating piers, pier nosings, and a ladder recess at the west abutment. Additional special details included:

- Cast-in bent-plate armoring for the nosing panels (see Figure 5 for detail).
- Cast-in angle armoring for the trash-rack panels at guide locations.
- Beveled edges at nosing panels.
- Chamfers, 1-in. wide, at joint locations.
- Two-in. grouted horizontal and 3/4-in. sealed vertical joints.

The panels were fabricated by Binghamton Precast and Supply in their Binghamton, NY, precast plant during the summer and fall of 1994. They were then shipped approximately 150 miles by truck to the project site as they were needed.

The general contractor, LeChase Construction, installed the panels for each concrete structure quickly and simply by means of a track-mounted crane located on the downstream concrete sill slab or rock riverbed. Work at each structure was performed during various cofferdaming phases from late 1994 through late 1995, with many of the panels being installed during the winter months.

A total of 3,625 sq ft of panels were installed for the structures at Court Street Dam with an average bid price of \$42.40/sq ft and a low bid price of \$25/sq ft for the panels alone. However, the average bid price for the panels installed at the Court Street Dam is not as low as for other recent New York State canal projects, in large part because of the lack of repetition of the panel dimensions and low total quantity needed for this project.

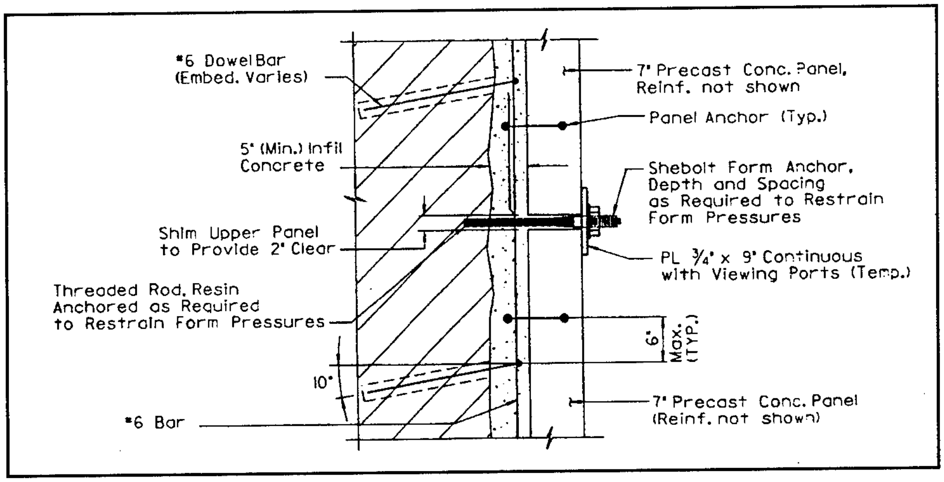

Figure 4. Precast repair detail

Sector Gate Repairs

As a result of over 70 years of use and constant wear from water and ice forces, the four steel sector-type tainter gates at the Court Street Dam had suffered extensive deterioration. Based on previous biennial inspection data and in-depth hands-on inspection, including exterior, interior, and underwater, the various structural elements of the gate were evaluated, and repairs were developed for necessary rehabilitation. See Figure 6 for a typical pier and gate cross section.

The primary gate repairs provided under the Phase II repair contract included the following:

- New improved rubber seal systems.
- New steel seal plates embedded in pier and abutment mating surfaces.
- Localized structural steel replacement.
- Extensive rivet replacement with high-strength bolts.
- Replacement of gate stop angles.
- Replacement of top skin plates and ice angles (for Gates 1 and 3 only).
- Heat straightening of localized ice angles (for Gates 2 and 4 only).
- Repair and realignment of gate prop system.
- Blast cleaning (with Class A containment) and painting of the total gate structures with a three-coat immersible, vinyl paint system.
- Partial disassembling of hinge systems for inspection during construction.

