

Geometry and the Sagrada Familia - A Client In No Hurry



Nothing quite prepares you for the first view of the Sagrada Familia. It is every bit as startling as the Grand Canyon. You emerge from the efficient Barcelona Metro system, turn around and there it is; this extraordinary concoction in stone and concrete, unlike any similar building you've ever seen. It is truly jaw-dropping. I saw a tourist emerge look up and stay frozen on the spot for several minutes taking it all in. I did much the same.

Pinnacles and towers soar to the sky to be surmounted by baskets of coloured fruit, nuts and vegetables. Although redolent in Christian symbolism, delicately carved scenes surround entrances, some with the finest of detail drawn from nature. A triumph of the stonemason's art. Beyond the overall concept, there is barely a straight or symmetrical figure in the whole construct, or so it seems. Its architecture is described as combining

Gothic and curvilinear Art Nouveau forms. Not surprising, it is a UNESCO world heritage site.

Painstaking Work

How do the builders, for this is work still in hand, manage to make progress on a site visited by millions of tourists (over 3 million in 2012)? When I was there in May they were painstakingly positioning a slab high above the nave, the operation controlled by a hydraulic levelling device between the tower crane and the slings attached to each corner of the slab. Inside the great nave the sound of drilling and hammering reverberates amid the ethereal sound of medieval music. This is seriously challenging work for the builders who, incidentally, have been at it on and off since 1882.

The design of this unique cathedral-like structure – Temple La Sagrada Familia to give its full title – was conceived by the Catalan architect Antoni Gaudi, whose works can also be found in many other buildings around his native city. But Gaudi was not the first to work on the project.

Initial designs were prepared by the diocesan architect Francesc de Paula Villar. He envisaged a conventional neo-Gothic cathedral with a dome climbing to 80 metres and a 100-metre tower above the entrance. Villar resigned a year later and the management of the project was given to Antoni Gaudi. Gradually, as he gained the confidence of the promoters, he changed the design to the radical structure we see today. He spent 43 years working on the project, exclusively for the last 12 of his life.

Nature's Influence

Gaudi's designs were inspired by nature where curves flow naturally, there is a feeling of movement, and form defies Cartesian geometry. The archetypal main pillars of the nave are a radical departure from traditional forms. They begin as square in plan, transform to octagons, 16 and 32-sided polygons as they flow upwards becoming circles as they near their apex, all the while twisting. The final appearance of the pillars resemble trees with branches running along the ceiling. Below, creatures hold two of the pillars up, one by a turtle and the other by a tortoise – representing respectively the earth and the sea.

This is a nightmare, or so it seems, to define as geometry for the builders. But Gaudi developed his ideas over many years and although challenging to build all of these features are geometrically defined. In the Sagrada Familia he created what has become a new architecture, which endures today through the works of others.

Walker Inspiration

So how have the builders fared working from models, drawings and sketches made almost a century ago? Gaudi left highly detailed models and drawings of key features with carefully drawn ellipsoidal geometry. His paraboloids and hyperboloids help to define the great inclined columns, vaulting and other structural elements. To achieve greater stability and a slender harmonious effect, Gaudí designed all the branching columns as a double-twist formed by two helicoidal columns. The base of each column has a cross-section as a polygon or star which then twists to the right and left transforming into a circle as it rises. Gaudi was once asked why he designed the columns on an incline. "For the same reason that the weary walker, when he stops props himself up with the walking stick at an angle, since in the upright position he would find no rest".

Proportions and Ratios

Gaudi's architecture relied on a system of proportions to be applied to all the dimensions of all parts of the Sagrada Familia. He repeatedly used simple ratios based on twelfths of the largest dimension, as in 1 to $\frac{1}{2}$, 1 to $\frac{1}{3}$... , 1 to $\frac{1}{4}$... etc. to provide proportions for the width,

length and height of every part of the temple. For example; dividing the total length of the temple (90 metres) by 12 gives us a module of 7.5 metres, which is used in the design of the floor plan and the heights of the cathedral.

The construction site according to www.sagradafamilia.org, is one of the largest testing grounds for construction methods in the world. Many structural elements are in reinforced concrete, the more delicate ones formed under workshop conditions. Today stone cutting is done by computer control and CAD guides the builders. But there is much work still to do if the current completion date of 2026 (the centenary of Gaudi's death) is to be achieved, not the least of which is the erection of the great tower which will rise 170 metres above the 17 other towers, each commemorating key biblical characters decorate the fantastical façades. Sculptures of biblical figures are by J. Busquets, Etsuro Sotoo and the controversial Josep Subirachs whose angular style contrasts strongly with Gaudi's architecture.

Why has it taken so long to build? Medieval cathedrals were always work in progress. York Minster's principal layout and design spanned well over 200 years and continues to evolve today. Questioned on how long construction might take, Gaudi is reported to have said, "My client is not in a hurry". Alas the works of man intervened. He perished long before the cathedral was even half built, the victim of a tram accident. His tomb is in the crypt of his life's work.

End Piece

This brief article can only hint at Gaudi's genius. You must visit the great temple itself to understand one of humanity's crowning achievements. If you visit no other great heritage site in the world the Sagrada Familia has to be the truly standout of those built by man.

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