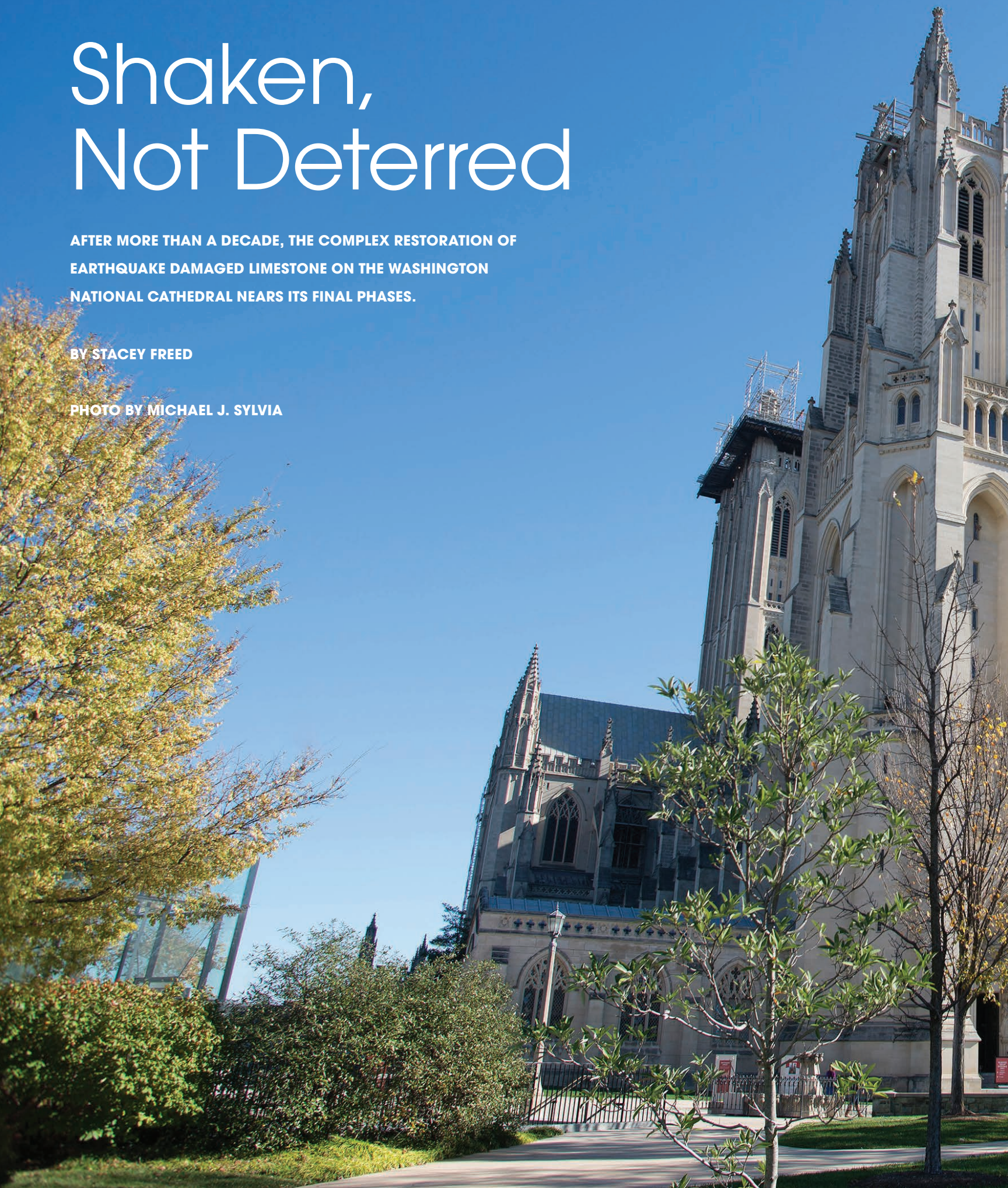


Shaken, Not Deterred

AFTER MORE THAN A DECADE, THE COMPLEX RESTORATION OF
EARTHQUAKE DAMAGED LIMESTONE ON THE WASHINGTON
NATIONAL CATHEDRAL NEARS ITS FINAL PHASES.

