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Alberti's Proportion Theory and San Sebastiano Church

Did you ever wonder every time you look at a twenty-five-cent coin, who was responsible for the pictorial image engraved on the surface? The answer would be Leon Battista Alberti, the notable Italian Architect who was born in 1404 in Genoa, Italy and later died in 1472 in Rome. When he was 31 years old, Alberti was credited with being the first to produce a self-portrait in the form of a medallion often used in royalty, notable medals, and in modern day, the coins used for money (Art Story, 2023). Alberti founded the agreed set of compositional rules of how to produce a pictorial perspective, which spread throughout Europe and America, and influenced sculpting and engraving even in today's modern world. However, engraving pictorial images on medallions was just a small piece of his numerous accomplishments. Alberti was best recognized for being a pioneer of Renaissance art theory.

Alberti, born as an illegitimate son to a Bolognese widow, was raised by his father who was affluent and belonged to a prosperous family of Merchant bankers. Being from a family of money, Alberti was fortunate to obtain excellent academic opportunities and became very versed in mathematics, business, humanities, and later an expert in Latin. Alberti (Fig. 1) is not only recognized as a notable architect, he is also recognized as a notable literary author and gifted literary stylist (Famous Architects, 2023). Alberti was revered as the founder of modern architecture and known as the "Universal Man". He was a "jack of many trades", who eventually gravitated to architecture combined with meaningful literary works and brought him notoriety because of his ability to produce treatises inspiring the next generations of architects, including today's.

Shortly after founding the pictorial image on the medallions, in 1438 Alberti indulged his studies and talents in the field of architecture and nearly ten years later, he was appointed the

Pope's architectural adviser. Alberti worked on remarkable Renaissance projects including the reconstruction of St. Peter's and the Vatican Palace (Famous Architects, 2023). Alberti was known for a number of significant architectural works including the Tempio Malatestiano, Palazzo Rucellai, Santa Maria Novella Basilica, San Sebastiano Church, Rucellai Sepulchre, and the Church of Sant'Andrea (Art Story, 2023). Alberti added beauty and balance to Roman arches and columns expanding their function beyond the structural aspect, inspiring the next level of aesthetics, influence, and antiquity in churches, palaces, and palazzos. Alberti brought special organization and orderly hierarchy; he raised the bar on decorative and ornamental features including arcades, arches, vaults and pilasters; he re-appropriated an ancient sense of classical order; and he laid the foundation for spatial homogeneity and proportions. Alberti founded the mathematical formula of architectural proportions and outlined this theory in his treatise, *De re aedificatoria* (Ten Books on Architecture). This analytical analysis evaluates Alberti's proportion theory as applied to one of Alberti's signature architectural works, the San Sebastiano Church (Fig. 2). The analysis compares reality verses theory and assesses the documented proportions of the constructed Church with Alberti's theory outlined in his treatise, *De re aedificatoria* (Ten Books on Architecture).

Alberti was greatly influenced by ancient Roman history and literature, and this is where he "began deriving his ideologies on the basis of the urbane, secular and rational perspectives that he discovered in his study of ancient Rome" (Famous Architects, 2023). Alberti drew inspiration from ancient civilizations and documented his ideas in several groundbreaking treatises having a profound and lasting effect on Early Renaissance art and architecture even inspiring the Renaissance artists Piero della Francesca and Leonardo da Vinci (Art Story, 2023). His three groundbreaking treatises include his first in 1435, *De pittura*; his second in 1452, *De re aedificatoria*; and his third in 1468, *De statua*. The three treatises were developed over a thirtyyear span and founded the core of the Florentine Renaissance with rules of scientific and mathematical balance, sparking a new generation of art and art theory (Art Story, 2023). Alberti's publication in 1452, *De re aedificatoria* (Ten Books on Architecture), won him the title of "Florentine Vitruvius" (Famous Architects, 2023).

Alberti emphasizes in his treatise that proportion provides "the successful combination of number, measure, and form" (Alberti, p. 424) and comes from *concinnitas*. Scholars have drawn attention to this term, *concinnitas*, when highlighting Alberti's approach to architecture. Alberti indicates the demands of proportion and *concinnitas* marries practical convenience with dignity and grace. He emphasizes *concinnitas* is the composition and connection of beauty, dividing beauty into three principles of number, outline, and position; and although each part is separate from each other, they correspond to one another in appearance (Alberti, 1988). Alberti states, "Beauty is a form of sympathy and consonance of the parts within a body, according to definite number, outline, and position, as dictated by *concinnitas,* the absolute and fundamental rule in Nature. This is the main object of the art of building, and the source of her dignity, charm, authority, and worth" (Alberti, p. 422). Basically, Alberti emphasizes beauty has a meaningful relationship to skillfully presenting proportions in a space.