The various gate repairs required each gate to be individually cofferdamed with steel sheet piling and shoring members and to be jacked up onto temporary shores. Only then could each gate be taken out of service, dewatered, and thoroughly cleaned. Cleaning of the gate structures required the removal of extensive silt and

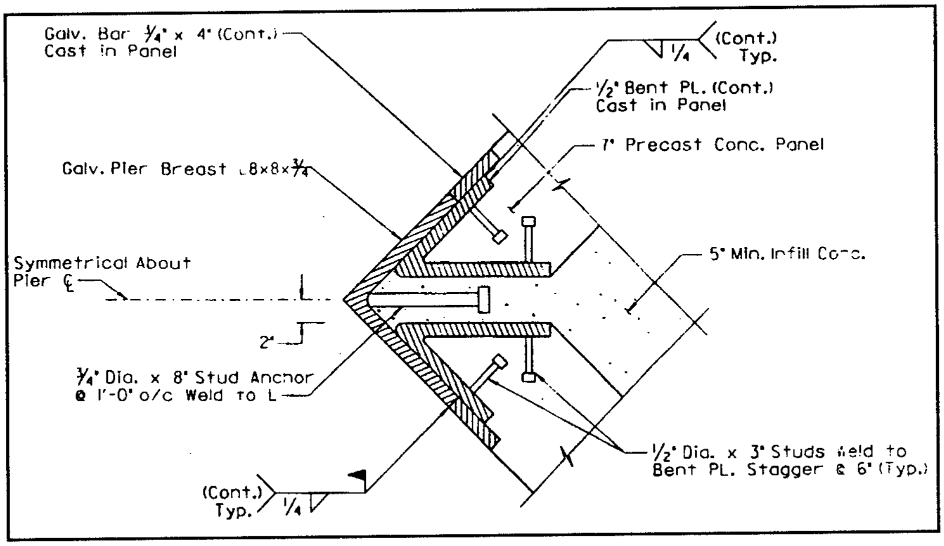

Figure 5. Nosing panel detail

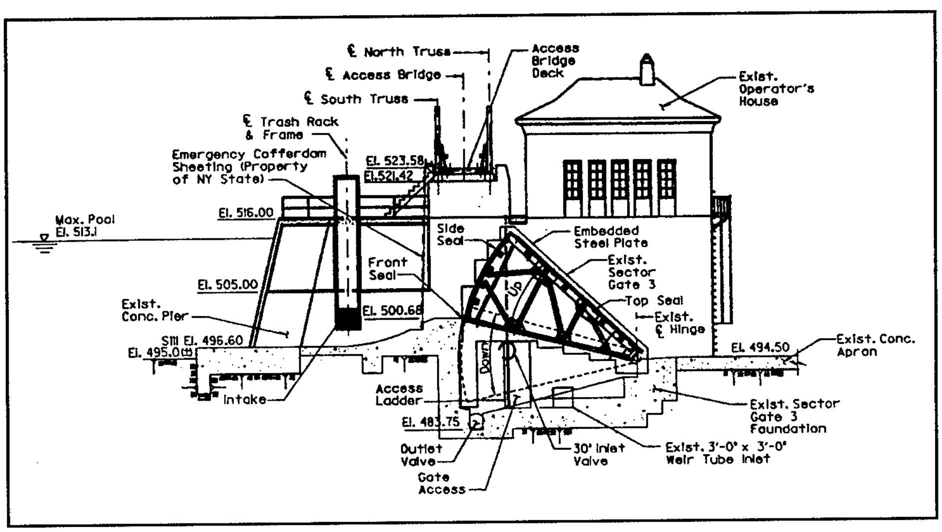

Figure 6. Pier and gate section

zebra mussel buildup caused in part by the partially failed original seal systems.

Replacement seal systems

The original top seal system at each gate consisted of a two-piece section of conveyor belting in the form of a tee that was originally considered experimental. Those seals had a tendency to be forced out of the tee-shape by water and ice pressure. The result was substantial leakage, especially near the bottom of the top plate. The original front seal system consisted of a bent plate that was connected to the fixed concrete sill and closed against the front skin plate of the sector gate by water pressure. The original gates had no side seal system, which meant the gate maintenance staff was forced to plug spaces with rope, sand bags, and gravel during gate dewatering operations.

The new seal systems installed under the Phase II rehabilitation contract consisted of new rubber sections as shown in Figure 7. The new top seals consist of a rubber J section connected to an 8- by 6-in. steel angle that extends inside the gate end frames. They seal against the steel seal plates cast into the piers and abutments by means of interior water pressure.

The new front seals consist of a rubber J section connected to a 1/2-in. bent plate connected to existing breast wall steel sections. They seal against the steel front skin plates of the sector gates by means of the upstream water pressure. Both the top and front seal J sections have a 0.03-in. thickness of fluorocarbon film on the bearing surfaces for improved durability.

