

# Symbolism in Hindu Temple Architecture and Fractal Geometry - 'Thought Behind Form'

Tanisha Dutta<sup>1</sup>, Vinayak S. Adane<sup>2</sup>

<sup>1</sup>PhD Research Scholar, Department of Architecture and Planning, Visvesvaraya National Institute of Technology (VNIT), Nagpur, India

<sup>2</sup>Professor, Department of Architecture and Planning, Visvesvaraya National Institute of Technology (VNIT), Nagpur, India

**Abstract:** *The structural order followed by nature, also adopted in the construction of Hindu temples, was to depict the ultimate truth. This became possible by following fractal geometry. Fractal geometry plays a major part in the transmission of the symbolic intended meanings from the visibly manifested art and architecture of the temple, to the intellect of human beings, for perception in the correct sense. This paper is therefore an attempt to integrate and analyse the fields of study of, temple architecture, fractal geometry, symbolism, human perception of architectural expression, and temple concept through cosmology and philosophy. It is advocated that the use of fractal geometry in the construction of temples, and sculptures adorning them, helps in imparting the temple concept and idea in its correct value.*

**Keywords:** Temple architecture; fractal geometry; symbolism; self similarity; human perception

## 1. Introduction and background to Hindu architectural philosophy

"Hindu temples go beyond just being the visual results of a mathematical process with interesting properties, but touch us deeper, almost on a spiritual level, like all objects of pure beauty."

(Trivedi, 1993)

It is significant that nowhere in the extensive vocabulary of the Indian languages is there a word that corresponds to the term 'religion'. In fact, religious and non-religious matters are never distinguished in Hinduism, as it is unimaginable that any activity, impulse or process, can be without some divine potential (Michell, 1977, 1988). The term *dharma*, which is sometimes mistakenly used for religion, actually means righteousness or propriety. This gives some insight into the minds of the people following a *dharma* which teaches, not of religion, but of righteousness.

Hinduism believes that the universe is created, destroyed, and recreated in an endless series of repetitive cycles, where Brahma is the creator, Vishnu the sustainer and Shiva the destroyer. This trinity combines to form *Parameshwar (Purush)*, the Supreme Being who is the manifested form of the whole of infinity. Hindu philosophy views the cosmos to be holonomic and self similar in nature. According to ancient architectural tradition, Hindu temples are symbols of the model of the cosmos and their form represents the cosmos symbolically (Trivedi, 1993). This is significant and inevitable because of the strong relationship between the cosmos philosophy and the philosophy behind the temple structure. Hindu thought adheres to the related view that the macrocosm is 'enclosed' in the microcosm (Joye, Fractal Architecture Could Be Good For You, 2007), reinforced by Trivedi (1989) when he says that the whole cosmic principle (in Hindu philosophy) replicates itself again and again in ever smaller scales.

It is imperative to mention that there exist numerous theories regarding the concept of the temple, and subsequently, its

various parts. Some of these theories are more relevant and accepted in some cases, whereas the others in other cases. This discrepancy does not undermine the validity of the concepts in any way, but reinforces the idea of interpretation at various levels and in different scenarios. With a higher objective, the variety in concepts helps each individual to take his own path and attain satisfaction of enlightenment in his own way.

Implicit in the motion of holonomy are the properties of homogeneity, isotropy, self-similarity and symmetries of various kinds (Trivedi, 1993). These are the values which are common to both geometric generation of temple forms and its philosophical concept. It is significant that these properties form the basis for the concepts of the temple structure and the geometry used, which will form the discussion in the later part of the paper. The human being is said to contain within itself, the entire cosmos - '*Aham Bhramosmi*' philosophy (Trivedi, 1993), thus reinforcing the idea of 'part in whole' and 'whole in part'.

