APPLICATOR

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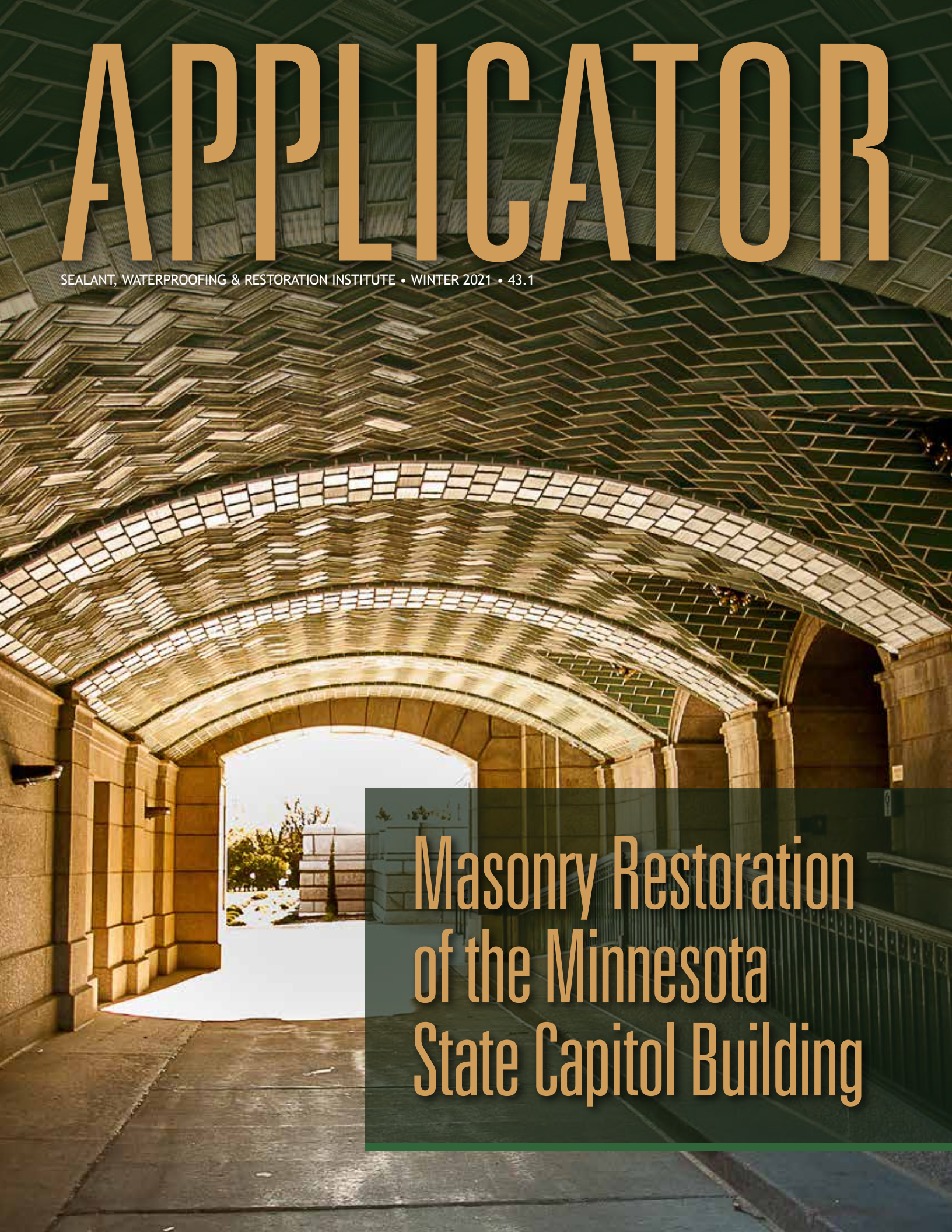

Masonry Restoration of the Minnesota State Capitol Building

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BY TIM MILLER

Advanced Masonry Restoration had the honor and privilege of being selected as the interior and exterior masonry restoration contractor for the four year comprehensive renovation of the Minnesota State Capitol beginning in 2013.

The current state Capitol building, the third in Minnesota's history, was completed in 1905. The first one burned down, the second one was almost immediately outgrown. The current capitol had a 12 year construction schedule at a cost of $12.5 million, approximately $110 million today. Considering the state was only 37 years old at the time of the groundbreaking, it was an ambitious project. The Capitol contains the second largest self-supported dome in the world after St. Peter's Basilica in Rome. The dome has three layers: the outer layer is a self-supporting dome made of Georgia marble blocks resting upon their own weight. Hidden inside is a brick and steel cone that supports the lantern and gold ball at the top of the dome. Below that is the decorative masonry dome visible by looking up from the rotunda. Local architect Cass Gilbert was the designer, and this project gave him a national reputation which eventually led to his selection as designer of the US Supreme Court building.

Trial areas selected incorporated all architectural elements on the Capitol.

