ZORN PUMP STATION NO. 1 RESTORATION

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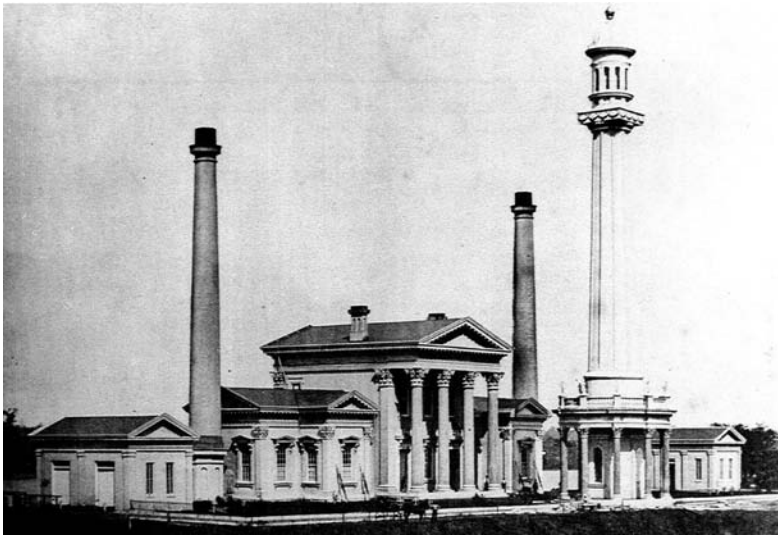
Built 150 years ago, Zorn Pump Station No. 1 is an iconic structure located along the Ohio River in Louisville, KY. The pump station was designed in classical revival style by Theodore R. Scowden and Charles Hermany, his assistant. Sitting on a 120 acre site (0.49 km^2), the engineers also envisioned a "park-like" setting for the station. They brought that vision to life, and it still holds true today.



Zorn Pump Station in 1861

Project prior to restoration

Bringing the station to Louisville was quite an accomplishment. At least six attempts were made to bring in a city water provider before this was finally successful in 1860. Construction of the station was a slow, backbreaking process that took nearly 600 workers over 3 1/2 years to complete. The project not only included the construction of the station but also the construction of a tower, the reservoir, and 26 miles (41.8 km) of cast iron pipe. The original cost of the project was $829,455.

The station pumped its first gallon of water on October 16, 1860, to 512 customers. In the beginning, the water company grew at a slow pace, but the city benefited from the station in other ways. The station allowed for a public drinking fountain, street sprinkling services, and fire protection.

150-YEAR-OLD HISTORIC LANDMARK

The station was nearing its 150th anniversary and was in need of a major exterior renovation. During its lifetime, the pump station had more than its fair share of natural disasters. Located at the edge of the Ohio River, the station had been flooded several times. It had also survived several tornadoes—the worst one completely destroyed the front tower structure in 1890. The building needed a complete exterior renovation to stabilize and sustain the integrity and historic nature of the building. Many of the protective coatings were extremely deteriorated and delaminating from the building, which compounded the deterioration of the underlying materials used to construct the building. Moisture infiltration had also been an ongoing problem for many years.

The most unique feature of this structure is the variety of different materials that were used during the original construction to create the extremely ornate building. There were also a variety of materials used over the years to repair different aspects of the building envelope. Materials used to originally construct the building include masonry, terra cotta, cast iron, wood, limestone, steel, slate, marble, granite, and copper. Some of the various other materials discovered during the initial inspection included plaster and tin, both of which were used to replace missing or damaged terra cotta modillions during previous repairs on the building.

Before the restoration work began, several investigations had to take place—the most intensive was that of the extremely ornate terra cotta column capitals and modillions. The building includes two different sizes of capitals and six different sizes and profiles of modillions. Several weeks were spent inspecting, documenting, labeling, and numbering each individual column capital piece and each individual modillion. For each of the 792 capital's terra cotta pieces and 448 modillions, current condition notes were taken and repair recommendations were made for any terra cotta piece requiring more extensive restoration work. During the inspection and documentation, it was determined that the capitals and modillions were in far worse condition than anyone initially anticipated.

