

## **The Replacement of Stone and Rebuilding of the Pentagon**

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### **ABSTRACT**

The methodology of quarrying changed significantly in the Indiana Limestone industry in the sixty years between September 11, 1941, the date of the Pentagon groundbreaking ceremony and September 11, 2001 when the building was damaged by American Airlines Flight 77. So too, though to a lesser degree, did the machinery and methods used to fabricate the stone. The rededication ceremony on September 11, 2002 marked the end of the Phoenix Project, as the rebuilding effort was named. The story of this remarkable project illustrates what the American construction (and Indiana Limestone) industry can accomplish when working toward a common goal.

### **INTRODUCTION**

The first Indiana Limestone quarry was opened in Stinesville, just west of Bloomington, in 1827, though the stone had been used prior to this for cabin sills and foundations. Though only found in three small counties in Indiana—Lawrence, Monroe, and Owen—known as the Indiana Limestone “belt,” this amazing material has had an enormous impact on the nation’s architecture. It’s warm neutral color, combined with its long-term durability and its ease of shaping made it the product of choice for a number of buildings, including 27 state capitols and many federal government buildings, including the Pentagon.

Much like everyone else, the Indiana Limestone industry was shocked at the unbelievable events that took place on September 11, 2001, or 9/11, as it’s come to be known. We all watched in disbelief as the twin towers of the World Trade Center collapsed, a plane carrying terrorists and passengers toward Washington DC and another target crashed in a cornfield in Pennsylvania, and American Airlines Flight 77, originating from Dulles International Airport bound for Los Angeles slammed into the Pentagon. The crash killed 189 people—125 inside the building and 64 on the plane—and damaged a 100-yard wide piece of the Pentagon’s western face. That area, including all five floors and three of the building’s five rings had to be dismantled and reassembled using new Indiana Limestone to replace the original stone, set back in 1940 and 1941, which was damaged in the attack. Approximately 18,000 cubic feet of variegated Indiana Limestone (2.5 million pounds) would be needed to do the repairs.

### **THE REBUILDING PROCESS BEGINS**

Recalling the day of the attacks and those which immediately followed, it seemed everyone had an overwhelming urge to want to do something to help restore order to our

country and to help the people of New York and Washington recover from this tragedy. Unlike most people, the workers at Bybee Stone Company in Ellettsville, IN, and Independent Limestone Company and Stone Belt Freight Lines, both in Bloomington, IN were able to put their desires into action.

Bybee Stone is a family-owned company that was founded in 1979 by the late Wilbur Bybee at the site of the former Matthews Brothers Stone Company. Wilbur's sons Will, George, and John carry on the tradition today. Their brother James Daniel Bybee was the president of the company and was very well known in the U.S. stone industry up until his untimely death in December of 2000. Bybee Stone has supplied stone for many projects over the years, including the Washington National Cathedral, Seattle Art Museum, several buildings at the University of Denver, the Washington DC Convention Center, Arlington National Cemetery Visitor's Center and stone for restoration work at the Iowa State Capitol, among others.

Independent Limestone Company was founded in 1927 and since that date, it has operated almost constantly as a quarry which sells and markets Indiana Limestone for buildings and other purposes. Over the years they've been one of the leading quarries in Southern Indiana. Among the many projects which have used stone from Independent are the Scottish Rite Cathedral in Indianapolis, the National Cathedral in Washington, DC, the Yale Graduate School in New Haven, CT and the U.S. Parcel Post Building in New York.

Stone Belt Freight Lines was incorporated in 1951 to serve the Indiana Limestone industry. It began by trucking blocks from the quarries to the mills, then later began delivering blocks, slabs, sills, and cut stone to firms and job sites outside of the Indiana Limestone belt. The firm stayed rather small until an expansion in 1982 enabled it to serve more customers. Today Stone Belt Freight operates 85 power units and 145 trailers and delivers limestone to all states east of the Rocky Mountains and has contracts with other trucking companies for loads farther west. Recent projects include the Federal Court House Eagle in Montgomery, Alabama and the Pentagon Restoration Project. William E. (Ted) Benckart Jr. is the current President of the Company. Past presidents include William E. Benckart Sr., Robert G. Benckart Jr. & Robert G Benckart Sr. Stone Belt has hauled products for Bybee Stone Company for over 20 years.

