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# ANCIENT TEMPLES, SPIRIT OF HUMANITIES

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## INTRODUCTION:

India has been praised by some of the great people who have lived on the Earth. The evidence of Indian civilization can be traced back to thousands of years. No other place can vouch for the sort of diversity, which fills every nook and cranny of this incredible country. The various religions, languages, dialects, traditions and customs provide many facets of the majestic country called India. The geographic land of India has several marks of faith spread all across its length and breadth. Certain structures have several centuries of devotion backing them, granting more authenticity and reverence.

“India has two million gods, and worships them all. In religion all other countries are paupers; India is the only millionaire.” – Mark Twain (American author)

Probably India was the land of ‘Engineering’ artists. Here, the old temples and forts have resisted the vagaries of the weather for centuries and they are the evidences of this statement. These temples have sustained floods, earthquakes, heavy winds with a very stable response; not only so a few temples have sustained the bombing by foreign armies in past and recently blasts, terrorist attacks etc. exhibiting stubborn design principles. In those days – architecture, planning, budgeting, designing, manufacturing and construction everything used to go hand in hand; the holistic or the ‘Complete’ thinking about the structure was a key principle behind the success and long life behind these structures. Thousand years back, when these temples were built, there were no established Design principles, testing methods, software, calculators, and spreadsheets etc. were available. Still the end results exhibited by these temples are fabulous (engineering performance in terms of forces, deflection, cracking etc). Thus these ‘Vastus’ are really ‘Structural Engineering Marvels’. In the present paper, briefly discussed various components /corners of the construction, in light of known engineering principles, as on today. Hopefully the paper will help the state-of-the-art engineering to excel ahead by studying the past.

## **Abstract:**

Today, Hindu temples across the globe form the cynosure of India's cultural tradition and spiritual succor. There are Hindu temples in all almost countries of the world, and contemporary India is bristling with beautiful temples, which hugely contribute to her cultural heritage. In 2005, arguably the largest temple complex was inaugurated in New Delhi on the banks of river Yamuna. The mammoth effort of 11,000 artisans and volunteers made the majestic grandeur of Akshardham temple a reality, an astounding feat which the proposed world's tallest Hindu temple of Mayapur.

Temple architecture of high standard developed in almost all regions during ancient India. The distinct architectural style of temple construction in different parts was a result of geographical, climatic, ethnic, racial, historical and linguistic diversities. Ancient Indian temples are classified in three broad types. This classification is based on different architectural styles, employed in the construction of the temples. Three main style of temple architecture are the Nagara or the Northern style, the Dravida or the Southern style and the Vesara or Mixed style. But at the same time, there are also some regional styles of Bengal, Kerala and the Himalayan areas. One important part of the ancient Indian temples was their decoration. It is reflected in the multitude details of figured sculpture as well as in the architectural elements. Another important component of Indian temples was the garbha-griha or the womb chamber, housing the deity of the temple. The garbha-griha was provided with a circumambulation passage around. However, there are also many subsidiary shrines within temple complexes, more common in the South Indian temple.

In the initial stages of its evolution, the temples of North and South India were distinguished on the basis of some specific features like sikhara and gateways. In the north Indian temples, the sikhara remained the most prominent component while the gateway was generally unassuming. The most prominent features of South Indian temples were enclosures around the temples and the Gopurams (huge gateways). The Gopurams led the devotees into the sacred courtyard. There were many common features in the Northern and the Southern styles. These included the ground

plan, positioning of stone-carved deities on the outside walls and the interior, and the range of decorative elements.

### **Design:**

The very essence of a Hindu temple is believed to have developed from the ideology that all things are one and everything is associated. The four essential and significant principles which are also aims of human life according to Indian philosophy are the quests for artha - wealth and prosperity; kama - sex and pleasure; dharma - moral life and virtues; and moksha - self knowledge and realisation. The mathematically structured spaces, intricate artworks, decorated and carved pillars and statues of Hindu temples illustrate and revere such philosophies. A hollow space without any embellishments situated at the centre of the temple, usually below the deity, may also be at the side or above the deity symbolises the complex concept of Purusha or Purusa meaning the Universal principle, Consciousness, the cosmic man or self without any form, however, omnipresent and associates all things. The Hindu temples suggest contemplations, encouragement and further purification of mind and prompt the process of self-realisation in devotees; however the preferred process is left to the convention of individual devotees.

