

History and Theory of Design in Traditional Temple Architecture of India

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Abstract:

Every culture and era has a distinctive building style that is unique to it and reflects the philosophy, technological development, artistic expression, and architectural style of that particular era or civilization. Hindu temples are the peak of science, artistry, architecture, and tradition. They serve as a representation of the historical developments in building science on the Indian subcontinent. The theology and customs of the Hindu Temples are still in existence today, maintaining the persistence of the traditional Indian principles and having a great influence on the socioeconomic well-being of the population. This paper highlights the various architectural styles and elements found in Hindu temples and discusses the structural systems, building techniques, and designs employed in them. The major purpose is to decode the linkages in history that establish a secure connection between architecture and Hinduism and to understand the theory of design in traditional temple architecture in India.

Keywords: Indian Temple Architecture, Traditional Architecture, Hindu Temples, Socio-economic well-being, Structure systems

1. INTRODUCTION

Finding the fundamental architectural principles and characteristics of Indian traditional temple architecture is the main goal of this study. Understanding Hinduism's fundamental beliefs and how they connect to the conception and design of Indian temple buildings is the first stage in the study. Examining the idea of an Indian temple, its history, the evolution of its architectural styles, and the materials used in them with a focus on Nagara, also known as the "north Indian style," and Dravidian, also frequently called the "south Indian style" (Kramrisch, 1976). Using illustrations, describe and evaluate the geometry and building methods used in Indian temple architecture. Examine the building supplies, techniques, and construction processes used to construct a Hindu temple.

The Nagara and Dravidian style are the two primary temple architectural styles that best demonstrate the brilliance of Indian temple construction (Coomaraswamy, 1985). Careful analysis of many aspects of beginnings, growth, and the philosophy that gave rise to it is done, along with its interpretation, in order to understand the structure and the civilization that gave rise to it. We will not talk about the Buddhist temples, which greatly influence the Hindu temples. Additionally, the Jain temples' iconography has not fundamentally changed from the Hindu temples' architecture, even though it differs from it more than the latter's form and style. The built form and character of Indian Temples have been highlighted in this research. The dimensional assessment of the temples is restricted to a few examples of Nagara and Dravidian-style temples due to a lack of applicable data and drawings. Most of the information was also obtained from secondary sources.

1.1 Methodology:

This research is based on historical study, textual, factual, and analytical evaluations of historical treatises, as well as current research on the architecture of Indian temples, as depicted in Figure 1. The archival research has helped to provide light on Hinduism's fundamental beliefs and how they influenced the building of Hindu temples. Passages from the Vastushastra, the Shilpashastra, and other extensive literature on Hindu architecture have been used to highlight the concepts that have been used since antiquity for the creation of revered Indian temples. This research emphasizes that there are disparities in the size and shape of Indian temples despite potential commonalities in their aspects (Bhandari, 2021). This is demonstrated using examples from "Northern style" and "Southern style" temples. A detailed description of the procedures followed is depicted in Figure 1 below.

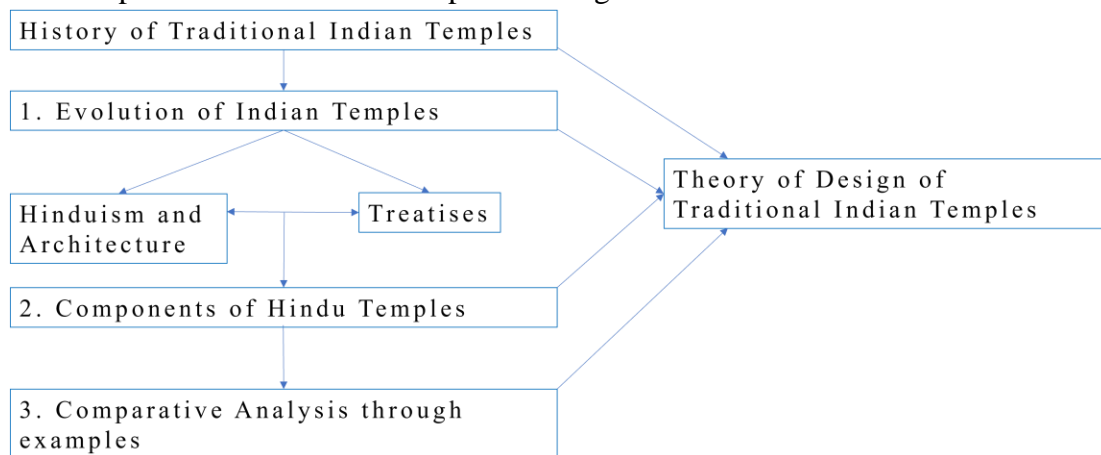


Figure 1 – Methodology followed for the research.

