More Than Meets The Eye

Invisible Waterproofing Membrane Layer Performs Heroically On Cincinnati's Historic Union Terminal Fountain

When people come to visit a historic landmark, it's all about the visual experience. They want to see what things looked like "back then," to get a feel for life in its original historic period. When Cincinnati's historic Union Terminal water fountain required a critical waterproofing membrane solution for the long-term preservation of its unique raw terrazzo cladding, a new polyurea coating from OBIC Products was chosen to ensure the structure would remain intact and perform beautifully for generations to come.

Preserving an Art Deco Treasure

Cincinnati's Union Terminal, one of the last great American train stations, was built in the Art Deco style so prevalent in the 1920s and '30s. Since its opening in 1933, the National Historic Landmark has had a long and storied history, from welcoming soldiers home from World War II to becoming the home of three museums, an OMNIMAX® Theater and the Cincinnati History Library and Archives.

Considered a historic architectural treasure and beloved in its hometown, Union Terminal includes a massive 5,000-square-foot "magical whispering fountain" water feature that sits across from the building's southern face. The fountain is considered an integral part of the terminal itself. So, when the Cincinnati Museum Center embarked on a two-year restoration of the historic Terminal complex, the badly deteriorated Art Deco fountain was included in the project.

Bringing in the big guns

John G. Waites Architects (Albany, N.Y. and New York City), subcontractor to GBBN Architects—the firm in charge of the project—is one of the premier architectural preservation firms in the country. They have been involved in such high-profile projects as restoration of the Vanderbilt Mansion in Hyde Park, N.Y. and studies for the long-term

Project:
Cincinnati Union Terminal Fountain

Installer:
Advanced Rehabilitation Technologies

Consulting Architect:
John G. Waites Architects

Solution Integrated:
OBIC Armor 1000

preservation of the Statue of Liberty National Monument. JGWA was tapped in 2016 to handle the exterior restoration of the Union Terminal building, and the interior restoration of the significant historic spaces. Exterior preservation included the fountain.

Clay Palazzo, historic preservation architect in charge of JGWA's part of the Union Terminal project, had to deal with several significant challenges posed by the fountain's restoration. The primary issue was the fountain's location atop a structural slab over the Children's Museum.

Far more complex than apparent

"For years, they had had problems with water infiltration (from the fountain above into the museum below)," he says. "Through a series of probes and examinations, it was determined that the original fountain was concrete with a rustic terrazzo finish," as opposed to the more common highly polished terrazzo that people are used to walking on in airports and other large, high-traffic public spaces.

The concrete for the cascading fountain, it was discovered, was laid on top of a lead pan, and that, in turn, was laid on top of coal tar waterproofing, which was on top of the structural slab. In other words, it was a nightmare layer cake of surface interest and historic beauty on top of a no-longer-effective waterstop solution.

Untenable design flaws

"The problem with the design," Palazzo explains, "was that it allowed water to percolate through the terrazzo and through the concrete. There was not really, as part of the design, a route for the water to escape: There was no drain for the lead liner." So water would percolate through the construction of the fountain, then would go through freeze/thaw cycles in Cincinnati's sometimes brutally cold winters. The leaking water eventually froze, expanded, and cracked the concrete.

In later years, there was an attempt to use pool paint to coat the well portion of the fountain, effectively moving the waterproof lining from the leaky lead pan up to the top of the fountain's finish, to keep the moisture from percolating down through the construction. "The problem with that approach," says Palazzo, "was that they never got the water out of the concrete. It continued to go through freeze/thaw cycles, and that movement and deterioration of the concrete actually telegraphed up through the pool paint."

So, lacking any other real solution aside from ripping the whole structure apart and rebuilding it, the pool paint application became an annual treatment every spring, to keep it in operation.

Starting from scratch

"But that was really not a satisfactory way to move forward," admits Palazzo. "So as part of the restoration, everything that was on top of that structural deck—not just the fountain, but the circular entry drive and the planting beds surrounding the fountain—was all actually scraped down to the concrete structural deck of the building. A new waterproofing system was laid on top of that deck, then we built back up from there."

