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ANTONI GAUDI: NATURE & GEOMETRY

by

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ABSTRACT

ANTONI GAUDÍ: NATURE & GEOMETRY

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Antoni Gaudí believed that architecture is the fusion of nature and geometry. He had the power to unite form and structure and he continued to achieve this in his work which made it hold a special place in the history of Barcelona's architecture. He is known for his work to have changed the way architecture was approached. Although many hated his work at first, it was after his death that they realized how he has the power to unite nature and geometry. To further understand his legacy, a collection, and analysis of books, journals, and scholarly material was undertaken. The study's significance lies in understanding Gaudí's design process, his impact on Barcelona's architecture, and how he has influenced architects worldwide. His legacy continues as the Sagrada Família is under construction which forever changed Barcelona's architecture.

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CHAPTER 1

EARLY LIFE OF ANTONI GAUDI

1.1 Childhood

Antoni Gaudí i Cornet was born in Reus, a small town in Catalonia, Spain on June 25, 1852. He was the youngest of five children born to Francesc Gaudí i Serra and Antonia Cornet i Bertran. His father, Francesc, was a coppersmith, and his mother, Antonia, came from a family of blacksmiths (Lahuerta, 2003). As a child, Gaudi was known to be shy and introverted; however, he was always curious and observant and had a deep love of nature. His upbringing, education, and environment all played a significant role in shaping his architectural style and approach.

Gaudí spent a lot of time outdoors exploring the countryside around Reus. He would often collect plants, insects, and other specimens to study because he was fascinated with the natural world. Gaudí's capacity for observation was a result of his rheumatic fever, which prevented him from playing with his friends. He spent a lot of his time observing nature. This love of nature would later influence his architectural



Figure 1.1: Portrait of Gaudí (Heritage Images)

styles, which incorporated organic shapes, natural materials, and motifs inspired by plants and animals (Roe, 2006).

Gaudí also showed a talent for drawing and mathematics from a young age. He was enrolled in a local school in Reus, where he excelled in these subjects. However, he struggled in subjects like language and literature. Due to his academic challenges, his father had hoped that Gaudí would follow in his footsteps and become a coppersmith. However, Gaudí's interest in drawing and design eventually led him to pursue a career in architecture (Collin, 1960).

1.2 Education

In 1868, when Gaudí was 16 years old, he moved to Barcelona to study art at the School of Fine Arts. He spent four years at the school, studying a wide range of subjects and disciplines including drawings, painting, sculpture, and architecture. He developed a strong interest in the Gothic¹ style of architecture (Lahuerta, 2003).

Gaudí then enrolled at the Escuela Técnica Superior de Arquitectura (Barcelona Architecture School) in 1873. He initially struggled with some of his coursework and was often criticized by his professors for his unconventional ideas. During his time at the school, he was exposed to a variety of architectural styles and ideas, which later influenced his work. He was involved with a group of artists who were pushing for new artistic and cultural movements in Barcelona which shaped Gaudí's work. He was particularly interested in the Gothic and Moorish² styles of architecture, as well as the work of contemporary architecture (Roe, 2006). Gaudí's studies were interrupted in 1876 when he

¹ A type of architecture popular in Europe from the 12th to 16th century that features pointed arches, ribbed vaults, and flying buttresses.

² A type of architecture that originated in the Muslim territories of the Iberian Peninsula characterized using horseshoe arches, intricate geometric patterns, and the ornate use of tiles.

was drafted into the Spanish army. He served for a year and then returned to school to complete his degree. He graduated in 1878 with a degree in architecture.

CHAPTER 2

DESIGN PROCESS

Gaudí was known for his unique and innovative designs that combine nature, art, and spirituality. His design process was deeply personal and intuitive, and he relied heavily on his imagination and artistic vision to create his iconic buildings as “they emerged instead as a reaction to experience and to life. i.e., to the relationship between beauty and necessity” (Sterner,1985). His designs were also shaped by his love of nature and his fascination with the principles of geometry, which allowed him to create buildings that were not only aesthetically stunning but also functionally efficient and sustainable. Throughout his career, Gaudí drew inspiration from the natural world and the principles of geometry, which he used as a means of achieving harmony and balance in his designs. By incorporating these elements into his work, Gaudí was able to create buildings that were both meaningful and visually striking.

