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GEOMETRY AND SYMBOLISM IN THE BAPTISTERY OF FLORENCE: THE PAVEMENT AND OTHER INTERNAL COMPONENTS

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Abstract

The analysis of Florence Baptistery pavement requires qualitative and quantitative research methodologies and diverse architectural survey techniques. The flooring presents possibilities for decoding shape, geometric roots, and symbolism. The research variables—the flooring geometric aspects—lay the groundwork for a hypothesis: "investigating the baptistery's flooring facilitates the reconstruction of its original shape and geometric components and enables an accurate interpretation of its symbolism". Through photogrammetric survey techniques, the symbolism in the baptistery's flooring was scrutinized and interpreted. The pavement geometric and formal recuperation, alongside the symbolic interpretation of other baptistery elements, the mullioned windows within the women's galleries—was undertaken to establish comparisons and contrasts with the flooring. The "recovery survey" proved instrumental in identifying the flooring constituents (compartments, slabs, tiles, and contour bands). It also unveiled the geometric procedures involved in shape generation (sequential juxtaposition, specular reflection, and splitting). Additionally, the survey facilitated an understanding of the origins of these modules (original, mirrored, and compositional). Furthermore, the process provided insights into the evolution of shapes, from basic geometric figures to more intricate and meaningful configurations (phytomorphic and zoomorphic). This theoretical and practical research methodology holds potential applicability to heritage buildings worldwide.

Keywords*: Florence Baptistery; Architectural survey of heritage buildings; Photogrammetric survey for restoration; Symbolism in architecture; Origins of geometric forms in architecture*

Introduction

Configuration of the pavement in the Florence Baptistery: Unraveling its geometric and mythical tapestry

The flooring within the Baptistery of Florence represents an exceptional and lavish pavement, renowned for its profound symbolic significance. Its intricate inlaid designs, primarily crafted from white, green, and red marbles, interweave to create geometric, phytomorphic, and zoomorphic imagery. The ornamentation of the baptistery encompasses tile compositions fashioned from white, green, and red marbles, organized in sequential arrangements portraying serpentine curves, polygons, triangles, lozenges, and various other geometric shapes. These patterns are sporadically interrupted by circular fields or discs, adorned with concentric circles or radial motifs. Within these designs, there are depictions of flora and

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fauna in a naturalistic style, alongside mythical creatures such as dragons, griffins and teratomorphic hybrids, which hold prominent positions [1].

Geometric forms, encompassing the triangle, square, rectangle, circle, spiral, cross and various others, hold profound significance across diverse cultural realms, particularly in an aniconic and ancient architectural context [2]. Within Christian architecture, numerous geometric shapes carry significant importance as they are considered sacred symbols within Christian tradition. This includes shapes like the square and the circle, along with their three-dimensional counterparts: the cube and the sphere. Similar significance applies to elaborate geometric shapes, such as the spiral and the cross, which carry specific Christian symbolism. The intricate geometric embellishments on the baptistery floor encompass an extensive array of forms, all derived from fundamental geometric figures. These decorations include squares, arrows, lozenges, waves, trapezoids, rectangles, circles, semicircles, quarter circles, assorted polygons, stars, crosses, zigzags, arches, almonds, checkered shapes, undulating wave motifs, herringbones, scales, cubes, intersections, and interlaced patterns.

All these symbolic geometric shapes are incorporated into the decorative elements of the *compartments*. These compartments are characterized by large squares adorned with consistent decorations. Meanwhile, the larger *plates*—squares of sufficient size to be disassembled into multiple tiles—and the individual *tiles* themselves—small squares—are primarily embellished with phytomorphic and zoomorphic motifs. The *contour bands* mainly consist of elongated strips featuring geometric ornamentation, including intertwining and crossing patterns (Fig. 1).

Fig. 1. Geometric decoration featuring rectangles and zigzags
(*compartment in the northeast sector of the flooring*)

Floral and mythical mosaics: Exploring phytomorphic and zoomorphic wonders in the Baptistery of Florence

The "*phytomorphic ornamentation*" encompasses diverse elements, including various types of leaves (such as clovers and shamrocks), fruits like dates, and flowers such as *gladioli*. Moreover, more intricate phytomorphic compositions are observed, such as diagonally positioned *gladioli*, helices adorned with angular lilies, squares featuring cross-shaped *gladioli*, *rosettes* adorned with radial *gladioli*, angled leaves, angled *girali*, among others. While the count of contour bands displaying phytomorphic decoration is fewer compared to those featuring geometric ornamentation, some bands exhibit sequences of faced *gladioli*, *girali* with a succession of flowers, fruits (dates), and leaves, *girali* with a sequence of leaves (clovers), as well as bands with a sequence of stylized shamrocks.Specific tiles showcase specular compositions of *rosettes* and leaves, helices embellished with diverse flowers, and spirals adorned with shamrocks, arranged rhythmically. Most of this type of phytomorphic decoration is found on *slabs* (single square or triangular tiles) and rarely on the compartments [3] (Fig. 2).

Fig. 2. Phytomorphic decoration set within a triangular tile, featuring a central *rosette* and angular *girali* (*tile from the southeast sector of the flooring*)

The pavement of the Florence Baptistery showcases "*zoomorphic embellishments*" portraying mythical and symbolic creatures like griffins (a combination of a lion and an eagle), dragons (an amalgamation of an eagle and a snake), and eagles. These depictions are predominantly found in a large plate featuring facing eagles, several individual tiles portraying griffins, and a sizable concentric circle panel or square adorned with angular, facing dragons. Additionally, other symbolic animals, including fish, bulls, and scorpions, are depicted in the large square representing the zodiac, situated adjacent to another large square featuring concentric circles. Notably, zoomorphic decoration is absent from the contour bands [4] (Fig. 3).

Fig 3. Zoomorphic decoration in the form of a griffi (*tile from one of the plates in the eastern sector of the flooring*).

Decoding illusions and transformations: The complex evolution of the Florence Baptistery Pavement

The pavement of the Florence Baptistery stands as a noteworthy example of "geometric," "phytomorphic," and "zoomorphic" symbolism for various compelling reasons. According to Mario Salmi, the original enamel flooring of the baptistery was positioned

approximately thirty centimeters lower than the current level. Subsequently, it underwent replacement with *opus tessellatum* and *opus sectile* crafted from white, black, and red marbles [5]. The construction of the lavish lithostrate pavement likely dates back to the early twelfth century, covering the entire octagonal area. However, during the renovation works for the baptism of Filippo di Francesco de' Medici directed by Buontalenti in 1577, which involved the location of the ancient font mentioned by Dante, the central part was destroyed. The flooring of the baptismal enclosure octagon did not always have its present appearance. Enrico Madoni further expands on the historical layout, revealing that the octagon was previously divided into eight trapezoids with a small octagon at the center. Each trapezoid featured rectangles adorned with segmented frames, each in four parts, despite their outward rectangular appearance [6].

The apparent rectangular configuration of Florence Baptistery's pavement proves to be an optical illusion. Contrary to their perceived shape, both the "rectangles" and frames (six of each per octagon division) were, in fact, trapezoidal, with dimensions progressively diminishing as they approached the center to seamlessly fit within each of the eight trapezoids. The central region of the octagonal enclosure, speculated to have once housed the Strozzi *gnomon*, underwent a subsequent transformation to accommodate a larger immersion baptismal font, surrounded by steps. Regrettably, the presence of a crack pattern on the flooring complicates accurate graphic restoration depicting the current state of decay [7]. Nevertheless, proposing a graphic hypothesis of the flooring's original appearance proves more feasible than attempting to represent its current state with all the intricate details of decay. Despite numerous and contentious restoration endeavors, the interpretation of the figurative elements on the flooring remains a challenging endeavor.

Materials and Methods

Methodology unveiling symbolism: A comprehensive approach to analyzing geometric and non-geometric elements in the Florence Baptistery Pavement

Despite the inherent challenges in surveying the deteriorating pavement of the Florence Baptistery, its intricate geometry did not impede an accurate formal and symbolic interpretation. Employing the "*recovery survey*" technique alongside other materials, methods, and procedures in this research endeavor proved instrumental in successfully achieving predetermined general and specific objectives. "This innovative measurement concept, referred to as the *recovery survey*, synthesizes graphical reality to eliminate irregularities. These irregularities arising from both the materialization of the project and construction labor, as well as natural wear and tear over time, are thereby mitigated. Consequently, this process facilitates the retrieval of the original design of the building." [8]. The baptistery flooring features a myriad of geometric shapes, spanning from the simplest to the most complex, often emerging from the amalgamation of basic forms [9]. Notably, not all shapes adhere strictly to geometric principles, as many incorporate phytomorphic and zoomorphic elements, depicting plants and fantastical animals explicitly. This inclusive approach facilitated the formal and symbolic interpretation of both the pavement's constituents and other internal components of the baptistery. Despite the difficulties encountered during the survey, these factors collectively enabled the successful study of the baptistery's flooring.

The primary objective of this research is to narrow down potential interpretations and guide them towards effective and objective analyses, grounded not only in the symbolism of geometric shapes but also in the significant meanings originating from diverse sources. Conversely, non-geometric figures that unmistakably represent tangible concepts (associated with Christian, fantastical, or pagan ideologies) necessitate individualized interpretation. The formal components were initially scrutinized within the baptistery's pavement and subsequently compared with those of other internal elements, such as the mullioned windows in the women's

galleries of the second internal order and the friezes on the entablatures of the third external order.

