

Robert Grier

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## The Geometry of Renaissance Architecture

Of all the remnants left behind by past cultures, structures are perhaps the most durable and telling. Architecture, imbedded with the practical and spiritual needs of its designers, is a window into the intellectual landscape of its time. The eclectic art form combines mathematics, design, and other concepts, and is a perfect illustration of the eclectic geniuses of the Renaissance. The Renaissance thinkers, dabbling into every field of artistic expression, mathematics, and even philosophy, entrenched their intellectual complexity into the earth through architecture. From their discovery and understanding of the harmonious ratios of Pythagoras, to their respect for the humble Platonic solids, Renaissance architects capitalized on ancient mathematical influences through revolutionary construction techniques. The designs are infused with secretive, geometrically spiritual significance, along with the not-so-subtle invocation of classical thinking, and influenced humanity's conceptions about architecture for the rest of time.

Most tales of Renaissance architecture begin in the Italian city of Florence. More specifically, Filippo Brunelleschi's (1377-1446) Cathedral Dome is the earliest of the iconic Renaissance structures. Referred to as the Florentine Duomo, it is considered a masterpiece of engineering. The design, a one hundred and thirty-eight-foot diameter octagonal dome of masonry, is reminiscent of Roman and Gothic forms. The ambition of it, however, was unprecedented. Filippo Brunelleschi began his career as a sculptor, but he produced nothing of significance in the eyes of art historians, until his remarkable feat of the Florentine Cathedral

Dome. Fascinatingly, he designed each stage of the construction to support the next to build a geometric structure that no one thought was possible. The octagonal monstrosity spreads the weight evenly, and amazingly, across each of its sides. The Cathedral's structural beauty is enhanced by the architects use of repeated, harmonious ratios and patterns. A rectangular motif is repeated across the entire Cathedral, leaving room for massive, circular windows. Classical elements like Greek columns and an oculus, which is an ancient Roman motif of a small, circular opening on the top of a dome, are included in the design. The proportions exhibit a perfection which accurately represents the nature of Renaissance architecture. The building's coloration and triangular roof blend in to the surrounding, homogenous buildings of Florence. Still, no other building in the city comes close the Cathedral's scale. The Dome alone towers above all else as a monument to the geometric perfection of classical design.

Filippo Brunelleschi went on to produce several other historical buildings after the Cathedral Dome. The excellence of the Florentine Duomo won him several important commissions, but he was not the sole architectural genius of the Renaissance. Although Brunelleschi's work, especially the Florentine Cathedral Dome, ignited the creativity of architects during this era, Leon Battista Alberti is considered the father of Renaissance architecture. A student of art, mathematics, and everything in between, Alberti was a true Renaissance man. He is remembered for his proportional aspirations in art and architecture. To a humanist like Alberti, a structure was an equation and its beauty was mathematical. It is hard to ignore the perfect symmetry of his work, along with the classical, geometric forms he calls upon for decoration. As an artist, Alberti understood geometric perspective, which he incorporated into the philosophy behind his designs. Because he was also a writer, he documented his ideas about proportion and his philosophy of construction. These ideas influenced Renaissance

architects and set the tone for modern architecture. Thanks to Alberti, Renaissance buildings use geometry for practical and aesthetic purposes, reflecting the humanist values of the time. To him, what made the form of a building brilliant was not aesthetic or structure alone. He believed in the interwoven excellence of beauty and practicality, where the strength of the walls is what makes them perfect, and the artistic value of a building supports its structure.

One of the Renaissance architects who was influenced by Alberti was Andrea Palladio. Palladio is known for having geometric clarity in his buildings. In other words, the geometric forms he uses are pleasantly distinguishable. Despite being meshed together, the basic shapes of his architecture are unmanipulated and obvious. More subtly, Palladio implemented whole number measurements and meaningful ratios into his designs. He was heavily influenced by the ancient mathematician Pythagoras, who derived certain ratios from musical harmonies. These ideas of geometric perfection define Palladio and the rest of the Renaissance architects. Palladio's most famous structure, Villa Rotonda, is the embodiment of these principles. The Villa is comprised of three main geometric forms. The outer, encompassing square is perfect and dressed on all four, identical sides with columnated terraces and staircases. The inner square is equally perfect and scaled down with harmonic precision. A circle, inscribed within the inner square, holds up the building's signature dome, and creates an interior space worthy of the gods. The structure, however, was not built for the gods, it was built for man. The countryside mansion hijacks the divine, mysterious, undefinable central circle and entraps it within the rigid walls of reason and mortality. Along with the enchanting use of shapes in the Villa Rotonda, it is given philosophical meaning through geography. Each side of the square structure faces in each cardinal direction perfectly. The Villa is positioned precisely in alignment with the Earth. Perhaps the architect intended for the central, round space to act as the center of the universe, only to be

inhabited by man. This perfectly describes the tone of Renaissance architecture, which aspires to embody the humanist values of the era.

Despite the culture's fascination with objective mathematics and individuality, religion maintained an unrivaled authority across Europe. The Church was, in fact, the primary recruiter and commissioner of the famous Renaissance artists and thinkers. The most famous Church-owned building of the Renaissance, and perhaps of all time, is the Papal Basilica of St. Peter in the Vatican. Built by a handful of architects, most notably Michelangelo, the church is truly a monument to the Roman Catholic Church's power. The design is outstandingly Roman, with gigantic frontal columns and a central pediment. The top of the building is lined with statues, which are flanked by the building's massive dome. The dome extremely similar to Filippo Brunelleschi's Florence Cathedral Dome, smaller in diameter but greater in height. The central dome's inscription within the smaller to two squares is reflective of Palladio's architecture. The final plan for the building, however, elongates the outer square, morphing the building into a cruciform structure. Once again, the circular dome has been domesticated by straight, measured lines, this time in the shape of a cross. The Godly form is no longer unimaginable, but contained as an asset to the rigid institution. The details of the church are all carefully planned with geometry and perspective in mind. The windows are placed so that even the rays of light invading the basilica may be perfectly symmetrical. St. Peter's Basilica is crucially important because its geometry is mimicked by most churches.

The influence of Renaissance architecture was widespread, and the mathematical principles it was directed by were cemented into the science of architecture. The Renaissance thinkers and architects translated their classical philosophies into revolutionary structures. The simple Platonic solids and Pythagorean proportions became staples of architecture across Europe

and even in America. Filippo Brunelleschi and his Florentine Cathedral is the first example of classical ideas being brought to life through revolutionary feats of engineering. This combination of historical philosophy and contemporary mathematics was continued by Alberti, who understood the architectural relationship between aesthetic and strength thanks to his theories on art and perspective. Palladio, the most influential of the Renaissance architects, brought together the humanist values of Alberti with the harmonic ratios of Pythagoras. The greatest building of the Renaissance, St. Peter's Basilica, maintained these concepts and perfected them. Renaissance architecture was a battlefield of philosophy, religion, classicism, art, science, and mathematics that produced some of the most geometrically magnificent structures of all time.

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