

HISTORY, MORPHOLOGY AND PERFECT PROPORTIONS OF MUGHAL TOMBS: THE SECRET TO CREATION OF TAJ MAHAL

Krupali Uplekar Krusche, Danny Aijian, Selena Anders,
Iva Dokonal and Jill Kapadia

Abstract

This study investigates the language of architecture of the east. Traditional Islamic architecture, especially Mughal architecture and its influence on India is examined through developmental growth and lineage of Mughal tombs. This paper basically presents research with emphasis on clarity of spatial characteristics on four Mughal tombs in India, two of which are world heritage sites including the world renowned Taj Mahal. A strong context of methodological approach in unfolding the codex of architecture at Taj and influences of its predecessors in creating this magnificent monument is examined. A key to some of the unknown mysteries of architecture in India, this paper can be of reference to historians, architects and the general reader alike in understanding what makes Taj the pinnacle of architecture in India. It lays emphasis on how western architectural students can get a better understanding of the paradigms of architecture in east. With methods like comparative understanding of ordering principles, proportional analysis and studies of composition and approach, this paper explains the process of systematically understanding the ground rules of architectural composition of non-western culture, especially Mughal architecture as developed through the renaissance phase in the east (AD 1508 to 1707).

Keywords

Mughal architecture; tomb design; Indian architecture; Taj Mahal; Humayun's Tomb.

Introduction

The era of Hindus that survived for more than 2500 years was highly transformed through the epoch making change brought by Islam in India. The Mughal invasion of India in AD 1400 saw a new rise of a refined set of planning tools that led to the creation of some of the finest contributions of Islamic architecture in India, ranging from mosques, tombs, palaces and forts that related to the architecture of that age and time. Mughal architecture found its roots in India and brought in influences from the West through Islamic planning principles refined by scholarly exchange between Persia and Europe. The idea of the use of shell dome construction and pointed arches brought a whole new perspective to architecture in India. This architecture served as a necessary statement pertaining to religion, through the use of an architectural language that infused both Hindu and Islamic principles, to further emphasize the permanence of the Mughal

Empire in India. Monumental tomb buildings that followed the principles of sacred geometry, proportion and scale were imposed rigidly on the landscapes of India's soil. As Brown (1990, p. 2) explains the following:

"The Indian masons had, for many centuries been engaged on the erection of great stone temples of exquisite design, and to their artistic ability the conquerors gave undoubted credit. On the other hand the conquerors not only brought with them an infusion of new blood, but also innovations gained from other lands, fresh principles and practices which had proved effective under all conditions."

This initiated a new era of prosperity in intellectual and artistic enhancement through the skills transferred by Persian craftsmen to traditional Hindu builders. The period of Mughal occupation has come to be known as the renaissance age of India and it led to the construction of some of the most magnificent freestanding monumental sacred buildings in the country.

This paper examines the Islamic planning system and the techniques used in building construction and design during the introduction and use of sacred building in the Mughal period (AD 1480 to 1858). The study is based on the analysis and documentation of four sacred tombs, two of which are world heritage sites, built in this period. They include and represent the most refined use of geometry and proportions that express a wealth of knowledge and artistic skill that developed in India during the renaissance period in the East. This paper investigates the architectural language utilized in creating one of the wonders of the world, Taj Mahal, while understanding the architectural lineage of tombs that helped bring the experience to

perfection. Elements of Mughal tomb design are explained and simplified so that they can be studied individually and as a whole to help the reader comprehend the components that make up Mughal designs.

Linage of Mughal Tombs in India

Before engaging in a discussion of design principles, it is necessary to briefly describe the history of the monuments in question, as well as their precedents: Mughal occupation of India began with the arrival of the Mughal Emperor Zāhir ud-Dīn Mohammad Babur (1483-1530). Known as the Mughal prince, Babur descended on his mother's side from the 13th century Mongol Temüjin Genghis Khan (1162-1227) and on his father's side, Timur bin Taraghay Barlas (1336 -1405), the great Asian conqueror of the later fourteenth and fifteenth century. The Mughals established a homeland, a dynasty and an empire in this new domain, marking it with dramatic architectural manifestations of their might and reminders of their lineage, simultaneously adopting elements of the pre-existing architecture and its conceptual associations. This new style, which blends elements of Roman, Islamic and Hindu architecture, reached its pinnacle with the construction of the Taj Mahal, encompassing the functional and symbolic nature of pre-existing mausoleum architecture, as well as elements of its form, and becoming emblematic of the Mughal Dynasty in India. These monuments created a visual presence, which symbolically legitimized those, responsible for their construction, leaving an identifiable and authoritative mark on the landscapes they inhabited; the imprint was both cultural and physical and endures till today in its principles

and iconography.

The typology of the Mughal mausoleum begins with the elementary need to cover the resting place of an important personage. This impulse has universal and varied application among humanity, but in India it finds some of its grandest expression. Mughal funerary architecture begins with the earliest burials of great men in the Islamic empire in mosques – a tradition most likely borrowed from the existing Christian examples of Martyria and churches dedicated to saint's relics which sought to link the idea of divinity with human leaders, and to provide followers with a place to venerate the divine through the presence of these exemplary entities. Martyria as well as their direct inspiration, the Greek and Roman examples of mauseolea, proved to hold a more lasting interest in the Islamic tradition; the mausoleum, according to scholar Hillenbrand (2004), becomes the "favored means of conspicuous consumption in architecture". Muslim belief in the soul's existence after death, bound by the limitations of time and space, explains the layout and spaciousness of Islamic tombs, which were decorated according to the spiritual and worldly power of the deceased.

"The building of mausolea was able to profit from the perennial Islamic tradition that any place could serve as a masjid [place of worship]" (Hillenbrand, 1994). Imperial Timurid architecture from the Iranian house of Timur, as the immediate familial and geographic relative of Mughal architecture in India, was a part of this tradition. Primarily, composed of brick architecture, Timurid monumental funerary structures are known for experimentation with colossal size, and the expression of the structural skeleton itself, which was then enhanced with

the use of colors and material articulation. Large iwans and highly symbolic entrance sequences created an air of expectancy and began to take major significance, along with scenic views, as well as perimeter walls which marked the edges of the sacred compound. There is also suggestion of an awareness of design principals, as evidenced by the discovery of fifteenth and sixteenth century drawings in Istanbul and Tashkent, which contained "the detailed notations for the layout of ground plans, and the construction of muqarna vaults" (Hillenbrand, 2004). Factors of axuality, rhythm, repetition, transition and sound are systematically used to yield a full effect. The Mughals adopt much of this typology, with the added introduction of a highly symbolic design program (Burton-Page, 2008) in plan, section and elevation.