2. LITERATURE REVIEW

This section explains the literature and information that is a prerequisite for understanding the evolution of Indian temple architecture. For gathering this information, books, journal articles, and research papers have been studied and conclusions have been drawn from them.

2.1 Hinduism- an introduction

Hinduism is the oldest religion on earth and one of among the most widely practiced faiths today. It has thrived for more than 2000 years in various regions of Asia, particularly the Indian subcontinent, the western sub-Himalayan areas, as well as the majority of Southeast Asia. It developed as a political, social, and religious force during this time. One-fifth of the world's population practices Hinduism nowadays. The religion contains thousands of gods, a complex caste system, and hundreds of languages and dialects, making it far from a homogeneous theistic tradition. Hundreds of millions of Hindus worldwide follow a wide variety of rites and practices as a result of this internal diversity (Michaels, 2004). Although Hindu cultural relics can be found all over Southeast Asia, the biggest concentrations are in India, Nepal, and Bali. Kim Knott provides a concise and comprehensive overview of this important religion and examines the problems it faces today. She talks about some of Hinduism's fundamental concerns, including the value of the Veda as a source of religious doctrine, the function of Brahmins, gurus, and storytellers in the dissemination of divine truths, and the moral and cultural significance of epics like the Ramayana. In this second edition, Knott examines how Hinduism has been affected by technological advancements and the growth of social media. She also examines how Hinduism has been incorporated into popular culture, taking songs like Sita Sings the Blues into

consideration. She also examines current events in India and the effects that Hindus worldwide are having due to topics like Hindu nationalism and the politicization of Hinduism (Knott, 2016). *“Hinduism is not a single religion; rather, it is a conglomeration of many different religions that are indigenous to and prevalent in India. It does not adhere to any particular philosophic system or deity; therefore, it can be widely referred to as a way of life.”* (Shukla & Vol, 1960).”

2.2 Establishment of Hinduism in The World

India's societal structures were created with this faith in mind; Hindus make up the great majority of the population. Despite the fact that ancient writings including the Bhagavad Gita, Upanishads, Brahmanas, and Vedas express Hinduism's principles, there is no recognized canon of Hindu literature. The Indus River was only used by the Persians and Greeks to refer to the inhabitants; it had no religious connotations (Branfoot, 2000). At the end of the 18th century, it was heavily utilized by the Mughal and British empires to identify the religious, spiritual, and intellectual customs of the Indian subcontinent. Later, it was used to establish a distinct boundary between Hinduism, Buddhism, Jainism, and Sikhism (Appadurai & Breckenridge, 1976). Many of these ideas from between 3250 and 2750 BC are still common in Hinduism today. They were polytheists who worshipped a variety of natural deities. The Indus Valley was invaded and governed by the Aryans, a race of people with light skin, around 1500 BC. (Bansal & Chhabra, 2022).

The Rigveda is the most revered collection of mantras or hymns. The ancient Vedic Aryans worshipped Indra (rain), Agni (fire), and Surya (the sun) as the gods of nature. Despite not engaging in idolatry, their religion eventually included the Dravidian doctrines they had expelled. Religion that was primarily ceremonial placed great significance on ritual performance and sacrifice. Due to this, a more philosophic version with sections from the Upanishads emerged around 500 BC. The most rigid monotheistic, Brahmanism, embraces both a profound and all-encompassing monotheism as well as a compassionate appreciation of the Dravidian faith. The spirit known as Brahma is impersonal and all-pervasive. (Lewandowski & King, 1980).

2.3 Ancient Treatises and Their Influence on Hinduism

The historical scriptures and books of Hinduism are represented in Figure 2. The majority of these writings, which are classified as Shruti ("that which is heard") and Smriti ("that which is remembered"), were written in Sanskrit. These scriptures give knowledge on astrology, sociology, medicine, religious philosophy, practices, and architectural design concepts while also providing Hindus with daily guidance and aiding in the maintenance of religious elements of family and community. The Shilpa Shastras and Vastu Shastras are technical Sanskrit treatises that describe the basics of sculpting and construction, respectively (Bharne & Krusche, 2014).

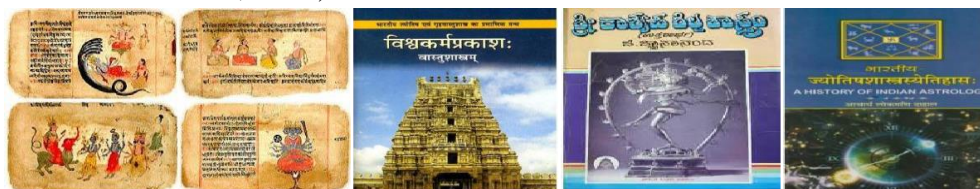


Figure 2 - Before building a temple, consult the Vedas, Vaastu Shastras, Shilpa Shastras, and Jyotish Shastra. (From left to right) (Source: www.indoarch.org, 2006)

2.4 Understanding the Evolution of Indian Temple Architecture

The figure 3, shows the timeline of the Hindu Temple Architecture starting from the most primitive structures that were simple plans made of stones, mud, and wood. The classical period was characterized by more complex plans with the rock-cut style of construction. The medieval period experienced the

development of various detailed components from stone, wood, and mud.

