

Research Article

Arches, Columns, and Domes: Architectural Evolution from the Renaissance to the Baroque Era

Vivaan Poddar*

Jayshree Periwal International School, Jaipur, India

Abstract

This research paper examines the evolution of architectural designs of arches, columns, and domes from the Renaissance to the Baroque period, uncovering the shifting cultural and artistic priorities of these eras. The analysis reveals how Renaissance architecture, characterized by symmetry, balance, and classical geometry, reflected the humanistic values of rationality and order. In contrast, Baroque architecture introduced dynamic, theatrical elements, prioritizing emotional resonance and spiritual grandeur. The paper demonstrates how these elements evolved in complexity, functionality, and symbolism by comparing notable structures such as Brunelleschi's Florence Cathedral and Borromini's San Carlo alle Quattro Fontane. The findings underscore that architecture during these periods was not merely a physical endeavor but also a profound cultural narrative. Through this exploration, the study highlights how the innovations of these styles continue to shape modern architecture, leaving an enduring legacy of creativity and beauty.

Keywords

Renaissance Architecture, Baroque Architecture, Arches, Columns, Domes, Cultural Evolution

1. Introduction

Picture yourself entering into a vast, seemingly endless, ceilinged architectural masterpiece or perhaps wandering through a spacious hallway where the columns meander and twist as they become impossible forms. These powerful images and experiences aren't just about the mesmerizing visuals but also illustrate a dramatic architectural evolution between the Renaissance and Baroque periods.

The Renaissance architects in the 14th to early 17th centuries took major influence from the ancient Greek & Roman structures and concentrated on symmetry, proportion & balance. On the other hand, the Baroque period, which began in 1580, was a radical change of style. Architects of the time created structures that overwhelmed one's senses,

captivating passersby who gazed upon structures that appeared to be somewhat alive [14].

In the Renaissance, architecture became a science as much as an art; everything in composition was to be proportional and ideally significant with its part of the whole [5]. The nature of architecture seemed to be governed by an almost perfect balance between all elements. Arches and architraves had specific curvature designs, domes, symmetrical geometry formations, and columns that followed classical orders carefully to give a notion of stability and order. The architecture was more than aesthetic; it mirrored the humanism of the Renaissance, its belief in man's intellect and creativity.

*Corresponding author: vivaanpoddar161@gmail.com (Vivaan Poddar)

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Being a transitional phase between the two, mannerism was an artistic style that predominated in Italy from the end of the High Renaissance in the 1520s to the beginnings of the Baroque style around 1590. The Baroque marked a departure from the elegance of Renaissance classicism and became even more ornate, vigorously active, and dynamic in style [8]. This ultimately resulted in an interest in imperfection - imperfect shapes to a certain degree, or even outright deformations - and the introduction of more emotions/movement within structures. The architects started to indulge in heavier forms and more complex structures with curves, spirals, and exaggerated designs, which could be considered gigantic monuments that were created for the gods. Now, arches, domes, and columns are more about creating atmosphere than physical structure.

Considering the aforementioned, this research paper aims to answer the following question: *How did the architectural designs of arches, domes, and columns evolve from the Renaissance to the Baroque period, and what do these changes reveal about the shifting cultural and artistic priorities of the time?*

This paper argues that the evolution of arch, dome, and column designs from the Renaissance to the Baroque period reflects a significant shift in cultural and artistic priorities. Baroque architecture emphasizes emotional impact and dynamism over the Renaissance's focus on symmetry and harmony.

2. The Arch

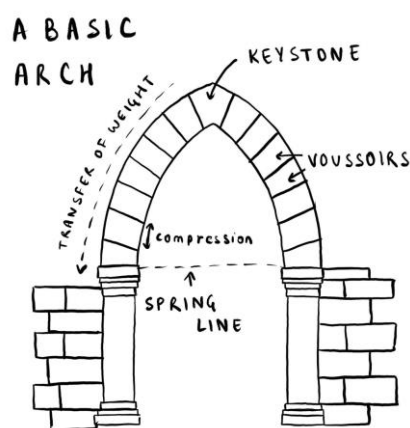


Figure 1. An Arch: sketched using Adobe Illustrator.