To restore the terra cotta column capitals and modillions, many different methods and techniques were used, depending on the type of deterioration. If the terra cotta was spalled or deteriorated, a special repair mortar was used to reprofile the damaged area to match the existing texture. If the terra cotta piece was cracked, it was injected with a structural bonding epoxy. If the column capital piece was too deteriorated to be repaired on site or missing, it was replicated. Because of the historic nature of this project, standards and guidelines for restoring historic buildings set by the National Park Service were followed. To ensure an exact in-kind match of the terra cotta pieces, one of the large capitals, one of the small capitals, and one of each type of modillion in good condition was disassembled and shipped to a California terra cotta manufacturer that specializes in replicating historic terra cotta pieces. The terra cotta replica pieces had a 9-month lead time that really drove the project schedule.

SITE PREPARATION

A major challenge during the project was that the building remained occupied during the exterior restoration work. The site had to remain secure and safe while also providing the general public access to the building and maintaining all the needed emergency egress from the building. This was accomplished by completely enclosing the construction site with a temporary construction fence and constructing enclosed walkways to access the building. Temporary measures were also taken to protect the roof, windows, and doors. This was not only to keep the building secure but also to prevent snow, wind, and rain intrusion.

APPLICATION METHOD SELECTION

The application method was determined by each type of material and the severity of deterioration. Because this is a historic structure, application methods had to follow historic guidelines that would

Typical deteriorated coating

Typical deteriorated capital

As doors and windows were removed to be repaired, openings were filled to prevent moisture infiltration

Different product mockups were tested to determine the most effective coating removal product

The specified paint removal product was ineffective against the unexpected 0.25 in. (6.4 mm) thick existing lead coatings

Project during restoration

not damage the substrate. Following these guidelines determined the scope and methods of repair. The application methods employed and product selected to aid removal also changed after the mockups for the coating removal. The building had an unusually thick amount of existing coatings on a large variety of different materials. There were a variety of different substrate materials that complicated the process because what worked on the wood may not work as well on the masonry. Additional mockups were performed using around 15 different coating removal products until one product was selected that gave the most desirable results.

STRIPPING THE OLD AND ON WITH THE NEW

Given the age of the building and all the detrimental environmental factors over the years, the historic pump station was very much in need of new protective coatings. A few of the building's existing coatings were never removed; they were simply scraped and recoated. Before the paint removal process began, the paint was tested and was found to contain high levels of lead. Once the coating removal process started, it was discovered that, in some areas, the lead-based coatings were up to 0.25 in. (6.4 mm) thick.

Paint removal began on the west elevation of the building and continued counter-clockwise around the perimeter until all the paint was removed. At the start of the project, the Environmental Protection Agency lead abatement rules changed, and this project followed the new guidelines issued in April 2010. All of the removed coatings were collected in protective plastic and bagged in 6 mil garbage bags. Because the paint contained such large amounts of lead, the discarded coating material was taken to a hazardous waste site for proper disposal.

As the paint was being removed, the tuck pointers followed and began removing the deteriorated mortar joints and tuck pointing the historic pump station. Nearly 80% of the building had to be re-tuck pointed. Over the years, the mortar had deteriorated and, in many cases, the masonry joints had been caulked instead of tuck pointed properly. Once the mortar was cured and the pH levels dropped to a safe coating level, the new protective coatings were applied. Each different construction material received a different high-performance coating, which required a great deal of planning and coordination.

ADDITIONAL BUILDING REPAIRS AND RESTORATION

Some of the additional repairs and restoration that were performed on the building are as follows:

Door and window restoration:

- Each oversized door and window sash was removed, stripped, and restored;

- Custom fabricated pieces were made to replace wood pieces that were too badly deteriorated to be restored;
- New 0.5 in. (13 mm) insulated glass panes were installed in the existing window sashes; and
- New door hardware and reconditioned existing door panic hardware were installed to operable condition.