The three main objects of study: the baptistery pavement, the matronea bifora of the second internal order, and the entablature friezes of the third external order

The selection of these three components from the Florence Baptistery was purposeful and guided by specific considerations. The 1) *pavement* serves as an exceptional showcase of geometric creativity and mathematical precision, where both basic and intricate shapes exhibit an almost perfect rigor in accuracy. The analysis of these foundational shapes allows for the identification of key concepts such as: a) *symmetry* (*horizontal*, *vertical*, *transversal*, or *mixed*, contingent upon the orientation of the symmetry axis), b) *affrontature* (*binding* or *unbinding*, depending on the orientation of the hierarchical element facing towards the center or opposite sides of the affrontature center), c) *specularization* (*horizontal* or *vertical*, based on the orientation of the splitting axis in the direction of the 'X's' or the 'Y's'; nearby or distant, contingent on the shorter or longer distance between the two mirrored elements, respectively), and d) *sequential juxtaposition (rhythmic* or *arrhythmic*, contingent on the continuous or alternate repetition of the juxtaposed elements consecutively). Through these analyses, the significance of both simple and complex forms was unveiled. Furthermore, within the geometry of the designs, particularly in the entablatures' friezes, two additional compositional strategies were identified: e) *radiality* and f) *concentricity*. Radiality manifests as a creative phenomenon generating elements that radiate from a center at regular intervals, measurable at angles such as 15, 30, 45 and 60 degrees and smaller increments. In contrast, concentricity involves circular elements diverging from a center, with larger scales as they extend outward; essentially, circular designs increase their radii as they move away from the center of concentricity. The amalgamation of these two geometric design concepts or strategies results in spirographic creations possessing both significant artistic and symbolic value.

The two *mullioned windows situated in the women's galleries of the second internal order*, also referred to as the *bifora of the matronea*, present a formal alternative that extends beyond geometry, incorporating rich Christian symbolism. Each of the marble inlays takes on a rectangular shape, divided into three squares, each adorned with a combination of geometric and non-geometric elements, each reflecting Christian symbology. These boxes, while comparatively simpler and more minimalist in their geometry than the intricate patterns of the pavement, hold greater significance. Two alternatives and segments are worth juxtaposing: the pavement, characterized by its complex geometry wherein shapes align with specific symbology, and the mullioned windows of the women's galleries, distinguished by simpler geometry yet possessing profound significance.

The three friezes located in the entablatures of the third external order (attic) present an alternative interpretation that is both phytomorphic and rooted in geometry, holding significant symbolic value. Comprising sequences of small, rhythmically arranged, juxtaposed diamonds, along with small circles inscribed within these rotated squares, the friezes exhibit noteworthy geometric intricacies. Some of these rhombuses feature internal circles with impressive geometric content, showcasing intricate and creative shapes that are consistently concentric and radial. While certain shapes draw inspiration from objects with symbolic significance of pagan origin, such as the elaborate decorations found in the indigenous cultures of Nordic regions with Viking heritage, others distinctly reference phytomorphic elements. Additionally, certain shapes allude to various flowers, kaleidoscopic compositions, or specific Christian symbols, such as the cross.

The crucial role of abstract and concrete connections of the "architectural sign" components in unraveling the significance of both the pavement and the matronea bifora

In the case of the pavement, the interplay between *architectural signified* and *signifier* assumes an abstract role in its symbolic interpretation, characterized by an idealistic

relationship. For instance, the *architectural sign* of the "square" is dissected into its *signifier* (the term "square" and the mental image of a shape with four equal sides) and its *signified* (the interpretation of this shape as representing the mundane and terrestrial, in contrast to the "circle," symbolizing the divine and heavenly). Conversely, concerning the mullioned windows of the women's galleries, the relationship between *architectural signified* and *signifier* assumes a more specific and less abstract role, shaping their symbolic interpretation as a physical reference. In this context, the relationship between the *signified* and *signifier* is purely representative. For example, the architectural sign of the "chalice" is separated into its *signifier* (the term "chalice" and the mental image of an object existing in reality) and its *signified* (the interpretation of this object as representing the Holy Grail, a mystical vessel or sacred chalice used by Jesus Christ at the Last Supper). In the Middle Ages, the Holy Grail was perceived as a container or cup in which Jesus consecrated his blood during the last Passover with His Disciples; later, this cup was utilized by Joseph of Arimathea to collect the blood shed by Jesus' body. It is evident that the relationship between *signified* and *signifier* is objective, unlike the abstract nature seen in the case of geometric figures.

Comparative analysis of three surveying techniques

The surveying techniques employed for the comprehensive assessment of the three components within the Florence Baptistery encompassed *direct*, *indirect*, and primarily *photogrammetric* methods. In Jorge Romero's article titled "*Architectural Survey of Historical Buildings: The Orders of Classical Architecture in the Baptistery of Florence*," the "*direct*" method utilized traditional measurement tools such as flexometers, measuring tapes (dual-scale, roll-up, self-retracting plastic, or metal measuring tapes), calipers, mechanical vernier scales, and micrometers. The "*indirect*" method, described as the second technique, accelerates and streamlines measurement collection, providing heightened accuracy compared to conventional tools. However, this approach mandates the use of costly rental equipment, including electronic and digital theodolites. The third method, known as "*photogrammetric*," is a relatively modern yet well-established technique dating back to the 19th century. This method involves capturing high-resolution images from specific viewpoints using professional cameras and top-quality lenses. Utilizing specialized software and computer assistance, these images are rectified and transformed into facades featuring parallel vanishing lines, such as elevations, entirely perpendicular to the point of view.

Photogrammetry emerged as the predominant technique employed in surveying the baptistery's pavement and the friezes of the entablatures of the third external order. This method facilitated the survey of the entire complex compositional and distributive structure of the floor, categorized into *macro* and *micro* sectors. Such a comprehensive task would have been unfeasible with the initial two survey methods due to the deteriorating condition of the floor. Photogrammetry proved particularly advantageous in measuring the friezes of the entablatures of the third external order, whose height and location would have posed significant challenges with traditional measurement techniques. Additionally, this technique was instrumental in surveying the mullioned windows of the women's galleries of the second internal order.

Objectives and hypotheses

From an operational standpoint, specific objectives were delineated, encompassing the survey of the flooring to categorize its *macro sectors* (*north*, *northeast*, *east*, *southeast*, *south*, *southwest*, *west*, and *northwest*) and define the *micro sectors* (*compartments*, *slabs*, *tiles*, and *contour bands*). The formal components within each of these sections and subsections underwent evaluation to initiate the "*recovery survey*" and formal interpretation, grounded in the geometric and symbolic origins of shapes, many of which were associated with Christian symbolism. A hypothesis was also formulated, leading to a mixed research approach involving both *quantitative* and *qualitative* methods. This assumption guided the sequential and technical organization of activities employed for the effective realization and publication of the research

results: *"the survey of Florence Baptistery pavement allows not only a recovery of its original shape and geometrical components but also an accurate symbolic interpretation*."

Results and discussion

The geometric patterns in the pavement of the Baptistery of Florence

The term "geometry" originates from the Greek word "*gheometria*," composed of the prefix '*gheo-*' derived from '*ghê*,' meaning 'earth, surface, terrestrial globe,' and the suffix '*-metria*' from '*métron*,' signifying 'measure.' Hence, the complete term can be translated to "measurement of the earth" [10]. This etymological interpretation sheds light on the word's origins. However, the significance of "geometry" extends far beyond its etymology. In the realm of mathematics, to which it belongs, geometry is the branch dedicated to studying points in space and the figures they generate. "Geometry, serving as the foundation for the modern science of representing solid bodies and space, originated from a shared set of physical speculations. It later evolved independently across various applications such as astronomy, gnomonics, geodesy, topography, perspective (understood as stereotomy and orthogonal projection), and more recently, photogrammetry (interpreted as automatic drawing)".

The term "geometry" presently denotes the historical inclination of human beings to portray figures in space. Geometric representations have evolved in diverse manners since the earliest cave drawings, all with the common objective of "representing something that exists or is a reference to something that exists," whether tangible or abstract. The shift from representation to the represented object unveils an intriguing connection that symbology aims to elucidate, particularly concerning abstract geometric shapes with intricate and challenging-to-decipher meanings.

According to Giuseppe Richa, specific geometric shapes found in the Baptistery of Florence were inspired by drapes, specifically luxurious and delicate fabrics. These textiles, predominantly crafted from silk, were utilized in the creation of opulent clothing, vestments, as well as curtains and upholstery. Richa highlighted that this influence was particularly evident in the vicinity of the southern entrance, reconstructed in the year 1200 using white, black, and red marble pieces [11]. The tiles were adorned with arabesque patterns, waves, and indistinctly shaped circles, serving as inspiration for the Art of Silk (*l'Arte della Seta*) in its initial drapery works (1757. *Historical News of the Florentine Churches, Vol. V: Saint John*). All geometric shapes, including the square, circle, triangle, rectangle, lozenge, trapezoid, pyramid, sphere, *girale*, and other intricate forms like the cross, *rosette*, helix, and spiral, among numerous others resulting from the combination of well-recognized shapes, carry profound cultural significance.

The symbolic significance of the pavement in the Baptistery of Florence

The flooring of the baptistery stands as a remarkable example of geometric symbolism, offering an excellent opportunity to unravel its concealed meanings. The intricate inlaid designs form the basis for these geometric figures, each carrying specific symbolic significance. It is important to note that this interpretation does not claim to be exhaustive or exclusive; instead, it seeks to shed light on the origin of the geometric shapes and their unique configurations.

At a theological interpretative level, the circle symbolizes the cosmic sky and the spiritual world, both invisible and transcendent, particularly when contrasted with the earth symbolized by the square. The combination of the circle with the square immediately evokes the concept of the union between heavenly and earthly realities, the supreme and divine with the worldly (Figs. 4 and 5).

The *girale*, with its curves, symbolizes the undulating nature of terrestrial life, while the blooming flowers at its ends signify the potential for salvation through a life in Christ during the journey of human existence (Fig. 6). The cross, an enduring symbol since antiquity, along with the circle, square, and center, constitutes one of the fundamental symbols (Fig. 7). The cross, inscribed within a circle, forms four triangles through the union of its ends. The point where the two parts of

the cross intersection meet represents the center. Following the death of Christ, the cross emerged as the primary symbol of Christianity, representing the passion and death of the Savior. In symbolic terms, the center is not merely a static position but also the point of origin from which the universe's movement emanates, symbolizing the beginning of God [12].