Alberti linked the basis of proportions to the basis of the musical scale and highlighted, "the rules underlying proportion in the visual arts and music also permeated every day commercial life" (Alberti, p. 424). He connected aural and visual proportions to imitating nature and beauty. He established certain rules for numbers (ratios) of extremes and mean, and related their proportions to music, geometry, and arithmetic principles (Alberti, 1988). Alberti emphasized harmony of proportions should be achieved so "nothing may be added, taken way, or altered, but for the worse" (Alberti, p. 156) claiming that any systems of proportions are flexible and commensurate with each other expressing the creativity of the architect connecting their artistry to the body of work (*Unified Theory of Proportions*, NJIT).

The analytical paper, *Unified Theory of Proportions*, produced by New Jersey Institute of Technology (NJIT) tells us that Alberti's system of architecture uses a geometric sequence for replicating ratios, a complementary term to proportions. The analysis indicates Alberti bases his proportion theory on the ratios 2:1 and 3:1, which are based on the musical scale founded in ancient Greece by Timaeus of Plato. In fact, these pair of ratios created the ancient musical scale used by ancient Sumeria and ancient Greek Pythagoras. Alberti used ideas from ancient Greece and based his proportion theory from the works of 2nd century mathematician, Nicomachus. For example, the Nicomachus Table shown below reflect the following: rows have a ratio 2:1, the left edge a ratio 3:1, the left leaning diagonals a ratio 3:2, and the right leaning diagonals a ratio 4:3. As one evaluates the table even deeper, it also shows the arithmetic mean is the two numbers which flank it from above, e.g., 9 is the arithmetic mean of 6 and 12; the harmonic mean is the two numbers which flank it from below, e.g., 8 is the harmonic mean of 6 and 12; and the geometric mean is the two numbers which frame it along any diagonal, e.g., 12 is the geometric mean of 6 and 24 and also 8 and 18 and 9 and 16 (*Unified Theory of Proportions*, NJIT).

Table 1: Nicomachus Table

1	2	4	8	16	32				
	3	6	12	24	48				
			9	18	36	72			
					27	54	108		
							81	162	

The NJIT analytical paper describes how these proportions are related to music, such as, any pair of tones whose frequency ratio is a power of 2 are the same tone in a different octave and sounds alike to the ear. It describes placing a bridge at the 2/3 point up the string will give rise to the musical fifth, e.g. tone D will be five letters higher to A (DEFGA), or placing the bridge 3/4 point up the string will give rise to the musical fourth. In addition, the analysis even goes on to describe how the connection of the integers along the table's diagonal 16, 24, 36, 54, 81 relates to the pentatonic scale used to create much of the folk music in the world. Interestingly, this same pentatonic scale was used for the architectural portions of the Parthenon in Greece, noting its height is 16 modules, the width and length to the inner temple are 24 and 54 modules, and the width and length to the stylobate are 36 and 81 modules. Similarly, the paper goes on to also describe how Alberti used the proportions of music including the octave 2:1; the musical fifth 3:2, and the musical fourth 4:3, and used the hexagon of integers surrounding a number in the Nicomachus Table and apply it to his architectural works including the San Sebastiano Church located in Mantua, Italy (*Unified Theory of Proportions*, NJIT).

The ironic thing about the San Sebastiano Church is, it is probably one of the ugliest buildings constructed in Italy during the 15th century, perhaps because Alberti died prior to the completion. Alberti was the original architect, while another architect, Luca Fancelli completed his work. Ludovico III Gonzaga, the Marquis of Mantua, was responsible for the commissioning of the construction of the church which began with Alberti in 1460 and was finally completed in the early sixteenth century in 1529, fifty plus years after Alberti's death. Subsequently, the modest Church went through its first restoration in the early 17^{th} century, another in the early 20^{th} century, and with plaster falling from the walls, the Church was closed to the public in the late 20^{th} century (Lamoureux, 1975).

