ST. ALPHONSUS CHURCH: REPAIR AND SPIRE INSTALLATION

BY CHRISTIAN HILL AND MARK K. HOWELL

Located at the corner of Saratoga Street and Park Avenue in Baltimore, MD, St. Alphonsus Church is owned by the Baltimore Archdiocese. This 8200 ft^2 (760 m^2) property has been a landmark since 1845. Designed by the eminent architect Robert Cary Long in the Southern German neo-Gothic Style, it was once dubbed the "German Cathedral." In 1994, the church was designated as an Archdiocesan Shrine. The historic structure is constructed of brick with a slate roof and sandstone column capitals as well as cast iron adornments. Its bell tower and steeple reach 180 ft (55 m) into the skyline and can be seen throughout the city. In the early 1900s, the church's signature spires were deteriorated to the point that they were a safety concern for pedestrians. They were removed, but never replaced.

In 2006, the owner sought an architectural feature that would match the original spires. It was determined that new spires, designed to match the originals, were to be added around the lower roof-top perimeter of the sanctuary in the same locations where the original spires once stood. The existing capstones, however, exhibited various levels of deterioration, including cracking, spalling, and exfoliation. One capstone was entirely missing, and many mortar joints had failed around the capstones. The coping around the perimeter of the nave also needed repairs. With these existing conditions, the owner knew repairs were needed prior to installation of new spires.

An inspection was conducted by the repair contractor to ascertain the structural integrity of the sandstone capitals, using sounding techniques to identify delaminations. To complete the sounding, the column capstones were accessed from the roof side and light hammers were used to sound the surface. Where the stones were exfoliating, stone fragments were removed to expose sound stone. Hand tools and rubber mallets were used to prevent further damage to the stone.

REPAIR CONSIDERATIONS

Based on the inspection, it was determined that the deterioration of the sandstone capstones and spires was caused by years of weathering and subsequent failures, as well as maintenance neglect caused by difficult accessibility. The stone had

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failed due to natural wear-and-tear. Atmospheric contaminants accumulate in the air and are deposited on the stone. This process leads to a breakdown of the surface level of the stone matrix and subsequent exfoliation. Simultaneously microscopic cracks, either preexisting or newly formed, move with temperature fluctuations. Any water in these cracks freezes and expands numerous times throughout the freezing-and-thawing cycles and causes the crack to widen, or even worse, the stone to spall.

Work performed by the repair contractor prepared the pier caps for the spire installation. Any cracks existing within the capstones were filled with an injection grout and the broken or spalled capstones were built-up with a restoration mortar and carved back to their original shape. Exfoliation was removed from the capstones' surface with hand tools and rubber mallets, after which a consolidator was applied. Isolated patching repairs were made on the capstones as required. After the capstones were restored, all were covered with a stone stabilization compound. The liquid-applied stone

An 80 ft (24.4 m) boom lift was used for safe access to the work

consolidator is specially formulated to penetrate the substrate, soaking into the pores much like water into a sponge. This action decreases the volume of voids in the top layer of stone, minimizing the locations where atmospheric pollutants could lodge and cause further deterioration. It is important to note that the capstones were not fully restored or replaced in order to retain their architectural and historic value. Fortunately, because initial investigation showed that they were they were in a fairly good condition, the main objective was to restore them to a sound structural condition prior to spire installation.

INNOVATIVE SOLUTIONS

Also during this time period, the repair contractor worked on modeling the replacement spires. The church was still in possession of a 4 ft (1.2 m) tall wood spire that had been part of the original organ and matched the original rooftop spires. Computer-aided design (CAD) drawings of the organ spire were made—resizing it to 8 ft (2.4 m) tall—creating a model with a base size to match the top dimensions of the capstone.

When considering a material for the replacement spires, there were many options. Historically, pieces are carved out of wood or molded from fiberglass, cast stone, or cast iron. Ultimately, the cast stone, iron, and fiberglass options proved cost-prohibitive.

A cruciform bit was used to drill through limestone into masonry columns

Anchorage holes were vacuumed after drilling to ensure they were clean so a proper bond could be formed with the anchor

The 48 in. (1219 mm) long specialty anchor, covered in a long cotton sock to promote a good bond when the grout is pumped, is lowered into the anchor hole

Nonshrink grout placement below the receiver plate

Lightning arrestor system attached to the stainless steel skeleton

The repair contractor found another unique alternative—polyvinyl chloride (PVC). A PVC option was selected because of its economic efficiency, aesthetics (as seen from a built sample), and durability. This solution not only reduced the cost of the manufactured products, but also allowed for exceptional durability against the weather and pollution. While a simple fiberglass mold may not have allowed for such distinguished character within each member, these carved pieces were made individually by skilled craftsmen of a custom company specializing in ornamental features. Each of the pieces were hand-constructed with "routers

Alignment of spire in preparation for tack welding

and a bit of ingenuity" by the artisans. The PVC solution, however, had one drawback—it offered no structural capacity. Therefore, a stainless-steel skeleton/armature was designed to add the needed structural strength to withstand the high wind loads that were placed on the spires and could cause them to act like sails.