BY STACEY FREED

PHOTO BY MICHAEL J. SYLVIA







The 117-year-old Cathedral Church of Saint Peter and Saint Paul, the Washington National Cathedral, has been nearly restored to its original grandeur after being damaged by a 5.8 magnitude earthquake in 2011. The east end, the oldest part of the church, will celebrate its 118th anniversary on September 29, 2025. Photo courtesy of Wiss, Janney, Elstner Associates

Three hundred feet above ground, the air this mid-March afternoon is cold, and the wind is loud as it whips across the scaffolding surrounding the north side of the Cathedral Church of Saint Peter and Saint Paul, better known as the Washington National Cathedral. Joe Alonso isn't fazed. He's in his element and has been for the past 40 years as head mason for the almost 118-year-old Episcopal church sitting atop Mount St. Alban, one of the highest points in the nation's capital.

For the first two decades of Alonso's tenure, he tended to the usual needs of an old stone building — maintenance, upkeep, restoration. Then, in 2011, a 5.8 magnitude earthquake shook the structure to its core, and "we're back to full construction," he says. The work of painstakingly stabilizing and restoring the magnificent Gothic-style cathedral,

the sixth largest cathedral in the world, is complex. Alonso says his four-person staff along with installers Lorton Stone; engineers Wiss, Janney, Elstner Associates, and Scaffold Resource are up to the challenge.

IN THE BEGINNING

Many hands were involved in the cathedral's earliest design incarnations including architects Ernest Flagg, George F. Bodley, Henry Vaughn, Philip Hubert Frohman, Donald Robb, and Harry B. Little, each of whom brought their own expertise in gothic architecture. Ultimately, the firm of Frohman, Robb & Little would become the official architects for the cathedral. The renowned landscape architect Frederick Law Olmsted Jr. designed 57-acres of grounds crisscrossed by paths and rustic quadrangles. The George A.

Fuller Company, which had built New York City's Flatiron building and Pennsylvania Station, was the contractor. The cathedral would be that firm's last carved masonry structure.

On September 29, 1907, President Theodore Roosevelt laid the foundation stone. It had been sourced near Bethlehem, the birthplace of Jesus Christ, and placed inside American-sourced granite, but the rest of the structure is built from 150,000 tons of Indiana limestone — and without steel supports. Cranes and scaffolding surrounded the structure for the next 83 years until the last finial was craned in place on the southwest tower on September 29, 1990. President George H. W. Bush looked on from below, but it was Alonso standing at the top of the structure guiding the stone into place.

The cathedral features more than 1,000



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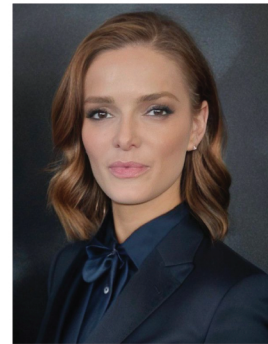
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grotesques (Darth Vader among them); 112 gargoyles, which are actually carved waterspouts; 762 boss stones, which function as structural key stones on the vaulted ceiling (the Moses boss stone above the west balcony is heaviest at 5.5 tons); and 288 carved angels atop the two west towers. The central tower tops out at 676 feet above sea level, making it the highest point in the District of Columbia.

DISASTER STRIKES — MORE THAN ONCE

The earthquake occurred in the afternoon of August 23, 2011. The epicenter was 5 miles south-southwest of Mineral, Virginia, and about 38 miles northwest of Richmond. The Washington Post reported it was a rare occurrence, the kind of “tremor that occurs about once every 2,000 years.” The quake reached into 12 states and some Canadian provinces and was felt by more people than any other quake in U.S. history. In Washington, D.C., in addition to the National Cathedral, the Washington Monument and Union Station also were damaged.

Alonso points toward the towers, recalling that afternoon. He heard a loud boom and the stones at the cathedral rotated and shook. “It was like a giant hand turned the pinnacle and snapped the columns,” he says, twisting his own large hand, fingers splayed as if opening a jar. “The earthquake lasted 58 seconds,” he says. And when it had passed, “the top of the tower looked like a game of Jenga. The stones were within a hair’s breadth of falling off. If it had lasted two or three more seconds they would have fallen to the ground. It would have been a catastrophe.”