2.1 Drawing and Sketching Process

Gaudí’s unique approach to architecture and design was heavily influenced by his use of nature and geometry. Gaudí was able to explore and refine his ideas through sketching and drawing, ultimately bringing them to life in his buildings and structures. One of the key features of Gaudí’s drawings is the use of natural forms and patterns. He often incorporated elements such as plants and animals that he observed in the natural world (Figure 2.1). These natural forms became integral in his designs, as he sought to create buildings that were in harmony with their surroundings. His drawings also reveal his

interest in geometry and mathematics. He was fascinated by using geometric forms in ancient architecture and sought to incorporate these elements into his work. He used geometry not only as a tool for creating structural integrity but also as a means of creating beauty and visual interests (Lahuerta, 2003).



Figure 2.1: Sketch of Goat's Head by Antoni Gaudí (Digital Memory of Catalonia)

In addition to his drawings, *The Drawings of Antonio Gaudí* by George R. Collins provides insight into Gaudí's manner of work. Gaudí was known for his attention to detail and his willingness to immerse himself in every aspect of a project from the overall design to the intricate details. He often worked collaboratively with craftsmen and artisans, incorporating their expertise into his designs. His manner of work was characterized by his commitment to experimentation and his willingness to take risks. He was not bound by traditional design conventions and sought to push the boundaries of what was possible in architecture and design. This approach allowed him to create some of the most iconic buildings in the world, such as the Sagrada Família and Park Güell.

2.2 Inspiration from Nature

Gaudí's deep appreciation for nature was a driving force behind his architectural designs with a vision circled around beauty and functionality. He was particularly interested in the way that nature has evolved over millions of years to create structures that were both efficient and resilient. His designs were heavily influenced by the organic shapes and forms found in nature, such as curved lines of leaves, the spirals of seashells, and the branching structure of trees. He did this by observing and studying the natural world. He was able to gain insights into how he could create buildings that were not only aesthetically pleasing but also structurally sound.



Figure 2.2: Columns Inside La Sagrada Família That Look Like the Canopy of Trees (Fatimah, 2022)

La Sagrada Família is a key example of how Gaudí uses nature in his building's design. The cathedral is full of organic forms and shapes that were inspired by the natural world. Walking through the cathedral, I noticed how the columns inside the church resemble trees, with branching columns that support the weight of the ceiling like the branches of a tree support its canopy as seen in Figure 2.2. Gaudí also incorporated a variety of natural motifs into the design, including plants, animals, and shells, which can be seen in the intricate details of the façade and interior (Lahuerta, 2003). In addition to these organic shapes and motifs, Gaudí also used natural light as a key element in the design of La Sagrada Família. He believed that light was essential to creating a sense of spiritual awe and wonder, and he wanted the light inside the church to evoke the feeling of being in a forest glade. To achieve this effect, Gaudí designed the windows to filter light in a way that mimics the dappled light of a forest, creating a serene atmosphere.



Figure 2.3: Casa Batlló Façade (Fatimah, 2022)

Another key example is Casa Batlló in Barcelona where Gaudí incorporated natural forms and shapes into his designs. The roof is shaped like the back of a dragon, with the tiles mimicking the shimmering scales of a reptile (Nonell & Levick, 2000). The tiles themselves are made of overlapping ceramic pieces, arranged in a way that created a three-dimensional effect, giving the roof the appearance of dragon scales. He was inspired by the legend of Saint George, the patron saint of Catalonia, who was said to have slain a dragon. He saw the roof of Casa Batlló as a tribute to the legend, with the house itself serving as a metaphor for the dragon. The roof was just one of the many elements of the building that Gaudí designed to be evocative of the natural world. When I first approached the building, I immediately noticed how the façade of the building is full of organic shapes and forms,

such as the curving balconies that resemble the waves of the sea. I was amazed by how Gaudí incorporated a variety of techniques into the design, such as shells, flowers, and other plant forms (Figure 2.3).