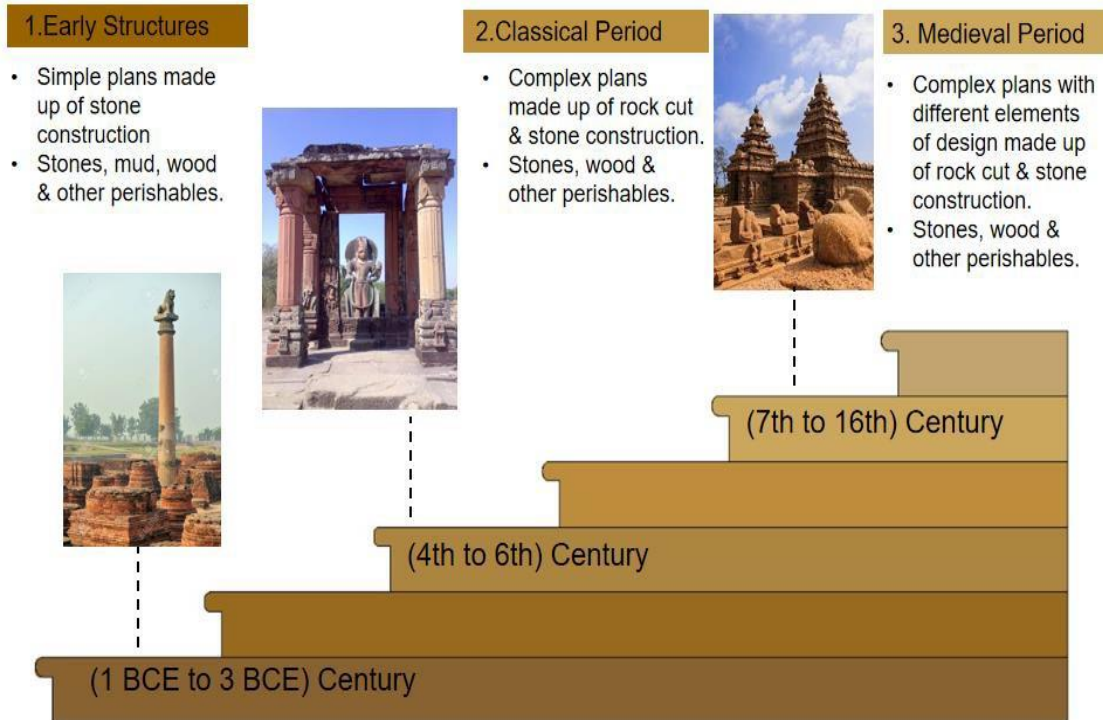


Figure 3 – Tracing the Evolution of Hindu Temple Architecture in India.

2.5 Classification of Hindu Temple Architecture

Due to the numerous geographical, climatic, cultural, ethnic, historical, and linguistic variations, Hindu temples have unique architectural styles. The two main Hindu temple architectural styles, which may be found in temples around Asia's southern coast and central plains, are very different from one another. Hindu temples were built in both the Northern and Southern architectural styles as shown in Table 1, figure 4 (Dutta & Adane, 2014)

Table 1- Classification of Hindu Temple Architecture.

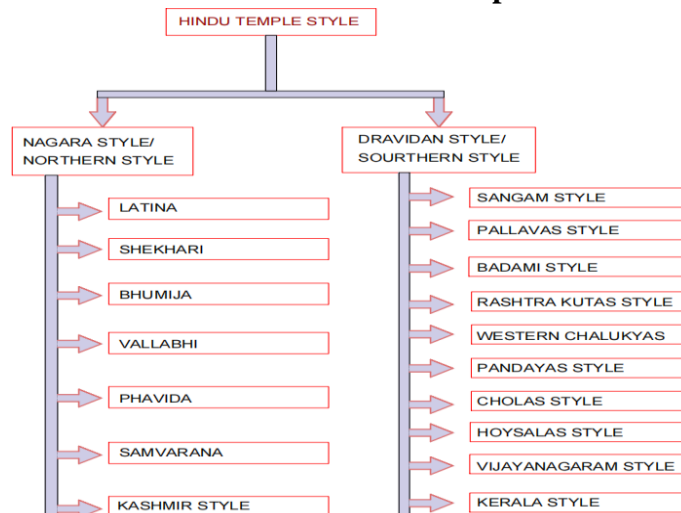




Figure 4 - Nagara temple(left) and Dravidian temple(right). (Source: www.indoarch.org, 2006)

2.6 Characteristics of Hindu Temples

Later in the 7th century, Hindu temple structures in India began to take on a more definite form. The following names, which are derived from Sanskrit, are used to refer to the typical elements of an Indian temple: The sanctuary's full name is The Vimana, which is divided into two sections. The upper half of the Vimana, known as the Shikhara, and the lower portion, known as the Garbhagriha (cella or inner chamber), are both referred to as the Vimana (Dutta & Adane, 2014).