San Sebastiano Church is located on the outer edges of Mantua, Italy in a more rustic setting. The two-level church is Greek-cross shaped with three identical short apses under a central cross vaulted space with no interior partitions. The lower level is accessed by three doorways to an area referred to as the crypt, which is large, dark and filled with piers providing the structures primary support. The crypt was originally intended to be a mausoleum for the Gonzaga family. The upper level is accessed by two separate flights of stairs, which flank the three arched doorway openings to the crypt and the three-square openings to the second level. The stairways lead to the narthex, or a porch located along the entire façade of the second level providing access to the church's main three openings (Lamoureux, 1975).

The solemn building, with its unusual two-level façade, appears to have been altered from the intent of Alberti's original design as demonstrated in Fig. 3. Alberti's design of the façade, although simple, had much more character including decorative and ornamental features to that of which was actually constructed. The concern from scholars has been if Alberti's design of the façade was changed, what changes may have occurred in the main structure itself including the size, length, width, and shape defining its proportions. There seems to be a number of scholars who have researched this theory including Ferrari and Medici of the University of Ferrara in Italy. They describe the initiative of analyzing the geometric works of Alberti's architecture using various data capturing techniques including 3D laser scanning, topographic scans, and photographic surveys, to provide a complex volumetric survey of Alberti's structures (Fig. 4). Ferrari and Medici notes that the technological evolution for capturing 3D data in high definition has been essential in producing a reconstructive analysis of the San Sebastiano Church (Ferrari and Medici, 2017).

Ferrari and Medici point out because the San Sebastiano Church was finished by another architect, there are some differences when comparing the two designs, most notable the addition of the crypt, the removal of the dome, and the placement of a double gable on the façade. However, Ferrari and Medici's results show Alberti's focus on proportions citing the height of the chapel is twice the size of the narthex (33-1/2 to 16-2/3) and the façade with the main body has a 1:2 ratio, just as Alberti emphasized in Book Seven: Ornament to Sacred Buildings in his treatise, *On the Art of Building in Ten Books*. Alberti tells us in Book Seven that a "basilica ought to have a plan with a length twice its width" (Alberti, p. 232). Ferrari and Medici conclude that Alberti's design established a 3:5 rule. For example, the distance between the columns in the crypt equals 5 fathoms to the height 8-1/3 fathoms, therefore, equaling a ratio of 3:5. Ferrari and Medici also determined that there was a 4:5 rule developed from the average proportion of 3:5, or (3+5)/2 = 4. Ferrari and Medici surveyed the heights of the internal spaces and compared their proportions producing a 3:5 or 4:5 ratio. For example, Alberti's height of the chapels compared with the height of the narthex is 16-2/3: 27-1/2 having a 3:5 ratio. The tables below verify the height of the crypt has a ratio of 3:5 to the tribuna, which is 4:5 to the narthex, which is 3:5 to the chapels, which is 4:5 to the exterior vault, and subsequently, 3:5 to the inner vault, as shown below. Ferrari and Medici verify Alberti's unique use of ratios through a comparative analysis of heights gathered for the predominant internal spaces and confirm "Alberti was searching for his *concinnitas* through the proportion" (2017, p. 292).

Measurement	Heights in Mantuan fathoms
Internal crypt	$8_{1/3}$
Internal tribuna	$13_{1/3}$
Inner narthex	$16_{2/3}$
Internal chapels	$27_{2/3}$
Extrados inner frame above vaults	$34_{1/2}$
Inside of the vault of the central square	46

Table 4. Heights measurement in San Sebastiano

Heights	Ratio
$8_{1/3}$: $13_{1/3}$	3:5
$13_{1/3}$: $16_{2/3}$	4:5
$16_{2/3}$: $27_{2/3}$	3:5
$27_{2/3}$: $34_{1/2}$	4:5
$34_{1/2}$: 46	3:5

Table 5. Heights ratio verification

Source: Ferrari and Medici, 2017, p. 292.