The exterior of the Minnesota State Capitol is made of white Georgia marble and St. Cloud granite. Gilbert insisted on using Georgia white marble, saying that the use of a darker color would make it look gloomy and forbidding. He won out over those who objected that Minnesotans would lose stone-cutting and carving jobs if stone from out-of-state was used. As a compromise, the general contractor, Butler-Ryan Co., leased the Georgia quarry and shipped the rough-cut marble to St. Paul to allow local

Typical condition of backup masonry.

The stone team consisted of the following companies:

Architects:
HGA

Engineer:
Wiss, Janney, Elstner

Construction Manager:
JE Dunn

Stone Restoration:
Advanced Masonry Restoration, Inc.

Stone Installation:
Mark 1

Supplier:
Polycor

Carving:
Traditional Cut Stone

Field Measurement:
Twin City Tile & Marble

GOALS:

- Finding the right balance of maintaining historic fabric and loss of integrity.
- Finding the acceptable minimum effort required to protect the building.
- Assessing to what extent modification or reshaping of historic material was appropriate.
- Ascertaining what would be an acceptable level of convincing detail.
- Deciding when replacement is necessary or acceptable.
- Deciding if new work should purposely be distinguishable from original, if so how.
- Deciding what could be done to extend the longevity of the marble.

craftsmen to do the work on site. Gilbert also specified Minnesota-quarried granite for the ground floor level, steps, and terraces, and sandstone and limestone for the foundation and interior walls to fully represent the various stones from the state.

Various exterior masonry repair or projects began on the building starting in the 1930's and continued over the decades. However none of these were ever fully funded and deterioration and decay began to build exponentially. Finally in 2011 it was recognized that the life safety issues that became undeniable with releasing stone, coupled with severe aging infrastructure issues, were not going to improve and a 22-person Capitol Preservation Commission was formed. This led to appropriations funding of $310 million beginning in 2013. Virtually every aspect of the building was replaced, rebuilt or renovated: HVAC replaced and re-routed, building envelope restored, roof replaced, code compliance brought up to date, modernization of electrical systems, artwork cleaned and restored; all this was accomplished while preserving the original appearance. In this article we will focus on the masonry restoration aspects of the project.

Replacement stone was sourced from Georgia Marble in Pickens County, GA, the original quarry.

While bid pricing was a factor, given the historical significance, public awareness and difficulty of this project, all members of the stone team were ultimately selected based on experience and knowledge. While some of these companies were not based in Minnesota, there was a project-wide focus on utilizing in-state workers and artisans as much as possible.

The primary objectives of the stone team were life safety, restoring the building integrity, water management and building stewardship. Stone repair trials began October of 2012. Trial areas were established to demonstrate the constructability of various techniques, effectiveness of the suggested repairs and the visual appearance of the overall result.

The exterior architectural features that were affected included displaced ashlar stone units, column capital elements and balustrade components. As with all restoration projects of this magnitude, integrity assessment based on visual observation was not always viable, so minimally destructive openings were made mainly to assist with peephole camera insertion at and around the damaged units.

Trial areas showed long term water infiltration from above, almost exclusively from poor maintenance of skyward facing joints.

- The backup masonry was saturated and was unable to ever completely dry out due to lack of an engineered drainage system.
- The brick and stone showed heavy evidence of freeze/thaw damage. Minnesota winters often have extreme temperature swings, from above freezing to below zero in as little as 18 hours. As water expands approximately 10% upon freezing, this wreaks havoc with saturated masonry.

Examples of deterioration on the building exterior.

Vein cracking at cornice.

- Freeze/thaw damage expansion also caused several units to shift outward.
- Stone anchors were corroded and for the most part ineffectual.
- Larger stone units, especially at the cornice, showed heavy vein erosion in the marble and diagonal cracking.

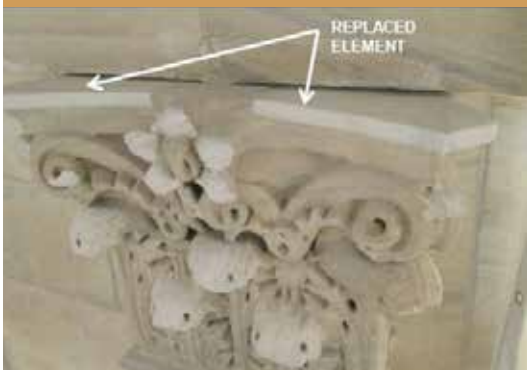
Repairs were made on a case-by-case basis depending on the condition of the stone. In some cases Dutchman repairs were opted for. Displaced units that were 100% undamaged were removed and salvaged. If required, the backup was repointed or replaced and the stone reinstalled with new stainless steel anchors. Unsalvageable units were replaced with new units. Mark 1 Restoration handled stone replacement such as this throughout the project. Chipped, surface cracked or spalled but otherwise structurally sound units were removed and re-anchored and then repaired by AMR. Profiles were patched and carved also utilizing Jahns.