Fig. 4. Tiles from a baptistery flooring compartment, featuring geometric decoration with circles and squares (*northeast section*)

Fig. 5. Tiles from a baptistery flooring compartment, featuring geometric decoration with circles and squares (*northwest sector*)

Fig. 6. Contour band of the baptistery flooring, featuring geometric decoration with girali (*northeast sector*)

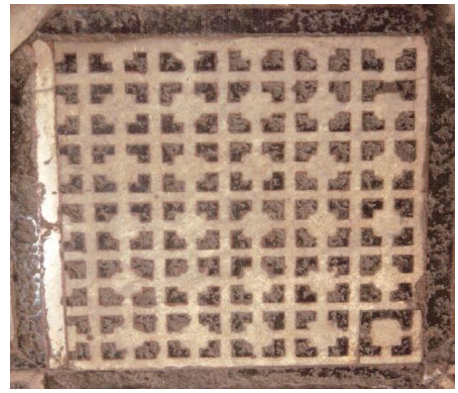

Fig. 7. Tile from one of the slabs of the baptistery flooring, featuring a geometric decoration with crosses (*east sector*)

The Baptistery flooring showcases several centralized figures with a distinctive center that serves as the point of origin for radial geometric shapes, intersecting lines, or intricately faced patterns (Fig. 8). The spiral symbolizes the world's evolution from a central point, in this case, the initiatory point of God and Creation [13] (Fig. 9). The symbolism of the triangle is linked to number three, signifying the Trinity [14].

The concept of affrontature implies the juxtaposition of opposing poles or dichotomous concepts, representing pairs of references that share common characteristics yet differ at the same time. For instance, the soul and the body both constitute aspects of human existence, where the former is intangible and imperceptible through human senses, while the latter is composed of matter. The unity of Christ and the Church illustrates the Son of God incarnate in human form, with the Church symbolizing the collective of believers (Figs. 10-13). In biblical narratives, figures like Cain and Abel, although brothers, embody opposing moral qualities—one representing evil and the other representing good [15, 16] (Figs. 12 and 14).

Fig. 8. Tile from one of the slabs of the baptistery flooring, featuring geometric decoration with a central point and radial arrangement (*east sector*)

Fig. 9. Tiles from one of the slabs of the baptistery flooring, featuring geometric decoration with a spiral (*east sector*)

Fig. 10. Tiles from one of the compartments of the baptistery flooring, featuring geometric decoration with triangles(*north sector*)

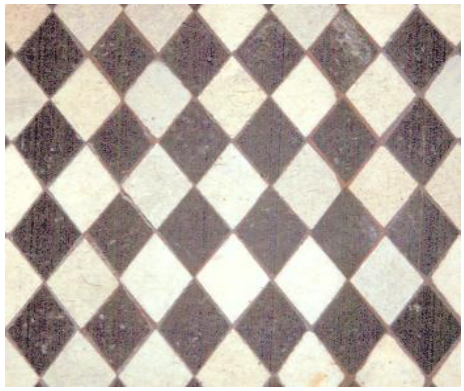

Fig. 11. Tiles from one of the compartments of the baptistery flooring, featuring geometric decoration with a lozenge (*northeast sector*)

Fig. 12. Tile from one of the slabs of the baptistery flooring, featuring geometric decoration with a rosette (*east sector*)

Fig. 13. Tile from one of the slabs of the baptistery flooring, featuring geometric decoration with a helix (*east sector*)

Fig. 14. Tile from one of the slabs of the baptistery flooring, featuring geometric decoration with facing images (*southeast sector*)

The phytomorphic and/or zoomorphic decorations found in certain flooring inlays offer a more tangible and explicit symbolic interpretation of their content (Figs. 15 and 16). This dialectic interplay between different geometric shapes, such as the circle and the square, symbolizes the opposition between the celestial and the terrestrial, the perfect and the imperfect, and God and man, among other contrasts, frequently depicted not only in the flooring but also in the marble inlays both inside and outside the baptistery.

Fig. 15. Part of one of the tiles from the baptistery flooring, featuring zoomorphic geometric decoration (*east sector*)

Fig. 16. One of the tiles from the baptistery flooring, featuring phytomorphic geometric decoration (*southeast sector*)

The spatial organization of the Florence Baptistery's pavement: analysis of sectors, compartments, slabs, tiles, and contour bands

In the analysis of the composition and distribution of the baptistery's flooring, it is essential to distinguish between *sectors*, *compartments*, *slabs*, *tiles*, and *contour bands*. *Sectors*, being the largest divisions of the flooring, were systematically categorized into eight sections, aligned precisely with the cardinal points for organizational clarity. *Compartments*, in contrast, represent larger squares, often square or rectangular, shaped by various geometric designs. Some of these designs can be likened to ancient Roman flooring techniques, such as *opus spicatum* (herringbone), *opus segmentatum* (intricate marble fragments), *opus scutulatum* (polychrome marble lozenges), *opus tessellatum* (square tesserae), and *opus sectile* (marble inlay). While compartments cannot be modularly subdivided into smaller squares, they may contain, on occasion, a smaller *slab* or *tile* (square or circular). *Slabs*, in turn, are squares encompassing smaller squares (*tiles*) within them. To sum up, the analysis of the baptistery's

flooring highlights a clear organizational hierarchy, where sectors, compartments, slabs, and tiles play distinct roles in the overall composition. By aligning sectors with cardinal points and employing Roman flooring techniques, the design achieves both geometric precision and historical resonance. This intricate layering of patterns and forms showcases a sophisticated blend of tradition and craftsmanship in the architectural detailing (Figs. 17-22).

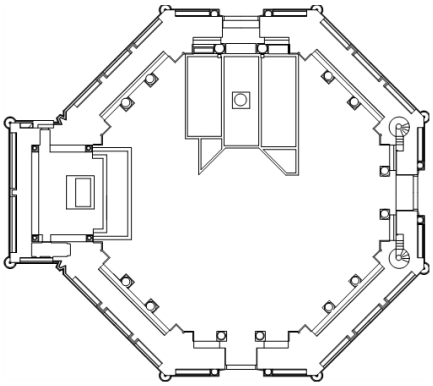

Fig. 17. Representation of a typical sector of the main sides flooring (*north side*)

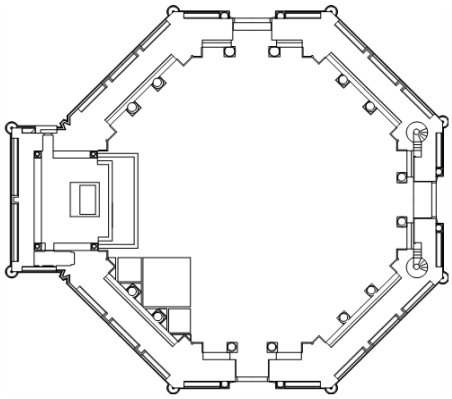

Fig. 18. Representation of a typical sector of the secondary sides flooring (*southwest side*)

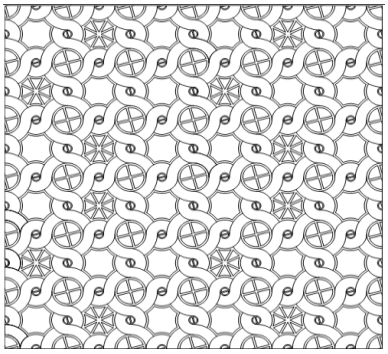

Fig. 19. Representation of a compartment (*northeast sector*)

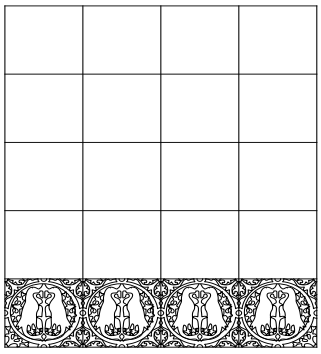

Fig. 20. Representation of a slab (*southeast sector*)

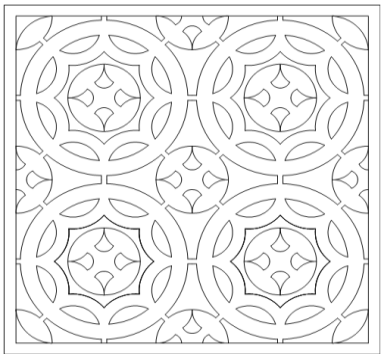

Fig. 21. Representation of a tile (*east sector*)

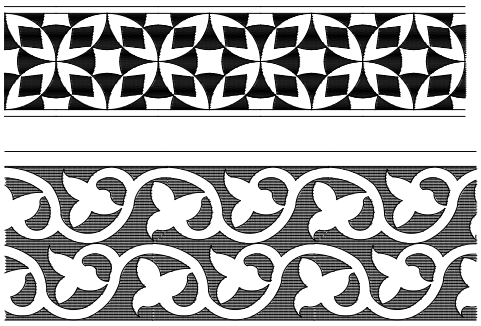

Fig. 22. Representations of two contour bands (*southwest sector* and *northeast sector*)

The *slabs*, typically rectangular or square, are comprised of one or more *tiles*, which may be square or circular in shape. The *slabs* are characterized by a specific number of *tiles* in both width and length, denoted by x number of *tiles* in width and x number of *tiles* in length. The *tiles* themselves, generally square, triangular, or circular, lack further sub-squares. *Tiles* cannot be subdivided into smaller compositional elements. *Contour bands* are stripes that delineate the compartments, running along the periphery of the slabs or compartments but never along the individual *tiles*. The width and length of the *contour bands* vary; the former depends on the area of the *compartment* or *slab* it surrounds, with a larger area corresponding to greater width. The latter is typically determined by the length of the *compartment* or *slab* the *band* encloses. In some instances, the length of the *contour band* may not align with the longest dimension of the *compartment*, occurring when the *band* is non-uniform, and multiple *band* types adorn the longest dimension of the *compartment* (Figs. 17-22).

The significance of color and shape in the baptistery pavement

Concerning the pigmentation of the inlaid slabs, there is a prevalence of ***two-color*** *patterns* (*white* and *green*) and three-color patterns (*white*, green, and *red*). The dominance of two or three colors varies among different slabs, contingent upon the sector of the baptistery flooring. *White* is associated with unity and peace, making it a commonly used color for acts of reconciliation between individuals or nations and conveying positive attitudes in interpersonal relationships. Biblically, white symbolizes justice, purity, light, and truth.