The impulse to build funerary monuments transcends theological boundaries and the Muslims were not immune to this undeniable human ritual or to the need for the utilitarian purpose of the mausoleum - namely commemoration. This same set of ancient monuments, and consequently the set of ideologies they embody, likewise inspired the artists of the Renaissance. Europe had come into new contact with west Asian regions following the conquests and losses of the crusades, and a newly rediscovered trade of ideas and aesthetics flowed between East and West. Many of these ideas found new life and were immediately translated into physical form – the pointed arch, the centralized plan, symbolic relationship of proportions, the tie between architecture and music, the iconography of strict geometries and numbering systems to name a few. These principles, many of which have universal human appeal, were once again consciously adopted into the design strategies of architects.

The Mughal Renaissance Age in India

Mughal Rulers	Title	Tomb Structure and Location
Timur bin Taraghay Barlas (1336 –1405)		Gur-Emir, Samarkand
Zāhir ud-Dīn Mohammad Babur (1483-1530)		Babur's tomb Kabul
Nasiruddin Humayun (1508-1556)	'The August'	Humayun's Tomb, New Delhi (completed 1571)
Jalaluddin Mohammad Akbar (1542-1605)	'The Great'	Akbar's Tom, Sikandra (completed 1613)
Nuruddin Salim Jahangir (1569-1627)	'Worldholder'	Jahangir's Tomb, Lahore, Itmud-ud-Daulah Tomb (completed 1628)
Shihab-ud-din Muhammad Shah Jahan (1592-1666)	'King of the World'	Taj Mahal, Agra Taj Mahal (completed 1632)
Muhammad Aurangzeb Bahadur (1618-1707)	'Throne Ornament' / 'Worldholder'	Aurangzeb's tomb, Khuldabad

Table 1: Mughal rulers, titles, and tomb types (Source: Authors).

The Mughal Renaissance Age in India

The thrust of movement that ended with the construction of the Taj Mahal is generally accepted to have begun with the design of Nasiruddin Humayun's tomb (completed 1571) [Figure.1]. Humayun's Tomb marks the beginning of a distinctly Mughal tomb architecture. Persian and Timurid craftsmen traditionally worked with brick, and it was not until the Mughal domination of a Hindu populace whose craftsmen worked with stone, that an all stone Islamic mausoleum appeared. Humayun's tomb was built by his son Jalaluddin Mohammad Akbar to establish, through a visual display of strength and power, the presence of the Mughals in a foreign place and to legitimize the Mughal line. The design shows a continuing importance of gardens (imported by the first Mughal emperor, Babur)

as a symbol of the Mughals ability to tame the arid landscape of India with lush vegetation and irrigation systems.

Gardens offered the emperor the opportunity to evoke a highly charged vision of paradise and consequently allude to his own divinity and might. Akbar's tomb (completed 1613) [Figure 2] was built during the reign of his son Nuruddin Salim Jahangir and evokes the highly popular attempts of Akbar to bring cohesion to the empire through the dismantling of religious boundaries. The idea of a family mausoleum in Delhi is abandoned at this time, and a new structure rises at Sikandra, just outside Akbar's capital at Agra, which displays the might of the empire in its ability to absorb multicultural influences and simultaneously remain true to its roots. Jahangir's tomb follows this same logic, as

does that of Itmud-ud-Daulah (tomb completed 1628) [Figure 3], royal official to Akbar and vizier to Jahangir. Nur Jahan, Jahangir's wife, built the mausoleum of Itmad-ud-Daulah for her parents.

Nur Jahan Jahangir is known as a prolific patron of architecture including gardens at Agra and in Kashmir and caravanserais in Punjab.



Figure 1: Humayun's Tomb (Source: Authors).

Last in the series of well-articulated stone tomb monuments built under Mughal empire is the Taj Mahal (completed 1632) [Figure. 4]. Built by Jahangir's son and heir, Shihab-ud-din Muhammad Shah Jahan, it is a grand symbol of Mughal power, a tomb ostensibly for his favorite

wife, but completed just after Michelangelo's celebrated dome appears on the Roman skyline and when the Mughal world was in frequent contact with the west; this time period marks the appearance of western visitors and traders who bring philosophy, painting, jewelry design, and

various other imports to the Mughal world. The designer of the Taj Mahal is the first to abandon the symbolic centrality of the garden in order to occupy a prime position of importance on the river– the main thoroughfare of Mughal life – and become visible from the royal palace (not to mention the nobility villas along the riverbank), in fact dominating the skyline thus, not only the royal family, but all the many visitors flocking to the site must see it. Mughal tombs reveal the existence of an impetus to dominate the visual imagination of the populace and

create a symbol of wealth and power to which onlookers must submit. The dominance of the Mughal reign, not only as a ruling body in India, but in the wider world, is clearly established. Taj Mahal's evident beauty and perfect proportions illustrate the transmission of similar ideologies and interests in creating aesthetics that are transformative and appealing in a universal form.



Figure 2: Akbar's Tomb (Source: Authors).



Figure 3: Itmad-ud-Daulah's Tomb (Source: Authors).



Figure 4: Taj Mahal (Source: Authors).