There was no pre-approved standard color, every area that was patched required a different blend of colors to match both the base and the marble veining. The highly carved elements such as those on the pilasters and capitals demonstrated the most severe damage and loss of detail. It was determined that these projecting units have larger surface areas that are more exposed to damaging climate factors. In addition, ornately carved figures are more vulnerable to distress than are flat surfaces. Also the original carving practices utilized hand chisels and hammers; unfortunately this method exacerbates naturally occurring micro-fractures, leaving the stone more vulnerable to water infiltration.

Ultimately every piece of stone on the building was touched, and 4,000 pieces of stone were replaced. As the scope grew, the original single fabricator receiving stone from the quarry was expanded to a total of five. Some blocks were sent to Toronto and Italy for carving, to assist the four master carvers who were onsite for the project duration.

Eroded element, base patching started.

Before and after replacement elements were put into place.



> "Ultimately every piece of stone on the building was touched, and 4,000 pieces of stone were replaced."

Specially carved pieces being installed.

Eroded element, patched to match profile.

One of the larger unforeseen repairs that arose was the replacement of the 15,000 square foot stairs fronting the Capitol. Since they were repaired in the 1990's it was assumed they were sound, however shifting treads led to the discovery that the limestone foundation has lost its bearing capacity. The stair system was dismantled and rebuilt with the original treads salvaged and reinstalled.

The final scope of work on the interior masonry components ended up being much more extensive than originally planned, especially as ceilings and walls covered over in the last 100 years were exposed. AMR's staff of masons restored and repaired Kasota limestone, several types of marble, terrazzo, Guastavino tile and black granite. Cracked stone was patched, missing pieces recreated, old bad patches replaced, stone joints regrouted and stone surfaces refinished.

There was extensive penetration of the Guastavino tile by ceiling grid support hangers, as well as numerous missing tiles. Our journeywomen had to develop a patching mortar that would hold, and then match the existing color of the tile. They then needed to find or fabricate the tools needed to match the notched profile, as well as develop the techniques necessary to match the profile of the tiles. This was all done through trial and error and maximized by their knowledge from previous projects, as well as their artistic abilities. Sarah Arkeh, AMR's Master Stonemason for the project, visited pet stores, hobby stores and elsewhere attempting to find items that would

Damaged tile, base patching started.

Front stairs of the Capitol.

Profile matching in progress.

match the necessary grooving for the tile. Of all things she eventually found an older style flat edged paper clip that worked perfectly. All of this time and effort culminated with what we refer to as the centerpiece of AMR's contribution to the project, the renovation of the Guastavino tile ceiling in the East Porte cochere of the Capitol that had been hidden for years. Edison Thinfill 55 was used on the Guastavino tiles, coated with a terra cotta glaze to match the existing finish.

Color and texture matches had to be perfect on every single patch on every single material type. After marble patching, potassium silicate of various hues was uses to match the veining.

No standard colors were acceptable, every patch was custom colored to blend perfectly. Every patch had to match the texture of the surface it was applied to and then colorized to match the surrounding stone and patina.

After installing every one of the over 1,200 repairs on the ceiling, floors and walls, the repair locations were marked on the plans for later architectural inspections. Incredibly,

Matched profile.

Interior marble base patch.

"No standard colors were acceptable, every patch was custom colored to blend perfectly."

Cracked marble.

Completed patch, profiled and colored to emulate natural veining.

Completed patch.

94% of the patches could not be found without the aid of the person who repaired it. Documentation of the locations was subsequently turned over to the State of Minnesota for archival purposes, cementing AMR's place as a part of our state's history.

There is a reason why the cover page of AMR's website features the State Capitol project. This prestigious project is the culmination of all of the blood, sweat and tears we have spent in building our company over the last 25 years. We employ an average of 80 union masons every year, and

Completed matched profile, color and glazing.

have been able to build and preserve a premier core of artisans for many of these years, many since day one. This gave us the skill set, from assessment to completion, that enabled AMR to not only be selected as the project masonry restoration contractor, but allowed us to perform the work to so much praise and accolades.

About the Author

Tim Miller, Principal and Founder, Advanced Masonry Restoration, St. Paul, MN.

As one of the original founders of Advanced Masonry Restoration, Tim has overseen the growth of the company over a 20-year period with hands on knowledge of over 2,000 projects. The variety of projects over 30 plus years in the restoration industry has exposed Tim to all facets of repairs and causes of defective workmanship. Besides managing Advanced Masonry Restoration, Tim has been hired as a consultant and expert witness for the repair of building envelopes and reviewing the existing conditions, for conformity to the specifications.

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Some photos and information provided by Wiss, Janney, Elstner and Hammel, Green and Abrahamson, Inc.


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Muslims in a Bible Belt town uneasy as Trump presidency nears
Medical missionary keeps a promise he made 75 years ago during WWII

Two of AMR's stonemasons for the Capitol Project, **Sara Arkeh** & **Krista Rogers**, highlighted on the front page of the St. Paul newspaper.