An arch is an architectural element that dates back to ancient civilizations, with its development playing a pivotal role in Renaissance and Baroque architecture. The basic structure of an arch includes several key components: the keystone, voussoirs, and a spring line [4]. The central wedge-shaped stone at the apex of the arch is called a keystone, which serves to lock all other stones into their

places. The wedge-shaped stones comprising the curved portion of the arch support the keystone; these are called the voussoirs. The spring line is an imaginary line or plane from which the arch springs; it is the starting point where the curve commencement occurs on each side of the arch.

The physics that makes arches structurally sound involves the distribution of weight and the transfer of loads. Arches are particularly effective in routing the force of gravity downward because their curved structure converts this force into compression, which pushes outward along the curve. This compression is then transferred down to the spring line and into the supporting structures or foundations. This design allows arches to carry heavy loads without collapsing. Unlike a flat beam, which would bend or break under excessive stress, an arch disperses the load evenly, making it significantly stronger [1].

The structural integrity of an arch is rooted in the principle of compression. Most building materials, such as stone and brick, are much stronger under compression than tension. The design of the arch takes advantage of this property, as the forces acting on an arch are predominantly compressive. This ensures that arches maintain their form and stability over time, even under substantial loads.

2.1. The Application of Arches in Renaissance and Baroque Architecture

Between the 14th and early 17th centuries, architects during the Renaissance period looked back to the classical architectural precepts of the Romans and Greeks. They integrated them into new designs but with symmetry, proportion, and harmony. Arches from the Renaissance typically exhibited a semi-circular feel and were applied together with columns and pilasters in an attempt to add order and balance. Arches were used in restraint, often incorporated into building facades, arcades, and even window construction to provide a coherent and consistent architectural language. The Basilica of Sant'Andrea at Mantua by Leon Battista Alberti expressed the Renaissance stimulus toward geometric precision and Classical proportions [10].

Being the movement between Renaissance clarity and Baroque dynamics, arches in the Mannerist style were segmental, entangled, or displaced, creating tension and visual ambiguity. Costa's Palazzo Te in Mantua exemplifies this with double arches and unexpected curvature breaking classical symmetry. This was also a precursor to the Baroque era's complex, dynamic, and expressive arches. Baroque architects used arches not only as structural elements but also as decorative features to enhance the drama and theatricality that the style promised even more. While the arches of the Baroque are often elliptical or oval, suggesting a fluidity of motion, somewhat less common to the more restrained expression of the Renaissance style, this period saw the use of arches being much more ornate and inventive: put into facades, interiors, and complicated compositions intended to

stir a specific emotional response [11].

While both dealt considerably with arches, they became even more salient features of the Baroque style because the latter was more inclined toward dynamic forms and heavy ornamentation. This style, in the usage of arches, pushed the boundaries beyond the imaginable construction, incorporating grandeur, movement, and complication.

2.2. Examples of Arches in Renaissance and Baroque Architecture

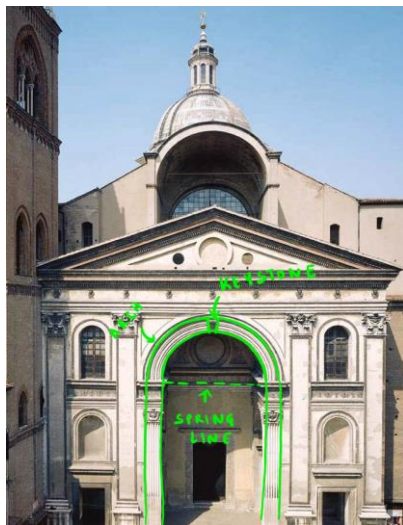


Figure 2. Basilica of Sant'Andrea, Mantua (designed by Leon Battista Alberti, construction began in 1472).



Figure 3. Church of the Gesù, Rome (designed by Giacomo Barozzi da Vignola; façade by Giacomo della Porta, completed in 1584).

A perfect example of the use of arches in Renaissance

architecture is the Basilica of Sant'Andrea in Mantua by Leon Battista Alberti, as seen in [Figure 2](#). Using semicircular arches, Alberti inserted a triumphal arch motif into the basilica's facade. Furthermore, the arches carry through the weight of the facade itself, providing aesthetic cohesion. This is exemplary of the Renaissance emphasis on symmetry and classical proportions in design, as seen in the proportionate scale of the arches relative to the surrounding columns and pilasters. In this context, arches are not only functional, serving as a distributive method of weight and support for the structure, but also aesthetic, reinforcing the harmonic, balanced composition typical of Renaissance architecture [10].