The issue with this complete tear-down/rebuild approach was that, due to the project's significant funding sources from government tax credits, absolute historical faithfulness was demanded to the extent possible using available modern materials. "The entire

process had to be reviewed by the historic preservation office and the National Park Service, so that they could qualify for the tax credits," Palazzo explains. "So historical accuracy was extremely important."

Historical accuracy required

To accomplish this, extreme pains were taken to get accurate measurements of the existing fountain before it was demolished. The fountain's construction subcontractor, Cincinnati's Prus Construction, brought in portable laser measuring devices. These act much like the smaller versions used to scan pieces that will be recreated using 3D printing technology, but they are much larger, to accommodate big structures with a reasonable amount of scan passes.

From this, crews mapped out the general forms of the fountain structure, allowing for the thickness of the rustic terrazzo finish, and reconstructed the basic structure and its cascading pools, with its signature scallop design, from concrete. Over that, they applied a waterproof membrane, and on the outside, the rustic signature green terrazzo.

Compromise between materials and maintenance

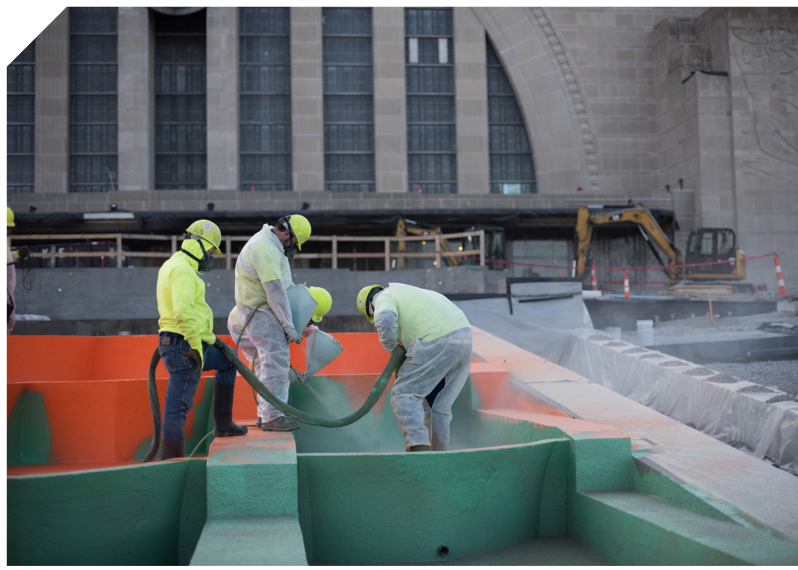
The terrazzo itself does not hold back moisture because the requisite rustic style cannot be sealed, but the builder did apply a water repellent to it, and maintenance crews will empty the pools before freeze-up each year to prevent any major cyclic cracking. They will also need to do some occasional patching over the years.

That was a given in restoring the original surface as faithfully as possible, and was accepted as a cost of maintaining the historical accuracy. "What was very important was to see that there was a maintenance program set up to deal with it, so that things would not accelerate and get out of control," Palazzo explains.

Workable as this compromise was from a historical standpoint, it did make the waterproofing membrane between the terrazzo and the concrete base of critical importance. If they couldn't find a waterproof membrane that could do the job over the long haul, they were just applying a band-aid over what would eventually become a bleeding wound again. This was one of the major challenges Palazzo faced in the redesign and specification phase.

Research and resolve

Palazzo and his colleagues did a great deal of research into what types of highly effective water barriers were available for modern construction. After much reading, they decided that a polyurea membrane was what they needed. Palazzo describes the search results: "We know that it was used for the waterproofing for The Big Dig, the tunnels in Boston. It seemed like an appropriate fit. We're always looking for a way to have new technology coincide with historic finishes and historic construction. We're very much in



favor of improving the performance of historic structures, so this seemed like an ideal use for the material."