Many chunks of stone had fallen to the ground. More than 75% of the cathedral’s pinnacles were damaged, including all four grand pinnacles. One of them on the central tower was missing its top. Flying buttresses on the east end, the oldest section of the church, had shifted and cracked. The finials from the southeast and northeast pinnacles had fallen onto

More than 75% of the cathedral’s pinnacles were damaged, including all four grand pinnacles. Image courtesy of Washington National Cathedral



For forty years head mason Joe Alonso has tended to the stone needs of the cathedral. Here he begins "mason triage" during early visual assessments after the rare 5.8 magnitude earthquake shook the 118-year-old structure to its core. Image courtesy of Washington National Cathedral

the roof and shattered. Inside, mortar and stone from the vaulted ceiling littered the nave's marble floor.

Architect James W. Shepherd, in his book, *The Day the Earth Shook*, a chronicle of the day's events at the cathedral, wrote, "A two-ton section of the southwest pinnacle had fallen inward, landing on top of the tower roof. If it had fallen the other way, over the edge, it would have crashed through the roof of the cathedral and landed inside on the marble floor."

In the days and months after the quake, Alonso says, they walked the perimeter and "did 'mason triage.'" He and his crew, along with Matthew Farmer, senior principal at Wiss, Janney, Elstner Associates (WJE) and project manager for the cathedral project, mapped the damage and did a visual assessment of every part of the building and grounds. "We did what we call 'make safe operations,'" Farmer says. They looked for cracks and displacement, making sure "the load paths for all the

loads hadn't changed dramatically from its original design intent," he says.

The cathedral staff wanted to be able to reopen to worshippers as quickly as possible, but the cathedral also was scheduled to host dignitaries from around the world for the 10th anniversary memorial of September 11. They worked day and night to cordon off dangerous areas and dismantle unstable elements. Alonso created a boneyard as a repository for damaged or broken stonework. "We



Above and opposite page before and after images. The earthquake shook the elements of the cathedral, loosening the stones. This is one of the grand pinnacles of the south transept, which rotated severely on eight slender columns that supported almost 30 tons of limestone. The pinnacles were disassembled, structurally enhanced and reassembled. Photo courtesy of Lorton Stone, LLC

worked together to decide which stones were unstable. We capped off anything that was open or exposed to temporarily stabilize it," Farmer says.