The new side seals consist of a rectangular rubber section that is bolted to bent steel plates which in turn are bolted and welded to the pier and abutment faces. These seals function only when the gate is raised on its prop systems and dewatered. Only then does the upstream water pressure force this seal section against the curved front skin plates to seal off the end joints. The side seals were detailed to make them more resistant to impact damage from floating logs, a common hazard at the dam.

These new seal systems are similar to those used on another tainter-gate dam located farther down the Genesee River. They have functioned well at that site for over 10 years and have been functioning well for approximately 1 year at the Court Street Dam. The approximate bid cost for the new top, front, and side seals was $155,000 for the four sector gates.

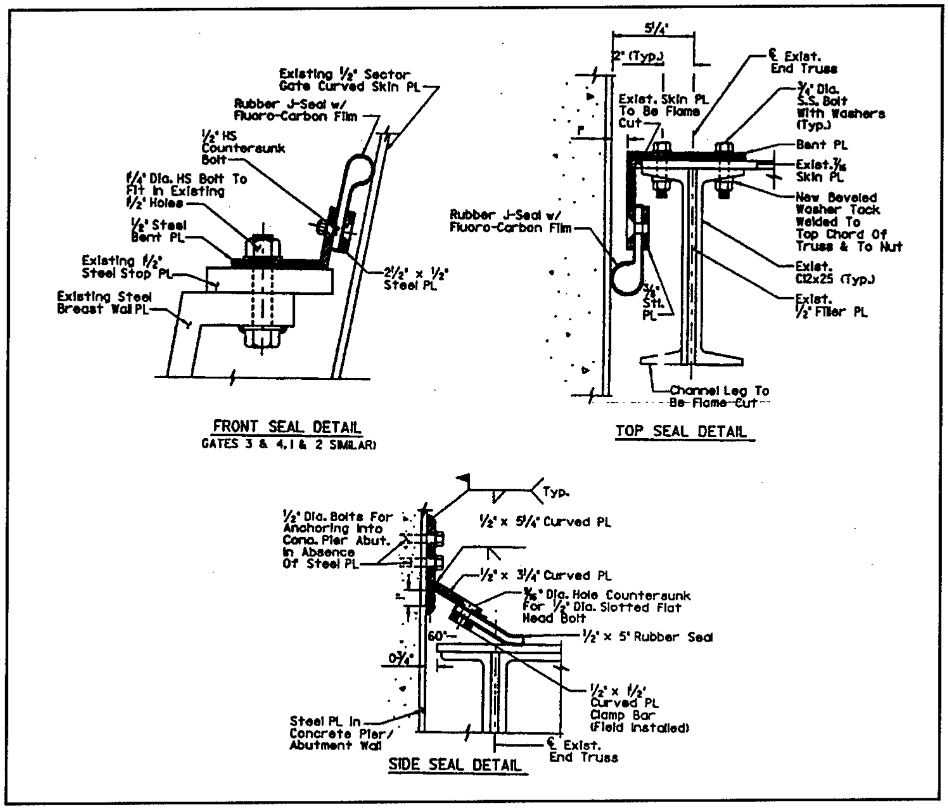

Figure 7. Seal replacement details

Gate steel repairs

A significant portion of the repair cost for the gates consisted of the localized steel replacement and patching, the blast cleaning and containment systems, and the new vinyl paint systems. Framing members within each of the gate trusses or diagonal bracing were replaced where there was an estimated 25 percent or greater loss of total section.

The top skin plates were severely pitted from corrosion as the result of frequent wetting and drying cycles. This deterioration necessitated the replacement of the total plates for Gates No. 1 and 3 and frequent small patches installed on the interior for Gate No. 2. Also, original rivets were replaced with new 3/4-in. high-strength bolts throughout the skin-plated areas where there was a loss of section of the rivet head of 50 percent or greater. As a result, over 15,000 rivets were replaced on the four gates.

Many of the miscellaneous metal items were also replaced in the gates including the fine and coarse trash racks and guides, the access ladders, the bearing plates at each truss support pad, the stop angles, and various valves.