The Making of Taj Mahal

The Taj Mahal was the only Mughal mausoleum that was built by a ruler for his own purposes during his own lifetime. This may serve as one of the reasons that the sheer scale, delicacy of material usage, and overall harmonic aesthetics are more prevalent in this structure than any other Mughal mausoleum. Built to honor his wife, Mumtaz Mahal, Shah Jahan built not only one but two major mausoleums during his lifetime, one for his wife and another for his father Jahangir. It was under the rule of Shah Jahan, that it is said that Mughal architecture entered its classical phase (Koch, 1991, p. 93). The intentional use of design principles in sacred buildings demonstrates the desire to express the complex relationship between the human and the divine through architecture. Evidence of careful composition and study of these principles is seen during Mughal rule in India, through the progressive understanding of construction of predecessors to the Taj Mahal. Constructed successively, these structures became the paradigm by which all other successors were judged. As building type, the Taj Mahal primarily served the function of veneration, and secondarily, exhibits governing authority. Identification and analysis of the principles used to compose paradigmatic structures help describe the devices with which to continue the discourse of sacred architecture, so that designers are equipped with the necessary understanding and tools to compose equally commendable, contemporary centers for veneration. The overall site plan of the Taj Mahal is more complex than any of its precedents. To elucidate why Taj became the most refined building in the history of tomb designs in India,

the various components used to create tombs are examined and their alteration to perfection studied. The components include 1) The use of Charbagh (the Garden that reflects paradise) 2) The complex use of the Nine-fold, Hasht-Bihisht plan 3) Hierarchy of materials used 4) The careful planning of building approach at Taj 5) Proportion and Geometry 6) The use of Perfect Proportions

The Use of Charbagh (The Garden That Reflects Paradise)

Charbagh when simply translated from Urdu means, four (char) gardens (bagh). Derived from the Persian name chahār bāgh, this style of design in architecture was first utilized to strict symmetry and the use of simple forms of geometry to create Persian gardens. Heavily influenced by the Persian style of architecture, the Mughals in India started creating and then further evolving prototypes of charbagh in Mughal tomb garden designs. The basic principle of the charbagh is to divide a square garden into four symmetrical parts by use of two transverse pathways in the middle. These individual parts are then divided further into smaller symmetrical squares to create flower and plant beds that can be accessed throughout with smaller walkways. The use of waterways is also incorporated generally on the same axis as the pathways leading to the tomb and on the periphery of the garden. Water is source of life, vehicle of cleansing and center of regeneration; traditions of water symbolism are seen in various cultures. Also running water is known to have regenerative as well as protective properties. So passing through water not only cleanses the body but also protects the monument itself lending it an extra aura of sanctity. In India they

generally located these gardens near river sources to create a water irrigation system. These waterways served two purposes: 1) to keep the gardens hydrated 2) to reduce the temperatures of the hot arid climate found in India by means of water fountains at various intervals. Water was pulled from the rivers into a garden storage well by means of animals like bulls or cows pulling at a pulley attached with water bins. This was moved through the garden in form of shallow water channels that allowed irrigation and covering large areas of irrigated land with less amount of water. In the Hindu interpretation of the sacred mountain Meru, rivers flow in all cardinal directions forming a "cosmic cross", similarly the Mughals saw the charbagh as a physical manifestation of the four rivers flowing from paradise.

Moore interprets the description of paradise from Koran. He writes, "The Koran promises that the faithful shall dwell in a cool, fruitful paradise and gives details of the attractions that await them there" (Moore, Mitchell & Turnbull, 1988, p. 179). He further states, "Sura 55 tells of gardens, green pastures, palm trees, and pomegranates, and of hours, cloistered in cool pavilions." (Moore et al., 1988, p. 179). Thus the gardens attached to the tombs were seen as reflections of paradise and needed to be associated with fruit bearing plants to indicate life and cypress trees to indicate death. Thus the charbagh and the abode of the mausoleum were meant to be a place where death connected to life in paradise and earth connected to the heavens above. Thus the peaceful walks from the gardens to the mausoleum related to the fact that the buried lied in peace in the arms of the fruitful paradise.

As some of the major mausoleums built by the Mughals attained great scales so did

the charbaghs proportionately increase in scale and grandeur. This can be best seen in both Humayun's and Akbar's tombs. Humayun's tomb was one of the first tombs to be built in India at such magnificent scale. Proportionately the charbagh is kept in proportion to the tomb building and encompasses the tomb well as the viewer walks through the first gateway to the gardens. Akbar's tomb is even more monumental in spread of its layout. The tomb is much broader in relation to its height and charbagh is also laid to the width of two thousand feet in comparison to twelve hundred feet width of the charbagh at Humayun's tomb. Given the large scale of the garden, four water wells are drilled in each garden to provide adequate water supply to the large irrigated land. The plants and trees are also much larger in scale to provide the proportionate visual appearance to the viewer in relation to the tomb itself. Interesting to solve the problem of ever increasing garden proportions in relation to the tomb, the builders of Taj Mahal, came up with an indigenous solution. They moved the mausoleum from the central cross axis of the garden to the uppermost edge of the garden on a platformed terrace [Figure 5]. This allowed the garden scale to be maintained at a much smaller dimension but at the same time gave the visual presence required while walking through the gardens to reach the mausoleum.

The Taj complex incorporates not only the charbagh but manipulates it to fit within a riverfront garden plan that pushes the mausoleum from the center of the garden to the edge of the waterfront to maximize visibility of the structure. The garden is entered

through a transitional forecourt that contains structures that would house a number of staff and leads to a planned market place. The overall composition of the market place is similar to that of a charbagh, composed

of four equal parts that are governed by a central cross axis.