2.7 Composition and Specifications of Construction Materials

Ancient temples witnessed substantial alteration in terms of their architecture and construction materials. The rationale for the building materials was determined by the builder's desire and the resources that were readily available nearby. As building materials, loose stones, chiseled rocks like granite and basalt, or any other locally available rocks were widely used. Without using cement, unsecured stones were positioned according to their centers of gravity. The chiseled rocks were connected by interlocking techniques. Along the western and eastern Ghats, massive boulders were cut out to create temples. Modern temples were constructed with brick and cement mortar (Reddy, 2009).

Types of mortars:

1. White guggul + Δ → Linear binding mortar
2. Lime stone powder + Guggle + Butter + Δ → Cubic binding mortar
3. Lime stone + Jaggery + Banana + Δ → Cubic binding mortar
4. Lime stone 1p + Guggle 2p + Ravvalaka 3/4p + Butter 1p + Kasayam 1p + Δ → Penta binding mortar
(Where as Kasayam =Haritaki powder + Amla powder + Palm fruit)
5. Amber colored powder 7 1/2p + Lime stone powder 25 1/2p + Guggal 9p + Erupu practice 1p + Ravvalakka 3 3/4p + Jati lingam 7 1/2p + White wax 3 3/4p + Butter 7 1/2p + Δ → Octa binding motor
(Where as Δ = Heat and P= Parts)

Figure 5 – Types of mortars used in Hindu temple construction. (Reddy, 2009)

2.8 Vastupurashamandala- the Conceptual Spirit

Le Corbusier and Leonardo da Vinci were motivated by Hinduism, one of the earliest intellectual systems, to build their Modular system of measurement on the human form. According to Hindu philosophy, the Purusha (human body) geometry was developed to strengthen the concept of the square, as shown in Figure 5.

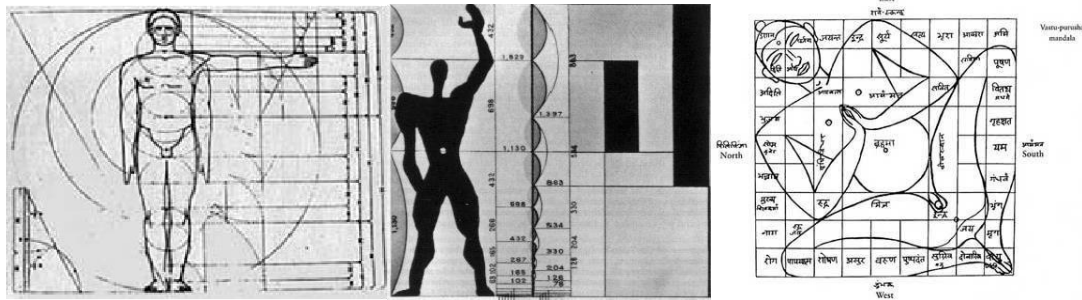


Figure 6- 1. The well-known Vitruvian Man, from www.boloji.com 2. The famous Modular (Reference: [www. My pages.surrey.ac.uk](http://www.My pages.surrey.ac.uk)).3. The historic Vastupurushamandala (Website: exotic India) (moving right to left)

The term "Vastupurushamandala" derives from three terms, all of which has distinct meaning: "mandala" refers to a design or chart; "vastu" denotes the physical world; and "purusha" denotes energy, force, or a cosmic being (Rian, et al. 2007).

The different kinds of square grids known as vastupurushamandals are made using the square, a basic shape. One padas, the smaller grid squares, can have a size of 1, 4, 9, 16, 25, and so forth, up to 1024. (Datta & Beynon, 2005).

Figure 6 shows the various names of mandalas changing with the number of pada in the grids. The following figure shows their respective names with 1, 4, 9, 16, 25, and 36 numbers of pada within the grid that are as follows; paramasaayikai mandala for 1 pada; pitah mandala for 4; sakalamandala for 9; pechaka mandala for 16; mahapitah for 25 and mandukai chandita mandala for 36 padas respectively.