"Job 306," as the Pentagon or Phoenix Project became known at Bybee Stone, generated a lot of interest, both from the general public and from the workers at the company. Bybee was awarded the contract to supply the stone on October 29, 2001 after the review of the limestone mock-up consisting of sample panels showing the range of color and the finish that would be used to rebuild the Pentagon's west side. A small ceremony was held on December 19, 2001 (ironically exactly one year to the day of James Daniel (Dan) Bybee's death). Attended by Bybee Stone Company employees, along with representatives from Independent Limestone and Stone Belt Freight Lines, as well as various members of the media and local dignitaries, the ceremony included the signing of a limestone panel inscribed with a quote from President George W. Bush which read "Terrorist acts can shake the foundation of our biggest buildings but cannot touch the

foundation of America.” That panel was then loaded on a truck with other stone destined for the Pentagon and headed for the job-site while those in attendance watched.

Throughout the project, the mood around the Bybee mill was one of excitement combined with a resolve to get the job done right and within the scheduled time frame. Will Bybee, President of Bybee Stone Company noted in an article which appeared in the March 11, 2002 issue of Construction Digest that “The Pentagon is a special project because of what happened in Washington and in New York.” He continued by noting that the project was “unique in its meaning” and concluded by saying “We were told that we need to be done with our work by April and we will meet that schedule.”

Others in the company echoed these feelings. Pat Riley, Drafting Supervisor at Bybee took the project personally and was quoted in a December 19, 2001 Bybee press release as saying “When you first see that destruction, it gets you in the heart. I’m all about putting that back together because it is a symbol of all of us, of America, and of our national strength.” Jeremy Glass, a stonecutter with Bybee was quoted in the same press release as saying “We are taking part in history and that is something that only a proud few can say.” Tom Dixon, a fellow stone cutter of Glass added, “It was exciting to learn that we would be working on a building of such historical significance as the Pentagon.”

Independent Limestone General Manager Harry “Steve” Cummings, in a recent conversation had similar comments calling the Pentagon project “by far the most meaningful” of the projects done by the company. “We are very proud to have provided limestone for the Phoenix Project. It’s an honor to have limestone from our quarry on this prominent building.”

Ted Benckart of Stone Belt Freight considers the project one of the most “unique” they have been a part of and has incorporated pictures from the project into the company’s web site. In short, the project holds a special place in the hearts of all its participants.

## THE ORIGINAL BUILDING

Looking back on the original construction of the Pentagon shows some interesting contrasts, as well as some similarities in methods used to rebuild the building some 60 years later. According to the Bybee Stone Company press release dated December 19, 2001, the impetus to build the Pentagon stemmed from the fact that the outbreak of war in Europe in 1939 increased the demand for office space in the War Department. By 1941 the Department’s personnel worked in at least 17 different buildings around Washington, DC and the War Department envisioned a single structure to house all its components. Congress appropriated the funds for construction on August 4, 1941, and ground was broken just over a month later on, and again, ironically September 11, 1941. The original design for the Pentagon evolved due to the fact that the original site for the building was bound by five roadways. President Roosevelt directed that the proposed location be moved 3/4 of a mile down the Potomac and Brigadier General Brehon G. Somerville and his associates took less than four days to develop a plan for the facility to house 40,000 people. The architect for the project was George E. Bergstrom and the prime contractor

was the John T. McShain Company. In all, 460,000 cubic feet of Indiana Limestone supplied by the Indiana Limestone Company was used in the original project, requiring 1200 railroad cars to transport it. At peak times there were upwards of 13,000 workers on the project. Three shifts of architects, construction workers and tradesmen worked 24 hours a day, constructing the Pentagon wedge by wedge. By April 29, 1942, eight months after ground breaking, the contractor had completed the first two sections and War Department personnel had begun to move in. Construction was completed on January 15, 1943, a mere 16 months after it began at a cost of \$49,600,000.

In contrast, 18,000 cubic feet of stone was needed to rebuild the Pentagon following the destruction of September 11, 2001. The work was begun shortly after the plane hit the building and was completed in time for the rededication ceremony on September 11, 2002, at a cost of \$700,000,000.