Green, typically associated with nature, including grass, plants, and trees, represents growth and renewal as the color of spring and rebirth. In Christianity, *green* symbolizes hope and new life, including eternal life. In conclusion, *green*, characterized by a strong personality, is commonly utilized in design, despite not being the most visible color from a technical standpoint. Objects colored in *green* have the ability to appear closer than those of a different color. *Red* is associated with the physical world, capable of stimulating and provoking reactions in individuals by increasing their pulse rate. Symbolically, red represents blood, fire, heat, revolution, passion, action, and strength. Its temperament is material, ambitious, and vital, often led by impulse rather than reflection. Within Christianity, red symbolizes the Blood of Christ and is associated with sacrifice and fire, among other biblical aspects [17].

For instance, in the inlaid slabs featuring *opus tessellatum* motifs in the north and northwest sectors, the prevalent *trichromy* of *white*, *green*, and *red* is noteworthy [18]. The inlays adorning the upper part of the mullioned windows of the women's galleries deserve special mention, displaying intricate geometric patterns involving circles combined with squares, central points with radial compositions, rotated squares, compositions based on triangles, phytomorphic forms such as crossed *gladioli*, concrete symbols such as the cup (referring to the chalice of Christ's Last Supper), *rosettes*, and helices (Figs. 23 and 24). Similar geometric decorations can be observed in the inlays covering the seven walls of the first internal register (Fig. 25) and the *scarsella* (Fig. 26).

The inlaid decoration on the exterior walls of the baptistery displays less intricacy on the first and second orders. The designs incorporate commonly used geometric shapes like squares, rectangles, circles, diamonds, and triangles arranged in facing or radial patterns, arches, and checkered patterns, often combining these shapes (Fig. 27).

Fig. 23. Marble inlay above the left mullioned window on the southwest side (*second internal order or women's alleries*)

Fig. 24. Marble inlay above the central mullioned window on the southwest side (*second internal order or women's galleries*)

Fig. 25. Marble inlays with geometric decoration on one of the sides of the first internal order (*northeast side*)

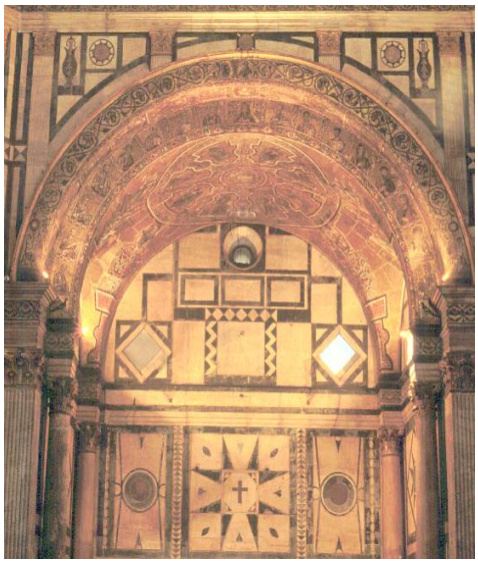

Fig. 26. Marble inlays with geometric decoration on one of the sides of the first internal order (*west side* or *scarsella)*

Conversely, the entablature friezes on the third order present a higher level of complexity in their geometric decoration. The lozenges and triangles within these friezes exhibit intricate combinations of various geometric figures. In summary, the inlaid slabs of the baptistery use white, green, and red to symbolize purity, renewal, and sacrifice, respectively. White represents unity and truth, green signifies growth and hope, and red evokes strength and passion. The intricate geometric patterns further enhance the visual and symbolic depth of the design. Both the interior and exterior decoration reflect a rich blend of spiritual and artistic elements.

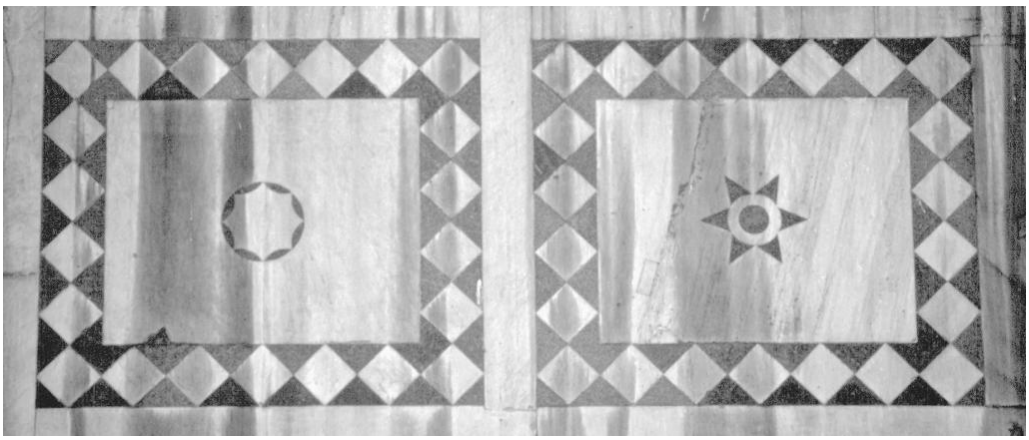

Fig. 27. One of the marble inlays on the sides of the south door (*first external order*)

Geographical segmentation of the Florence Baptistery pavement: northern, southern, eastern, and western sectors

Regarding the distribution of the Florence Baptistery's pavement, it is suitable to categorize it into eight sections, aligning with each of the building's eight sides. Notably, due to

observable symmetry along the east-west axis (while less conspicuous along the north-south axis), the sectors can be readily discerned and classified into eight main areas: four polygonal and four triangular. The initial four sectors align with the primary sides of the building (*north*, *south*, *east*, and *west*), whereas the remaining four triangular sectors correspond to the secondary sides (*northeast*, *northwest*, *southeast*, and *southwest*).

The *northern sector* of the baptistery is comprised of *eight compartments*. The initial *three rectangular panels*, being the smallest among the set of eight, embellish the flooring within the three intercolumniations along the same primary side. Following suit, *three* additional larger *rectangular panels*, representing the largest within this grouping, extend from the intercolumniation towards the baptistery's center. Concluding the arrangement, the last *two panels*, characterized by a medium size and a shape that is neither square nor rectangular, assume a polygonal form aligned with the octagonal perimeter of the ancient baptismal enclosure. The sectoral distribution of the southern side closely mirrors that of the northern side, attributed to the east-west axis of symmetry.

The *eastern sector* is composed of *three sub-sectors* aligning with the three intercolumniations—specifically the *left*, *central*, and *right* sections—of the main side. Within the *left sub-sector*, there are two rectangular panels: a small one on the intercolumniation flooring and a significantly larger one extending towards the center of the baptistery. In the *central sub-sector*, there are four panels: a small rectangular one on the entrance door (Porta del Paradiso), a larger square one following it, another square of similar size comprised of concentric circles, and a square panel adorned with an inlaid depiction of the zodiac. This *central sub-sector* forms the entrance band spanning from the east door to the corresponding side of the ancient baptismal enclosure. The *right sub-sector* mirrors the left but with a slight variation—instead of a straightforward second panel, there is a panel of similar dimensions adorned with a diverse array of square tiles.

The *western sector*, while less intricate compared to other sectors, exhibits a similar area to that of the eastern sector. Its primary function is to demarcate the confines of the *scarsella* enclosure and the extension of the altar towards the center of the baptistery. This sector's flooring is organized into *three subsectors* positioned in front of the altar, aligning with the three intercolumniations on the opposite east side. The remaining *four sectors*, corresponding to the secondary sides, take on a triangular form and demonstrate a relative symmetry to one another.

The *northwest* and *southwest sectors* exhibit symmetrical distribution and possess similar perimeters. Each of these sectors is characterized by *three large square panels*, each angularly corresponding to the three intercolumniations. Additionally, both sectors feature *ten small triangular compartments* delineating the perimeter of the column bases and cantonal pillars. Notably, the squares in the central intercolumniation are larger than those on the lateral sides. The key distinction between the two sectors lies in the number of *triangular panels*; the *northwest side* comprises *four*, while the southwest side features *six*. It is worth mentioning that the left panel of the northwest sector is incorporated into the perimeter of the two cantonal pillars lacking triangular panels, resulting in a polygonal shape instead of a square.

The *northeast* and *southeast* sectors demonstrate perimeter symmetry, while their internal distribution differs significantly. The *northeast sector* is composed of *six square compartments* corresponding to the left, central, and right intercolumniations. Additionally, it features *six triangular panels* delineating the perimeter of the column bases and cantonal pillars. A minor irregularity exists, specifically, the *square panel* closest to the central intercolumniation is divided into *two spaces—one triangular* and *the other diamond-shaped*.

The composition of the *southeast sector* is notably intricate, although it allows for the identification of an axial correspondence and a specific number of panels, despite the baptismal font being present on the sector's flooring. *Four large slabs*, divided into additional *modular panels*, form the basis of this complexity. *Two slabs* initiate angularly from the right

intercolumniation, the *third* corresponds to the central one, and the *fourth* begins angularly from the left intercolumniation. Additionally, a part of a *fifth slab* and a *triangular tile*, unfortunately damaged due to the font's presence, can be discerned. Furthermore, *two more tiles*, *one square* and *one rectangular*, are positioned near the left intercolumniation. Lastly, *six triangular tiles* define the perimeter of the column bases and cantonal pillars.

Modular composition of the baptistery pavement: genesis of geometric patterns

The modular construction of geometric designs on the baptistery flooring is a subject of intrigue. Through meticulous examination, three discernible types of modules have been identified, contributing to a comprehensive understanding of the structural and graphical genesis of the geometric patterns. These three module types include the *original*, *mirrored*, and *compositional*.