Gaudí understood that nature had evolved over millions of years to create structures that were both efficient and resilient. By incorporating natural forms and shapes into his designs, Gaudí was able to create buildings not only beautiful but also structurally sound. His deep understanding of nature was truly a driving force behind his architectural designs.

2.3 Incorporation of Geometry

In addition to his use of natural forms, Gaudí also incorporated geometric principles in his designs. He believed that geometry was a fundamental part of nature and that by using geometric shapes and patterns in his buildings, he could create harmonious and balanced structures. However, his use of geometry was not limited to purely aesthetic considerations. He understood that geometry was also essential to create structurally sound buildings. It can be seen in the intricate mosaics and colorful tiles that adorn his buildings, as well as in the mathematical precision of his structural designs. He was particularly fascinated with the geometry of circles and hyperboles³, and he used these shapes extensively in his designs. It was evident in many of his designs, from the hyperbolic paraboloid roof of Casa Milà (Figure 2.4) to the intricate tessellations of the tiles in Park Güell.

³ A type of conic section that is defined as the set of all points in a plane such that the difference of the distances between the point and two fixed points is a constant.

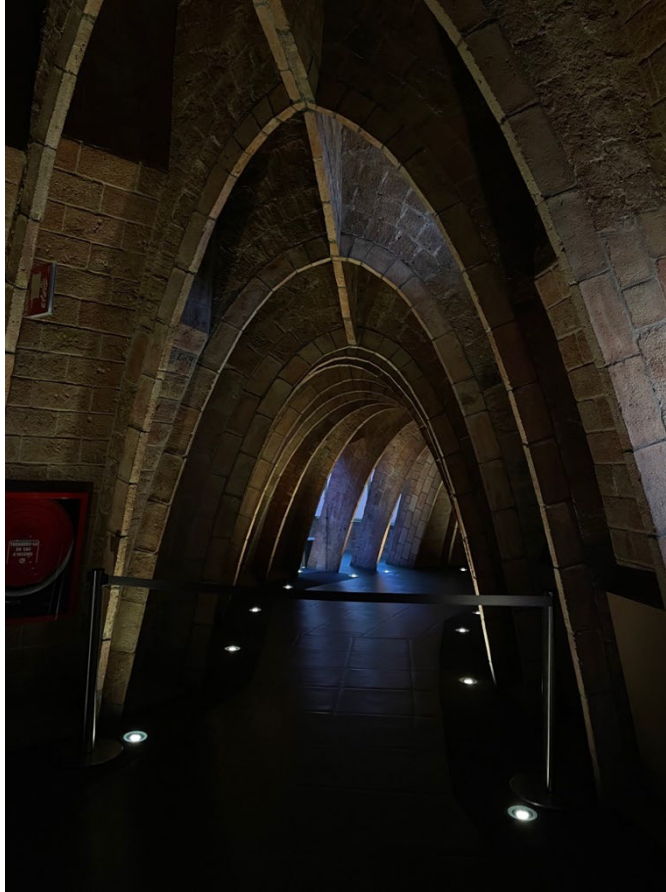


Figure 2.4: Hyperbolic Paraboloid Roof in Casa Milà (Fatimah, 2022)

One notable example is Casa Milà, where Gaudí employed hyperbolic paraboloid roofs. These curved, undulating surfaces allowed him to create a self-supporting structure without the need for columns or other supporting elements. These surfaces were constructed using a system of brick arches that supported thin layers of concrete, which were then covered with ceramic tiles. This resulted in a roof that was not only appealing but also incredibly strong and durable. In addition to its structural benefits, the hyperbolic paraboloid roof also allowed for natural light and ventilation to enter the building. The undulating surfaces created a series of skylights and air vents that helped to reduce the need for artificial lighting and air conditioning (Collins, 1963). The use of geometry was not

only limited to the roof, but the building's façade also features a series of curved lines and intricate patterns that are based on mathematical principles (Figure 2.5).