When the original building was constructed back in the 1940's quarry methods and transportation were much different than those used during the rebuilding process, though the milling techniques and equipment used were almost identical. The original stone was quarried using channeling machines, described by Bill McDonald in his 1995 book titled "A Short History of Indiana Limestone" as small locomotives running on steel rails attached to the quarry floor. They had a series of long-shafted chisels attached to a driving device. The chisels' impacts on the stone cut a channel parallel to the rails, and dust from the cut was flushed or dipped from the deepening groove. After channels were cut along the ledge, additional channels were cut to intersect them, so that stone blocks were freed on four sides. "Key" blocks were broken loose on the bottom by using huge wedges. The blocks could then be hooked up to a device called a dog chain, and lifted out of the hole. With the removal of the key blocks, a space was available for drilling additional blocks loose at their lower edges. The quarried blocks were then often roughly squared up by a scabbling machine or something similar to save weight in shipping, then loaded on railroad cars by derricks and shipped to the mills. The blocks were then sawn into slabs by the use of a gang saw, which is defined in the 1974 Patton Glossary as an assemblage of parallel reciprocating saw blades which generally utilize some loose abrasive material (for example sand, chat, silicon carbide) with water to effect the cutting. Gang saws were also used, in some instances to apply a finish to the stone and, as will be shown later in this paper, the gang saw played an important role in the rebuilding of the project. Finishes were also applied using a planer, consisting of a bed which moves horizontally back and forth while tools of carborundum or hardened steel mounted above and often to the sides, of the planer bed shaped the stones into the specified profile and applied the finish, which could be smooth or of various textures, depending on the desire of the architect and the building owner and the tool used. Finally, the finished pieces, cut to fit and ready to set, were loaded on rail cars for the trip to the job site along the Potomac.

## QUARRYING AND FABRICATING STONE FOR THE PHOENIX PROJECT

In the 60 or so years between the building of the Pentagon and the restoration effort following the crash of Flight 77, the Indiana Limestone industry had undergone many

changes in their quarrying methods. The channeling machine had been replaced, first by the wire saw, then, some 15 years ago, by the belt saw. Again, according to the McDonald book, the belt saw utilizes a “blade” or belt of neoprene, molded around airplane cable and fitted with diamond segments at 6" to 8" intervals along its length. This belt is a development of W.F. Meyers. Inc., a Bedford, IN company which has served as a saw maker to the Indiana Limestone industry for over 100 years. Like its predecessor the channeling machine, the belt saw also runs on tracks, while the belt, mounted on an assembly that resembles a large chain saw bar, cuts the stone. The belt saw runs on electrical power and utilizes modern controls mounted at the back of a box-like structure that houses the motor and other essential parts. The saw is aided in the cutting by water, which, in many operations, is recycled. Once the cuts are made and the bottom of the cut is separated from the rest of the deposit, either by an undercut saw or by the use of slips and wedges, air bags are inserted and inflated to slowly turn the cut over onto the quarry floor. Once the cut is turned (and stacks of rocks or “pillows” are used to cushion the cut) the desired block sizes are lined off and workers drill a series of holes with pneumatic drills. Slips and wedges are inserted into the holes and driven into the stone until the blocks split away from the rest of the cut. High-wheeled front loaders with forks are used to carry the individual blocks to the stacking area, where they will be loaded onto trucks and shipped to the mills for fabrication. Derricks, which were so important to the industry when the stone for the original building was quarried, are no longer needed. Most have been torn down, though a few still remain in the limestone belt as a symbol of a by-gone era.

Though some changes have occurred in the fabrication process since the building of the Pentagon, they’ve not been as widespread as those in the quarry. The Meyers belt saw has replaced the gang saw in many mills, though several area mills still utilize them. That Bybee Stone is among that group played a very important role in the fabrication of the replacement stones. Besides cutting the blocks into slabs, the gang saw is also used to apply certain finishes. When the original building was constructed, many of the stones had a shot-sawn finish. The 21st Edition Indiana Limestone Handbook describes this as a coarse uneven finish ranging from a pebbled surface to one ripped with irregular, roughly parallel grooves. The random markings are obtained by using steel shot in the gang sawing process, in combination with chat sand. The steel shot rusts during this process, permitting varying amounts of rust stain to develop and adding permanent brown tones to the natural color variations in the stone. The demise of the gang saw in many mills has led to a decrease in the popularity and use of the shot-sawn finish, though many restoration projects and building additions call for this finish to match their existing buildings. That has led some mills to develop simulated shot-sawn finishes, applied with various tools. Due to the history and significance of the Pentagon, many people involved with the project wanted the finish on the replacement stones to be applied with the same equipment that was used on the original project. While other companies still had gang saws that could have been converted and used on the project, Bybee had the only operating shot gang left in the belt. However, this was but one factor that led to their being awarded the contract. Another was their long-standing relationship with the mason contractor, Masonry Arts of Birmingham, AL, but probably the main factor was their

extensive experience gained through many other restoration projects, including the Iowa State Capitol.