The *original module* represents the foundational, primitive form that serves as the basis for all subsequent variations within a specific geometric composition, and it cannot be further subdivided. This *original module* may be replicated or repeated through mirrored or sequentially juxtaposed arrangements, constituting the second category of modules. The *original module*, on its own, lacks an independent identity or value, adapting its form based on the number of mirror splits or sequential combinations. To gain a better understanding of these three module types, consider a compartment in the northeast sector of the baptistery flooring. Figure 28 depicts the minimum indivisible unit of the intricate geometric composition of the square, providing insight into its complex final form and its significance as a compositional unit. Conversely, the *mirrored module* involves the division of an *original module* through a mirroring process, resembling the reflection in a mirror. This mirroring can occur along various axes, including vertical, horizontal, diagonal, or angular axes. It is important to emphasize that this second module may result from one, two, three, or more mirrorings, leading to multiple divisions of the original module. However, the number of mirror splits should not exceed the limit required to reach the third module category. The mirrored form can reproduce or repeat itself through one or several mirrorings or sequential juxtapositions. Despite being derived from at least one mirroring or one sequential juxtaposition, this second module already possesses a degree of autonomy and a concrete form. To illustrate, consider the baptistery flooring example, where the subsequent image demonstrates the original module being split once and multiple times. It is noteworthy that the symbolic autonomy and progressive significance of the shapes increase with different splittings or juxtapositions (Fig. 29).

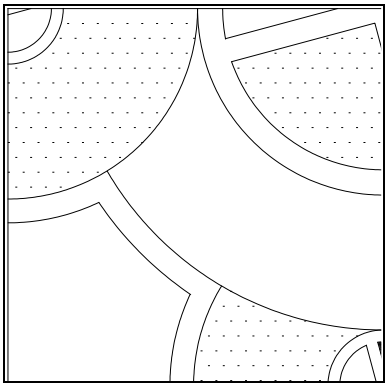

Fig. 28. Representation of the *original module* from a compartment of the northeast sector flooring

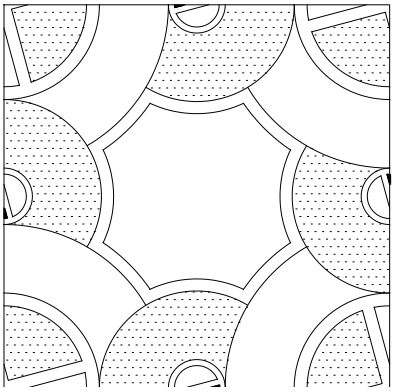

Fig. 29. Representation of the *mirrored module* from a compartment of the northeast sector flooring

The *compositional module* represents a self-contained design unit with a distinct identity and an independent form, requiring no further mirroring or sequential juxtapositions to achieve

a concrete value and shape. Typically, the *compositional module* exhibits symmetry, conveying the notion of a fully realized form that doesn't necessitate additional elements for comprehensive interpretation. For example, a *rosette*, a polar geometric composition featuring radii rotated around a central point, can be understood as a flower. Replication or repetition of the *compositional module* occurs solely through one or several sequential juxtapositions, distinguishing it from the earlier modules. This distinction holds particular significance in geometric composition, especially within the compartments of the baptistery flooring. Successive combinations or juxtapositions of the *compositional module* do not augment its formal value or meaning, as it has already achieved completeness as a singular composition unit. Instead, these combinations serve to amplify the overall magnitude of the geometric composition. The accompanying diagram illustrates a finalized module, rich in meaning, thus open to both formal and symbolic interpretation (Fig. 30).

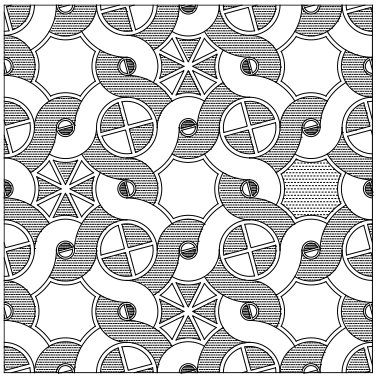

Fig. 30. Representation of the *compositional module* from a compartment of the northeast sector flooring

Discussions

Unlocking the geometric mysteries of the Florence Baptistery: significance and strategies in paving reconstruction

Among the variables considered in the research hypothesis, it was identified that the most pivotal factor for acquiring both qualitative and quantitative data was the "geometry of the paving". This significance surpassed other variables, including "the women's galleries mullioned windows of the second internal order" and "the entablatures friezes of the third external order". Traditional and recovery surveys played a crucial role in understanding the geometry of compartments, slabs, tiles, and contour bands. The detailed measurement and representation of the Florence Baptistery's paving, as outlined in the specific objectives of this investigation, would have been impossible without photogrammetric surveys. The recovery of the original forms, envisioned by medieval artists on the drawing board, emerged as the primary strategy. This strategy not only facilitated the accurate interpretation of both geometric and non-geometric original forms but also enabled the exploration of pagan or Christian symbolism associated with specific non-abstract forms.

The progression and maturation of geometric forms, evolving from an initial module to a compositional unit, reaching a full-fledged composition, involved strategic grouping techniques such as *affrontature*, *specularization*, and *sequential juxtaposition*. While the investigation did not initially anticipate the examination of the pavement's geometry as a specific objective or part of the overarching hypothesis, it emerged as a noteworthy categorization of modules. This classification proved instrumental in comprehending the inherent genesis of geometric compositions across various levels of the Florence Baptistery.

Approximately 85% of the compartments across the eight paving sectors originate strictly from geometric designs, and there is no evident differentiation in terms of geometric or non-geometric origins among the various sectors. Compartments with geometric compositions are present in all sectors, dispersed without a discernible pattern. However, grouping compartments based on this criterion proves challenging due to the gradual and unplanned nature of the paving's design and construction, spanning from 1205 to potentially 1207. The completion of the marble *intarsias* in the San Miniato al Monte pavement is believed to have occurred concurrently with the Florence Baptistery, evidenced by the perfect alignment of the two zodiac circles in the pavements of both religious monuments.

In essence, the pavement designs within the Florence Baptistery are deeply rooted in the interior embellishments of Roman structures, such as the Pantheon, renowned for its extensive use of polychrome marble compositions. Originally, the baptismal font occupied the central space of the flooring, now an octagon crafted from *cocciopesto* [19]. The floor boasts marble inlays that continue to be highly esteemed. Some of these inlays draw inspiration from oriental geometric motifs, while others replicate nature through phytomorphic and zoomorphic designs, often featuring fantastical creatures like griffins—mythical beings with an eagle's upper body and a lion's hindquarters. Additional inlays are influenced by pagan or Christian themes, as well as the intricate decorative patterns of the barbaric peoples in northern Europe. Mosaics from textiles in the southern and eastern Mediterranean regions also served as a wellspring of inspiration for other designs. The bichrome inlaid mosaics of the flooring were likely crafted by the same artisans who labored at San Miniato al Monte until 1207 [20].

While the Florence Baptistery stands as a pinnacle of Italian Romanesque architecture, the ancient Florentine tradition, prevailing until the 16th century, suggested that the baptistery originated as a temple dedicated to the god Mars. According to this belief, modifications were limited to its apse and lantern during the Middle Ages [21]. Although this notion has been debunked in contemporary times, the unmistakable geometric influence from the Roman world is evident in both the interiors and exteriors of the baptistery, including its flooring. Analogous to the stone mosaics that adorned the floors of Roman *domuses*, the baptistery's flooring is characterized by inlaid marble mosaics. Notably, excavations in the 19th century beneath the baptistery revealed remnants of a Roman domus, likely dating back to the 1st century AD. Scholarly opinions regarding the age of the baptistery vary, with some proposing its origin in the Paleo-Christian era of the 4th-5th centuries AD [22], while others posit a dating around the year 1000 based on the mentioned archaeological discoveries. A document confirming the baptistery's consecration by Pope Nicholas II on November 6, 1059, provides a definitive historical anchor. Some scholars also speculate on alterations during the 11th century and possibly beyond, reaching into the threshold of the Renaissance [23].

The specialized literature focusing on the assessment of the conservation status of architectural structures in cultural heritage churches [24-26] takes into account factors such as the materials used, the age of the monument, its heritage value, and the technology employed in its construction. It also considers the degree of geometric influence, encompassing symbolic elements like phytomorphic or zoomorphic motifs, pagan or Christian themes, and other architectural geometric forms [27-29]. This body of work facilitates an evaluation of how geometric elements are integrated into both external and internal finishes, either in pre-designed forms or developed during implementation. These include visible structures such as brick, terracotta, parietal mosaics, tiles, and contour strips, often with variations inspired by diverse sources [30-32]. Following this, the layout of the baptistery flooring compartments is presented, highlighting the frequency with which various symbols are incorporated as architectural geometric forms.

Baptistery flooring: analysis of sectors, compartments, slabs, tiles and contour bands

Despite the considerations mentioned above, it remains viable to categorize the pavement into *sectors*, grouping them based on varying degrees of geometric influence, as well

as phytomorphic or zoomorphic, pagan, or Christian, and other sources of inspiration, detailed below. The north sector predominantly exhibits geometric elements in its *compartments*, *slabs*, *tiles*, and *contour bands*, with occasional variations inspired by diverse sources, particularly evident in the contour bands.

Two compartments of notable interest in this sector, namely (Appendix 4, C-4) and (Appendix 5, C-2), are exclusively geometric. *Compartment 4* features a geometry centered on squares with opposing diagonals dividing each square into four triangles. Here, the original module is the triangle, and the compositional module takes the form of a bow tie resulting from an irregular horizontal specularization. The resulting composition forms a sequence of squares with green triangles mirrored horizontally and white ones mirrored vertically, creating a chessboard-like pattern. Conversely, *compartment 2* is divided into a series of small rectangles and squares, alternating strips of rectangles and squares that create an optical illusion of movement. The final composition in this compartment is an irregular juxtaposition of small squares with distinct designs. Most geometric compositions in this sector result from bichromatic or trichromatic marble *intarsias*, employing white marble from Carrara, green from Prato, and likely red from Verona.