The paint system used for coating the four gates was specified as a three-coat black vinyl system with a minimum total dry film thickness of 7.5 mils. This is the typical paint system used successfully by the NYSTA for all of its waterway structures. A special three-coat system with a copper epoxy top coat (18 mils total minimum dry film thickness) was used on the trash racks and guides as a trial usage to discourage zebra mussel encrustation at the pier inlet areas. It is too early to evaluate the success of this antifouling paint system at the dam.

The Phase II rehabilitation of the Court Street Dam was recently completed at an approximate total cost of $5.0 million. For more information, contact William R. Miles at 716-232-5135.

References

Cooman, C.C. (1927). "110-Foot Sector Gate Dam at Court Street, Rochester, N.Y.," *Cornell Civil Engineer* XXXV (6).

Miles, William R. (1993). "Comparison of Cast-in-Place Concrete Versus Precast Concrete Stay-in-Place Forming Systems for Lock Wall Rehabilitation," Technical Report REMR-CS-41, U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS.

McDonald, J.E., and Curtis, N.F. (1995). "Applications of Precast Concrete in Repair and Replacement of Civil Works Structures," Technical Report REMR-CS-49, U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS.

William R. Miles is a structural project manager at Bergmann Associates, P.C., in Rochester, NY. He received a B.S. degree from Syracuse University and has over 23 years experience working as consulting engineer and project manager on various design and repair projects for waterways facilities, hydraulic structures, buildings, and transportation structures. He is a licensed civil engineer in the States of New York, Maryland, New Jersey, and Florida and is also an active member of the International Concrete Repair Institute.

REMR Publications Update

The following REMR technical reports have been published and are now available for distribution. These reports document research in the concrete and steel, electrical and mechanical, and operations management problem areas. Complete listings of REMR technical reports, technical notes, material data sheets, and bulletin articles are available on the Internet at http://www.wes.army.mil/REMR/remr.html. In addition, the REMR Homepage includes a bibliography database that can be searched by key word, title, or author. Currently, REMR Bulletins, Vol. 12, No. 1 through Vol. 13, No. 3 have been placed online. For additional information about these publications, contact Lee Byrne at (601) 634-2587 (e-mail: byrnee@ex1.wes.army.

Christensen, J.C., Marcy, M.A., Scuero, A.M., and Vaschetti, G.L. (1995). "A Conceptual Design for Underwater Installation of Geomembrane Systems on Concrete Hydraulic Structures," Technical Report REMR-CS-50, U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS.

Geomembrane systems have been installed successfully on the upstream face of more than 20 concrete and masonry dams during the past 25 years. The success of these systems are considered competitive with other repair alternatives. With a few exceptions, geomembrane installations to date have been accomplished in a dry environment by dewatering the structure on which the geomembrane is to be installed. Dewatering, however, can be extremely expensive and in many cases may not be possible because of project constraints. A geomembrane system that could be installed underwater would significantly increase the repair potential of hydraulic structures. This report describes conceptual designs for underwater installation of a geomembrane system to minimize or eliminate water intrusion and leakage through cracked or deteriorated concrete and defective joints in concrete hydraulic structures. Key words are concrete structures, dams, geomembranes, hydraulic structures, leakage, repair, and underwater repair.

Beitelman, A.D. (1996). "Abrasion Resistant, Volatile Organic Compound (VOC) Compliant Coatings for Hydraulic Structures," Technical Report REMR-EM-9, U.S. Army Construction Engineering Research Laboratories, Champaign, IL.

The U.S. Army Corps of Engineers has used solution vinyl paints for the corrosion protection of hydraulic structures on inland waterways for many years. These coatings have an excellent service life; however, the liquid paint contains high quantities of solvents. To comply with existing and anticipated pollution regulations, it is necessary to evaluate potential coatings to replace those being currently used. Ten elastomeric polyurethanes were tested in the laboratory; six were recommended for field testing. They were applied to an epoxy basecoat system consisting of MIL-P-24441/29 F150, Type IV primer and MIL-P-2441/30 F151, Type IV topcoat. This report includes laboratory and field test results. Key words are coatings, hydraulic structures, and volatile organic compound.

Beitelman, A.D., and Huffman, D. (1996). "High Solids and Zinc-Rich Epoxy Coatings for Corps of Engineers Civil Works Structures," Technical Report REMR-EM-10, U.S. Army Construction Engineering Research Laboratories, Champaign, IL.