Figure 2.5: Façade of Casa Milà (Fatimah, 2022)

Another noteworthy example is Park Güell where Gaudí uses various geometric shapes and forms to create a unique landscape design. Throughout the park, Gaudí incorporated numerous mosaics and sculptures featuring geometric shapes, such as circles, squares, and triangles. I remember sitting on one of the undulating benches that line the park's main terrace which is designed using a series of overlapping circles and ovals, creating a fluid and dynamic form (Figure 2.6). I noticed the use of a series of small triangular cutouts that added visual interest and created a play of light and shadow. One of

the park's most iconic features is the dragon sculpture fountain located at the entrance, which is designed using a combination of geometric shapes and organic forms (Cirlot, 2012). The dragon's body is made up of a series of brightly colored ceramic tiles arranged in a mosaic pattern, while its scales are created using a series of small, triangular ceramic pieces. The dragon's body is designed in a twisting and curving shape, creating a sense of movement and dynamism.



Figure 2.6: Benches in Park Güell (Fatimah, 2022)

Gaudí's use of geometry was not just limited to the shapes of the buildings. He also used mathematical principles to create a sense of harmony and balance in his designs. He used the golden ratio, a mathematical proportion that is found throughout the natural world, to create satisfying proportions in his buildings. By using mathematical principles and geometric shapes in his designs, Gaudí was able to create buildings that were both

picturesque and practical, taking advantage of the efficiency and stability found in geometric forms.

2.4 Intersection of Nature and Geometry

The most striking example of the intersection of nature and geometry is Park Güell in Barcelona. The park is characterized by its winding pathways, elaborate sculptures, and intricate mosaics. The design is based on the natural forms of the landscape, with the addition of geometric patterns and shapes that enhances the overall aesthetic.

In the case of Park Güell, the design of the park is based on the natural forms of the landscape on site. Gaudí used the undulating hills and valleys of the site to create a series of terraces, each with its unique character and purpose (Collins, 1960). He used natural stone and local materials to build walls, columns, and other structural elements that blend seamlessly with the surrounding environment.

Gaudí added geometric patterns and shapes to the design to bring nature and geometry together. The park's winding pathways are lined with colorful mosaics that feature intricate geometric patterns. The columns and arches that support the park's structures are decorated with ornate sculptures and carvings that incorporate symmetrical shapes and patterns (Figure 2.7).



Figure 2.7: Columns in Park Güell (Fatimah, 2022)

Gaudí's use of nature and geometry in Park Güell created a design that was not only visually stunning but also highly functional. The terraces and pathways were carefully designed to provide visitors with different views of the park and to accommodate the flow of pedestrian traffic. The use of natural materials and forms help to create a sense of stability and calmness within the park, while the addition of geometric patterns and shapes added interaction and complexity to the design. Gaudí's integration of nature and geometry in his designs was a groundbreaking approach that forever changed Barcelona.

CHAPTER 3

IMPACT ON BARCELONA

Gaudí is considered one of the most important figures in the history of architecture, and his impact on the city of Barcelona cannot be overstated. Through his use of nature and geometry, Gaudí created a unique and distinctive style that has become synonymous with the city.

The most visible example of Gaudí's impact on Barcelona is the Sagrada Família. The massive basilica, which has been under construction since 1882, is one of the most recognizable landmarks in the city. Its towering spires and intricate facades are a testament to Gaudí's vision and creativity and draw millions of visitors to Barcelona. But Gaudí's impact on the city goes beyond just the Sagrada Família. His influence can be seen throughout Barcelona, from the colorful mosaics and whimsical sculptures of Park Güell to the undulation roof of the Casa Milà (Figure 3.1). Gaudí's use of natural forms and geometric patterns has become a defining characteristic of Barcelona's architecture and has helped shape the city's identity (Busquets & Giovannoni, 2012).