Three contour bands in this sector stand out (Appendix 7, CB-2, 4) and (Appendix 8, CB-3). *Contour band 2 of appendix 7* comprises a sequence of curves based on semicircles, giving the illusion of an endless chain alternated with white almond-shaped figures. It represents compositional modules arranged rhythmically and sequentially, unfolding horizontally in a specular manner to create a double band effect. *Contour bands 4 of appendix 7* originate from complex original and compositional modules, featuring strategies like arrhythmic juxtaposition and horizontal specularization. The final composition forms a garland of intricate geometric shapes, evoking an abstraction of floral elements. *Contour band 3 of appendix 8* also originates from intersecting circular shapes, creating the illusion of floral garlands with diverse phytomorphic compositional results. This pattern, with interweaving circles in rhythmic sequential juxtaposition, reflects decorative elements reminiscent of Norse cultures.

An *atypical element* found in this north sector, specifically in the center of the central compartment along the north-south axis, immediately after the north door, is a *slab* based on circles arranged in an irregular sequential juxtaposition and radial position. This forms a spirographic image, resembling a circular mandala inscribed in a square with a perimetrical phytomorphic garland, imbued with Christian significance.

In the south sector, the pavement primarily features geometric patterns with occasional variations inspired by different sources evident in its compartments, *slabs*, *tiles*, and *contour bands*. Notably, *three compartments* stand out as points of interest (Appendix 2, C-4), (Appendix 4, C-1) and (Appendix 6, C-2), displaying a geometric foundation with certain zoomorphic elements. *Compartment 4 of Appendix 2* exhibits a geometry inspired by fisheyes, replicated in both "x" and "y" directions using a rhythmic sequential juxtaposition pattern based on the three-color marble system (white, green, and red). Conversely, *compartment 1 of Appendix 4* features an original module based on a quarter circle, evolving into a semicircular compositional module. This semicircle creates a circular composition following an arrhythmic sequential juxtaposition pattern in both "x" and "y" directions, employing the trichrome marble (white, green, and red). In *Appendix 6*, *Compartment 2* incorporates an original triangular module transforming into a rhomboid compositional module. The rhomboids form a composition that adheres to the pattern of rhythmic sequential juxtaposition in both "x" and "y" directions, utilizing the prevailing paving colors of white and green.

Within this sector, a notable *contour band* is identified (Appendix 8, CB-2), composed of intersecting circles forming a floral garland with unfolded and repetitive elements in the "x" direction, adhering to the criterion of arrhythmic sequential juxtaposition.

An *exceptional element* in the south sector, specifically in the center of the right compartment along the north-south axis, immediately after and to the right of the south door, is a *slab* featuring white and green triangles expanding outward in a circular and radial manner. The *slab* creates a large circle with concentric rings based on triangles diverging from a central red marble circle, resembling a kaleidoscopic image.

In the east sector, it is noteworthy to highlight *two compartments* of interest (Appendix 2, C-2, C-3), both characterized by purely geometric designs. *Compartment 2* features a simple geometry comprised of white and green lozenges, arranged in a specularly unfolded sequential juxtaposition along the north-south axis. Similarly, *Compartment 3* displays straightforward geometry, akin to *Compartment 2*, but this time based on white and green trapezoids, arranged in a specularly unfolded sequential juxtaposition along the east-west axis.

Furthermore, a *contour band* of significance (Appendix 7, CB-2) traverses this sector, also serving as a boundary element between the east and north sectors.

An *unusual feature* within this east sector, situated to the south of the east door known as Porta del Paradiso, crafted by the Italian sculptor and goldsmith Lorenzo Ghiberti between 1425 and 1452 [33], is a *slab* adorned with multiple *tiles* primarily exhibiting phytomorphic decoration (Appendix 9, T-1, T-2, T-3 and T-4). Symbolically and creatively significant, this *slab* showcases tiles with diverse designs ranging from simple to intricate geometric figures, resulting in a chessboard-like composition of remarkable creativity. For example, *tiles 2* and *4* feature phytomorphic designs. *Tile 2* depicts a spiral adorned with radial lilies emanating concentrically from the center of the spiral. *Tile 4* showcases a *rosette*-like circular-module composition, which, when multiplied fourfold, forms a composition with four axes of symmetry along the "x" and "y" directions and two diagonals (Appendix 9, T-2, T-4). *Tile 1* presents a composition consisting of central and outer squares interconnected by vertical and horizontal lines, imparting a textile-like impression (Appendix 9, T-1). *Tile 3* features white and green triangles arranged within several concentric circles, all inscribed within square frames, also in white and green, with four axes of symmetry along the "x" and "y" directions and two diagonals (Appendix 9, T-3).

The west sector displays the least embellishment among all the sectors, largely attributable to the presence of the *scarsella* apse. This sector encompasses the altar and a platform facilitating access to both the altar and *scarsella*. Within this sector, there are merely *five small compartments* featuring geometric decorations, consisting of *three rectangular* and *two triangular compartments*. The *three rectangular compartments*, positioned at the base of the altar, showcase compositions grounded in squares, rectangles, and trapezoids, lack intricate geometric details. However, an exception is found in the north *triangular compartment*, which is adorned with multiple stripes displaying phytomorphic compositions arranged in a sequence of eight contour bands.

Of the four remaining sectors of the Florence Baptistery pavement—*northeast*, *southeast*, *northwest*, and *southwest*—three distinguish themselves due to their complexity. The northeast sector comprises *eight compartments* (Appendix 2 (C-1, C-2)), (Appendix 3 (C-1, C-2, C-4)), (Appendix 4 (C-3)), and (Appendix 6 (C-1, C-2)), showcasing a geometric origin with multiple interpretative possibilities.

Compartment 1 of Appendix 2 presents a complex geometry featuring two types of squares with distinct internal designs. The first type is subdivided into four small vertical stripes of white and green marble arranged sequentially, while the second type comprises four smaller squares with quarter circles on each outer corner, alternating between white and green akin to a chessboard. *Compartment 2 of Appendix 2* in the northeast sector is analogous to Compartment 2 of Appendix 2 in the eastern sector. *Compartment 1 of Appendix 3* showcases one of the most intricate geometric compositions in the entire flooring. The modules, in sequential juxtaposition, center around a circle with filigree resembling textile fabric. These circles are subdivided into four quarter circles, alternately white and green. The remaining spaces feature

eight-sided shields subdivided into alternating white and green triangular spaces, creating a captivating composition. *Compartment 2 of Appendix 3* resembles a chessboard, featuring two types of squares arranged sequentially. The first type is subdivided into four horizontal bands, alternately white and green, while the second type exhibits a more complex geometric composition based on wide and thin zig-zag bands of white and green. *Compartment 4 of Appendix 3* comprises rhombuses with a central circle divided into quarter circles, alternating between white and green. At the diagonal ends of the circle, four tangentially positioned semicircles add further intricacy, resulting in a composition reminiscent of a tiled floor with perfectly fitting circles. *Compartment 3 of Appendix 4* introduces a novelty to the sector, featuring axe-shaped original modules with semicircular edges arranged in alternating sequential juxtapositions of white and green marble, resembling a roof with colored tiles. *Compartment 1 of Appendix 6* showcases a simple geometric composition based on green shields with four curved sides arranged vertically and horizontally in sequential juxtaposition. *Compartment 2 of Appendix 6* features one of the simplest geometric compositions, comprising alternately arranged white and green rhombuses.

This sector is also notable for its *four contour bands* (Appendix 7 (CB-1, CB-2, CB-3)) and (Appendix 8 (CB-4)), each contributing to the overall visual richness. *Contour band 1 of Appendix 7* is composed of vertically and horizontally alternated groups of two rectangular bands of green marble, resembling a Roman-style fretwork. *Contour band 2 of Appendix 7* is shared by two sectors (northeast and north) and is identical in both. *Contour band 3 of Appendix 7* is the thinnest, consisting of a horizontal series of white marble rhomboids interspersed with vertical obols on a background of green marble. In contrast, *contour band 4 of Appendix 8* is intricate, featuring horizontally intersecting circles creating various shapes such as *mandorlas*, smaller circles, triangles, and shields with four curved sides. The combination of marbles in three primary colors contributes to the complexity of this band.

The *northwest sector* shows *three* notable *compartments* (Appendix 5, (C-1, C-3, C-4)) characterized by a distinct geometric design. These compartments are organized in squares, each exhibiting a unique arrangement reminiscent of checkerboards with some variations. *Compartment 1* presents an irregular sequence of squares, distributed both horizontally and vertically. The squares sharing the same design do not meet on adjacent sides but rather diagonally, creating a chessboard-like pattern. The first square features a white marble *mandorla* inscribed horizontally on a green background. In contrast, the second square has two diagonals dividing it into four symmetrically aligned triangles—two white triangles oriented horizontally, and two green triangles oriented vertically. *Compartment 3* shares a similar irregular distribution of squares, both horizontally and vertically, but with a different design. The first square has two quarter circles inscribed in white marble, symmetrically arranged towards the ends, with a green marble background in the center. The second square, while similar to the first, exhibits transversal symmetry, reversing the colors of the quarter circles and the centralized background. When arranged sequentially, horizontally, and vertically, the final composition creates an optical illusion where the hierarchical center of the compositional modules appears to be the circle rather than the square. *Compartment 4* also resembles a chessboard but with notably thick dividing bands between the squares. The squares are identical, featuring a second rotated square inscribed within the first and a *mandorla* inscribed within the second, all oriented in the same direction. The first square and *mandorla* are made of green marble, while the second rotated square is made of white marble. The dividing bands, made of white marble, create small squares of green marble at their intersection points. The final composition produces an optical illusion of movement, particularly in the small intersecting squares. This sector features only *one* noteworthy *contour band* (Appendix 8, CB-3), which is identical to the left lateral compartment of the north sector, as these two sectors share it.

The southwest sector encompasses *three* noteworthy *compartments* (Appendix 3, (C-3)) and (Appendix 6, (C-3, C-4)), characterized by intricate geometric designs featuring curved lines. *Compartment 3 of Appendix 3* consists of a network of curved bands forming both large and small circles. The large circles contain a rhombus-like shape created by four segment sides, which, in turn, generates additional circles within it. Inside these rhombuses, another smaller rhombus is formed by four circle segment sides. The curved line serves as the foundation for the original module, the compositional module, and the final composition. The most prominent and highest-order curved bands are composed of green marble.