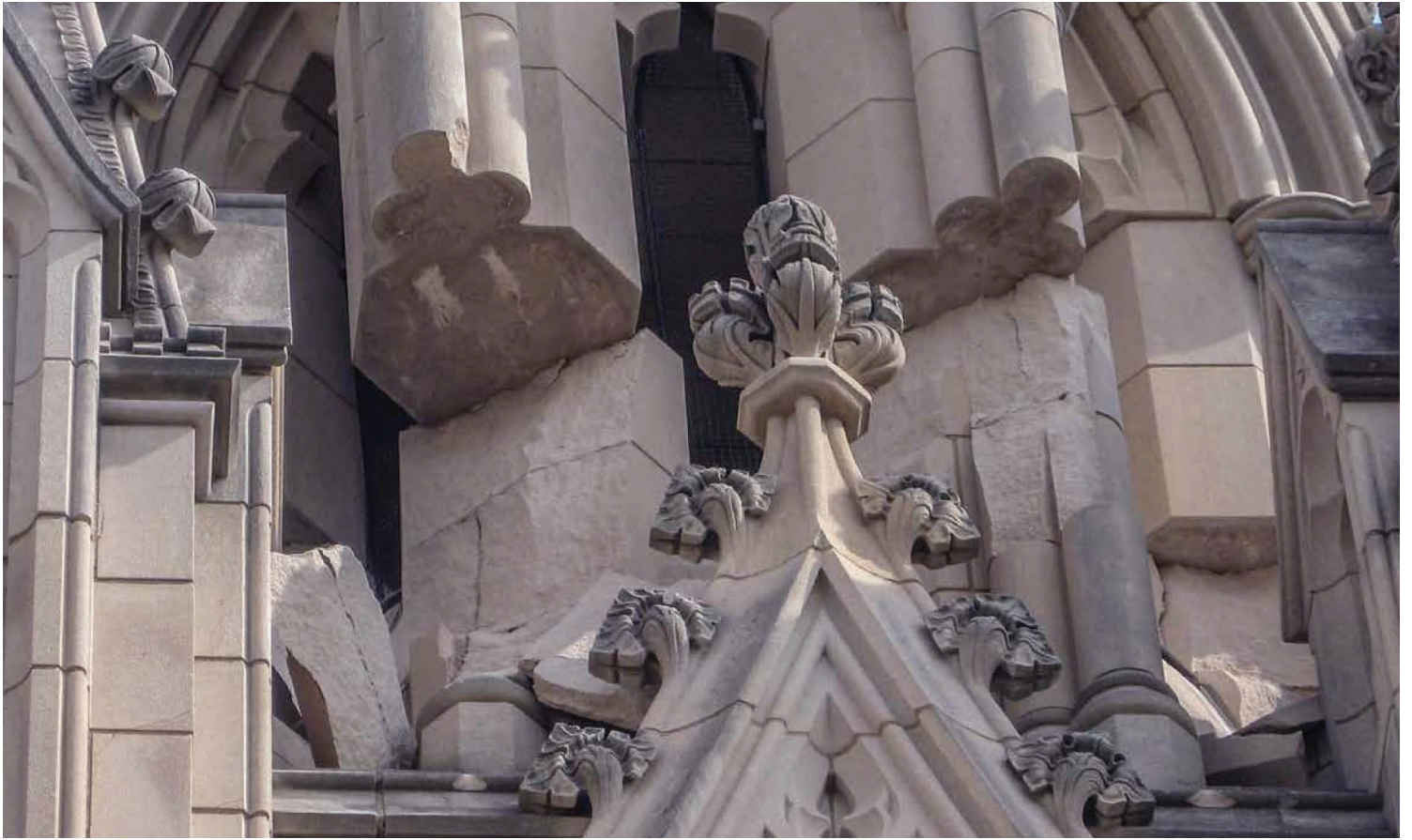
As if that weren't enough, about a week after the earthquake, Hurricane Irene was heading toward Washington, D.C. "We cabled and stabilized elements in place trying to reinforce and tie things back so if the hurricane came through at the predicted Category 5 force, we wouldn't lose any additional elements," Farmer

says. Irene did hit but it came in instead as a Category 3. "We all kind of breathed a sigh of relief and went home and slept for about 12 hours." The storm caused no additional damage.

They continued making a push to get the cathedral safe enough for the September 11 memorial. They put up scaffolding and netting, temporary protection for the public's safety. But during that process, Farmer says, a 500-ton crane used to pull many of the larger stones from the

central tower fell. No one was hurt and the cathedral didn't suffer more damage, but the fallen crane crashed into the old baptistry, a small ancillary building. In the end, the memorial was relocated to the Kennedy Center.

That gave them a little more time for the "rope access folks who rappelled off the exterior to continue the 'pick and clean' process, where we remove loose and unstable material that otherwise might remain and potentially become disrupted





The rope access team from Wiss, Janney, Elstner Associates rappelled off the exterior to inspect stone and continue the 'pick and clean' process to remove loose and unstable material that otherwise might remain and potentially become disrupted downstream. After this point, the team felt confident that the public could safely return. Photo courtesy of Wiss, Janney, Elstner Associates

downstream," Farmer says, adding that "at that point, we were able to feel confident that we could have the public return in early November."

In the meantime, the church had to raise money to fund the restoration, which came in at a \$34 million price tag. It wasn't until 2014 that they were ready to begin true reconstruction.

RESTORATION UNLIMITED

In his work trailer, practically wallpapered in charts, elevations and plans, Alonso points out the restoration's trajectory. He explains that areas marked in green, the east end, were completed in 2014 and 2015; the north elevation was done in 2016; the south in 2017 and on and on. In 2022, they worked on the south side's flying buttresses. This year, 2025, is marked in pink. What awaits is the final phase, the top of central tower, the "'Big Daddy' of them all," Alonso says.

His ordered recitation of events eludes the painstaking work behind each element's restoration. As Farmer puts it, "The National Cathedral is basically a bunch of tall, slender elements with big heavy things on top — which in an earthquake is like the worst combination you could have. And because the original construction didn't include a lot of integration between the individual stone units, they're essentially just stacked on top of each other with very minimal engagement in between. It's a very large pile of rocks."