On the other hand, the Gesù Church of Rome, captured in [Figure 3](#), represents an example of the Baroque period, where the innovative use of arches enhances both dynamic movement and decorative effect. Giacomo della Porta designed the facade of the Gesù Church, while Giacomo Barozzi da Vignola was responsible for the church's overall design. The use of arches is dramatized on both its facade and interior [19]. Each of the arches at its facade plays a structural and expressive function, framing niches and windows, as well as other architectural elements that impart motion and energy—hallmarks of the Baroque style. Inside, the church employs arches to frame chapels and altars, drawing the viewer's eyes along curving lines and creating an ever-changing play of light and shadow, a defining characteristic of Baroque architecture's dramatic and theatrical aesthetic.

3. The Column

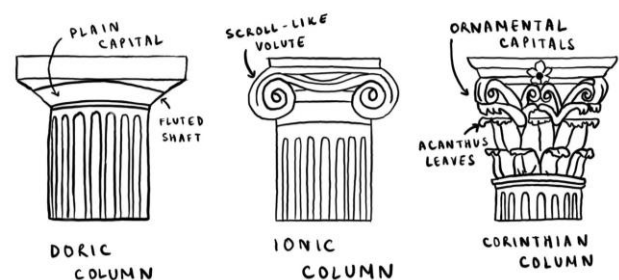


Figure 4. Columns: sketched using Adobe Illustrator.

Columns are an integral part of classical architecture. They can either be functional or just for decoration. The three main column orders are Doric, Ionic, and Corinthian, each with peculiarities flowing from their origin in Ancient Greek architecture. The Doric column is the most stark, the biggest of the three, and the strongest, with a plain capital, a fluted shaft, and without a base. It is, therefore, solid and rugged-looking. Doric columns have come to represent strength and are thus most used in structures where a heavy

and supported look is needed. The Ionic column is slender and graceful, identified by the scroll-like volutes in its capital and a base to raise the shaft. The Ionic order speaks to elegance and is usually applied for lighter and finer buildings. The Corinthian column is the most elaborate, with highly ornamented capitals featuring acanthus leaves. The latter style is most ornate and is commonly employed where significant effect and detail are desired [2].

Structurally, columns work on the principles of load-bearing and weight distribution. When a load is applied upon a column, the force is transmitted vertically down through the shaft and dispersed into the building's foundation [16]. Columns are particularly effective in compression - that is, they are particularly effective in supporting very heavy loads from forces that work downward on them. The material, height, and diameter of a column significantly influence its weight-bearing capabilities; shorter and thicker columns can bear more weight than taller and thinner ones because the latter are more prone to buckling. Additionally, the physics of columns involves balancing forces to prevent collapse. With their vertical orientation, columns efficiently transform horizontal forces into vertical forces that the foundation can sustain. This effective force distribution alone makes columns better suited to carrying roofs, entablatures, and other building features.

3.1. Columns in the Renaissance and Baroque Periods

Columns saw their rebirth during the Renaissance, from the 14th to the early 17th century, from classical Greek and Roman architecture. Through direct use of sources, such as Vitruvius or actual Roman building ruins [18], Renaissance architects aimed to attain the same clarity, symmetry, and proportion as those achieved by the ancients. One of those responsible for this revival was Andrea Palladio, who supported the classical orders of Doric, Ionic, and Corinthian in his designs. The work of Palladio, especially his "I Quattro Libri dell'Architettura" or "The Four Books of Architecture" [12], underlined the importance of columns in creating a well-balanced and harmonious structure. The column for Palladio was not a mere decoration but was an essential feature to achieve an architectural order in buildings representative of humanist ideals of beauty and rationality. His designs often showed a strict adherence to classical proportions in which columns were used to create a balance and stability evocative of the broader Renaissance striving for order and symmetry.

During the transitional phase of Mannerism, columns began to take on a more expressive and even ironic role, which challenged the classical conventions rather than simply following them. This was quite evident in the works of architects like Giulio Romano, particularly the Palazzo del Te in Mantua, which used columns in intentionally awkward or unconventional ways to create an element of tension or

surprise. Mannerist architects also strategically used columns in a more ornamental than structural manner, which started to lay the foundation of how columns would be used in the baroque period, i.e., for reinforcing theatricality and emotion.