The cosmic order was the order found in the cosmos and simultaneously in the atom, and therefore in the intermediate scales. To maintain harmony, all man-made objects and structures were enjoined to be fashioned with the same measurements and principles with which the cosmos is made, and so the underlying order and symmetries of the cosmos manifest themselves in the designs and representations made by man (Trivedi, 1993). This is most relevant in the case of Hindu temples, because of the obvious necessity to relate with the cosmic dynamism. The notion of temple as a model of the cosmos has existed over 3000 years in texts and for more than 1000 years in actually realised monuments (Trivedi, 1993). Subhash Kak (2005) has explored the connections that tie the details of the temple form and its iconography to fundamental Vedic ideas related to transformation (Kak, Early Indian Architecture and Art, 2005).

If we trace the artistic forms of things, made by man, to their origin, we find a direct imitation of nature (Lethaby, 1891,

2005 ). This does explain the common processes used for the creation of art. It should be noted that sometimes the aesthetic appeal of fractal-like patterns is also explained by the fact that the nervous system is governed by fractal-like processes (explained later) (Joye, Architectural lessons from environmental psychology: the case of biophilic architecture, 2007). There is enough evidence to prove that nature, cosmos, human body and human mind all follow the same algorithm in geometrical progression.

## 2. Temple architecture - manifestation of the philosophy

"As the pigments are but the vehicle of painting, so is the building but the vehicle of architecture, which is *the thought behind form*, embodied and realised for the purpose of its manifestation and transmission. Architecture, then, interpenetrates building, not for satisfaction of the simple needs of the body, but the complex ones of the intellect."

(Lethaby, 1891, 2005 )

How humans experience architecture, is an extensively talked about subject. The conclusions can be drawn only after certain connect and relationship has been formed between the building and the observer. This connection needs a basis or connecting thread to be formed. The scales at which human beings can comfortably perceive things and interpret to understand, is limited. The cosmic scale and the atomic scale - the two ends of scale - are unperceivable to the human naked eye, and therefore contribute only conceptually to the ideas of homogeneity, isotropy, self similarity etc. So, the eternal truth embedded within these concepts geometrically, needed to be manifested into a scale which human eye can perceive and interpret in their own right, also being an inherent part of their worldly experience (For example in Figure 1: Jagdambi Temple, Khajuraho). Here, temple architecture comes to help.



**Figure 1:** Jagdambi Temple, Khajuraho

In the Hindu temple, the potentially divine becomes visibly manifest and therefore approachable by man (Michell, 1977, 1988). Hindu art is dedicated to rendering the world of the gods visible; its sacred images voice the messages of the gods (Michell, 1977, 1988). The role of the Hindu artist is to give visible form to the values of his society, rather than to communicate a personal interpretation of these values (Michell, 1977, 1988). These values may sometimes also be referred to as 'collective memory', which is not individual understanding, or memory, but the collective consciousness of the society. The form language is stored in collective

memory and recorded in physical materials, and is older than writing (Salingaros N. A., 2006, 2008). Each traditional form language is distinct, yet possesses a comparably high degree of organised complexity in terms of visual vocabulary and combinatoric possibilities (Salingaros N. A., 2006, 2008). This collective consciousness of the society carries memory in the form of concepts or images and manifests itself by favouring the most stable and comforting 'visual memes' (self sustaining conceptual entities that become fixed in human memory (Salingaros N. A., 2006, 2008)).



**Figure 2:** Outer Fascade, Kandaria Mahadev Temple, Khajuraho

In order that certain theological ideas should be translated into art, particularly in the fashioning of sacred images (Figure 2: Outer Fascade, Kandaria Mahadev Temple, Khajuraho), the priests set out elaborate prescriptions which governed all the details (Michell, 1977, 1988). *Brihatsamhita* and *Sthapatyaveda* give the solution as the temple which should act as the microcosm of the cosmos (Stierlin, 2002). These have been developed through the ages with serious consideration to the aspects of human mental comfort and intrinsic affiliations, and the ultimate truth to be conveyed to them.