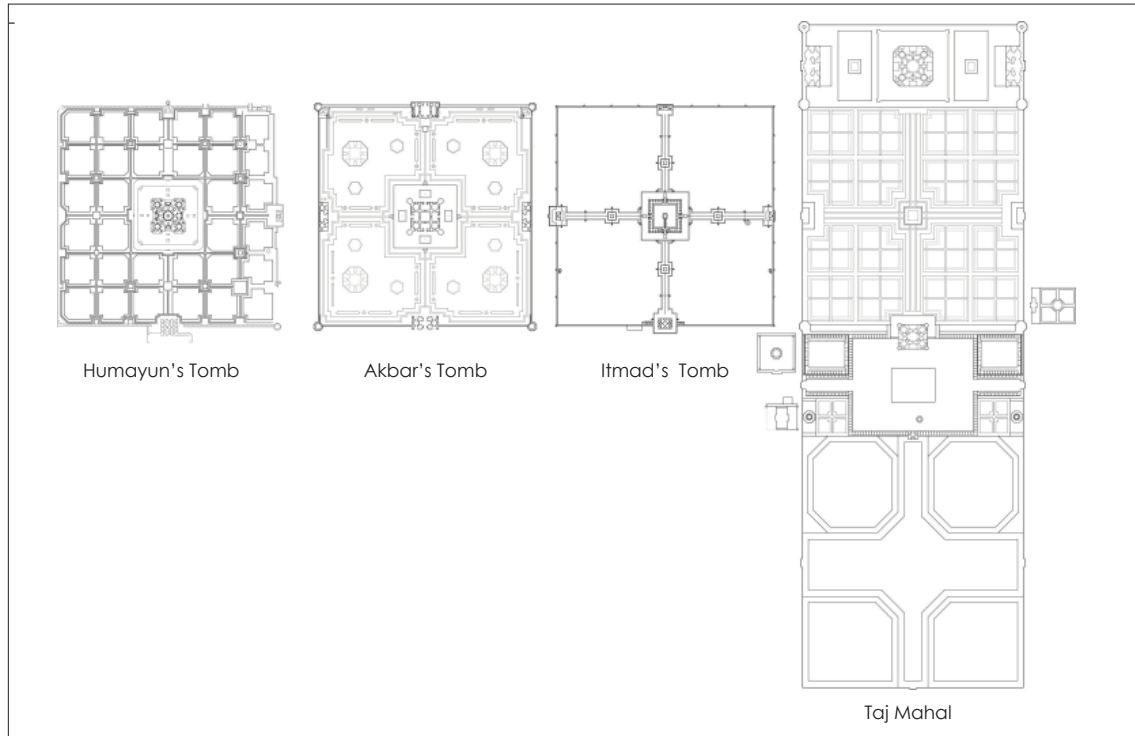


Figure 5: Garden Plan and Building Approach - Complex plans of Humayun, Akbar, Itmad, and Taj Mahal (Source: Authors).

The Complex Use of the Nine-Fold, Hasht-Bihisht Plan

The overall plan of the Taj Mahal is a square with chamfered corners, which creates an irregular octagon similar to the plan of Humayun. The central two-storey octagonal hall contains

the cenotaphs of Mumtaz and Shah Jahan. The importance of this space is made visible on the exterior by the large dome that rises above the central iwan of the elevation. The overall composition of the plan is governed by an emphasis on bilateral symmetry and

the central axis, denoting the most significant space in the complex. The plan of the Taj Mahal expresses a sophisticated and simplified design that evolved from tomb plans similar to that of Humayun and Itmad-ud-Daulah. The clarity of the nine-part plan (hasht bihisht) [Figure 6] and the direct passage to and from each of the rooms is similar to that of Itmad-ud-Daulah. The basic layout is divided into nine parts by four intersecting construction lines. The phrase *hasht bihisht*, meaning "eight paradises," has been interpreted as a reference to the eight rooms surrounding the central chamber.

For instance, Mughal mausoleums introduce new plans: the oblong, the square or oblong with chamfered corners, to produce a 'Baghdadi octagon' or *hasht bihisht* plan, a square chamber with engaged corner rooms or engaged corner turrets. They also incorporate independent symmetrically disposed minarets, and may stand within a formal garden (Burton-Page, 2008). The transition from solid to void, and the juxtaposition of one with the other, creates or resolves tension in a way that affects the pilgrim both physically and psychologically. According to Koch (1991, p.72) in her explanation of the use of the nine-fold plan in Mughal architecture, "while Timurid architecture uses the symmetrical nine-fold plan as the exception rather than the rule, it is the characteristic of Mughal architecture to have adopted and further developed the model in a perfect symmetry faithfully reflected in the elevation".

The use of an octagonal form at the corner of the building as an element to not only frame but give a sense of weight and purpose to the

building is eliminated and replaced by four free standing minarets that are placed atop the corners of the square platform that elevates the tomb above the rest of the complex. By eliminating the use of the projecting octagonal form at the four corners of the mausoleum, the Taj Mahal becomes a simplified form that lacks the weight and dynamism created by the undulating octagonal forms found at Humayun's tomb [Figure 7]. The placement of the minarets at the corners of the platforms and the use of *chhatris* placed above the center axis of the flanking pavilions and a massive bulbous dome rising above the central axis of the overall complex, creates a triangulation that leads your eye from the top of the domes spire down to the *chhatris*.

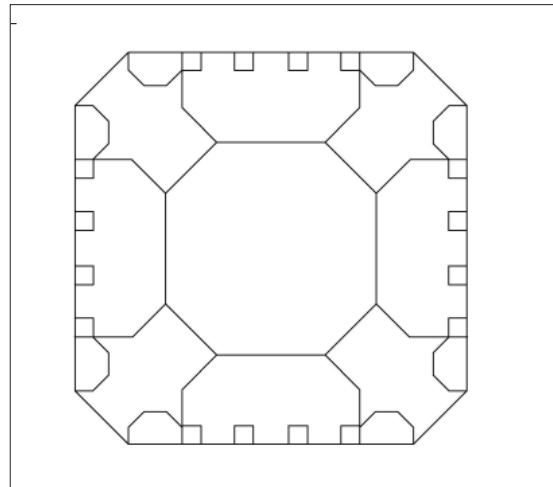


Figure 6: Typical Mughal Nine fold plan (Source: Authors).

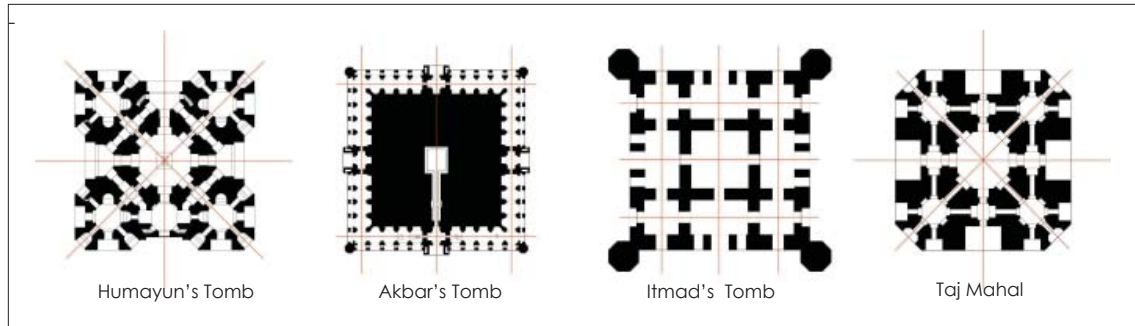


Figure 7: Centralized Organizations – These plans display the masonry forms of the buildings rendered as figure. (Source: Authors).