Compartment 3 of Appendix 6 presents a network of green marble curved bands arranged in rhythmic sequential juxtaposition vertically, creating a series of waves reminiscent of water. This design holds rich Christian symbolism associated with baptism. Interestingly, it evokes the aesthetic of the wide sidewalks along the beaches of Rio de Janeiro, probably serving as inspiration for the renowned artist Roberto Burle Marx. Marx, known for creating the iconic wave design symbolizing the Atlantic Ocean's waves on the Rio de Janeiro coastline, likely drew inspiration from similar patterns.

Compartment 4 of Appendix 6 features a network of circles tangentially overlapping and intersecting at the four points of their diagonals. The final composition results from a sequential juxtaposition of circles intersecting horizontally and placed tangentially. Within the intersection of every four circles, a rhombus is formed by four circle segment sides.

In summary, the baptistery features compartments with diverse degrees of geometric, phytomorphic, and zoomorphic decorations, some combining elements of both (Appendix 1). The southeast sector houses the present baptismal font. Regardless of the decorative type employed, each design in the floor compartments exhibits undeniable creative richness (Appendices 17-20). These compartments adhere to modular development patterns (*original module*, *compositional module*, and *final composition*) and employ various geometric composition strategies such as *symmetry*, *affrontature*, *specularization*, *sequential juxtaposition*, *radiality*, and *concentricity*.

While slabs also follow similar patterns and strategies, they are generally smaller in size and entail fewer splits, specularizations, affrontatures, and arrays (Appendix 23). Tiles represent even smaller spaces, and often, the entire tile serves as the final composition without further subdivision. Concerning contour bands, the compositional generation follows modular development and employs comparable geometric composition strategies, particularly rhythmic and arrhythmic sequential juxtaposition, albeit in a more linear fashion. This results in compositions that extend along a horizontal axis.

Baptistery mullioned windows: analysis of intarsia and panels

Concerning the mullioned windows situated in the women's galleries (second internal order), explicit Christian symbols, references to natural elements, and easily interpretable geometric compositions are present. The quadrangular marble inlays (*intarsias*) positioned above these windows are divided into *two*, *three*, or *four square* or *rectangular panels*. The configuration of these panels is determined by two factors: 1) the intarsia's placement, whether it is on the left, center, or right of the mullioned window concerning one of the baptistery's sides, and 2) the number of subdivisions, influencing whether the panels are square or rectangular. For instance, an *intarsia* with four subdivisions features square panels, while one with three subdivisions includes at least one rectangular panel in the center and two square panels on the sides, although variations exist. Additionally, there are *intarsias* with three square panels and slightly rectangular ones with two subdivisions. Each side of the second internal order accommodates three mullioned windows, except for the west side, where the barrel vault of the apse (*scarsella*) aligns with the second internal order. This configuration results in a total of twenty-one mullioned windows, each adorned with corresponding *intarsias* above. All intarsias are crafted from white and green marble, with occasional use of red marble in rare instances.

On the north side of the baptistery, each mullioned window is adorned with *three intarsias* positioned above, corresponding to the *left*, *center*, and *right* sections. The *left intarsia* comprises *three square panels* arranged from *left* to *right*. The *left* and *right panels* feature a sequence of squares and rotated squares, with a small circle positioned in the composition's center, all encompassed by a square frame. The *central square panel* is a fusion of concentric squares and diagonal rectangles intersecting to form small triangles radiating from the center, creating the impression of a diagonal cross within a square frame. The *central intarsia* is divided into *two square panels* on the *left* and *right* and *one rectangular panel in the center*. The *left* and *right square panels* consist of simple squares within another square, while the *central rectangular panel* is a rectangle within another rectangle. The *right intarsia* also features *three square panels*, with the *left* and *right panels* containing a rhombus within a circle, reminiscent of a Chinese coin. The *central square panel* comprises a square and four semicircles facing each other horizontally and vertically, with a circle positioned in the composition's center. All three *intarsias* are encased in rectangular frames that contain the square and rectangular panels (Appendix 24, (LMW, CMW and RMW)).

On the *south side* of the structure, each mullioned window is adorned with *three intarsias*, namely the *left*, *center*, and *right intarsias*. The *left intarsia* is identical to the right *intarsia* found on the north side. Similarly, the *center intarsia* is identical to the central intarsia found on the northern side. Lastly, the right intarsia is identical to the left *intarsia* found on the northern side. When stating that two *intarsias* are identical, it signifies that both possess the same geometric composition, although their dimensions may exhibit slight variations upon examination. These differences could include variations in the width of the square or rectangular bands framing the subdivisions of the three *intarsias* or in some other elements constituting the final compositions (Appendix 25, (LMW, CMW and RMW)).

The *east side* of the structure showcases *three intarsias*, each positioned above its corresponding mullioned window. The *left intarsia* is divided into *three square panels*, featuring a sun inscribed within a square on the *left panel*. This sun comprises eight diverging curved rays surrounding a small central circumference. The *central panel* depicts a phytomorphic representation, showcasing eight divergent leaves within a circumference, framed by a square. The *right square panel* presents a more intricate geometric representation square formed by sixteen intersecting circles, generating sixteen centers with four curved sides and a phytomorphic center with four leaves. All of this is framed within a square. The *center intarsia* is divided into *four square panels* (*left*, *two centrals*, *right*), with the *left* and *right panels* identical in composition. They both portray the abstraction of a sun with sixteen rays diverging from a small circumference and a central circle. The *two central square panels* are also identical, each featuring an abstraction of a sun with eight rays diverging from a small central circle. The suns in the *lateral square panels* are identical to each other but distinct from those in the *central square panels*. The squares and rotated squares in these panels resemble a Jewish cross but with eight points instead of six. The *right intarsia* mirrors the left *intarsia*, with their respective *square panels* inverted and specularly unfolded, exhibiting a vertical axis of symmetry that divides the east side into two identical halves. All three *intarsias* are encased in rectangular bands, within which the other square panels are positioned (Appendix 26, (LMW, CMW and RMW)).

The *northeast side* is adorned with *three intarsias* (*left*, *center*, and *right*), positioned above the respective mullioned windows. The *left intarsia* consists of *two square panels* (*left* and *right*). The *left square panel* features a radial composition inscribed in a square frame, comprising eight cuneiform spokes with the wedge vertex facing outward and an eight-pointed star with curved sides at the center. The *right square panel* also showcases a radial composition formed of eight segments of a circle, with the most curved sides-oriented inwards, and an eight-pointed star with curved sides at the center. The *center intarsia* consists of *two lateral*, vertically oriented *rectangular panels* and a *central*, horizontally oriented *rectangular panel* (*left*, *central*, *right*). The *left* and *right rectangular panels* are vertically oriented rectangles with a molding profile consisting of two affronted *cyma recta* and two *cyma reversa* on their upper

inner sides, distinct from the other three, which are straight. The *central rectangular panel* features a composition of forty cuneiform axes in two groups of twenty axes each, bound together through a horizontal axis of symmetry, all framed in a rectangle. The *right intarsia* follows the same subdivision pattern as the central *intarsia*. The *left* and *right rectangular panels* are akin to those of the central *intarsia*, except for their upper inner sides, which feature a molding profile with two affronted quarter circumferences and two diagonal lines instead of two affronted *cyma recta* and two *cyma reversa*. The *central rectangular panel* comprises twenty-six triangle-like axes in two groups of thirteen axes each, arranged in a relation of unbinding affrontature through a horizontal axis of symmetry, all framed in a rectangle. The three *intarsias* are framed by rectangular bands, within which the other square and rectangular panels are positioned (Appendix 27, (LMW, CMW and RMW)).

On the *northwest side*, *three intarsias* are positioned above the mullioned windows, labeled as *left*, *center*, and *right*, respectively. The *left intarsia* consists of *three-square panels*, further labeled as *left*, *central*, and *right*. The *left* and *right square panels* feature circular centers inscribed with a rotated square, followed by a circumference, all enclosed within a square band of considerable width. In contrast, the *central square panel* is a floral composition with an eight-pointed star featuring curved sides and a hollow center, along with four double wedge-shaped petals and four radial *mandorlas* within a circular background. This entire composition is inscribed in a square background with four additional double wedge-shaped petals on their four angles. The *center intarsia* is divided into *three square spaces* labeled as *left*, *central*, and *right*. The *left* and *right square panels* explicitly represent the chalice of Christ's blood, framed in square bands of considerable width. Meanwhile, the *central square panel* implicitly represents divinity through a full red marble circle within circumferences of green and white marble. These are all inscribed on a square background of green marble. The *right intarsia* shares the same subdivision pattern as the left and center intarsias but features distinct designs. The *left* and *right square panels* are phytomorphic compositions beginning with an eight-pointed star center, from which four diagonal petals emerge resembling three-petal lilies. These compositions are framed in square bands of considerable width. The *central square panel* starts with a square inscribed in a rhombus, followed by a circumference flanked tangentially by four small circumferences on its four diagonal ends, all set on a circular background. Finally, this composition is framed in a square background. All three *intarsias* have rectangular bands as frames within which the other square panels are placed (Appendix 28, labeled as LMW, CMW and RMW).

The *southeast side* precisely corresponds to the northeast side. The *left intarsia* mirrors the right *intarsia* on the northeastern side, and conversely, the *right intarsia* on the southeastern side is a mirror image of the left *intarsia* on the northeastern side. Additionally, the *central intarsias* on both sides are not only identical but also occupy the same position. It is evident that the southeast and northeast sides feature identical intarsias but with a transverse orientation. Specifically, the left *intarsia* on the southeast side corresponds to the right *intarsia* on the northeastern side, and vice versa. The central *intarsias* maintain their central positions on the mullioned windows (Appendix 29, (LMW, CMW and RMW)).