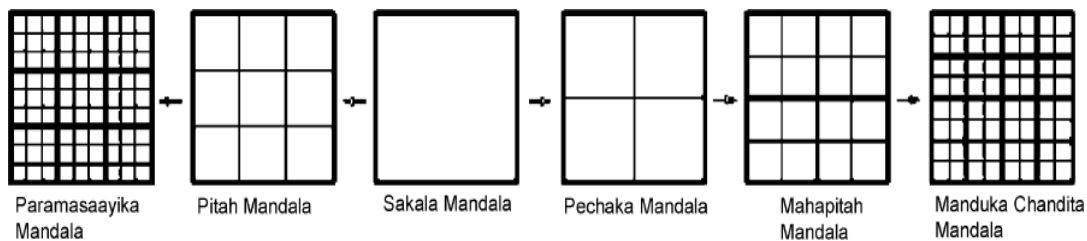


Figure 7 –Typologies of Vastupurushamandala (1, 4, 9, 16,64 and 81) (Source: Rian, et al 2007)

The Vastupurushamandala, which embodies all the principles of geometry, astronomy, and humanity, served as the model for the ground floor design of all Hindu temples. The basic shape of the temple's layout can be seen in Figure 7, where the outermost square of the mandala serves as the main shrine's wall thickness. The four squares, which also act as the garbhagriha's walls, are centered on the main deity. The Pradkshina Patha is comprised of the following 16 to 28 squares. The enormous squares of the mandala were broken into thousands of squares, thus forming a grid, to make it simpler for the architect to add a unit on one side and shift it back to the other.(Datta & Beynon, 2005).

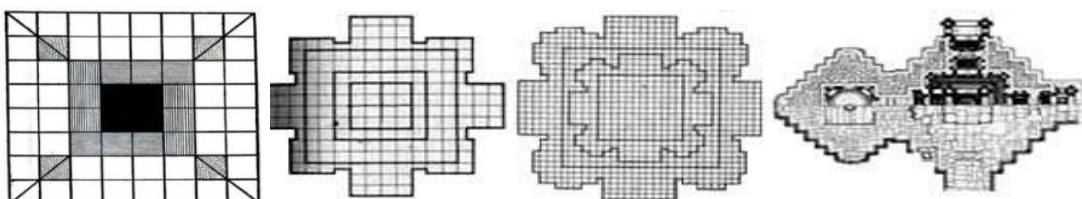


Figure 8 - Architectural plans based on Vastupurushamandala (Source: Grover, 1980) .

3. Comparative Analysis

This section compares the temples of Nagara and Dravidian style to draw comparison and theories of design in traditional Indian temples. The temples that have been selected for comparison are:

- A. Tanjore Temple, Brihadishwara temple, Thanjavur, Tamil Nadu – Dravidian style.
- B. BhadraChalam Temple, Telangana.
- C. Kandariya Mahadev Temple, Khajuraho, Madhya Pradesh – Nagara style.
- D. Holysaleswara Temple, Halebidu, Karnataka.

3.1 Based on Components of Hindu Temple

The word "Shikhara" means "tower" or "spire." Mount "Meru," or the greatest mountain peak in myth, is represented by the prismatic or sloping part of the temple. The size and shape of the tower differ from location to location. The Sanskrit word "garbhagriha" means "womb chamber." The idol is housed in this center chamber, which is also the deepest part of the temple. The mainly square floor design has an entryway on the eastern side that leads into the room. Priests are often the only people who have access to the garbhagriha, which is where the rites and worship are conducted. The circumambulatory path is called "Pradakshina patha". It consists of a walled passageway that goes around the outside of the garbhagriha. The devotees circle the deity clockwise as part of the dedication ritual and as a sign of respect for the temple god or goddess. In front of the garbhagriha, devotees congregate in the pillared hall known as the "Mandapa". The devotees utilize it as a place to sit, pray, chant, meditate, and observe the priests while they carry out the ceremonies. It was also known as "Nata Mandira," which translates to "temple hall of dancing," and it had previously been used for ceremonial dance and music. Some of the older temples had a mandapa that stood apart from the sanctuary. The middle room or vestibule is referred to as "Antarala". It connects the temple's main sanctuary and its pillared hall. The main porch or entrance of the temple that leads to the mandapa is referred to as the "Ardhamandapa". Most often found in south India are "gopurams," the grand and elaborate towers at temple compound entrances. "Pitha," the raised platform or plinth that supports the temple. The typical temple entrance, or "toranas," is mostly found in north Indian temples. The Yamanaka, a fluted disc-shaped stone, sits atop the shikhara (Sharma et al., 2019).

The tabular analysis in the table below is helpful in highlighting that the Nagara Style temples did not have a Gopuram; nor did they focus on Bali Peetam - The "Bali Peetam" may be found as soon as we enter the temple, close to the Dwajastambham. Bali means "Sacrifice" in Indonesian. Unfortunately, since the idea was misconstrued in the past, people began offering animal sacrifices inside temples on Bali Peetam and have continued to do so ever since. The actual reason for having a Bali Peetam in the temple, however, is entirely different. The Agama Sastra / Vidhi states that in order to enter the temple with a pure mind, we must sacrifice or surrender our ego and negative thoughts in front of the Bali Peetam. The Dhvajastambha (flag pillar) and Pushkarini (temple tank) are also not very prominent in the Nagara style of Hindu temples (Panda N.C & Reddy Negi Siva, 2018).