The U.S. Army Corps of Engineers relies heavily on the use of vinyl paints for coating hydraulic structures. Though the systems have performed well in many environments, their high solvent content has made their use illegal under some local air-pollution control legislation. High-solids epoxies available in the current guide specification will comply with the regulations and may provide acceptable performance in some applications. Responding to field inquiries relating to specific application irregularities and anticipated problems, this research investigated the application parameters of the currently used E-303d and MIL-P-2441 Formula 159 zinc-rich primers and MIL-P-2441 Type IV Formula 150 primer/Formula 151 topcoat epoxy polyamide coatings. Overall, this study showed that the coatings are tolerant of a wide range of applications and curing variables frequently encountered under field conditions. The results of this work do not indicate a need for revising CWGS-09940 at this time. The work supports the existing guidance in that, if the guidance is followed, satisfactory performance can be expected. Key words are coatings, epoxy coatings, guide specification, high-solids epoxies, hydraulic structures, and vinyl paints.

Bullock, R.E., and Foltz, S.D. (1995). "REMR Management Systems — Navigation and Reservoir Structures, Condition Rating Procedures for Concrete in Gravity Dams, Retaining Walls, and Spillways," Technical Report REMR-OM-16, U.S. Army Construction Engineering Research Laboratories, Champaign, IL.

The purpose of this report is to describe a proposed system for determining a condition index (CI) that numerically rates the condition of the concrete in a gravity dam monolith, retaining wall, or spillway on a scale of 1 to 100 by evaluating each concrete distress objectively. The rating system described herein allows the CI to be determined by the use of a visual investigation with limited equipment. The rating is related primarily to structural integrity and secondarily to serviceability. The CI procedure was developed by assigning deduct values to defects that include the following distress categories: alignment, cracking (checking, D-cracking, pattern, horizontal, vertical and transverse, vertical and horizontal, diagonal, random, and longitudinal floor), deposits, leakage, steel deterioration (corrosion stains, reinforcing, prestressing, and armor), and volume loss (abrasion, honeycomb, pop-outs, scaling, spalling, and disintegration). The deduct values are, in part, subtracted from 100 to establish the CI. Primary deduct values were determined with the intent of obtaining a CI of 40 when deterioration of a concrete monolith caused the safety of that monolith to become questionable. Nominal deduct values were assigned for defects in serviceability. The CI should be determined on at least one of each type of monolith and the more distressed monoliths. At least 20 percent of the monoliths should be rated. Key words are concrete, condition rating, condition indexes, gravity dams, hydraulic structures, maintenance and repair, management systems, and navigation structures.

Greimann, L., Stecker, J., and Nop, M. (1995). "REMR-Management Systems—Navigation Structures, Condition Rating Procedures for Tainter Dam and Lock Gates," Technical Report REMR-OM-17, U.S. Army Construction Engineering Research Laboratories, Champaign, IL.

The mission of the U.S. Army Corps of Engineers has been shifting from constructing new facilities to maintaining the large inventory of existing facilities. The objective of this work was to develop an inspection and rating system that uniformly and consistently describes the current condition of tainter dam and lock gate structures. The objective was achieved by conducting site visits and field investigations with experts from the Corps and by using their opinions to develop the rules that form the basis of the rating system. This report provides a general description of the inspection and rating system and includes the definition of a condition index and a description of tainter gate distresses. A detailed description of the inspection and rules for calculating condition indexes for tainter gates are provided. Key words are condition rating, condition indexes, hydraulic structures, locks and dams, management systems, navigation structures, and tainter gates.

Impacts of Volatile Organic Compound (VOC) Regulations and Acquisition Reform on Civil Works Painting

By Tim Race, U.S. Army Construction Engineering Research Laboratories

Volatile organic compound (VOC) emissions are known to result in the formation of ground-level ozone that may impact human health and plant life. On June 25, 1996, the U.S. Environmental Protection Agency (EPA) proposed a standard intended to govern the VOC content of architectural and industrial maintenance coatings sold in the United States. The regulation would reduce annual VOC emissions by 20 percent from the 1990 values.

The proposed rule describes 55 categories of architectural coatings and specifies the maximum allowable VOC for each. This rule would be applicable to the manufacture and import of coatings for sale in the United States effective April 1, 1997.

There are currently several states that already regulate the VOC-content of architectural coatings, most notably California. A national rule issued by the EPA would establish a minimum standard for all states, but states would retain the right to promulgate more stringent rules. In all probability, states with existing rules will exercise this right. California probably will not adopt the less stringent levels of the proposed national rule.

