Cathédrale Notre-Dame de Paris is neither the largest nor grandest cathedral in France. But when it was heavily damaged by fire in April, the outpouring of support for the historic monument was palpable. The fire ravaged the cathedral’s roof and destroyed its signature spire. But the cathedral survived, reaffirming the central place it holds in French identity and in the world’s heritage of landmarks.

“The mood is very somber,” says Steven W. Semes, a professor of architecture at the University of Notre Dame in Indiana. Semes recently visited the cathedral site, which remains cordoned off. “There were crowds of people standing there looking at it,” he says. Those viewing the damaged building were “very reverent, like looking at your house after it has burned down.”

While the fate of the cathedral is not yet clear, it would be unwise to bet against a structure that has stood for more than 850 years. Notre-Dame emerged in the midst of a church-building era that swept across Europe starting in the 11th century, according to Richard Winston, author of Notre-Dame, A History (Boston: New Word City, 1971).

Raoul Glaber, a writer of the era, described a burst of creative energy as European nations tried to outdo each other with grander cathedrals: “It was as though the very world had shaken herself and cast off her old age, and were clothing herself everywhere in a white garment of churches.”

As cathedrals rose across Europe, and France in particular, a new form of architectural expression, Gothic, began to emerge. Gothic architecture, with its towering heights and copious number of stained-glass windows, celebrated light and inspired awe. Structurally, it was defined by sophisticated ribbed vaults that—built around a series of pointed arches—proved stronger and more flexible than the rounded arches and barrel vaults more commonly seen in Romanesque architecture. Additionally, dramatic flying buttresses relieved some of the load-bearing duties of cathedral walls, allowing them to be taller, thinner, and robust enough to be punctuated with windows that admitted more light into the cathedrals’ naves.

Gothic architecture took off in the 12th century—spurred by advanced construction techniques that the Crusaders picked up from the Middle East and brought home, according to John Harvey’s book The Master Builders: Architecture in the Middle Ages (New York City: McGraw-Hill Book Co., 1971). The first Gothic building is generally considered to be the Abbey of Saint-Denis, just north of Paris, completed...
by Abbot Suger in 1140. A church had existed near the site of Notre-Dame for centuries, but Maurice de Sully, who served as bishop of Paris from 1160 to 1196, decided to demolish it and build a new, larger structure.

Construction of the cathedral began in 1163 when the first stone was laid in the presence of Pope Alexander III. The layout called for a choir and apse on the east side and a nave on the west side. This main volume was bisected by a north–south transept. Two towers were later built on the west facade, rising to heights of 226 ft. The cathedral is roughly 420 ft long and, not counting the bulge of the transept, 131 ft wide.

Notre-Dame was as much a construction tour de force as it was an architectural marvel. The class of itinerant, skilled architects, masons, and carpenters “created something not too different from the modern construction company,” Winston wrote. During approximately the first 100 years of construction, the work was led by a highly respected series of masters—part architect, part general contractor, part foreman—though their identities are lost to us. (The first named master of Notre-Dame was Jean de Chelles, who took over, according to Bruzelius, sometime in the late 1240s.)

“The masters oversaw the indispensable work of the church’s highly skilled craftsmen. For instance, millions of tons of stone had to be quarried from Île-de-France, the region that surrounds Paris. (More stone was quarried during the cathedral-building centuries, Winston noted, than during the entire history of ancient Egypt.)

“The quarryman had to know stone intimately,” Winston wrote. “Working with primitive equipment, without benefit of explosives or mechanical saws, he had to find the lines of cleavage in the beds, to follow the grain of the stone.” Several varieties of Lutetian limestone were used. Softer stones were used for sculptures and facings, while a harder variant, called claquart, was used for “bearing surfaces, for the drums of columns, and overhanging cornices.” Ox-driven carts were used to transport stone from the quarry to the site.

Medievalist Jean Gimpel, who wrote The Cathedral Builders (translated by Teresa Waugh, New York City: Harper Perennial, 1992), noted that stonecutters used a wide variety of distinguishing marks. A cutter would engrave these marks “on every stone he cut so that the number of stones he had squared off could be counted before he was paid.” Gimpel added that the marks eventually became like signatures. “Fathers handed their own marks down to their sons, but in the father’s lifetime the son would add a mark of his own, like a dash.”