Installation of 4 ft (1.2 m) of waterproofing around the building perimeter:

- The existing building continues a couple stories below grade—the floors have since then been infilled and are no longer accessible.
- With the building's flood plain location and high water table, the building has had problems of wicking water up the masonry. An elaborate drainage system incorporating dry wells was installed.
- The coating previously used on the building prevented the masonry from breathing and held water in the masonry. This helped deteriorate the masonry faster. To prevent this, 4 ft (1.2 m) of foundation waterproofing and five dry wells were added to promote proper drainage at the foundation. This was a challenging process at the perimeter because of the existing utilities around the building. It became more challenging at the west elevation, where the grade is higher on the building. At this point, the excavation was 16 ft (4.9 m) below grade in an already tight location.
- A breathable masonry coating was used on the masonry that also lets any moisture that gets into the masonry out so it doesn't cause additional deterioration.

Cast iron restoration:

- To repair cracks in the cast iron window surrounds and the cast iron column bases, the cracks were welded. This is a difficult process to perform in a machine shop—even more so on a building using wood substrate.

Wood box gutters and wood trim:

- There were multiple areas where the existing wood box gutters were severely deteriorated and were required to be rebuilt;
- Wood trim that was too badly deteriorated to be repaired was replaced with custom replicated wood trim pieces; and
- All wood on the building was smoothed and prepped to receive new paint after the paint removal process.

Creation of GFRC replacement pieces:

- At some point in the building's history, the cast iron door surrounds were removed from the north elevation of the building. Glass fiber-reinforced concrete (GFRC) replicas were created to match these cast iron surrounds, and they were installed on the north elevation to bring the architecture details back to the building.

West elevation waterproofing excavation and north elevation waterproofing installation

GFRC piece replicated to match the existing cast iron door surrounds

Site work:

- The front and rear of the building at the water tower and overlooking the Ohio River were converted into plaza-type areas using pavers, curbs, decorative stone benches, special lighting, and metal work. These areas are a prime spot for wedding photography and other events.

UNFORESEEN CONDITIONS

One of the things that makes restoration work so interesting is that with every project, you find something new and surprising that catches you off guard. This restoration project was no different. The biggest surprise here was discovering that the 0.25 in. (6.4 mm) thick coating material needed to be removed so that the new coatings would properly adhere. This thick coating also helped to hide a great

Project after restoration

deal of the existing deterioration. Once the coating was removed, the severe masonry and wood deterioration became evident.

Before construction began, an investigation of the roof determined that a new roof was needed. Once the slate was removed, the wood box gutter was found to be extremely deteriorated in several locations and also needed to be removed and restored. From the beginning of the project, it was known that sections of the existing wooden gutter bed were deteriorated and needed to be rebuilt. Until the existing flashings were removed, however, the full extent of the deterioration was unknown. The deterioration extended farther than anyone initially anticipated and required additional structural repairs to stabilize the structure. A specially designed metal bracket was designed to conform to the original profile and provide an anchor to structurally resupport the box gutter.

It was also discovered that many of the capitals and modillions that were thought to be terra cotta or iron had actually been previously replaced with a combination of wood, tin, and plaster.

PROJECT SUCCESS

This project included a wide range of work areas that were simultaneously coordinated to make this a successful restoration project. There were also several different repair techniques and methods necessary to repair the large variety of materials used to construct this building, from performing welding to repair the cracks at the cast iron window surrounds to custom replicating parts to replace deteriorated parts of the 150-year-old wood window sashes. The Zorn Pump Station—still owned by the Louisville Water Company but currently leased by the Louisville Visual Arts Association—is currently used for exhibits and events and has now been restored to its original splendor.

Zorn Pump Station No. 1

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Louisville Water Company
Louisville, KY

PROJECT ENGINEER
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Louisville, KY

REPAIR CONTRACTOR
Structural Systems Repair Group
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MATERIAL SUPPLIERS
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3D Stone
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