A comparable correspondence is evident in the *intarsias* on the *southwest side*, unambiguously aligning with those on the northwest side. The *left intarsia* on the southwest side is identical to the right *intarsia* on the northwest side, while the *right intarsia* on the southwest side mirrors the left *intarsia* on the northwest side. Moreover, the *central intarsias* on the southwest and northwest sides are not only identical but also share the same position. Consequently, the two sides feature identical *intarsias*, albeit in transversely opposite locations. Specifically, the left *intarsia* on the southwest side corresponds to the right *intarsia* on the northwest side, and vice versa. The *central intarsias* maintain their original positions at the center of the mullioned windows. The intentional and rhythmic correspondence in the compositional strategies of the geometric designs in the flooring, as well as in the arrangement of decorative elements in the mullioned windows of the second internal order, is not

coincidental. Intriguingly, this correspondence also manifests in a distinct manner on the friezes of the entablatures of the third external order (attic) (Appendix 30, (LMW, CMW and RMW)).

Baptistery friezes: lateral bands and ornamental configurations

Concluding our examination of the friezes on the entablatures of the second external order, the *south side* features a band composed of circles arranged in sequential juxtaposition. Each circle exhibits a radial geometric decoration, encompassing a variety of basic shapes within them, resulting in compositions inspired by phytomorphism. Notably, among the thirty-six small circles, a few repeat themselves, showcasing intricate and distinct flower-like designs reminiscent of spirographic compositions (Appendix 14). Conversely, the *southwest side* displays a band of sequentially juxtaposed rhombuses (rotated squares). Only five of these rhombuses feature an inscribed design, two of which present cross-like shapes, while the remaining three exhibit radial and concentric-inspired compositions (Appendix 14). Similarly, the *west side* presents a series of sequentially juxtaposed rhombuses (rotated squares), with only six of them adorned with inscribed designs. Two of these feature cross-shaped elements, while the other three showcase radial and concentric compositions (Appendix 13). The *northwest side* follows the same distribution pattern as the previous two sides, with five decorated rhombuses containing compositions inspired by radial and concentric elements, ranging from simple to complex geometry (Appendix 13). Remarkably, the *southeast side* stands out as the sole side featuring a band of sequentially juxtaposed, uninterrupted geometric compositions. These compositions originate from two diagonally intercrossed *mandorlas*, resulting in a center resembling a rotated square with four curved sides and an embedded cross (Appendix 15). In summary, the prevailing designs in these adorned friezes stem from rotated squares and circles, laden with Christian symbolism. The employed geometric composition strategies encompass symmetry based on vertical, horizontal, and diagonal axes, radiality, and concentricity. The analysis also reveals the presence of original modules, compositional modules, and final compositions within the rhombuses and circles, including the rhombuses and circles themselves (Fig. 31) (Appendices 13-16). The analysis of the friezes reveals a meticulous use of geometric shapes—circles and rhombuses—imbued with Christian symbolism and crafted through intricate patterns of radiality, symmetry, and concentricity. The detailed examination uncovers both originality and repetition within these forms, emphasizing a sophisticated design strategy (Fig. 32). Overall, the friezes represent a harmonious blend of geometry and symbolic expression, reflecting the complexity and creativity of the architectural decoration.

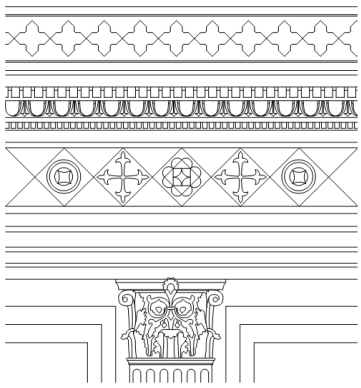

Fig. 31. Representation of the five lozenges with geometric decoration, that adorn the frieze of the entablature of the third external order or attic

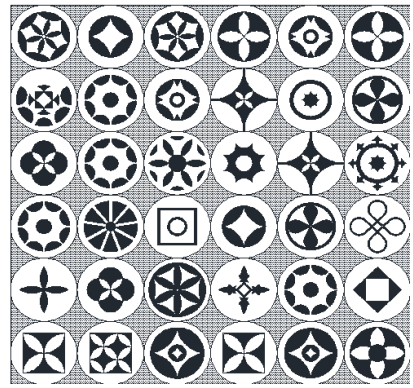

Fig. 32. Representation of the thirty-six circles within their respevtive lozenges with geometric decoration, that adorn the frieze of the entablature of the third external order or attic

Conclusions

Importance of geometry in paving Design

Among the variables considered in the research hypothesis, it was identified that the most pivotal factor for acquiring both qualitative and quantitative data was the "geometry of the paving." This significance surpassed other variables, including "the women's galleries mullioned windows of the second internal order" and "the entablatures friezes of the third external order." Traditional and recovery surveys played a crucial role in understanding the geometry of compartments, slabs, tiles, and contour bands. The detailed measurement and representation of the Florence Baptistery's paving, as outlined in the specific objectives of this investigation, would have been impossible without photogrammetric surveys. The recovery of the original forms, envisioned by medieval artists on the drawing board, emerged as the primary strategy. This strategy not only facilitated the accurate interpretation of both geometric and non-geometric original forms but also enabled the exploration of pagan or Christian symbolism associated with specific non-abstract forms.

Evolution of geometric compositions

The progression and maturation of geometric forms, evolving from an initial module to a compositional unit, reaching a full-fledged composition, involved strategic grouping techniques such as 'affrontature,' 'specularization,' and 'sequential juxtaposition.' While the investigation did not initially anticipate the examination of the pavement's geometry as a specific objective or part of the overarching hypothesis, it emerged as a noteworthy categorization of modules. This classification proved instrumental in comprehending the inherent genesis of geometric compositions across various levels of the Florence Baptistery.

Distribution and symbolism in paving sectors

Approximately 85% of the compartments across the eight paving sectors originate strictly from geometric designs, and there is no evident differentiation in terms of geometric or non-geometric origins among the various sectors. Compartments with geometric compositions are present in all sectors, dispersed without a discernible pattern. However, grouping compartments based on this criterion proves challenging due to the gradual and unplanned nature of the paving's design and construction, spanning from 1205 to potentially 1207. The completion of the marble intarsias in the San Miniato al Monte pavement is believed to have occurred concurrently with the Florence Baptistery, evidenced by the perfect alignment of the two zodiac circles in the pavements of both religious monuments.

In essence, the pavement designs within the Florence Baptistery are deeply rooted in the interior embellishments of Roman structures, such as the Pantheon, renowned for its extensive use of polychrome marble compositions. Originally, the baptismal font occupied the central space of the flooring, now an octagon crafted from cocciopesto. The floor boasts marble inlays that continue to be highly esteemed. Some of these inlays draw inspiration from oriental geometric motifs, while others replicate nature through phytomorphic and zoomorphic designs, often featuring fantastical creatures like griffins. Additional inlays are influenced by pagan or Christian themes, as well as the intricate decorative patterns of the barbaric peoples in northern Europe. Mosaics from textiles in the southern and eastern Mediterranean regions also served as a wellspring of inspiration for other designs. The bichrome inlaid mosaics of the flooring were likely crafted by the same artisans who labored at San Miniato al Monte until 1207.

Sector-specific characteristics of the pavement

The pavement of the Florence Baptistery, with its intricate design, is categorized into various sectors, each characterized by unique geometric patterns, phytomorphic and zoomorphic influences, and symbolism drawn from both pagan and Christian sources.

- **North sector:** Dominated by geometric elements, featuring a spirographic design in the central compartment and complex contour bands inspired by floral and Norse elements.

- **South sector**: Shares similar geometric foundations with occasional zoomorphic motifs, such as the fish-eye inspired design, and a kaleidoscopic pattern in a slab near the south door.
- **East sector**: Marked by a phytomorphic slab featuring intricate tiles with concentric designs.
- **West sector**: Minimal ornamentation, focusing on the altar area, with an exception in the north triangular compartment adorned with phytomorphic stripes.
- **Northeast sector**: Features intricate designs like alternating squares and rhombuses, producing captivating optical illusions.
- **Northwest sector**: Showcases intricate designs, particularly in Compartment 1, creating a chessboard-like pattern with unique color orientations.
- **Southwest sector**: Characterized by curved lines and rhythmic juxtaposition of green marble, deeply symbolic of Christian baptism.

Mullioned windows and intarsia designs

The mullioned windows of the Baptistery, particularly in the second internal order, feature distinct intarsias that combine Christian symbols, natural elements, and geometric patterns. These inlays, made from white, green, and occasionally red marble, are divided into square and rectangular panels that vary in composition depending on their placement. The windows are arranged across all sides of the structure, with each mullioned window adorned with three intarsias, each possessing unique designs yet often sharing similar geometric forms across different sides.

The east, northeast, and northwest sides exhibit specific correspondences in their intarsia designs, with mirrored and identical patterns between opposite sides, indicating intentional and rhythmic compositional strategies. These arrangements reflect a deliberate and symmetrical approach in the design, not only in the intarsias but also in the corresponding friezes of the third external order (attic), showcasing the cohesion of the decorative elements across the Baptistery. The geometric and symbolic precision in these intarsias underscores the intricate and meaningful design choices made in the structure's decorative scheme.

Geometric friezes and symbolism

The friezes on the entablatures of the second external order feature intricate geometric designs across different sides, each with distinct symbolic and decorative elements:

- **South side**: A sequence of thirty-six circles arranged with radial geometric patterns evoking phytomorphic motifs, including flower-like designs.
- **Southwest and west sides**: A series of sequential rhombuses (rotated squares), with some featuring inscribed designs such as crosses or concentric radial patterns.
- **Northwest side**: Mirrors the southwest and west sides, maintaining the same distribution of decorated rhombuses.
- **Southeast side**: Features a continuous band of geometric compositions formed by two intercrossed mandorlas, resembling a rotated square with curved sides and a cross embedded within.

These frieze decorations incorporate a variety of geometric forms, particularly circles and rhombuses, imbued with Christian symbolism. The elements are arranged with a clear compositional strategy based on vertical, horizontal, and diagonal axes, creating a sense of balance and harmony. The analysis reveals both original and repeated design modules, contributing to a sophisticated aesthetic strategy that blends geometry with symbolic expression. The meticulous use of geometric patterns, such as radial and concentric compositions, highlights the complexity and creativity of the architectural decoration, making the friezes an integral part of the baptistery’s visual and symbolic language.

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