Alberti's iconic Renaissance Style Architectural pieces of work have established him as one of architecture's great practitioners. With knowledge in overlapping fields like science and classical languages, Alberti gravitated to mathematical principles and rational order. Alberti's precision regarding beauty was mathematically inspiring because he divided beauty into three components numerically, harmonically, and geometrically igniting the importance of proportions in architectural works. Alberti based his proportion theory on the ratios 2:1 and 3:1 using the musical scale founded in ancient Greece by Timaeus of Plato and the Nicomachus Table produced by the 2nd century mathematician. Alberti believed proportions of combined spaces should have harmony, similar to that of music having deep, intermediate, and low voices, and when all combined ring out in harmony producing a balance of proportions increasing the pleasure to the ear of an audience. Alberti urges architects to use this same notion when designing structures. Alberti's proportion theory provides a relationship to the three dimensions to create harmony by producing a successful combination of number, measure, and form, known as *concinnitas*. Alberti's philosophy was that everything nature produces is regulated by the law of *concinnitas* and notes its importance in decisions made when determining the arrangement of a building. Alberti used this theory in many of his architectural works including the San Sebastiano Church that scholars have verified the measurements using modern technology such as advanced 3-D high resolution imagery to conclude the church completed 50 years after his death was built consistent with Alberti's *concinnitas* supporting his use of proportions. Leon Battista Alberti's signature designs still stand today as timeless monuments to his architectural vision.

Figure 1: Leon Battista Alberti, Famous Architects.