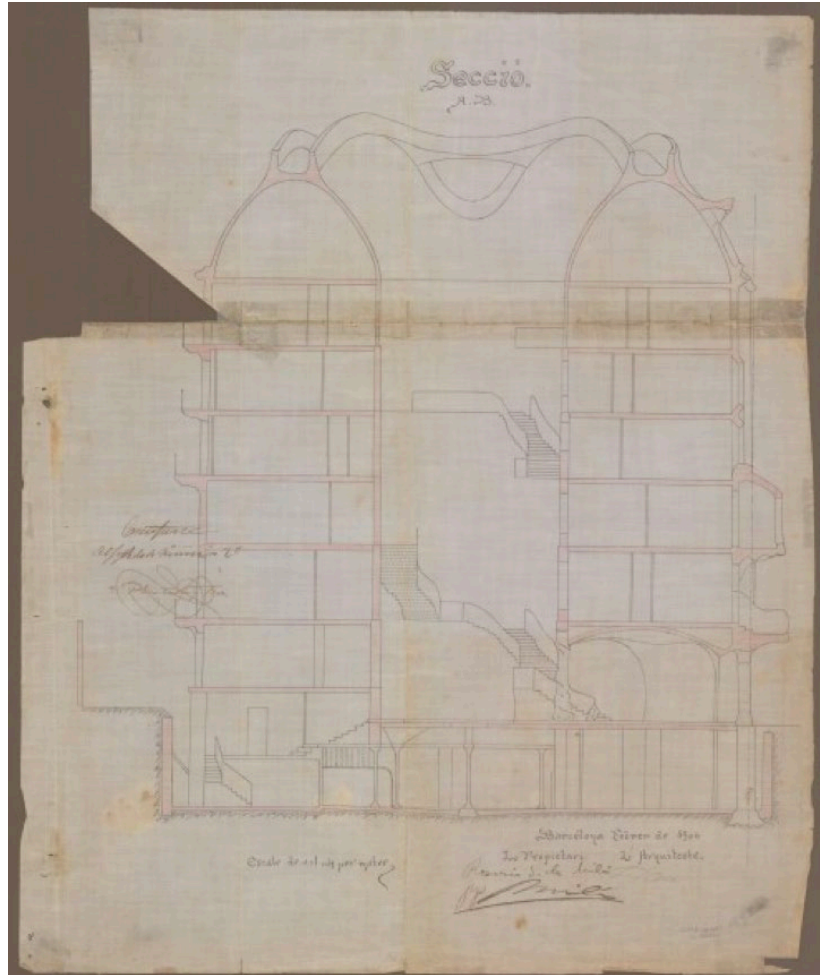


Figure 3.1: Section of Casa Milà by Gaudí Showing Undulating Roof (Digital Memory of Catalonia)

Gaudí's architecture also had a significant impact on the city's economy. The popularity of his designs, particularly the Sagrada Família, which is an unfinished Catholic church, has drawn millions of tourists to the city over the years, generating significant revenue for the city's hospitality and tourism industries. According to the Barcelona City Counsel, the city welcomed more than 32 million visitors in 2019, making it one of the most popular tourist destinations in the world. Many of these visitors come specifically to see Gaudí's works, especially the Sagrada Família, Park Güell, and Casa Batlló. The Sagrada Família church construction project has been ongoing for more than a century and

has created jobs and driven economic growth in the city (Figure 3.2). In recent years, construction has also helped drive innovation in construction techniques and materials, with architects and engineers working to create new ways to build complex structures.



Figure 3.2: Sagrada Família Under Construction (Fatimah, 2022)

Beyond his economic and architectural impact, Gaudí's influence on Barcelona has helped shape the city's cultural identity. Gaudí's designs have become an essential part of the city's heritage and identity, representing the innovative and creative spirit of the Catalan people. The incorporation of organic forms and natural motifs in his design has become a defining characteristic of Barcelona's architecture which also enabled a sense of cultural and economic identity. His use of color, light, and space has also impacted

aesthetics, inspiring generations of architects and designers. Gaudí's work has also helped to celebrate the city's cultural diversity and history. His designs reflect a deep appreciation for the city's Catalan identity, incorporating local materials and traditional techniques into his buildings. At the same time, his work also incorporates elements of the broader European artistic movements of his time. Moreover, Gaudí's works have become a source of pride for the people of Barcelona. His architecture has come to symbolize the city's independent spirit and creative energy and has become a defining feature of the city's cultural identity.