Every element has to be catalogued, repaired and cleaned before it can be reinstalled. One finial can weigh 1,000 pounds or more. Depending on the damage, it might be repaired in situ with mortar and limestone, or it might be craned to the ground, "which is stressful as you have to worry about wind," says Shane Flynn, project manager at Lorton Stone. "Typically, we bring them down as one piece, but if there are smaller pieces



Painstaking work takes place high above the city. Building the scaffolding alone can take months. Then damaged or unstable stones are removed with a crane. Salvageable stones are taken into the shop to be repaired, and if needed, new pieces are made. Then structural upgrades are completed and the stones re-set with a crane. Photo courtesy Lorton Stone, LLC



Sean Callahan, a cathedral stone carver, finishes one of the rough cuts done by robotic carving. It takes about eight weeks to go from rough to ready. Photo courtesy Wiss, Janney, Elstner Associates

we strap them together and bring them down as one.”

So that the cathedral wouldn’t face earthquake damage again, WJE worked with its San Francisco office to come up with a plan for seismic upgrades. Lorton Stone subcontracted the work of core drilling to Baltimore-based Masonry Solutions International, a specialty drilling firm. They core drill three-inch-diameter holes down 18 to 30 feet through the limestone columns. They also core sample the flying buttresses. “Sometimes we hit steel or rebar and have to redrill,” Flynn says, acknowledging that earlier construction practices sometimes had no rhyme or

reason. They then install a steel rod into the shaft and pump in a cementitious grout.

When elements need replacement Alonso sends the damaged pieces out to be scanned into a CAD system. From there, blanks are roughed out by a CNC machine.

Stone carvers at the cathedral then finish the rough pieces by hand. “It takes about eight weeks to go from rough to ready depending on the type of piece,” Alonso says. One thing he’s excited about is getting to see how the stone artistry changed over time. He points out the differences to the crockets—grapefruit-sized decorative elements in the shape of a bud or curled leaf—carved in the 1930s and the crockets

carved in the 1960s, which look slightly rounder and more modern.

FUTURE PERFECT

Unlike masons tasked with building the great cathedrals in centuries’ past, Alonso and his crew see the proverbial light at the end of the tunnel. Barring further disruptions, the restoration work at this magnificent cathedral should be completed in five to six years.

But those may be the most difficult years. Alonso points toward the heavens, his forefinger picking out the central towers’ grand pinnacles, intricately carved 50-foot-tall stones weighing about 50 tons, set 676



Alonso (right) sees the proverbial light at the end of the tunnel. Barring further disruptions, the restoration work at this magnificent cathedral should be completed in five to six more years. Photo courtesy of Lorton Stone, LLC

feet above sea level. Portions of these will have to be recarved and restored.

The “challenge and complexity of it will be my magnum opus,” Alonso says. And after that? He’ll retire. But he knows he has been part of a special undertaking that connects generations and will live into the future.

Like any long-time mason, Alonso has heard a version of the parable of the three bricklayers: During the rebuilding of London’s St. Paul’s Cathedral, architect Christopher Wren watched three bricklayers at work. He asked each man, “What are you doing?” The first said, “I’m a bricklayer. I’m working hard laying bricks to feed my family.” The second said, “I’m a builder. I’m

building a wall.” The third bricklayer, who was the most productive of the three and the future leader of the group, answered, “I’m a cathedral builder. I’m building a great cathedral to The Almighty.”

Alonso sees himself “as the cathedral builder, of course,” he says. “I am constantly aware, as are my colleagues, of how special this place is. This cathedral is the ultimate place to practice the trade of stonemasonry. You look at the incredible craftsmanship all around you, some of it done generations before you, and I always think I have to be as good, if not better than those who came before me. Then you hope that your work is viewed

the same by those who come after us — which will hopefully make them want to be as good.” ■

Washington National Cathedral Earthquake Restoration – Washington, DC

Client: Washington National Cathedral

(Head mason - Joe Alonso), Washington, DC

Project Architect/Engineer: Wiss, Janney, Elstner Associates, Falls Church, VA

General Contractor/Stone Installer: Lorton Stone, LLC 🍷, Springfield, VA

Stone Supplier: Polycor, Inc. 🍷 (Indiana limestone), Bloomington, IN