Civil Works Guide Specification CWGS-09940, "Painting: Hydraulic Structures" (December 1995), covers the requirements for painting hydraulic structures and appurtenant items. The full range of coatings specified in CWGS-09940 are described by just nine of the EPA's fifty-five categories. Table 1 lists these nine categories as well as some additional coating categories potentially of interest in Civil Works painting. Most of the coatings specified in CWGS-09940 may be categorized as industrial maintenance, metallic-pigmented, or impacted-immersion. Of lesser importance or lower use are coatings covered by the EPA categories for high-temperature, flat, floor, and nonflat coatings as well as primers and pretreatment wash primers.

Table 1. VOC Categories and Limits

Coating Category	VOC Limit (g/L)
Antifouling coatings	400
Concrete curing compounds	350
Concrete protective coatings	400
Fire-retardant/resistive coatings:	
Clear	850
Opaque	450
Flat coatings:	
Exterior	250
Interior	250
Floor coatings	400
Form release compounds	450
High-temperature coatings	650
Impacted-immersion coatings	780
Industrial maintenance coatings	450
Metallic-pigmented coatings	500
Nonflat coatings:	
Exterior	380
Interior	380
Pretreatment wash primers	780
Primers and undercoaters	350

Table 2 lists the coatings found in CWGS-09940 and their VOC contents and summarizes the potential options for complying with the proposed rule.

The Paint Technology Center of the U.S. Army Construction Engineering Laboratories (CERL) has been proactively researching low VOC coating technologies for many years. The goal has always been to be good environmental stewards while maximizing coating performance. Of long-standing concern has been the potential ban of vinyl coatings (V-766, V-102, V-103, V-106, and VZ-108) that the Corps of Engineers uses for protecting major components of hydraulic structures exposed to freshwater immersion. These coatings have very high VOC levels and were always assumed to be vulnerable to regulatory impact. Extensive research efforts at CERL in the early 1980's were unsuccessful at reformulating the vinyls. Subsequent work has focused on the identification of a suitable substitute technology. These efforts, while nominally successful, have yet to identify an appropriate technology to replace the vinyls.

The author had the fortunate opportunity to participate in a prerule-making regulatory negotiation between impacted sectors of the architectural coatings industry and the EPA. As a result, the EPA was able to establish the need for a separate category for impacted-immersion coatings. This need was supported by research conducted by CERL and presented to the EPA. The proposed rule would allow the continued use of vinyls for the most severe applications where other coating technologies fail, in other words impacted-immersion. Users of CWGS-09940 would need to limit the use of vinyls to this type of end use, and alternate systems such as systems 6-A-Z and 21-A-Z would need to be specified for nonimpact immersion. Users in states with existing or proposed state VOC regulations should note that the impacted-immersion category may not be a part of their state rule, and to the extent that this is true, Corps vinyls will probably not be allowed in those states.

Steel Structures Painting Council (SSPC) Paint 20 (1991), Zinc-Rich Primers (Type I - Inorganic and Type II - Organic), describes a range of commercially available coatings but does not limit VOC. Type I coatings, specified in CWGS-09940 for use on steel subject to elevated temperatures, typically have VOC contents less than the proposed EPA requirement of 500 g/L for metallic-pigmented coatings. Type II coatings, used by the Corps for painting over galvanizing, usually but not always, have VOC's less than 500 g/L. The SSPC is in the process of updating their specifications to include VOC limits. This action should resolve any concern that the Corps could be specifying noncompliant coatings when SSPC Paint 20 is called for.

Suitable low-VOC latex FED SPEC and General Services Administration (GSA) commercial item descriptions exist to replace the current generation of interior alkyds (TT-P-30, TT-E-505, TT-E-506, TT-E-508, and TT-E-509) specified in CWGS-09940 for use on masonry and wood substrates. The performance attributes for latex gloss and alkyd enamels are similar. While alkyds offer certain advantages such as excellent block resistance, latex coatings exhibit advantages of their own, such as superior flexibility.

Commercial item description A-A-50542 describes high-performance floor coatings for use on concrete. The VOC limit of 420 g/L established by the specification is above the 400-g/L limit proposed by the EPA. It is highly likely that GSA will act to lower the specified VOC content to the regulated limit. Another alternative for the Corps would be to use a lesser performing coating such as TT-E-2784, an acrylic enamel, to meet the EPA limit.

