

## 19126 Old and new science keep Notre Dame standing

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We can all celebrate that so much of Notre Dame cathedral seems to have survived after the disastrous fire last week. Much of the spectacular gothic architecture, including the 700-year-old flying buttresses on its east end, seem undamaged. And modern laser scans will help restorers keep it standing even longer.

The iconic landmark in Paris is one of the finest examples of Gothic architecture. It reaches for the heavens, with towers, spires, high arches supporting vaulted ceilings, and lots of tall window space to let the light shine through.

But building such a tall and graceful structure out of stone and masonry required innovative design all those hundreds of years ago. Stone is so heavy that stone walls are often built thick and low to support the weight. But the architectural triumph of the Gothic style was finding a way around that limit.

The solution to keeping the stone walls tall and thin was to support them on the outside by a series of buttresses, which are actually walls themselves that stick out at 90 degrees like wings along the side of the building. We don't know yet if the strength of the flying buttress design was a factor in keeping the main structure of the Cathedral from collapsing during the fire. But certainly time has proved the design.

The challenge now is to determine whether the walls have maintained their integrity and what needs to be done to keep them standing.

Fortunately, in 2010, art historian Andrew Tallon scanned the entire structure using a 3D laser system, producing a digital model of the cathedral involving one billion data points with a resolution down to less than a millimetre.

Tallon also took high-resolution photographs of the interior from the same position as the laser scanner, which can be superimposed on the digital points providing an incredibly realistic, three dimensional model of the cathedral as it actually stood.

When rendered in a computer, the building can be viewed from any angle and down to the finest detail. If another laser scan is done after the fire, the two can be compared to determine precisely how much the structure did or did not move.

Restoring Notre Dame back to its original glory will be an enormous task, blending modern science and engineering with the design of the original architects all those centuries ago.