### **Site:**

The areas of Hindu temple sites are usually vast with many of them built near water bodies, in the lap of nature. This is probably because according to ancient Sanskrit texts the most suitable site for a Hindu temple referred as 'Mandir' is at close proximity to water bodies and gardens where flowers blossom, chirping of birds and sounds of ducks and swans can be heard and animals can rest without any fear. These places exhibiting peace and tranquillity are recommended by the texts for building Hindu temples elucidating that Gods reside in such places. Although, leading Hindu temples are suggested near natural water bodies like confluence of rivers, river banks, seashores and lakes, according to the 'Puranas' and 'Bharat Samhita', Mandirs can even be constructed in sites devoid of natural water bodies. However, such suggestions include building up of a pond with water gardens in front of the 'Mandir' or towards left. In the absence of both natural and man-made water bodies, water remains typically present during consecration of the deity or the Mandir. Part III of Chapter 93 of the Hindu text VishnudharmottaraPurana also recommends building of temples within caves and chiselled out

stones; atop hills amidst spectacular and serene views; within hermitages and forests; beside gardens; and at the upper end of a street of a town.

## **Layout:**

Layout of a Hindu temple pursues a geometrical design known as vastu-purusha-mandala, the name of which is derived from the three vital components of the design namely Vastu meaning Vaas or a place of dwelling; Purusha, meaning the Universal principle; and Mandala meaning circle. Vastupurushamandala is a mystical diagram referred in Sanskrit as a Yantra. The symmetrical and self-repeating model of a Hindu temple demonstrated in the design is derived from the primary convictions, traditions, myths, fundamentality and mathematical standards. According to Vastupurushamandala, the most sacred and typical template for a Hindu temple is the 8x8 (64) grid Manduka Hindu Temple Floor Plan also referred as Bhekapada and Ajira. The layout displays a vivid saffron centre with intersecting diagonals which according to Hindu philosophy symbolises the Purusha. The axis of the Mandir is created with the aid of the four fundamentally significant directions and thus, a perfect square is created around the axis within the available space. This square which is circumscribed by the Mandala circle and divided into perfect square grids is held sacred. On the other hand, the circle is regarded as human and worldly that can be perceived or noticed in daily life such as the Sun, Moon, rainbow, horizon or water drops. Both the square and the circle support each other. The model is usually seen in large temples while an 81 sub-square grid is observed in ceremonial temple superstructures.

Each square within the main square referred as 'Pada' symbolise a specific element that can be in the form of a deity, an apsara or a spirit. The primary or the innermost square/s of the 64 grid model called Brahma Padas is dedicated to Brahman. The Garbhagruha or centre of the house situated in the Brahma Padas houses the main deity. The outer concentric layer to Brahma Padas is the Devika Padas signifying facets of Devas or Gods which is again surrounded by the next layer, the Manusha Padas, with the ambulatory. The devotees circumambulate clockwise to perform Parikrama in the Manusha Padas with Devika Padas in the inner side and the Paishachika Padas, symbolising facets of Asuras and evils, on the outer side forming the last concentric square. The three outer Padas in larger temples generally adorn inspirational paintings, carvings and images with the wall reliefs and images of different temples depicting legends from different Hindu Epics and Vedic stories. Illustrations of artha, kama, dharma and

moksha can be found in the embellished carvings and images adorning the walls, ceiling and pillars of the temples.

Pillared outdoor halls or pavilions called Mandapa meant for public rituals with the ones in the east serving as waiting room for devotees adorns the large temples. The Mandir's spire, usually a tapering conical or pyramidal superstructure with a dome designed adhering principles of concentric squares and circles and referred in North India as Shikhaa and Vimana in South India is symmetrically aligned exactly above the Brahma Pada or the central core of the Mandir. Compounds of many larger temples house smaller temples and shrines that also follow fundamental aspects of grids, symmetry and mathematical perfection. Repetition and mirroring of fractal-like design structure forms a significant principle of Hindu temple designs.

The manuals comprising of Hindu temple layouts elucidates plans with squares in the count of 1, 4, 9, 16, 25 and thus, reaching up to 1024. Each plan of different Padas has individual significance, for instance in one pada plan the pada is regarded as the seat for a devotee or hermit to perform yoga, meditation or offer Vedic fire; a four Padas plan, also a meditative design represents a core at the center; and a nine Padas layout that generally forms model of smallest temples has a divine surrounded centre. Although the perfect square grid principle is primarily found in different temples of India, some others hold exception such as the Teli-ka-mandir and the Naresar temple in Madhya Pradesh and the Nakti-Mata temple in Rajasthan, indicating that Hinduism welcomed flexibility, creativity and aesthetic independence of artists.