The Baroque period, in general, from the late 16th to the mid-18th century, had another way of interpreting the use of columns. While the Baroque architects used classical orders, they did it in such a way as to enhance movement and grandeur, often theatricality. Columns were also much more decorative in their carving, gilding, and elaborately treated capitals that stretched conventional design. They formed part of a composition that incorporated other elements such as pilasters, entablatures, and arches, often in a layering effect to produce deeply modulated facades that dramatized light and shade. This deployment of columns is less a question of strict proportion and more one of dynamic appearance, which chimes with the essential Baroque concern with emotion, drama, and spectacle. One feels this immediately in the omnipresent use of columns in Baroque architecture, but most specifically in the use of Solomonic-twisted or helical columns that helped to give a sense of movement and energy to facades and altarpieces [9]. Such inventions point to the essential spirit of Baroque, which is to address the watcher's senses and emotions, as opposed to the more discrete and planned use of columns during the Renaissance.

3.2. Examples of Columns in Renaissance and Baroque Architecture

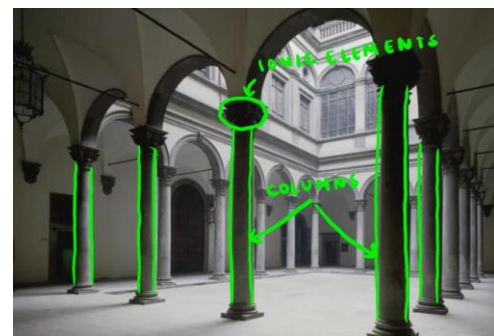


Figure 5. Palazzo Rucellai, Florence (designed by Leon Battista Alberti, constructed between 1446 and 1451).

A prominent example of the use of columns in the Renaissance is the Palazzo Rucellai of Florence, as seen in Figure 5, by Leon Battista Alberti, designed during the middle of the 15th century. Alberti adopted the ancient orders of columns to provide a front that expresses balance, proportion, and harmony. Pilasters - a column that projects from but is attached to a wall - were placed on the building's facade in hierarchical order: Doric on the ground floor, Ionic on the second floor, and Corinthian on the top floor [20]. It not only tends to the structure but also imparts a rhythm upwards to the eye, satisfying those ideals of order and symmetry relevant to

the Renaissance period. This is how Palazzo Rucellai by Maiano can serve as a perfect example of how Renaissance architects could use columns to evoke the classical past and still achieve a harmonious and rational design that suited their time.

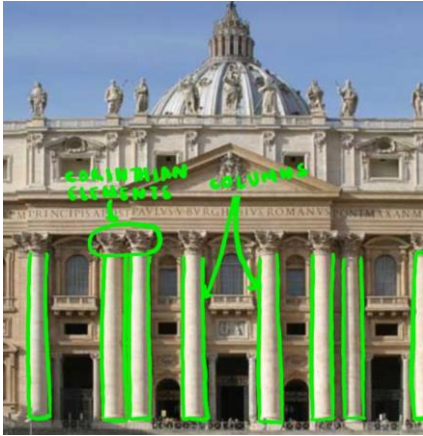


Figure 6. St. Peter's Basilica (façade designed by Carlo Maderno, completed in 1612; overall basilica constructed 1506-1626, Vatican City).

On the other hand, the St. Peter's Basilica facade by Carlo Maderno in Vatican City, seen in [Figure 6](#), completed at the beginning of the 17th century, follows a somewhat different approach to columns - the Baroque one. A couple of enormous Corinthian columns stand on the facade, creating a powerful visual effect and a sensation of its enormous size [6]. These support a deep entablature and form part of a larger, dynamic composition in which the play of light and shadow is used to enhance the theatrical effect of the building. The columns at St. Peter's Basilica are not merely supportive but form the core of the architectural drama in creating an awe-inspiring experience for the viewer. This use of columns agrees with the Baroque purpose of enhancing emotions, fully contrasting with the more restrained use of columns in Renaissance architecture.

4. The Dome

Domes are one of the wonders of architecture, representing engineering genius along with aesthetics. A dome's basic structure includes several important elements: the drum, the pendentives, and the oculus. In this case, the base will be cylindrical, called a drum, which raises the dome to transfer its weight onto supporting walls or columns [17]. Pendentives are arched triangular features that transfer the square or polygonal plan of a building's base to the circular shape of the dome. Finally, there is the Oculus (open or covered) - a circular opening at the crown that provides less weight at the dome's apex and often serves as a natural light source.