The installation of the spires began by evaluating a number of drilling methods. Holes, 42 in. (1067 mm) deep and 1.5 in. (38 mm) in diameter, had to be drilled through the pier caps and into the brick piers. Ideally, the repair contractor did not want to use typical hole-boring equipment because most use water to lubricate the drive through the substrate. Water, if combined with the dust from the drilling, posed a serious problem as cementitious slurry would result. The paste could run down the pier, potentially staining the historic brick. Instead, the contractor used a waterless drilling mechanism. A special drill bit and an extension rod were purchased to allow for dry drilling. In the few areas where a wet boring was needed in order to avoid splitting a pier, a small containment reservoir was built on the cap and continuously vacuumed to control the slurry.

After the holes were drilled, the repair contractor inserted specialty anchors to allow for stabilization of the entire system. Special anchors for the spires were selected for their compatibility with the masonry and their ability to flex with the structure. They work by inserting a 48 in. (1219 mm) long piece of 0.75 in. (19 mm) stainless steel all-thread into the hole. A cotton sock with a plastic hose running to its bottom was wrapped around the bottom of the all-thread. A highly fluid cementitious grout was pumped into the hose until the sock was completely full and expanded to hold the entire piece in place against the substrate. Next, a 1 in. (25 mm) thick grout bed was poured to bond the pier cap and receiver plate together. An 8 x 8 in. (200 x 200 mm) stainless steel receiver plate was placed on top of the grout, and once everything had set and cured, the spires were attached to the plate by bolting the entire unit to the receiver plate.

As part of the repair process, the team also installed a lightning arrestor system. The wiring for the system was attached to the spire base and the actual lightning rod was screwed into the tip of the spire. The connection between these components was completed with a stainless steel rod running through the body of the spire.

The repair contractor was also cognizant of the fact that the piers were not supported in a vertical fashion, which would result in the spires appearing out-of-line when placed vertically into the holes. In response to this challenge, the repair contractor suggested shimming the brick piers, allowing for easy straightening as needed. Because many of the original capitals were not completely plumb, the stainless steel receiver plates were shimmed up to level, and then a nonshrink grout bed was poured in under the base plates. The PVC base molding that was added not only served to increase the base footprint, but also covered the stainless steel receiver plates and lightning arrestor system connection.

As a final step, recognizing the initial causes of failure, the specialty contractor took steps to ensure that ongoing deterioration of the spires, caused by an increase in pollution, volatile chemical usage, and natural wear-and-tear, would be slowed or even halted. The solution selected was a brush-on application of an additional coat of paint on top of the one coat of primer and two coats of spray finish. This coating ensures that any soiling of the project will occur at a slower rate. Long term, this solution will enable the spires to be easily cleaned by a nonspecialized maintenance staff.

CHALLENGING CONDITIONS

During the course of the project, the weather presented unforeseen challenges. An extended period of below-freezing conditions resulted in a thick layer of ice that remained on the new slate and copper roof and the concrete alley throughout the majority of the project. The working area became very slippery in these adverse wintry conditions. To create a safe work environment, the repair contractor took advantage of the newly reconstructed roof. A tie-back line was placed around the entire roof perimeter, and throughout the entire construction process, every worker was tied to the roof to increase fall protection measures.

After 100 years, the original gothic element is restored

The public and surrounding property were kept safe by obtaining occupancy permits for all the parking meters and the parking lane on an adjoining street. All passing vehicles and foot traffic were kept a reasonable distance away from the overhead work, eliminating the risk of danger to themselves and the crew.

Another challenge was locating material for the spire construction that not only matched the original but also would be durable enough to withstand inner-city conditions and meet the owner's budget. The design-build effort that went into finding the optimal solution went above and beyond the services of a typical specialty repair contractor, and the effort paid off. The use of PVC cut costs significantly, enabling the project to be completed for a fraction of the cost of stone.

The necessary anchor drilling also was a challenge due to the depth of the threaded rod. These 48 in. (1219 mm) long rods required custom made/designed anchors to achieve the capacity for these spires to withstand the wind loads. Further, a few of the brick piers through which the spires were anchored were chimneys, meaning they were hollow in the middle. To address this scenario

Like sentinels over the sanctuary, the spires have restored the original beauty for the next generation of parishioners

and achieve the needed depth, some build-up in the void was required.

PROJECT SUCCESS

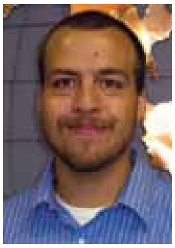
Addressing the challenges and developing innovations, such as including the lightning arrestor system into the decorative spires, were all components of this successful project. The project, which was completed in approximately 1 month, also represented one of the first times that most of the project members had been involved with the placement of a dual-use rooftop sculpture. By using the spires for multiple purposes, St. Alphonsus Church was able to maintain the safety of its building, as well as develop a decorative architectural feature that will enrich the building and surrounding community.

St. Alphonsus Church

OWNER
Archdiocese of Baltimore
Baltimore, MD

PROJECT ENGINEER
Keast & Hood Company
Washington, DC

REPAIR CONTRACTOR
Structural Preservation Systems
Elkridge, MD



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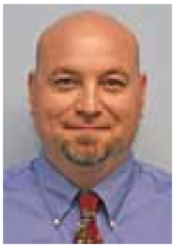

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