Other actions unrelated to the pending VOC requirements include the elimination of SSPC Paint 27 (1991), Basic Zinc Chromate-Vinyl Butyral Wash Primer, and the elimination or augmentation of Paint Systems 21-A-Z and 21-B-Z. The wash primer contains a hexavalent chromium compound with associated health and environmental risks. The Paint Technology Center is in the process of evaluating alternates to SSPC Paint 27 for use on nonferrous metal substrates. System 21-A-Z consists of E-303, zinc-rich epoxy primer, and MIL-P-24441 epoxy polyamide topcoat. A commercial item description for a similar system is under development. This effort is in keeping with the requirements of the revised Federal Acquisition Regulation to buy commercial products and to eliminate or reduce the use of MIL SPECS.

Regulated categories of paints other than those listed in CWGS-09940 may also have some applications in Civil Works

Table 2. Summary of CWGS-09940 Coating Systems and Compliance Options

Specification	VOC[1] (g/L)	Applicable Categories	Compliance Options
TT-P-28	~ 540	High temperature	No action required
TT-P-30	~ 450	Flat: Interior	Replace with flat interior latex such as TT-P-29 or A-A-2248
TT-P-38	~ 430	Metallic pigmented	No action required
TT-E-489	~ 380	Industrial maintenance	No action required
TT-E-505	~ 420	Nonflat: Interior	Replace with gloss latex TT-P-1511 or TT-P-2784
TT-E-506	~ 420	Nonflat: Interior	Replace with gloss latex TT-P-1511 or TT-P-2784
TT-E-508	~ 420	Nonflat: Interior	Replace with semigloss latex TT-P-1511 or TT-P-2784
TT-E-509	~ 420	Nonflat: Interior	Replace with semigloss latex TT-P-1511 or TT-P-2784
TT-E-545	< 350	Primers and undercoaters	No action required
E-303	~ 495	Metallic pigmented	No action required. Commercial item description under development
V-766	~ 695	Impacted immersion Industrial maintenance	Restrict use to impacted immersion
V-102	~ 680	Impacted immersion Industrial maintenance	Restrict use to impacted immersion
V-103	~ 700	Impacted immersion Industrial maintenance	Restrict use to impacted immersion
V-106	~ 650	Impacted immersion Industrial maintenance	Restrict use to impacted immersion
VZ-108	~ 640	Impacted immersion Industrial maintenance	Restrict use to impacted immersion
SSPC No. 16 (C-200a)	~ 165	Industrial maintenance	No action required
SSPC No. 20 Type I	NA	Metallic pigmented	VOC not established but most products conform
SSPC No. 20 Type II	NA	Metallic pigmented	VOC not established but many products conform
SSPC No. 25	~ 320	Industrial maintenance	No action required
SSPC No. 27	< 780	Pretreatment wash primer	No action required. Nonchromate containing options being investigated
SSPC No. 33	< 420	Industrial maintenance	No action required
A-A-2248	< 250	Flat: Interior	No action required
A-A-50542	< 420	Floor	Ask GSA to revise VOC limit
MIL-P-2441	< 340	Industrial maintenance	No action required. Commercial item description under development

[1] VOC as supplied except V-766, V-102, V-103, V-106, and VZ-108 thinned 20 percent by volume and E-303 thinned 40 percent by volume.

projects. Antifouling coatings may be used to reduce the impact of zebra mussels on Corps structures. Research underway at CERL seeks to identify the most appropriate coatings for use by the Corps. Concrete-curing and form-release compounds are used in the placement of concrete. Their use is described elsewhere in Corps guidance. Concrete protective coatings may be used on some local projects to reduce water and chloride penetration that may cause degradation of the concrete. Fire-retardant coatings are used to retard ignition and flame spread or to delay structural weakening of steel and may find occasional use on Corps projects.

The CERL Paint Technology Center is working with CECW-EE to update CWGS-09940 to be compliant with the EPA's proposed rule. For additional information, contact Tim Race at (217) 373-6769.