Table 2 – A comparative analysis of Nagara & Dravidian style.

S.NO	ELEMENTS	TANJORE TEMPLE	BHADRA CHALAM TEMPLE	KANDARIYA MAHADEO TEMPLE	HALEBIDU SHIVA TEMPLE
1	GARBHAGRIHA	YES	YES	YES	YES
2	PRADAKSHINA	YES	YES	YES	YES
3	GOPURAM	YES	YES	NO	NO
4	BALI PEETAM	YES	YES	NO	NO
5	VIMANA/SHIKHARA	YES	YES	YES	YES
6	PATHA	YES	YES	YES	YES
7	MANDAPA	YES	YES	YES	YES
8	ARDHAMANDAPA	YES	YES	YES	YES
9	DWAJA STHAMBHA	YES	YES	NO	NO
10	AMALAKA	YES	YES	YES	YES
11	PUSHKARINI	YES	YES	NO	NO

3.2 Planning form and Geometry

Depending on the region, the temple designs vary greatly. A temple plan might be organized, for instance, along an individual straight axis or in concentric rings. As can be seen in Table 3, this chapter addresses Hindu temple geometry in relation to Hindu science and thought, which are based on the cosmic "Vastupurushamandala," and the way they connect to temple construction (Tartakov, 1980) as shown in Table 3.

Hindu temple designs can differ depending on where they are, yet a common architectural idea served as their main inspiration. The most distant parts of India seem to be dominated by this way of considering things. The Vastushastra and Shilpshastra, as well as other generic publications on Hindu architecture, are still used in the perpetual building of revered Hindu temples (Meister, 1983).

Table 3 -Geometric Evolution Plan Form of Nagara Style.

LANGUAGE	MODE	GEOMETRY(EVOLUTION OF PLAN FORM)	CHRONOLOGY
Nagara	Latina	Orthogonal	6 TH TO 12 TH CENTURY (500AD TO 1100AD)
	Shekhari	Orthogonal	
	Bhumija	Orthogonal	
	Bhumija	Stellate	
	Vallabhi	Orthogonal	
	Phamsana	Orthogonal	
	Samvarana	Orthogonal	
Dravida	Dravida	Orthogonal	
	VESARA	STELLATE	

(Source: <http://www.hrpub.org>)

The structure and form of evolution depend on how they relate to one another in terms of height, size, distance from property lines, and character, buildings can define open spaces to varying degrees. The architectural form should take into account its surroundings. The play of open, semi-open, and close spaces play a crucial role in the temple design and define the visitor's experience. (Bathre & Verma, 2022).

3.4 Analysis of Hindu Temple Plans

Vast mandala application: A suitable grid is chosen from the thirty-two mandalas of 4, 9, 16, 25...1024 squares or Padas(Mitra &Sadhukhan, 2020).

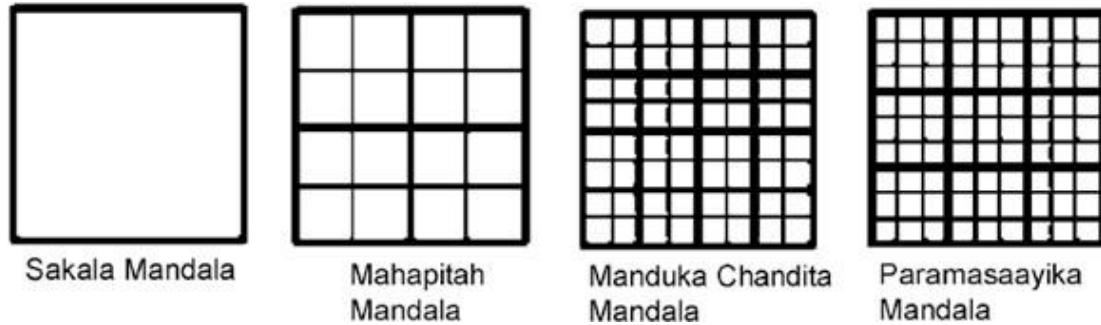


Figure 9 – Mandala’s typologies.

Ad-quadrature: The procedure to calculate the thickness of the walls surrounding the garbhagriha, where the interior wall's length is M and the external wall's length is $\sqrt{2}M$ as shown in figure 9.