## **Different Styles of Temple Structure:**

### **❖ Nagara**

The Nagara style that is palpable in different parts of India with varied elaborations in different localities has two particular features. The first being presence of several graduated projections or rathakas in the centre of all sides of the square temple, thus bearing a cross-shape with several re-

entrant angles on all sides. The second feature includes design of the spire or Shikhara that follow principles of concentric squares and circles and gradually taper in a convex curve while stretching upwards. The KandariyaMahadeva Temple in Khajuraho in Madhya Pradesh is a fine example of this style.

### ❖ Dravidian



Fig 1. Dravidian



Fig 2. Nagara

Dravidian temple architecture evolved in South India predominantly comprise of temples built of sandstone, soapstone or granite. The square-shaped temple called Vimana has one or more storied pyramidal roof while its cell houses the image or emblem of the God. The Mandapas/Mandapams or porches are built in such a way that these precede and cover the door that leads to the cell. The Gopurams/Gopuras or elaborate gateway-towers or gate-pyramids encloses the temples. The Chaultris or pillared halls employed for different purposes forms one of the principal and constant features of this style. Temple tanks, wells, abodes of priests and other important buildings form part of this temple style. The famous Thanjavur temple of Tamil Nadu typifies this style

### ❖ Badami-chalukya

Indian architecture saw an illustrious phase during the BadamiChalukyas rule. The foundation of cave temple architecture was laid by them on the banks of Malaprabha River in Karnataka during 500 and 757 CE. The Badami Cave temples situated in the town of Badami in northern

Karnataka dating back to the 6th century is one of the finest examples of this architecture that consist of decorative pillars, finely chiselled ceiling panels and sculptures. More than 150 temples in the historic temple complex situated in the village of Aihole called ‘Cradle of Indian architecture’ and also Group of Monuments of Pattadakal are marked by UNESCO as World Heritage site comprising of architectural edifices like the Virupaksha temple and the Mallikarjuna temple are also brilliant examples of this style.



Fig 3.Badami-chalukya Fig 4. Gadag

### ❖ Gadag

The Western Chalukya architecture or Gadag style of architecture is a specific style of decorative architecture that originated from the old dravida style and defines the Karnatadravida tradition. Evolved during 11th century it prospered for around 150 years till 1200 CE during the reign of Western Chalukya Empire in the Tungabhadra region of Karnataka and saw construction of around 50 temples. A distinct feature of this style was articulation. Kasivisvesvara Temple at Lakkundi and Saraswati temple in the temple complex of Trikuteshwara at Gadag are some of the temples that illustrate this style.

### ❖ Kalinga

This style having three specific types of temples prospered in Odisha and Northern Andhra Pradesh. The three styles are PidhaDeula, RekhaDeula and KhakharaDeula with the first two linked with Shiva, Surya and Vishnu and the latter is predominantly associated with Goddesses Durga and Chamunda. Again the first type comprises of outer halls for offerings and dancing while the latter two comprise of the sanctum sanctorum. The word Deula means temple. The

famous Jagannath Temple of Puri and Lingaraj Temple of Bhubaneswar portray RekhaDeula style while VaitalDeula of Bhubaneswar typifies KhakharaDeula and the Sun Temple at Konark remains a prominent example of PidhaDeula.



Fig 5.Kalinga

India has many temples which are as old as 1000yrs or even more. As we know, mainly these temples were the places for spiritual practices / pilgrimage; but apart from that many temples were also used for education, accommodation and political movements, and as for practicing archery and gym (body building, yoga etc.) too. Most of the temples were built by the kings / emperors / 'Raja' and 'Maharajs' or even rich people like merchants and jewellers. Ancient temples were classified as per their era, viz. Shiv-Kalin temples, 'Pandav-Kalin temples, 'PeshvaKalin' temples etc. (word 'Kalin' indicates the respective Era / time). Mostly the temples were built in stone, with limited use of timber and metal (mainly for carving and architectural details). Strong stones viz. sandstone, basalt, marble was given a first choice. Often the Idol of a deity was preferred to be carved in a glazing-black coloured river stone from Nepal (stone obtained from River Gandaaki). But the local availability of the stone often used to decide the selection of material for construction of structural components. In certain cases the temples are found to be carved out of a single large rock formation (viz. caves and Stupas). The temples can be broadly classified as North-Indian, south-Indian temples and central Indian temples, based on the style adopted. The availability of river water near construction sites, expert workers, elephants or bulls to doze the construction material has also made significant impact on the structure. The carving done in hard stone with fine grain size like marble, basalt and pink sandstone has shown better performance than the carving done in stone with large grain size or porosity, cracks, empty pockets etc. e.g. amygdaloidal basalt, Deccan-trap etc.