Antoni Gaudí's impact on Barcelona cannot be overstated. Through his use of nature and geometry, he created a unique and distinctive architectural style that has become an integral part of the city's identity. It has helped to establish Barcelona as one of the most vibrant and creative cities in the world. Gaudí's legacy continues to inspire architects and designers around the world and his impact on Barcelona will be felt for generations to come.

CHAPTER 4

IMPACT ON ARCHITECTURE

Gaudí's innovative use of nature and geometry in his designs has had a significant impact on architects and designers around the world. His unique style, which blends organic forms and natural motifs with geometric shapes, has inspired generations of designers to push the boundaries of traditional architectural styles. It has inspired countless designers to explore new ways of incorporating organic forms and patterns into their work.

One of the most notable ways that Gaudí's work has influenced architects and designers is through biomimicry⁴. Gaudí's designs were heavily influenced by the natural world, and he often used organic forms and shapes in his buildings (Benyus, 1997). His use of biomimicry was also ahead of its time in terms of sustainability. Many architects and designers today continue to draw inspiration from nature, seeking to replicate the efficiency, sustainability, and beauty of natural forms in their designs. For example, some architects have looked to the structure of bones or shells for inspiration, incorporating similar structural patterns into their buildings to create stronger, more efficient structures. Others have looked to the patterns found in nature such as fractals of the Fibonacci sequence⁵, to create more aesthetically pleasing designs.

⁴ It involves studying and imitating natural systems and processes to create products, technologies, and designs that are more efficient, resilient, and environmentally friendly.

⁵ A mathematical sequence of numbers in which each number is the sum of two preceding numbers, starting from 0.

One architect who was particularly influenced by Gaudí’s work is Frank Gehry. Gehry, a Canadian American architect, is known for his iconic buildings that feature sculptural forms and dynamic curves. His work is heavily influenced by Gaudí’s use of organic forms and shapes, which he had adapted and expanded upon his designs. One of Gehry’s famous works is “Peix d’Or” sculpture, located in Barcelona (Figure 4.1). The sculpture, which is Catalan for “Golden Fish,” is a massive steel structure that sits on the waterfront in the Port Olympic area of Barcelona. The undulating curves and abstract forms are reminiscent of Gaudí’s use of organic shapes and patterns. Gehry’s interest in biomimicry is seen as evident in the sculpture’s design, as it mimics the movement and fluidity of a fish in the water (Co and Foster, 1998). Like Gaudí, Gehry’s work blurs the boundaries between art and architecture, creating structures that are not only functional but also visually striking. The Peix d’Or is a testament to the continued influence of Gaudí’s approach to design, as Gehry has adapted and expanded upon his use of nature and geometry to create a new and innovative work of art.



Figure 4.1: Peix d’Or by Frank Gehry (Zoonar/Vladyslav Danilin)

In addition to his influence on modern architecture, Gaudí's work has also had a significant impact on the field of design. His use of organic forms and natural motifs has inspired designers across a range of disciplines, including product design, fashion, and graphic design. Gaudí's emphasis on creating beautiful and functional designs influenced designers to prioritize usability and sustainability in their work.

Gaudí's impact on architects and designs has been significant and far-reaching. His innovative use of nature and geometry in his designs has inspired generations to push the boundaries of traditional architectural styles and explore new ways to create beautiful and functional buildings. Gaudí's emphasis on biomimicry, color and light, and the relationship between form and function has had a lasting impact on modern architecture and design in which his legacy continues to inspire designers to this day.

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BIOGRAPHICAL INFORMATION

Sana Ashfaq Fatimah is a fourth-year Honors College student at The University of Texas at Arlington pursuing a Bachelor of Science in Architecture with a minor in Business Administration. She is graduating Magna Cum Laude in May 2023 before heading to graduate school. While at UTA, Sana has been involved on campus through various student organizations and programs, including serving as an Orientation leader, a UTA Ambassador, and a CAMP mentor. Sana has already gained valuable experience through her current internship at Parkway Construction & Architecture where she has contributed to projects all over the United States. She is deeply interested in the intersection of culture and history in architecture and plans to explore this area of focus in her future studies. She plans to continue her education by obtaining a master's degree in Architecture and eventually becoming a licensed architect.