Hierarchy of Materials Used

Material in architecture is responsible for providing both the color and texture to a composition. In the case of the buildings we are examining, the colors also have symbolic meaning, which enhances the impact of the architects design decisions as well as how the building is read.

The primary construction materials used in Mughal mausoleums are red sandstone and white marble. These are then inlaid with either intarsia or pietra dura, or sometimes decorated with glazed tile. The function of the decoration as well as the colors used for the inlay and the background are all chosen to convey a message, or to enhance an effect. The choice of white marble is significant because around 1577-9 white marble structures were limited exclusively to the tombs enshrining important saints. The adaptation of these iconographies to Mughal mausolea is directly related to an increasing desire to portray the ruler as extraordinary, at times even taking on the status of a saint or God (Asher, 2004).

Like the tomb of Itmad-ud-Daulah, the Taj Mahal is clad entirely in white marble and accented with semi-precious stones, the technique, derived from the Italian method of Pietra Dura. The use of inlaid stones is again simplified on the façade of the Taj Mahal and found in greater profusion on the interior. The use of red-sandstone and white marble inlay is made use of in the flanking mosque and pavilion as well as the gateways, music hall and guest pavilion. At the Taj very little difference in tonal value on the appearance of the Taj conveys a sense of spirituality and harmony. However, the value contrast of the red sandstone and green gardens to the white of the buildings creates a dramatic mood due in part to the contrast between light and dark. Using only a few rich tactile materials, which are enhanced by natural light they created a strong mystical ambience. Progression of increasingly expensive materials indicates the golden age of the Mughal Empire.

Building	Material
Humayun's Tomb	Red Sandstone, White Marble, (Black Onyx, Persian Glazed Tile), Built Around a Rubble Core, Marble Jali Screens
Akbar's Tomb	White Marble, Red Sandstone, Persian Glazed Tile on Chatri domes, Marble Jali Screens, Iron Clamps
Itmad-ud-Daula's Tomb	White Marble, Red Sandstone, Black Onyx, Semi-Precious Stones Marble Jali Screens
Taj Mahal	White Marble, Red Sandstone, Black Onyx, Semi-Precious Gems, Marble Jali Screens, Iron Clamps, Well Foundations filled with rubble and iron parts

Table 2: Types of Materials use in Mughal Tombs (Source: Authors).

The Careful Planning of Building Approach at Taj

The orientation and placement of a building within the physical world is subject to cosmological considerations as well as adjacency to natural features or historically significant spots. Cosmology, which taps into the nature of the universe through understanding of heavenly movements and cardinal axes is recognized by humans everywhere and is both easily communicated and awe inspiring in its precision. The human interest in cosmology reflects a need for order, and a search for direction. This need is fulfilled at the Taj Mahal through the clear establishment of its structures in a significant orientation on a strict North-South grid.

The Mughals utilized symmetry in both garden and building plans, creating a comprehensive unified building complex that provided linear direction and visual clarity to the observer. Each of these gardens is distinguished by a perimeter wall that is marked by gateways that are placed at the primary cross axes of the garden. The specific placement of these gateways directs the viewer's attention in a

specific way, forcing visitors to approach the building on axis, followed by paved walkways that bring visitors to the building by means of a linear approach [Figure 8]. Approach towards the building is a processional route that begins at the gateway with a framed view of the building. Upon entrance into the complex the view is expanded and encompasses the walled garden together with the centrally located mausoleum. At the intermediate point between the entrance gate and mausoleum, the field of vision is again dominated by the mausoleum. Once the platform is reached the view again narrows and is dominated by surface intricacies of solid and void. Upon ascension of the platform the field of vision is narrowed once more and focused on the central entryway. In each instance, the viewer experiences the building at a different level thus making the journey or approach towards the mausoleum as dynamic as the mausoleum itself.

Axiality in the composition of both plan and elevation are universal features of Mughal tombs and are meant to suggest a powerful regulating device. At the Taj axiality is the

dominant feature of the complex. The horizontal thrust of entrance once the monument has been seen is unavoidable. Although the visitor must pass through the first courtyard without being able to see the mausoleum at first, the sudden shift in direction brings them to the main garden gate, which is the only entrance into the garden, where they glimpse a distant white light and dark opening, suggesting the presence of a grand tomb, and then are blinded upon entering the gate chamber, where the eyes quickly adjust to the lush garden and shining mausoleum at its end. In this way, the architects of the Taj made use of both the effect of approach in

which gardens and water both play important roles, as well as the entrance through multiple portals. The approach through the courtyard and garden is carefully orchestrated at the Taj Mahal, with more subtlety than at any of the other monuments. The location of the structure at the end of the garden means that it occupies both the highly visible spot on the river which dominates the skyline as well as creating the promise of wonder for the visitor who comes to visit the compound itself.

Proportion and Geometry

When considering ideal forms, the circle and square and have been used as a source of

