



Structural Epoxy Lining System Restores Culvert Pipe Integrity

In November 2013, a large-diameter steel culvert (78"–90") located in Syracuse, New York needed attention before it reached the end of its life cycle. The culvert was part of a storm draining system that was aging and deteriorating due to seasonal high flow and freeze/thaw cycles. The pipe's original galvanic zinc protection was nearly gone, leaving the surface exposed to oxidation.

Various experts were called in to strategize regarding the logistical challenges, limitations, and needs of the structure. Specific challenges were encountered because the rehab and lining project took place in the dead of winter in upstate N.Y., traditional preparation methods were limited due to the conditions of the galvanized surface, and the high build structural lining material required high temperatures for conditioning material with complex, heated plural-component equipment.

When a culvert or steel pipe ages and corrodes, metal loss can be minuscule at first, but can slowly compound. Year after year, what seems like a non-issue in the short-term eventually builds up as oxidation that eats at the support strength of its original design. If left unattended, the fatigued walls simply cannot handle the load, and they will eventually start collapsing.

Once collapsing occurs, more economical options associated with trenchless repair vanish. To avoid replacement, trenchless restoration with technologies that enhance strength and stop corrosion must be considered and installed before this critical tipping point.

The project owner commissioned, O'Brien & Gere, a well-recognized infrastructure-solution consulting and engineering firm located throughout the East Coast, as consultants for the project to assist with system selection options. O'Brien & Gere knew they had some challenges ahead of them and that traditional Curing in Place Pipe (CIPP) options would not be right for this project. Traditional lining methods can often lead to issues during installation when structures have a combination of bends, diverse pipe formations, various transitions, scattered seams, standing water, and a concrete base being poured, as this structure did; therefore, the firm sought a more dynamic solution to account for all these variables.

The end result needed to not only restore, rehabilitate, and enhance the pipe structurally but also be a forgiving application with features allowing it to tie into different substrates and conditions. This had to be achieved while overcoming logistical challenges in order to create a monolithic liner, sealing inflow and infiltration (I&I) and protecting against future corrosive and abrasive conditions. For instance, the cold winter environment proved to be challenging for traditional lining methods, which commonly require the maintenance of moderate substrate temperatures and heat. Water inflow was also a challenge; the pipe was part of a storm system that had spikes in flow. Therefore, at times, the solution would also need to cure in the presence of water. A rapid cure would

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Featured Products

CPP Sprayliner (formerly CPP Sprayable)



Project Information

Location

New York

Completion Date

November 2013

Structure

Culvert Pipe

Engineer

O'Brien & Gere



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also be beneficial in case of sudden snowmelt or rain. Having different adhesion capabilities was necessary because the culvert included both concrete and metal substrates. Therefore, the lining material needed to bond to both metal and concrete. It became evident that it was important to use a lining method that cured quickly in the presence of water and that had great surface tolerance and forgiveness to overcome these logistical challenges.

The selected solution came from Epoxytec, a leading manufacturer of high-build, structural-grade epoxy lining systems. Utilizing an ultra-high build, structural-grade epoxy lining system delivers the proper balance of properties required for the dynamic pipe restoration and conditions of the culvert rehabilitation and lining project requirements.

Even after selecting a proper system to fit the needs of the culvert project, the application was still a challenge, requiring an experienced industrial coating contractor who could properly navigate the winter elements found in upstate New York. The contractor had to be experienced in managing a plural-component, heated spray rig to ensure that epoxy material stayed at 150°F so it could be sprayed and that it could maintain high heat while traveling in 150' sections. In addition, the contractor was required to have NACE training and the highest tier of manufacturer certification as well as experience with specified quality control standards to deliver a successful installation with proper design thickness and uniformity. Therefore, the contractor invested in training, and tested various scenarios with their custom-built plural equipment, enhanced with heated pumps, heated hoses, and recirculating fluid handling prior to the job. The project required a warranty; turning to its Certified Applicator Network, Epoxytec teamed with CPE, a leading contractor in the area, to ensure a high quality installation with rounds of training and verifying capabilities to help CPE to achieve manufacturer-certified status.

The Epoxytec CPP Sprayable system delivers a liner with high tolerances to both steel and concrete. The CPP series is a part of the Epoxytec Structural Epoxy Lining System for pipes, provide high build and high flexural strength lining solutions. The product allows high-build applications on a variety of structures ranging from 100–250 mils per pass (and higher upwards to 1" when applied in multiple passes). The CPP products are formulated as highly advanced filled polymers with a proprietary mix of reinforcing fibers, ceramics, and other natural and synthetic reinforcement fillers to achieve high flexural strengths as a fiber-reinforced-polymer (FRP) epoxy system. The technology was also a great candidate for this culvert-lining project due to its surface forgiveness, moisture tolerance, and high-performance protection. Once cured, the system seals and protects from corrosion; the material incorporates ceramics to combat abrasion and wear.

The CPP Sprayable material provides resistance against many known chemicals found in collection systems and in other similar wastewater systems.

An assortment of chemical constituents provided by O'Brien & Gere at various concentrations were validated by Epoxytec for compatibility. Due to the combination of a 100% solid formulation for the safe installation and its recognition as an EPA Verified Technology, the Epoxytec liner for the culvert offered many of the advantages desired for the project.

To protect the integrity of the steel and avoid further metal loss, abrasive blasting could not be utilized. Instead, the project execution began with an ultra-high pressure (UHP) water jetting blast to prep the steel and concrete base that had been poured. UHP hydro-blasting is often considered more difficult and specialized than abrasive blasting, and would be essential to keep the maximum metal thickness from being compromised. This removed all loose rust, scale, degraded zinc, chlorides, and contaminants without cutting into the steel.

To ensure uniformity in its design build-up and to prevent excessive flash rusting from becoming problematic, a tack coat of the Epoxytec CPP Sprayable was sprayed to create a base-coat barrier layer on which subsequent higher-build second layer could be applied to achieve the 250 mil minimum, DFT (1/4") design thickness. Flash rusting can occur within less than an hour after blasting, so getting ready to apply the first tack coat immediately after blasting was important. Due to good planning, this was not difficult to achieve; the crew had the spray rig ready hours before beginning each day so they could be ready to spray when necessary. This process also included stripe coating all the seams to ensure that the material would bridge gaps with zero holidays.

Once the first pass became tacky, a second high-build layer of the Epoxytec CPP Sprayable was applied to complete the specified design build. The concrete floor was uniform and horizontal, so it received one continuous high-build layer to tie in as a continuous monolithic system.

To satisfy the warranty, quality assurances and controls were written in the project specifications and documented via inspection. Initial inspections involved the on-site manufacturer acceptance of the surface preparation techniques in accordance with NACE/SSPC standards. While the application took place, other inspection milestones and recordings were put in place, such as monitoring surface temperatures, ambient conditions, humidity levels, chlorides, pH, mil thickness, and bond strength. Then, a final inspection was performed to check for holidays via spark testing. Cure-time hardness was further validated, and the pipe was ready for its return-to-service, featuring enhanced flow capabilities, abrasion shielding, and refortification with enhanced strength while providing life-extending protection against corrosion and erosive I&I.