Some of the stone also had to be planed, and Bybee, like many mills in the area, still had planers in use, yet another way that they were able to adhere to the spirit of the original project. As with the original project, the stone was shipped from Bybee's mill to the job site cut to fit and ready to set, though instead of being shipped by rail, as was the case in the early 40's, the stone was trucked to the project by Stone Belt Freight.

## THE PREPARATION AND PROCEDURES FOR THE PHOENIX PROJECT

The Phoenix Project was indeed unique in its own way. Almost immediately after the plane hit the building, the planning and rebuilding process began. Companies were invited to the Pentagon and shown the areas which would need to be replaced. The damaged stone was being removed from column line to column line on the building and, according to Bybee Drafting Supervisor Pat Riley, the companies were expected to give the contractor the price for the stone in a relatively short period of time. "The process is really pretty simple comparatively," Riley stated in the December 19, 2001 Bybee Press Release. "The short time frame is a big issue in this case and, since it is completely a renovation job, everything we are creating has to match exactly with what was already there."

Riley, along with Bybee Chief Estimator Jeff Chitwood visited the site and climbed over areas adjacent to the damaged section, which were identical to the areas which had to be rebuilt, measuring stones in an effort to identify quantities and sizes of the variegated Indiana Limestone which would be needed for the restoration project. Riley expressed amazement at the work, which was already underway when he arrived at the site. "They had two guys with a snorkel, working all day spraying the area to keep the dust down. There were three claw machines working to remove the rubble and two hundred dumpsters were lined up waiting to receive it. The trucks were moving in and out constantly the whole time we were there."

Security was also a major issue, as there was a continuous military presence on site throughout the reconstruction project. Identification was checked to make sure only authorized personnel were on site, and no cameras were allowed.

Time was such a factor that Bybee actually started fabricating the stone on the strength of a verbal agreement with Masonry Arts before any construction documents had been executed. Roy Swindal, the President of Masonry Arts also brought in Roy Thompson, a retired stone contractor, to help work out the details. Riley and other Bybee personnel made a total of three trips to the site. They were able to get some of the old shop drawings from the original construction, which showed different, yet similar areas of the building. Those drawings, coupled with the measurements they'd taken themselves, enabled them to get typical stone sizes and to develop section drawings, which were further refined when they came back to the plant and involved more of their drafting staff.

The second trip to the site was spent finalizing details and going through some of the original stones, which had been removed, from the building. This was done because there was a bisecting corridor which those involved wanted to rebuild with the original stones. Included in this area was one charred shot-sawn stone, which remained fully intact. The date was cut into the stone and it was re-installed into this reconstructed area. The third and last trip was to go over questions with Masonry Arts, General Contractor AMEC, and architects RTKL and HOK and to further clarify their details. Then the fabrication process, discussed elsewhere in this paper could begin.

In a recent interview with this writer, Will Bybee and Pat Riley both marveled at how unique the project was in the fact that everyone worked together. According to both when problems arose, as they do in every job, there was no drawing of lines in the sand or arguing about whose responsibility it was to take care of the issue at hand. The project had to get done and had to get done on time, and everyone on the team worked toward that goal. At the rededication ceremony, which Will Bybee attended on September 11, 2002, the building was not only completed but the ground was re-sodded and the landscaping was installed, so that those present for the rededication ceremony could take pride in a job well done

In closing, one can't help but think back to the words of President Bush which were carved on the signed panel—"Terrorist acts can shake the foundations of our biggest buildings, but cannot touch the foundation of America." The foundation and work ethic of America was never more evident than in the teamwork and dedication shown in the completion of this project in an efficient and timely manner. All Americans and the American Construction industry can take pride in the rebuilding of the Pentagon.

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