Domes depend on a system of compression. When weight presses on a dome, it is distributed along the curve, pushing outward and downward toward the base. A dome can support a considerable load without collapsing, even when covering a vast interior space. However, this outward force - known as thrust - creates a structural challenge: the dome's base must counteract this outward thrust to prevent breaking or bulging. Reinforcements such as buttresses, thickened walls, or iron chains embedded within the drum counteract this outward force, ensuring the dome's stability. The dome's shape also helps evenly distribute the loads applied to it. Domes transfer downward pressure into radial compression forces, allowing them to span large openings without requiring internal supports. This efficiency of design makes domes an ideal architectural choice for large public spaces, as they create expansive, unobstructed interiors free from columns or beams.

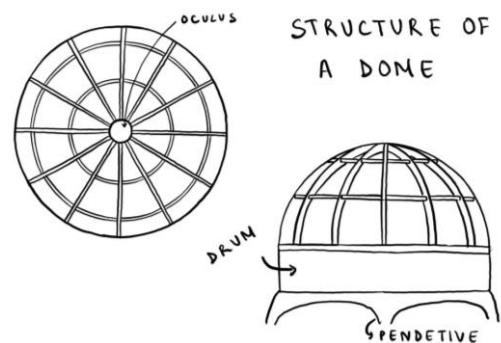


Figure 7. A Dome: sketched using Adobe Illustrator.

4.1. Domes in the Renaissance and Baroque Periods

During the Renaissance, architects revived dome construction techniques inspired by classical antiquity, above all Roman buildings such as the Pantheon. The Renaissance prized balance, harmony, and classical proportions, and the domes became icons of these values. The resurgence of domes during this period began with Filippo Brunelleschi, whose engineering innovations redefined dome construction and influenced subsequent generations of architects. His solution for the dome of the Cathedral of Florence, Santa Maria del Fiore, expressed how classical engineering could be combined with the Renaissance ideal of proportion and symmetry.

During the mannerist period, domes began to take on more ambiguous and experimental roles. Once again, this was a reflection of the broader mannerist tendency to disrupt classical expectations. This shift manifested in several ways. For instance, there was a subversion of the classical form of domes whereby they were flattened and distorted or even oddly proportioned to create visual tension. The architecture of this time also played with illusion and structure, whereby in

some churches, painted domes replaced structural ones entirely or merged into the ceiling, confusing boundaries between architecture and illusion. Somewhere, this was a glimpse into the greater emotional role that domes were going to take during the Baroque period.

In line with the above, the Baroque period - roughly from the late 16th to the mid-18th century - pushed the construction of domes into fresh dimensions of visual drama and structural complication. While the Renaissance aimed to attain symmetrical forms in domes, Baroque architects utilized them to enhance dynamic compositions and emotional effects. Baroque domes were often far more spectacular and provided with elaborate stucco work, gilding, or painted frescoes, creating illusions of movement and depth. They lay at the center of awe-inspiring interiors, designed to lead the viewer's eye upwards in a sense of divine grandeur. Baroque architects also moved toward more complex geometries and inventive manipulations of light by using hidden windows and oculi to make dramatic contrasts of light and dark. Domes now came in far larger expressive compositions tending toward the Baroque ideal of a theatrical, immersive architectural experience [3].

4.2. Examples of Domes in Renaissance and Baroque Architecture

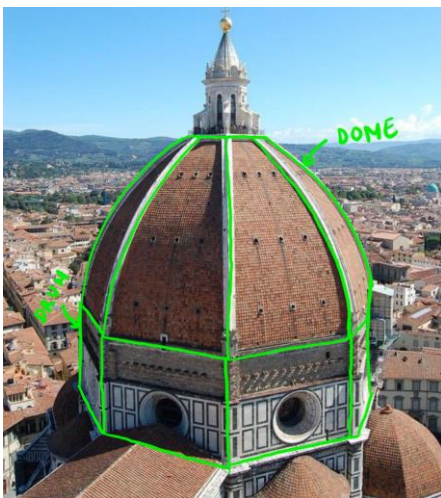


Figure 8. Santa Maria del Fiore (Florence Cathedral dome engineered by Filippo Brunelleschi, completed in 1436).