There were three polyurea products in the running for consideration: VersaFlex AquaLok II moisture barrier system, which was in the original specs; a polyurea from Sherwin-Williams, which one of two terrazzo bidders had advocated; and OBIC Armor 1000 aromatic polyurea coating. When the terrazzo companies realized that the fountain surfaces to be covered included 3,000 feet of vertical surfaces, they withdrew their interest in the project. They were uncomfortable due to inexperience with the performance of any of these products in a vertical application, fearing sag or the inability of the terrazzo mortar bed to properly and permanently adhere to the membrane.

Experience breeds confidence

Despite being told that the polyurea wouldn't work for these reasons, Palazzo was undeterred. He believed polyurea was the right material for the job. In November, 2016, he was introduced to Gary Mock, vice president of Advanced Rehabilitation Technology (ART). Prus had reached out to Mock when they learned that polyurea was in the spec, because they knew ART had been doing some successful projects with it.

Mock agreed that polyurea was the way to go. "I indicated to the group that polyurea is used on many bridge deck projects as the waterproofing membrane, and asphalt is laid over it without issue," he recalls. He even knew the product he would recommend. He had previously installed the Armor 1000 system from OBIC Products with great success. Armor 1000 is a spray-applied coating that forms a seamless, monolithic waterproof membrane that is tough and durable. Palazzo recalls: "We didn't really have a strong feeling one way or another for which brand name product we were going to go with. We became comfortable with Gary, and he was comfortable with that particular product. We had no reason not to go with a product that he had experience with. And that was a big selling point, the experience he had with it being used in the architectural construction market."

Pre-installation testing

Still, the risk was significant, as was the project price tag, so Palazzo wanted to be as sure as possible that the Armor 1000 was the way to go. There were others in the project who also wanted to test it against the pool paint. So, at the request of Palazzo and Richard Prekaiski, senior project manager for Turner Construction (offices throughout the U.S.)—the project's prime contractor—the subcontractors set up a test bed of two, 4-foot-square precast concrete cubes, one for each material. These were open cubes, created so that installers and applicators had to deal with inside corners, outside corners and coping at the top edge. "It was an inexpensive way to sort of simulate the different circumstances we'd have for our application," says Palazzo.

Experimental finishing

Mock was happy to have a chance for his recommended material to prove itself, but he shared the terrazzo installers' concerns that their mortar beds might not adhere well to the smooth, plastic-like polyurea cured membrane surface. This was a particular concern related to bond on vertical surfaces.

Lathing was not ideal work for this application, so he cast about for something to rough up the surface to give the mortar bed something to grab onto. He came up with the idea of broadcasting aluminum oxide granules (black sand) across the wet surface of the polyurea before it was cured. This would add roughness that the mortar bed could key into for best possible adhesion. However, the architect felt the aluminum may have a reaction to the chlorine in the fountain water, some of which would eventually leach down through the terrazzo to the waterproof membrane layer. Finally, he settled on simply changing the broadcast granules to silica sand, a common component of Portland cement. So, it was decided to use a silica sand broadcast.

Bonus performance

Although chlorine reaching the concrete beneath the polyurea was a concern and discussed during the design consultation phase, he wasn't worried since the membrane is chemical-resistant—a benefit of using the OBIC product. And the outcome of the mockup test was conclusive.

The two mockups had set outside from November through January freezing, thawing, and holding rain and snow. The pool material had several cracks appear in it, while the terrazzo over the polyurea was holding firmly. "I was allowed to take a hammer in front of our group and test the adhesion," remembers Mock. "It took several heavy blows, and even with that, it was the terrazzo that came off of the mortar bed before the mortar bed came off of the polyurea."

Full waterproofing process

It was now February, 2018, and the entire project had to be completed by October. The waterproof membrane was scheduled to be completed by April 1. The fountain's structural concrete had yet to be poured, which requires a minimum of 28 days cure, prior to the waterproofing application.