## **Building Structure :**

The main construction used to be placed on a stable soil, on the massive foundation block. Often, the plinth level used to be of 6 feet height or even more than that. The foundations used to be dug deep below the existing ground level. To avoid seepage of water to the foundation, and even to facilitate the visitors to move around / encircle the temple, stone paving used to be provided on the periphery of the main temple. The paving used to keep the growth of large trees and shrubs away from the main temple, and thus helped to protect the footing. Because of the pavement it was possible to maintain the cleanliness of the temple also. During the festivals and processions, the stone pavement used to be helpful to act like a floor slab for people to dance, sleep, dine etc. On the massive foundation-plinth block the workers used to place strong pillars to withstand the entire vertical loads of the roof, except the central dome, just above the deity. The central dome used to be supported using solid stone walls on the periphery of the dome. Often these pillars (columns) used to be derived out from a single piece of stone, usually away from the site and then transported and placed at the desired destination. In rare cases it is observed that the columns are made up of two or more pieces glued together using organic resins or some times with molten lead. The verticality of the columns was a critical issue, as in olden days there were no heavy load lifting devices / hydraulic cranes in existence. The job used to be done by a team of skilled masons along with helpers in a few weeks time, using a simple plumb bob suspended on all four sides from the top of the columns / capital. Considering the present situation and scientific growth the job done by our ancestors is very much satisfying. The artists used to use circular / rounded pebbles (looking like potatoes) from the river bed to transport the heavy objects on the slopes (in absence of elephants or bulls or horses). The pebbles used to serve as ball bearings to roll-on the object. In a few cases circular wooden logs were also used. Rarely even poor men / villagers were used in place of animals. In olden Indian temples constructed using seasoned wood (especially in northern most India and Konkan region), could have longer beam spans as timber has lesser weight and better performance in flexure as compared to stone. On the main beam seating on the corbel, secondary beams / slab panels used to be placed in stone or timber (as per the requirement), to form the roof enclosure. Lightweight stones like slate or shell were preferred more. The stone roof used to have even cantilever projection at the outer boundaries of the temple, the flexural moment at the end of the cantilever used to be resisted by

burring the support under heavy dome / walls on the top of the roofs The temples which were constructed in dry / arid or dessert type land, water storage was of great importance. In such temples, tapping of perennial resources like large natural / artificial ponds / reservoirs / streams used to be very important task. Crack free bedrock for retaining the water was also an important parameter which the planner had to keep in mind. Temples located in Maharashtra, Madhya-Pradesh, Karnataka it was not a major problem to source water but temples in Rajasthan of even in Hilly areas were built considering the problem of water retention in mind. Clay strata (in the form of aquifers / acquiclud) to store water was even used by the visionary artists.

### **Maintainance:**

From the structural construction it may be clear that the olden temples required very nominal maintenance. In most of the stone structures, the seepage of water and growth of vegetation, algae was a commonly faced problem. In modern time the contractors just solve this problem using acidic solutions. But in olden days it was not a feasible solution. Hence in many olden temples we find damages due to vegetation growth also. The timber structures were damaged due to fires by the foreign army. Apart from the protection of structure from environment, protection from attacks of the Foreign army was a major issue which Indian temples have faced. The planning used to take care of the possibility of attack, still the attack done by use of launchers 'Toaph' used to be an issue of worry. In certain temples were metals or molten lead was used at joinery, could sustain the bomb attacks to a great comfort. But other temples just got flat in such attacks. In history many temples are found to be partly constructed. Or even a few are constructed by unskilled labours. Most of such temples came down to earth during seismic activity also. The kingdom used to appoint a special team of workers to maintain the temples, law and order at these places. This could be the reason behind the sound health of these temples.

### **Conclusion :**

Indian temple presents humanity of India. Protection of these temples is responsibility of every person of india. Indian Archaeological department, civil and structural engineers, common citizens, local authorities have done handsome job to Identify and preserve this 'Ancient indian Temples'. But still they need to be studied in more depth from 'mathematical' and 'Structural Analysis' and 'Design' point of view. Because in absence of intricate mathematics how the olden

masons / workers were successful to quantify the structural behaviour, is the unsolved question? Also, in absence of modern concepts like durability, ductility, performance, strength, stiffness, flexibility etc. how the material has sustained for so many years (a large numbers of structures built in modern time start showing the signs of dilapidation in first ten or twenty years only )

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