Figure 2: Church of San Sebastiano, Italyscapes.com

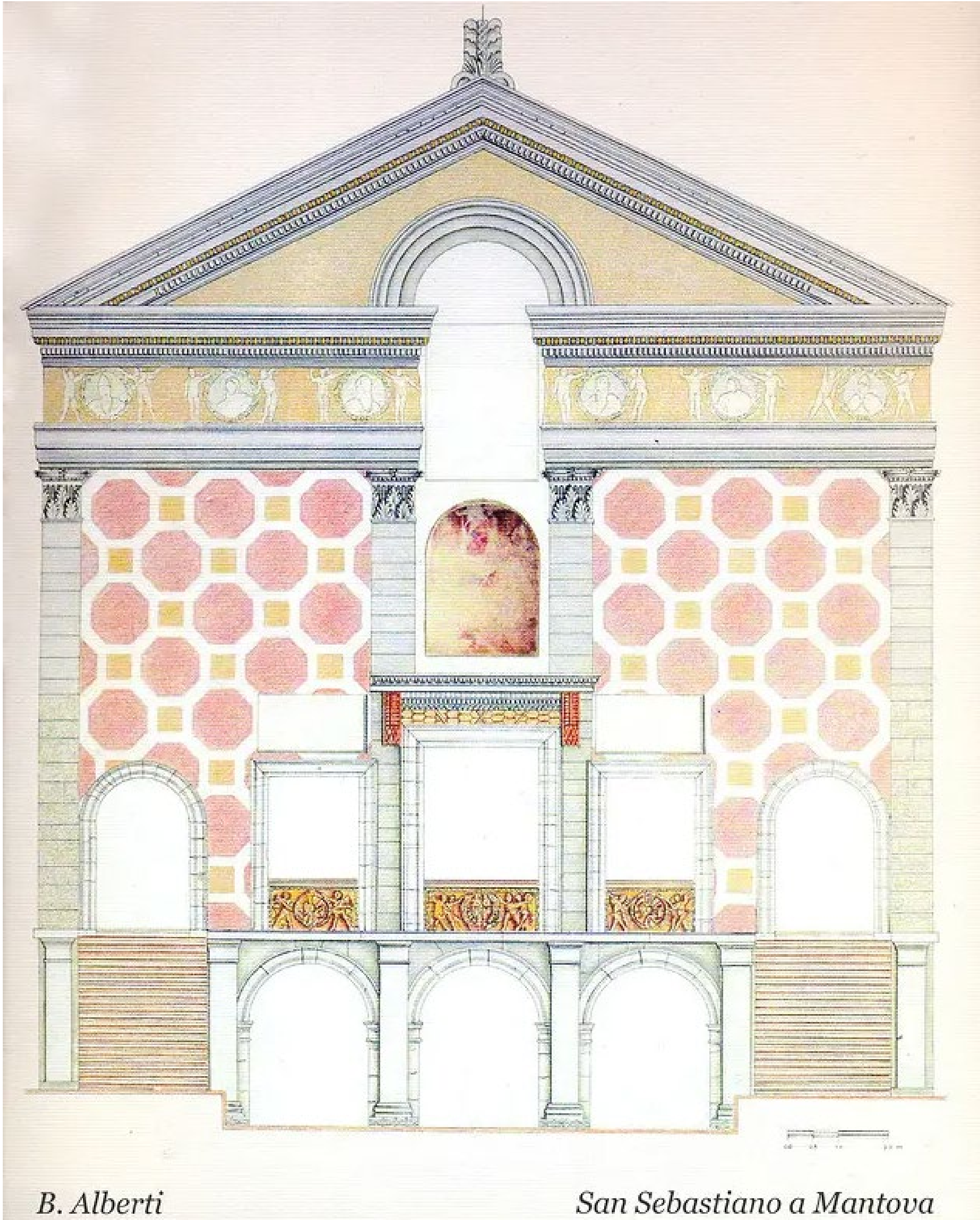

Figure 3: Church of San Sebastiano, Façade Design. arthive.com

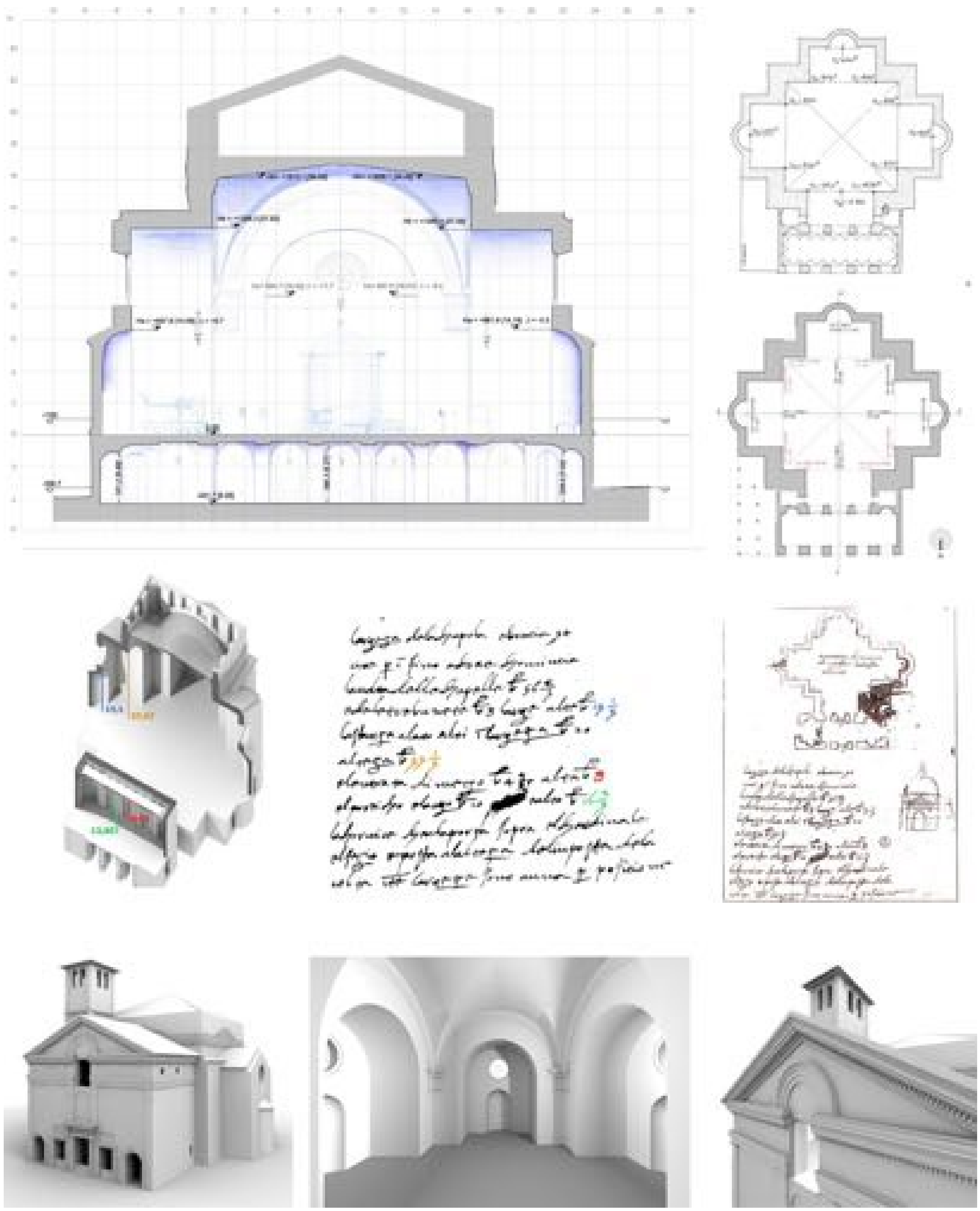

Figure 4: Comparative Analysis of Heights, San Sebastiano Church. Ferrari and Medici, 2017.

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