This became a concern, because green concrete can cause pinholes in the coating if it off-gasses, which is caused by residual moisture. A concrete additive was used, guaranteed not to allow off-gassing. Problems arose because the concrete had to be poured in freezing weather, after which it rained for weeks. At that point, the fountain's structure had become an outdoor pool, just holding water.

Weather issues

ART's options were to wait until weather conditions and time allowed the concrete to cure further, tent the fountain for a period of time to dry out the concrete, or work with it, which would cause the use of additional time and material. Because tenting would require installing anchors through the waterproofing below grade around the fountain, that was not an option. The tight construction schedule would not allow them to wait another month or so for better weather conditions. So it was decided that they would simply work with the existing conditions.

"We had to dry that concrete out manually," says Mock, with torches out there trying to dry it out, fans blowing, vacuums sucking, trying to get it to the condition where we could apply the material. Even with that and the additive, there was still an issue with off-gassing.

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--Clay Palazzo

First they did the prep work, which took five days. This included masking off the area around the structure so any overspray would be caught. The next week they intended to install the polyurea, which begins with a primer coat of about six to ten mils.

As they were beginning, technicians noticed some little pinholes. This slowed the crew down. They worked cautiously to make sure they weren't getting more pinholes, and reapplying to cover those that did appear. This meant a keen eye was needed during the spark testing. Again, they needed to go very slowly and methodically, to make sure no pinholes were missed.

Tag-team application

Next came the actual polyurea layer, an A/B resin and isocyanate heated to 165° F and applied through a plural component machine at 2000 psi. The base layer is 60-80 mils, and the aliphatic top layer is 20 mils. This layer must be applied within a 24-hour period, to ensure the best possible chemical bond with the base coat. To accommodate this, one technician sprayed out the base coat, and another technician came immediately behind him, within a half-hour window, to spray the topcoat.

As technicians applied this topcoat, a third sprayer came behind to broadcast a silica sand aggregate across it, to improve the bonding surface for the terrazzo mortar bed. Mock explains, "It's a tough job, since polyurea is a fast gel material, which means it sets up quickly. So getting the aggregate to stick in it is difficult, because installers must use quite a bit of velocity and a lot of material."

The terrazzo applicator was not pleased with the aggregate broadcast, so ART came back in and touched up some areas. "We did have a couple small defects to repair a few weeks later," says Mock, "but as far as I know, there were no other issues that arose. The terrazzo application took three months or so. During that time, terrazzo workers were walking and moving their equipment and supplies across the polyurea membrane. Because it's so tough, it was not affected."

Challenges overcome

The biggest challenge was staying ahead of the weather. "We had to work hard," recalls Mock. "Every day, we were sucking water out of that fountain and drying off the concrete, so we could get to doing the application." In the end, it took six days to install the polyurea membrane. The total install took two weeks. The crew ended up working the entire final weekend to hit their April 1 deadline.

Heroic effort recognized

It was a heroic effort by all involved, which did not go unnoticed by the client. The contractors, subcontractors and dignitaries were invited to an opening for the fountain. The Director of the Historical Society called all those who had worked on the project superheroes.

She went on to explain that the Hanna Barbera animated features company was headquartered in Cincinnati, and that one of their artists drove by the Union Terminal regularly. It's believed that the Terminal was the inspiration for the design of the Super Friends' Hall of Justice.

"And if you get a chance to look at those photos," says Mock, with no small amount of pride, "you can tell that's what it is!"

Pearls of wisdom

Mock feels great satisfaction that, even though his crew's work isn't visible to all the visitors who will enjoy the Union Terminal fountain, "the material we applied is going to provide, I believe, the longest-lasting system they could have put in there." He knows their work will allow many more years of service than might otherwise have been possible.

He ascribes this success to his client advocating for the right material, his crew's thorough training in the painstaking application process and dedication to doing it right, and not panicking when things go sideways on the job. "Just be calm," he advises," and do the things you know are right."

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