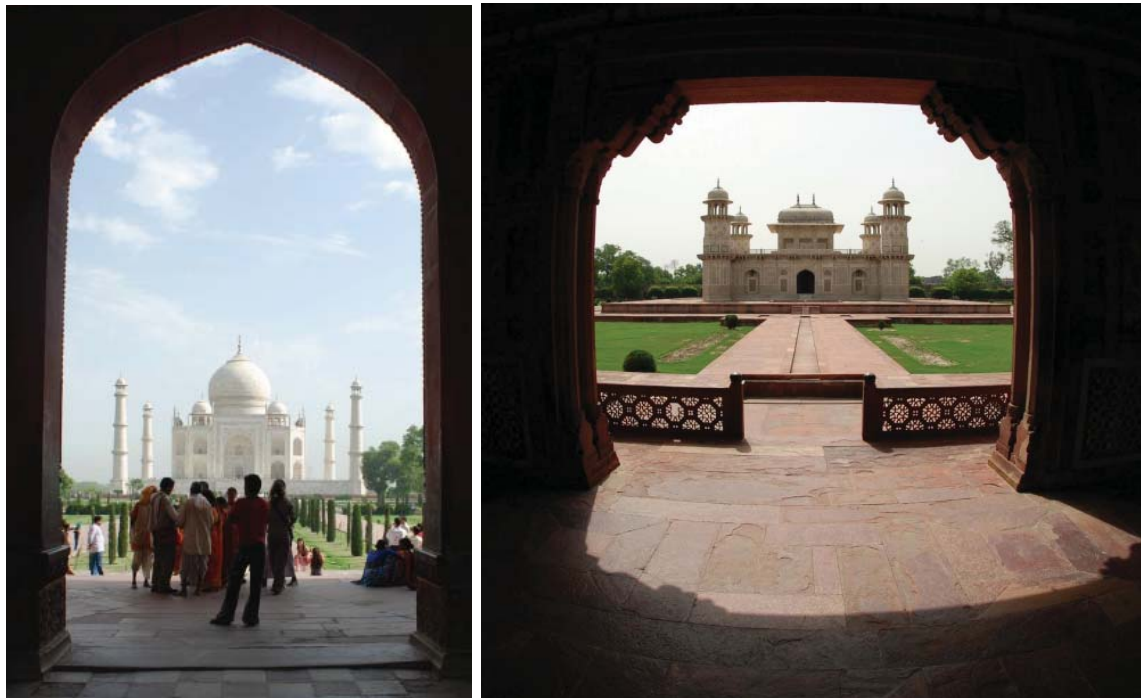


Figure 8: Framed View of Taj Mahal and Itmad-ud-Daula (Source: Authors).

completeness in architecture around the world (Critchlow 1999). On occasion, the equilateral triangle can be considered idyllic as well. These have been given remarkable prominence because of their simplicity. They are believed to be perfect shapes due to the regularity of the distance from the perimeter to the center. This perfection has been linked to eternity and divinity. The circle and the square can also be related to the human figure proportioning system as first seen in the drawing of the Vitruvian man by Marcus Vitruvius Pollio, the Roman writer, architect, and engineer (Indra McEwen, 2003). The applications of simple geometries were greatly influential during the Renaissance (Adam 1990). Variations are often created with these geometric forms such as the octagon, hexagon and pentagon. These polygon variations are more commonly found in Mughal architecture as a direct derivation of the circle or sphere.

There are no predetermined rules or formulas for good design but there is a number of ways in which to layout and detail a building in a manner so that it embodies characteristics of a distinct or classical tradition. The defining elements at the root of a classical tradition are usually based on symmetry and axis from which a building is laid out. This symmetry is made to reflect the balance of nature and the human form. Symmetry in two directions, such as the plan of the Taj Mahal (similar to Palladio's Villa Rotonda near Venice of 1550), is rare and it is more often on a single axis, such as the tombs of Humayun and Akbar. The overall symmetry does not always lend itself to equally balanced rooms [Figure. 9]. The axis is more than the geometric structure of the plan and volumetrically describes

the way someone would move through the space, view and understand the building. The Mughal tombs in this study are symmetrical on a number of axes, but are still focused to have a primary entry into the mausoleums due to the religious practice of orienting a the body of the deceased on a north-south axis with the head turned towards Mecca.

The challenge of creating a space for the interaction between the earthly and the ethereal is to represent each in its own right – demarcating the square from the circle – but simultaneously negotiating their interface and the subtlety related to their geometric combination through inscription, circumscription, superimposition and adjacency. Such design decisions allow for the conveyance of different meaning, but it is the effective composition of these forms to manipulate the volumetric relationships that direct attention from the viewer toward an intended reading of the structure as a vehicle for interaction with the divine.

The extents of the mass of both the Taj Mahal mausoleum is identified as earthly represented, through cubical form. Further still, the crowning element of this structure, articulated through innovation in dome construction during this period is a direct volumetric representation of the sphere symbolizing and reaching toward the heavens. The Taj Mahal uses a double dome to establish divine axiality, and is also unique in how it negotiates emphasis of the vertical axis and directional movement from the form of the building to the sacred space within the dome. The use of a drum to support the dome and transfer tectonic loads is an indication that the visual transfer from circle/sphere to square/

cube is carefully contemplated. The square volume holds the circular dome from below, but to be able to create this transition as the physical device for making that connection, there is an understanding that the structure directly attempts to act as intermediary for the pilgrim to the divine. The transition is further emphasized and resolved smoothly by using chamfered octagonal exteriors and interiors that allow the building to address eight sides instead of just four. The experience within the interior is heightened through the dematerialization of the corners which inhibits the perception of space, thus altering the

conception of reality. This effect marks the transition from the earthly realm to the spiritual since the difficulty of comprehending the interior all at once heightens the sense of awe and awareness of the sacred. This relationship is also evident on the exterior of the building, where the corners are de-emphasized to give precedence to the dominance of the dome as the marker of the focal point.

The Use of Perfect Proportions

The use of the double square, 1:2 ratio, is used in the overall composition of the mausoleum including the platform and minarets. At