Tim Race is a principal investigator for the Materials Science and Technology Division at the U.S. Army Construction Engineering Research Laboratories in Champaign, IL. He is a graduate of the University of Michigan and is an active member of the Steel Structures Painting Council, serving as unit committee chair for the Surface Tolerant Coatings and Performance Evaluation committees and Group Chair for Methods of Improved Performance. He is also a member of the American Society for Testing and Material (ASTM) Committee D-1 on Paint and Related Coatings and chairs an ASTM task group on Whole Paint Specifications. His research focuses primarily on high- performance coatings for Civil Works applications with an emphasis on environmentally compliant technologies.

Changes in REMR Key Personnel

Dr. Tony C. Liu (CERD-C) has been named the REMR Coordinator at the Directorate of Research and Development. Dr. Liu has been affiliated with the REMR Research Program for 12 years, having served as a Technical Monitor since the program's inception in 1984 and as a member of the Overview Committee since 1985.

Changes in REMR Technical Monitors include Mr. Jerry Foster (CECW-ED), who replaces Mr. Don Dressler in the Steel Structures Problem Area; Mr. M. K. Lee, who replaces Dr. Liu in the Concrete Structures Problem Area; Mr. Mike Klosterman (CECW-E), who replaces Mr. John Sanda in the Geotechnical Rock Problem Area; and Mr. Tohlen, who replaces Mr. James E. Crews in Operations Management.

Changes in REMR Field Review Group members are Mr. Tom Hugenberg, who replaces Mr. Dave Pattison as the Ohio River Division representative, and Mr. Steve Jones, who replaces Mr. Jim Bentley for the Lower Mississippi Valley.

Positive Note Sets Tone for REMR-II Research Program Review

With ongoing projects on-schedule and program completion targeted for 1998, a positive tone set the pace for the eighth annual meeting of the REMR-II Field Review Group (FRG) held August 13, 1996, at the U.S. Army Engineer Waterways Experiment Station (WES), Vicksburg, MS.

Approximately 30 Corps District and Division representatives scrutinized ongoing work units to ensure effective technology transfer to the Corps of Engineers and private industry. Citing the value of REMR-developed technology to the field, FRG members expressed interest in the program's continuation beyond 1998.

Some of the recent accomplishments reported at the meeting included:

- Completion of a small-scale underwater geomembrane constructibility demonstration for repair of leakage in hydraulic structures.
- Completion of a study of the variation in uplift pressures along a single rock joint under a concrete gravity structure.
- Development of a new design for navigation lock lift-gates with a fatigue life twice that of the old designs.
- Development of a method for determining a stable toe stone weight for a coastal structure in a breaking wave and ebb-flow environment.
- Development of condition indices for roller dam gates, lock and dam operating machinery, and rubble breakwaters and jetties.
- Guidance on the removal of lead-pigmented paints from hydraulic structures.
- Evaluation of environmentally acceptable greases and oils for use on hydraulic structures and in hydroelectric units.
- Development of a field-usable, PC-based, numerical flow model for the evaluation and maintenance of high-velocity channels.

Additional projects that will be performed on or before September 1998 include the following:

- Development of performance criteria for dimensionally compatible repair materials for concrete structures and an expert system to aid in the selection of repair materials.
- Development of a nonlinear, ultrasonic pulse-echo system for nondestructive testing of concrete to depths up to ten times that of currently available systems.
- Publication of procedures for the selection of repair materials for hydraulic steel structures and typical connection and repair details.
- Guidance for the design of a stable toe for coastal structures in a combined wave and flow environment.
- Completion of testing of CORE-LOC armor units for coastal structures.
- Publication of a methodology and test procedures for determining the effects of vegetation on levee performance.
- Guidance for selecting, designing, and constructing biotechnical and low-cost structural erosion-control at reservoir shorelines.
- Development of a rock degradation classification system that can be used to predict field degradation and optimum use of stone.
- Publication of guidance for optimum solutions to icing problems at Corps hydraulic structures.
- Development of management systems for lift gates, earth and rock-fill dams, bridges/service bridges, non-rubble breakwaters and jetties, and seawall bulkheads and revetments.

To date, REMR research has been documented in 156 technical reports, over 117 *REMR Bulletin* articles, 164 technical notes, and 134 material data sheets. The program currently maintains a home page on the World Wide Web (http://www.wes.army.mil/REMR/remr. html). The REMR Bibliography Database, a searchable index to REMR publications, may be accessed at this Web site. REMR publications may be obtained by contacting Lee Byrne by telephone (601-634-2587) or e-mail (byrnee@ex1.wes.army.mil).