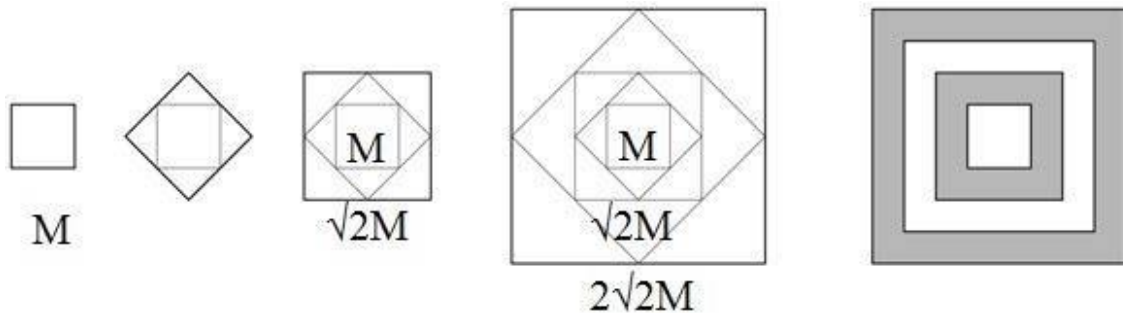


Figure 10 -Determining the wall thickness in relation to wall lengths.

Projections of Aditala: Three different types of components can be arranged in different and unique ways to form various plans as illustrated below. Kuta, Panjara, and Sala (Mitra &Sadhu khan, 2020) as shown in Figure 10.

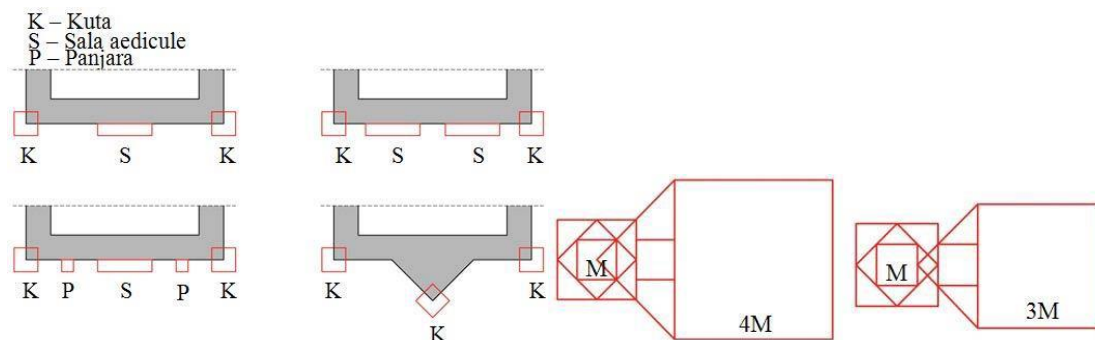


Figure 11- Aedicular Projections and Proportioning the Mandapa.

Organizational composition

The dimension of the Nantahala, mandapa, Nandi mandapa, and other features is directly influenced by the cella's length (M)(Meister, 1979) as shown in figure 11.

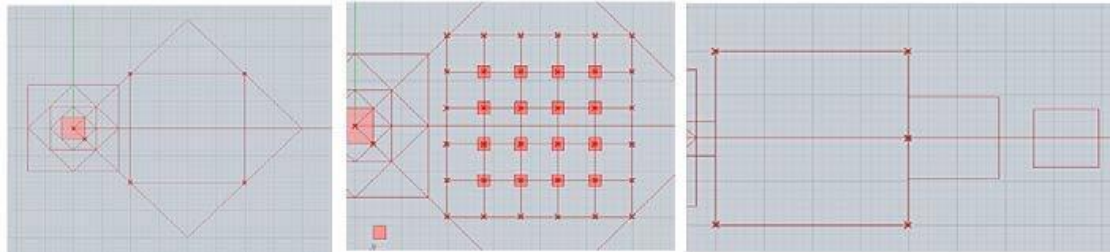


Figure 12 - Axially placed entrance porch, Nandi mandapa, and the size of the mandapa are all shown from left to right.

3.5 Analysis of Hindu Temple Elevations

As the Nagara style contains several shikhara, the Dravidian form only has one. While there are several towers in Nagara Style, there only exists one in Dravidian Style- the Central Tower is shaped like a Curvilinear in Nagara Style, but a Pyramid in Dravidian Style. The Shikhara is the most significant aspect of Nagara design, whereas the Gopuram is the most significant element in Dravidian architecture (Ronald et al., 2018). Nagara temple walls are not given adequate thought, whereas Dravidian temple boundaries are given top emphasis. In the Nagara style, pedestals are higher than the ground than they are in the Dravidian style. (Binda, 2000).

Table 4 - Comparative Analysis of Heights of Nagara and Dravidian style.