One of the most famous examples of Renaissance dome building is seen in Figure 8 in the dome over the Florence Cathedral (Santa Maria del Fiore) by Filippo Brunelleschi. Brunelleschi's dome, built from 1420 to 1436, was an innovative feat for its size and engineering. No dome this big ever existed without scaffolding at that time [13]; Brunelleschi's solution was a double-shell construction with two domes, one inside the other. This double-shell structure reduced the dome's weight and allowed for added stability and

a walkway between the shells. Brunelleschi achieved the building of the dome without central support through his specific method of using bricks in a herringbone pattern, which directed the forces down to the base. Tension chains made of wood and stone within the design counteracted the outward thrust, binding the dome together and preventing it essentially from expanding. This invention enabled Brunelleschi to build a dome more than 140 feet in diameter, something that had never been done before [15]. The dome of the Florence Cathedral sums up the Renaissance ideal of the search for perfection both in technique and taste, and provides an example of how ancient ideas could be adapted to the present.

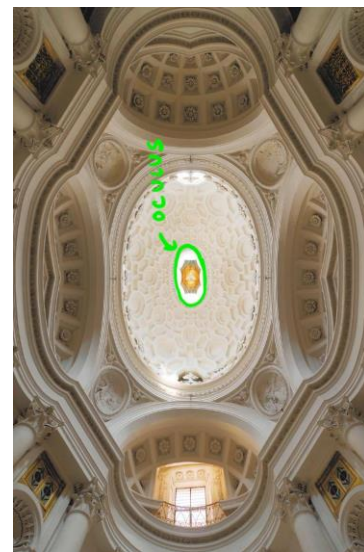


Figure 9. Church of San Carlo alle Quattro Fontane, Rome (designed by Francesco Borromini, constructed 1638-1646).

Well into the Baroque period, the dome for the Church of San Carlo alle Quattro Fontane in Rome by Francesco Borromini, captured in Figure 9, is a true example of the accomplished developments in dome construction made by the Baroque architects [7]. Completed in 1646, Borromini's dome is unique for its complex geometry and ornamental intricacy. Instead of being merely hemispherical or circular, Borromini's dome is oval, which is a departure from the Renaissance norms and provides an effect of movement and expansion. This choice reflects the Baroque fascination with dynamic forms and spatial innovation. Inside, the dome's surface is articulated with hexagons, octagons, and crosses in intricate stucco work. This design not only gives a sense of depth but also manipulates light and shadow to enhance a three-dimensional sense, thus making space appear even larger. Borromini also designed hidden windows at the dome's base to allow natural light to filter through and enhance the dome's already ethereal and uplifting quality. While the dome of Florence Cathedral was balanced and symmetrical, San Carlo is typical of the more experimental approach found in the Baroque,

using architectural forms to express spiritual wonder.

5. Conclusion

This research paper has proven that the transformation of arches, columns, and domes from the Renaissance to the Baroque periods is a reflection of something far more than stylistic variation - it signifies a fundamental shift in the manner in which architecture was used to communicate power, identity, and belief. Rather than simply serving decorative or structural purposes, these architectural elements evolved into powerful instruments of ideological messaging. The measured harmony of the Renaissance was a reflection of the era's commitment to rational humanism and civic virtue, where architecture was a testament to man's intellectual order and classical revival. In contrast, the dynamic and theatrical designs of the Baroque period emerged as deliberate tools of persuasion, aligning closely with the rise of absolutist power.

Crucially, the mannerist movement served as a bridge between these two architectural eras. It introduced distortions, exaggerations, and playful complexities in the use of classical elements. These experiments destabilised Renaissance order and laid the conceptual and stylistic groundwork for the dramatic expressiveness of the Baroque. In this sense, Mannerism was not merely a stylistic curiosity but a vital stage in architecture's evolving cultural role.

The evolution of the elements of arches, columns, and domes from one era to another highlights how architecture both shapes and responds to the values of its time. Architecture, therefore, stands not just as a built environment but as an active participant in historical discourse, encompassing cultural aspirations, ideological shifts, and collective identity in stone and space.

Author Contributions

Vivaan Poddar is the sole author. The author read and approved the final manuscript.

Conflicts of Interest

The authors declare no conflicts of interest.

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