In addition to the masons, Winston wrote, blacksmiths had to forge a steady supply of “hammers, picks, chisels, points, punches, claw chisels, drags, saws, and drills.” And they had to keep these tools sharp, because the stone quickly blunted the iron. Blacksmiths...
also made tong-like “nippers,” which gripped the large stone blocks, and the chains used for hoists.

Carpenters were also pivotal to ensuring that construction at the site could proceed, Winston wrote. Ramps had to be built to carry material, and shoring constructed to hold walls in position. Carpenters also installed the tie beams, plates, and rafters for the timber roof, “binding the members together with mortise-and-tenon joints, through which wooden pegs were driven,” Winston wrote. Additionally, they built the so-called great wheel, used to hoist heavy stones into position.

Perhaps trickiest of all, they had to correctly build the curving falsework to support the arches during construction—otherwise the arches wouldn’t hold when the supports were removed. Winston wrote, “If the wooden frame was removed too soon, while the mortar was still green, the arch might collapse. But leaving the centering in place too long was also dangerous. For if the mortar had set so hard that it had lost all plasticity, when the centering was removed and the building settled, the vault might crack open. The medieval carpenters seem to have devised ingenious methods of removing wedges a little at a time, so that the arches could settle gradually as the mortar hardened.”

The vault above the nave reached as high as 108 ft above the floor, 20 ft taller than “any of its early Gothic predecessors” and the “largest single-increment height increase for a new church over an earlier building of the era,” wrote Robert Mark (Light, Wind, and Structure: The Mystery of the Master Builders, Cambridge, Massachusetts: The MIT Press, 1990).

This created problems. “At higher elevations above ground level, wind speeds are significantly greater; and since wind pressures are proportional to the square of the wind speeds, experience with lower churches...would not have prepared the builders of Notre-Dame to cope with this new design problem,” Mark wrote. “Moreover, the Paris builders seem to have been equally unprepared for the decrease in the amount of light reaching the floor of the choir, another result of this new experience with height.”

This led to perhaps the signature achievements of the original cathedral: the arched exterior supports—the flying buttresses. Some have argued that the flying buttresses were added well after the cathedral’s nave was under construction, but Bruzelius argued that the cathedral’s nave—with its tall, thin walls—was designed with the buttresses in mind from the start.

Another key feature of the cathedral was the 32 ft diameter “rose” window on the western face. Winston noted that here, builders confronted three problems: “sustaining the immense pressure of the surrounding stone upon so large a gap in the wall,...dividing the space into approximately equal areas, and...providing room enough for the glass, so that the window would serve its function of admitting a flood of colored light to the interior.”

The solution was practical and aesthetic: builders divided the rose into concentric circles and arranged spoke-like colonnettes radiating from the center to the edge, providing strength to the glass and separation between the various story lines depicted in the panes.

According to the design website designingbuildings.co.uk, the finishing touches of the cathedral—including some 1,200 statues, tympana, and gargoyles—were added from the middle of the 13th century until the cathedral was finally finished in 1345.

Since then, Notre-Dame has served as both religious icon—capable of celebrating between 50 and 100 masses a day—and, in later centuries, political symbol. During the French Revolution, the cathedral was looted by anti-royalist forces; 28 statues of biblical kings dressed as French kings were publicly beheaded. The original spire, which dated to the 13th century, was torn down, and the cathedral was repurposed as a warehouse for storing food. (The cathedral was even briefly the site of an atheistic “Festival of Reason,” established during the First French Republic, in the late 18th century.)

While Notre-Dame’s political and religious importance had long been established, its cultural significance as an indelible symbol of French identity was established by the publication of Victor Hugo’s classic 1831
novel *The Hunchback of Notre Dame*. “That novel was written in part to draw attention to the cultural and historical significance of Gothic architecture and of the French medieval past,” says Gregory Brown, Ph.D., a professor of history at the University of Nevada, Las Vegas.