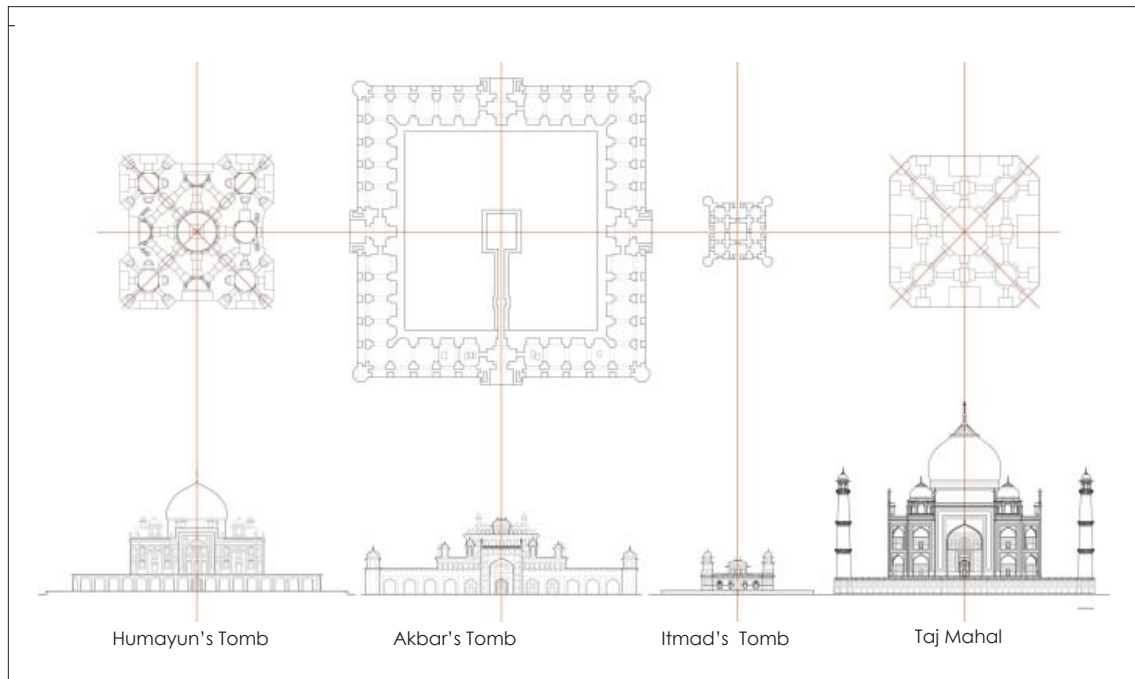


Figure 9: Axes – Plans and Elevations of mausoleums (to scale) (Source: Authors).

Humayun's tomb, the double square occurs from the base of the platform to the top of the domes spire, and mirrored about the buildings central axis. The double square found at Akbar's tomb does not encompass the entire building but does include the entire tiered structure. The same proportion at Itmad-ud-Daulah's tomb encloses the top pavilion and terminates on the center points of the octagonal piers but does not include the buildings platform. At the Taj Mahal, the double square does not include the top of the dome like at Humayun's but it does follow the concept of terminating points at the center of the minarets similar to that of Itmad-ud-Daulah. If one takes a closer look at the use of proportion of the iwan, a primary feature found on the façade of the monuments one can further break down the proportions of these buildings. Although there is a visible difference in scale, each one larger than the previous, the proportions remain the same throughout. The central archway is a 2:3 ratio where as the overall rectangular frame of the opening is a 4:5.

Rhythm of a façade is a compositional principle which regulates the elements of the design in a way often used to provide a sense of gravitas. The Taj shows a clearer rhythm in façade than its predecessors. The solid versus void relationship also enhances the idea of a number cosmological system – in which the entrance iwan is either the third in the sequence, framed by lesser openings, or the fifth in a sequence, if the minarets and void are considered elements in their own right. Both three and five are highly charged symbolic numbers. Each entrance portal breaks above the datum of the building itself and

becomes autonomous and important. Each façade carries an odd number of openings or elements so that a single emphasized segment is left over in the exact centre [Figure 10]. Each façade can be broken up into five parts – five is significant because it derives its symbolism from the fact that it is the sum of the first even and odd numbers ($2+3 = 5$) and secondly because it is at the centre of the first nine numbers. It is a sign of harmony and balance. It is also the symbol of the human being, which with arms outstretched in the shape of across appears to comprise five parts. It is also a symbol of the universe, its two axes, passing through the same centre. It also stands for the phenomenal world in its entirety – the five senses and the forms of matter amenable to sense perception. Five is a lucky number, five is the number of the hours of the prayer and the types of goods upon which tithes are payable; there are five elements in the hajj (pilgrimage), five types of fasting, five motives for ablution, five dispensations for Friday; there is a fifth of treasure of booty, five generations for a tribal feud, five camels for the diya and five takbir of formulae of prayer: God is Great! There were five witnesses to the Mubahala (treaty) and five keys to the Koranic mystery. There are also five fingers in the 'Hand of Fatima' (Chevalier & Gheerbrant, 1996).

There are many perfect geometries that can be found throughout the Mughal tombs. While the mausoleums fit within a perfect square in plan this form does not reveal itself in the same manner in all elevations. Taking a closer look at the mausoleums proper, the overall proportion of the structures wasn't perfected until the Taj Mahal. Humayun's tomb, including the plinth it rests on, is the only mausoleum that

comes closest to the perfect square found in both plan and elevation at the Taj Mahal. The Taj Mahal makes use of the cube that is found in the central chamber at Humayun's tomb, perfecting its use by applying the concept

to the overall building revealing itself on the exterior [Figure 11].

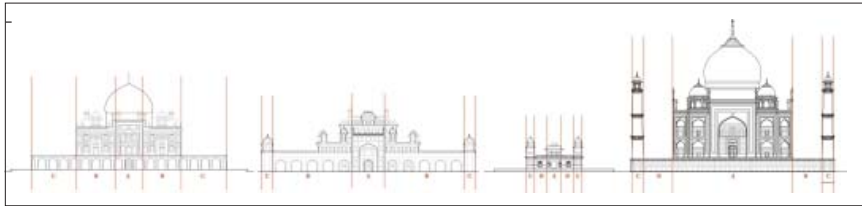


Figure 10: Rhythms
(Source: Authors).

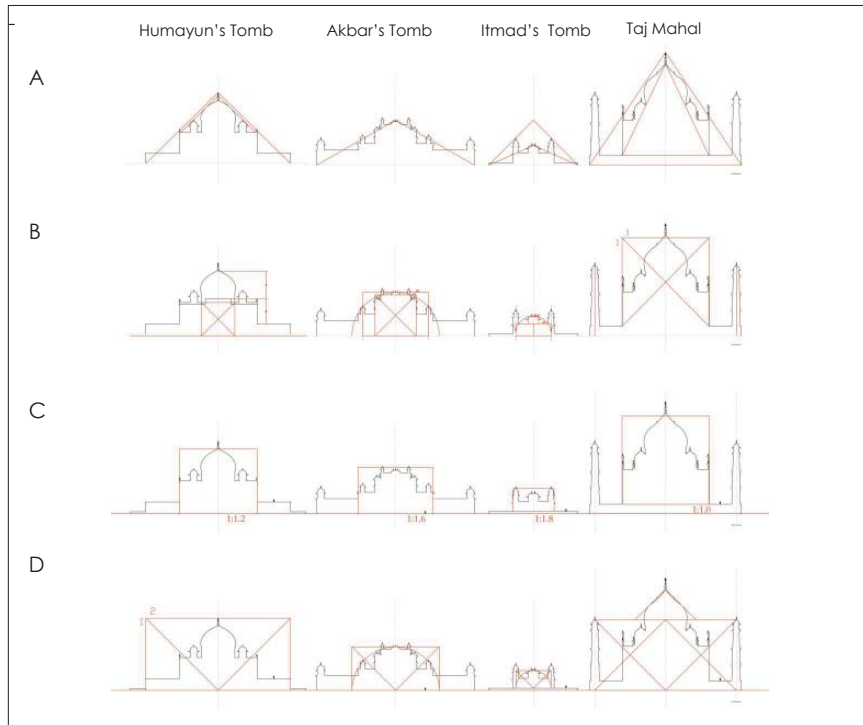


Figure 11: Proportion:
A – Triangulation;
B-Perfect Proportions;
C- Overall Composition
(Source: Authors).