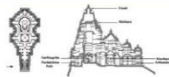







COMPONENTS	NAGARA STYLE	DRAVIDIAN STYLE
Adisthana (base)	2H	H
Tala (body)	4H	3H
Shikhara (tower)	8H	5H

(Source: Adam Hardy, Indian Temple architecture: Form and Transformation)

3.6 Principles of Planning

Hindu temples are highly designed structures that are symmetrical, balanced, rhythmic, pattern- and scale-based, built on a padas squared grid, and have precise geometrical shapes like circles and squares(Gandotra, 2011; Lourenço & Roque, 200(6). Table 5 showing the comparative analysis of Nagara and Dravidian style architecture by taking two example from each style.

Table 5 – Comparative Analysis of Nagara and Dravidian Style Architecture through examples.

Sr. no	Name of temple	Area of main shrine (sq.m)	Length of main shrine L (m)	Height of the sikhara H (m)	H/L	Slenderness ratio 1/(H/L)	PLAN	Section & Elevation
Nagara Style / Northern style								
1	Kandariya Mahadeva Temple	36.82	10.8	35	3.2407	1/3.2 1:3.3		
2	Halebidu Shiva Temple	90.25	11.4	28	2.4561	1/2.4		
Dravidian Style / Southern style								
3	Tanjore Temple	951.8	26.5	64.5	2.4339	1/2.4		
4	Bhadrachalam temple	243.4	24.3	14.2	0.5843	1/0.5		

4 CONCLUSIONS

The Indian subcontinent has a long and varied history that spans from 2000 B.C. to the colonial era, and as a component of its architectural legacy, has left behind a variety of building types in a wide spectrum of architectural styles. The richness of Indian culture is evident in the range of its artistic forms. Indian temple architecture is one of them, and it has contributed to the country's very outstanding building style in architectural history. There are many different types of temples in India, in both small towns and major cities. The Indian temples are the cradle for wisdom, aesthetics, and culture in addition to being a place of worship and the home of God. The traditions and practices of India's temples continue to have an impact on the country's social, economic, and traditional value systems. Hindu temples are still being erected today, but their character still reflects long-standing customs, even though their architectural style is influenced by local building practices and materials that are readily available.

Due to the numerous geographical, climatic, cultural, ethnic, historical, and linguistic variations, Hindu temples have unique architectural styles. The two primary architectural styles of Indian temples, which may be seen in the temples of the country's north plains and south coast, differ significantly in several ways. In these two areas, Hindu temples can be found in both the Nagara or "northern" style and the Dravidian or "southern" style. Technical treatises known as the Shilpa Shastras and Vastu Shastras, which were written in the ancient Indian language of Sanskrit (the language of the Vedas), offer basic standards for architecture and sculpture. The temple serves as a conduit between the spiritual realm of the Divine and the world of man. And to connect them, the foundations of the temples carried. Since the temple is a reflection of the mandala, the traditional Hindu temple design serves as an illustration of holy geometry. Sacred geometry in this context refers to the art of precisely mapping out the bottom floor of the temple in accordance with astronomical movements, locations, and cardinal directions. Mandalas are sacred shapes created by the intersection of circles and squares. Early Hindu temples were built using the trabeated system, also known as the post and beam method, which was eventually expanded by the application of bonding processes. This building method was first used in India to construct wooden structures before being used for stone structures. The column-beam-corbels system, however, evolved to be the fundamental structural philosophy guiding the construction of all Hindu temples. In the creation of Indian temples, the concepts of force balance in motion through the use of vaults, arches, and other functional design elements never really play a prominent part. As a result, the Hindu architects continued to use their traditional techniques and finished their work by attentively examining the laws of gravity. The structure's strength comes from the mass supporting the weight, while its stability comes from the weights' solid resistance when acting vertically. All pressure is transmitted directly downwards. Several steps are involved in building a Hindu temple, including selecting the location, inspecting the site, determining the temple's orientation, measuring and laying out the plan on the ground, selecting the material, carving the stone blocks, using tools and materials, adding joinery detail information, and finally assembling the temple. In order to avoid material failure, the temple's structure mainly depends on the geometric stability of its individual components under the applied load. As a result, dimensional analysis is a crucial step in the assessment of this type of construction's safety. Through a select few specific examples, knowledge of the key geometrical features of temples from north India and south India has been gathered and locked in this article. Though only a limited sample size was used.

Hindu temples can be studied extensively in many different regions of India, not only in terms of cultural history, shape, and evolution but also in terms of construction methods and structural analysis.

Some research has been done. For instance, even though it is commonly known that numerous temples have seldom collapsed owing to various calamities, there are still cases of temples that have survived cyclones and earthquakes because of their interlocking architecture, which was specified in ancient construction instructions. As a result, these buildings often tremble with the ground and always swing but never collapse during earthquakes and cyclones. Therefore, there is a chance for additional research on the structural features of Hindu temples, which may involve security.

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