In the decades following Hugo’s hugely successful novel, the city underwent a “quite significant, prolonged engagement with both historic preservation and urban renewal,” Brown says. The French Commission of Historical Monuments was established in 1840 to identify important structures in need of conservation. In 1844, architect Eugène Viollet-le-Duc, an inspector on the commission, was appointed to oversee the renovation of Notre-Dame, work that lasted 20 years and included the construction of the 300 ft oak spire that burned in April.

As for the city’s urban renewal, between 1853 and 1870, city official Baron Haussmann, at the behest of French Emperor Napoleon III, oversaw the complete transformation of Paris, which included carving grand boulevards through the medieval city to improve the circulation of goods, people, and police. Brown notes that overbuilt spaces around the cathedral were opened up; a Warren of houses was replaced with an open square. This enabled the cathedral, located on an island in the Seine River, to become a prominent visual symbol of a newly modernized capital.

During World War II the cathedral was earmarked for demolition by Adolf Hitler. Instead, Brown notes, the cathedral became a symbol of national continuity when Paris was liberated from Nazi Germany in August 1944; Charles de Gaulle, who would become the leader of a provisional government in France, concluded his commemoration march through the city by entering the cathedral.

Over the last 30 years, numerous restoration projects have taken place, including the refurbishment of stained-glass windows, the replacement of the cathedral’s organ, and upgraded lighting in the form of light-emitting diodes (LEDs). In 2017, on the eve of a new round of renovations, the *New York Times* described the cathedral in gloomy terms, noting that “broken gargoyles and fallen balustrades” had been replaced by “plastic pipes and wooden planks,” and that even the flying buttresses had been “darkened by pollution and eroded by rainwater.”

The edifice was in need of $185 million in renovation and was in the midst of a modest, $6.8-million renovation of its spire when fire broke out April 15. While the masonry walls of Notre-Dame survived, the intricate wooden roof, composed of thousands of oak beams that had been harvested from centuries-old trees, succumbed to the blaze, as did Viollet-le-Duc’s grand spire. (Commentators pointed to the height of the roof and its inaccessibility as factors in preventing firefighters from saving it.)

So far, more than $1 billion has been pledged for restoration, and French president Emmanuel Macron has vowed to rebuild the historic monument in five years, in time for the 2024 Summer Olympics. Semes cautions that a very careful assessment of the site will be needed before grand plans to refashion Notre-Dame are entertained, and it’s unrealistic to put any timetable on that work. He notes that masonry structures can withstand fire but can be weakened by it in ways that may not be immediately apparent. Masonry can expand when exposed to heat and then contract and potentially crack as it cools. “The point is, why would you rush it?”

Semes contends that the main challenge of renovating Notre-Dame won’t be technical; there are skilled engineers to evaluate the structure, detailed plans that can be followed, and skilled craftsmen available to rebuild. “If they choose to do it, an authentic restoration can be done,” he says. “The challenges are going to be cultural. A culture which elevates innovation and provocation above everything else is the thing we have to be aware of. I think that there are some places in the world that truly deserve reverence, and I think Notre-Dame is one of them.”

Brown notes that the cathedral has changed organically over the centuries, and any forthcoming project is simply an extension of that. “It has been built, it has been expanded, it has been renovated, and pieces have been replaced. In that sense, this is a continuation of that process.”

Nevertheless, Brown adds, “It is indispensable to the visual as well as the cultural landscape of the city and the country. There’s a limit to how much renovation, how much reconstruction, how much replacement will be tolerated, and how much interruption to the building will be tolerated.”

Architects have already floated unsolicited proposals for futuristic glass-and-steel roofs and spires. Viollet-le-Duc himself wrote in the 19th century that “to restore a building is not to preserve it, to repair, or rebuild it; it is to reinstate it in a condition of completeness which could never have existed at any given time.”

The meaning of Viollet-le-Duc’s words will surely be open for interpretation. “You can count on there being a very spirited debate,” Brown says. “I’d be very disappointed if there isn’t.”

—T.R. WITCHER

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