Conclusion

Architecture has a language; its vocabulary is meant to be understood by the viewer and its existence assumes the desire to communicate meaning. This concept is elementary in design theory, and universal in its application throughout the architectural oeuvre of humanity; principles of design which are used to this effect are generally shared and commonly understood.

As an architectural lineage each of the four Mughal tombs retains elements of its predecessor. These buildings represent the ways in which architecture as a distinct language evolves from the best examples that a tradition has to offer, leading to what can be considered classical forms. This is true of the evolution of Mughal tomb architecture and its culmination in the Taj Mahal. The combination of wealth and power of the Mughal Empire, along with the humanistic leanings of its emperors led to an architectural revolution that coincided with the Renaissance in the west. A revived interest in tradition was brought to India by Babur and reflected his understanding of Timurid architecture. Babur's dynastic lineage was grandly manifested in construction of the first imperial Mughal mausoleum of Humayun in Delhi. By employing a specific building type that was rooted in tradition and immediately recognizable in form, function, and meaning, Humayun's tomb was seen as a place of veneration for both Islamic and Hindu cultures in India. The establishment of a freestanding structure situated in the center of a walled four-part garden (chahar bagh) at Humayun's tomb provided a precedent for later mausoleums.

By noting the similarities in the usage of axis, symmetry and rhythm, it was found that each

of the mausoleums was planned in a manner that emphasized centralized planning and bilateral symmetry expressed in both plan and elevation. Rhythms were primarily created through the use of a five-part composition in elevation. The placements of openings that strengthen the overall form of the building was made possible by regulating openings to a single shape of the pointed arch, creating variety through a difference in scale. The experience of these four tomb complexes all followed a regimented program that included a framed view created by the entry gateway. The entrance gateways served as a transitional space from city to garden, followed by a linear approach that was purposely designed to focus attention on the mausoleum.

By further dividing these mausoleums into simple geometries such as the circle, square and triangle the decision process that led to the perfect geometries present in the Taj Mahal became apparent. Taj for the first time uses the perfect 1:1 ratio in both plan and elevation to create a perfect cube. This cube sits in the frame of minarets placed at 1:2 ratio to create a balance and harmonious composition surrounding the cubical tomb. The use of triangulation is present in all four mausoleums as a tool that takes the focus from earth to heaven. In each of these buildings the corner condition is altered to create a perfect framed view of the building. This is initiated at Humayun's tomb by the use of protruding octagonal forms. At the tomb of Akbar, the octagonal forms are capped by chhatris, which evolve into the form of engaged minarets at the tomb of Itmad-ud-Daulah. By detaching the minarets at Taj, the visual appeal of the cubical form is enhanced

and emphasized. The hard transition from a cube to a spherical dome is smoothened by using the octagonal form first seen at Humayun's tomb. This helps the eye transition from the pointed arch iwan to the circular dome rising to the heavens. Chhatris placed at the base of the circular dome further enhance this connection. The shimmering white marble masterpiece combined with the lustrous green garden complex is a delight and depiction of heaven on earth in strong contrast to the dry arid climate of Northern India. As one lays eyes upon this timeless beauty after passing through layers of transitioning spaces, the much-anticipated approach can only be satisfied by limitless magnificence of this building. Taj follows the principles of firmitas, utilitas, venustas as described in the true classical traditional (Smith 2004, Vitruvius, Rowland & Howe 2001) which describes beauty and aesthetics across all cultures. Such is the language of beauty and architecture of Taj that transcends all borders and has a universal appeal to people around the world.

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Krupali Krusche

Krupali Krusche is presently working as an Assistant Professor at the University of Notre Dame where she teaches urban design studio, historic preservation and structural design. Presently she is also working on developing a research program to laser scanning historic buildings for restoration, documentation and analysis of buildings of significance. In 2007, She started the DHARMA (Digital Historic Architectural Research and Material Analysis) research team that is specializing in 3D documentation of World Heritage Sites. In summer 2008, the DHARMA team spent four

weeks in India documenting some of the country's historic monuments including the Taj Mahal.

Danny Aijian

Danny Aijian is a graduate student in the Master of Architecture program at the University of Notre Dame. With a Bachelor of Arts from Santa Clara University in Communication with emphases in Video Production, Business, and Art History, Danny continues to seek innovative ways to synthesize technology and the built environment. As a research assistant with the DHARMA Research Team, Danny has contributed to the scholarship, scanning, and sample-testing of traditional Mughal architecture. His current research involves the study of Malta's preservation and urban development as an Ideal City.

in Business Administration from the State University of New York at Buffalo. She is a research assistant and part of the DHARMA team since last 3 years and was part of the team that did the documentation and study of Mughal tombs in India.

Selena Anders

Selena Anders is a Visiting Assistant Professor at the University of Notre Dame's Rome Studies Program as well as a recent graduate of the University of Notre Dame's Masters in Architecture program. Her present research interests have been focused in traditional architecture and urbanism, as well as historical conservation. She holds a design certificate from Archeworks, an alternative design school that works in multidisciplinary teams coupled with nonprofit partners to create design solutions for social and environmental concerns as well as a Bachelor of Arts from DePaul University in Anthropology and Art History with an emphasizing in Roman archaeology, and architectural history.

Iva Dokonal

Iva Dokonal is a Croatian-Australian graduate student currently finishing her Masters in Architecture at the University of Notre Dame, where her present interest is in traditional and sustainable design and urbanism, in historical conservation areas. She is a LEED Accredited Professional, and holds a Bachelor of Arts degree in Art History and Italian and a Bachelor of Science degree