The temple has been the centre of the intellectual, social and artistic life of the Hindu community, functioning not only as a place of worship, but also as a nucleus around which all artistic and cultural activity is concentrated and flourishes. The influence that this structure had on the society as a whole was immense; from suggesting worldly behaviour and practices, to striving to achieve the ultimate goal of human life; magnifying its responsibility of directing the individual's gaze towards the ultimate goal.

The most well known document which guides the construction of temples is the *Vastushastras* - texts where instructions are in the nature of general programs from which different temple forms may be generated. Ancient writings on *Vastushastra* are spread through a diverse body of texts ranging from philosophical texts such as *Upaishads*, to technical manuals encoding artisanal knowledge like the *Brihat Samhita*, *Mansara*, *Mayamata* and *Vastusutra* (Datta, 2010). Hindu temple architecture is vast and requires an understanding of not only Hindu philosophy, but also the nature of religious practices, rituals and temple worship in Hinduism (Trivedi, 1993). It combines the subjects of philosophy, cosmology, psychology, mathematics, geometry and an in-depth understanding of the social and cultural life of the people and the times, to be able to arrive at a form which satisfies every individual's intellect, imparting knowledge suitable to each.

Senses, feeling and embodiment interact with narrative in the quest for meaning. In order to maintain such a holistic awareness, it requires a shift from an oscillating to a circular dialectic that tracks the hermeneutic relations between the whole and its parts, and vice versa (Schorch, 2014). Architecture, described as thought behind form, is the most appropriate vehicle, for carrying the messages addressed for human mind. This special relationship formed between the structure and the human mind, substantiates the experience through symbolism. Therefore the connecting basis may be developed through the use of symbolism, which touches the intellect in more than one way.

### 3. Symbolic expression and perception

"The history of symbolism shows that everything can assume symbolic significance: natural objects (like stones, plants, animals, men, mountains and valleys, sun and moon, wind, water, and fire), or man-made things (like houses, boats, or cars), or even abstract forms (like numbers, or the triangle, the square, and the circle). In fact, the whole cosmos is a potential symbol." (Carl Gustav Jung, *Man and His Symbols*, 1964)

A Hindu temple is a symbolic structure that represents certain fundamental concepts of Hindu philosophy about the nature of cosmos, and the formal characteristics of the temple are the outcome of this symbolic representation (Trivedi, 1993). The Rig Veda used a subtle system of symbolism, so that in later Indian thought its meaning was always open to *interpretation at several levels* (Michell, 1977, 1988). A universe is the result of time that follows the cosmic order in which a fraction of moment is the microcosm of the biggest time unit (Md Rian, et al., 2007). It is most important to understand that the temple form, from a point of view, identifies itself with the form of the universe. This point, already been mentioned, will be elaborated as the discussion proceeds. The symbolism of

temple buildings sometimes seems to refer to the structure of the world and sometimes to the religious relationship of men to the gods (Saussaye, 1891). This dual role is fulfilled by the intricately complex symbolism which are 'open to interpretation at several levels', thus facilitating our understanding. Every religious expression in art represents, therefore, an encounter between man and divine (Eliade, 1985).

The very dynamics of the cosmos are expressed in the tensions of the conflict between good and evil rather than in an ultimate resolution which never takes place (Michell, 1977, 1988). This tug of war between the good and the bad is mundane, superficial and yet desirable (Dutta, 2013). They are part of us - our own creation - the product of our mind and body (Dutta, 2013). [Here], the religious man is confronted with the sacred character of the cosmos; that is, he discovers that the world has a sacred significance in its very structure (Eliade, 1985). Eliade says that sacred art seeks to represent the invisible by means of the visible and through the mediation of artistic expression the attributes of religious abstraction are revealed, so to speak, it is presented in visible form. This intent is especially true [for Hinduism], where philosophical speculation has evolved a systematic treatment of the nature and attributes of divinity. Her theory, that humans are interested to depict and display their God's 'form' as well as their 'works' is substantiated through the fact that cosmos is considered to be their supreme creation, at the same time the God Himself. To sum up, Hindu temple is therefore not only the abode of God but also the form of God (Md Rian, 2007).

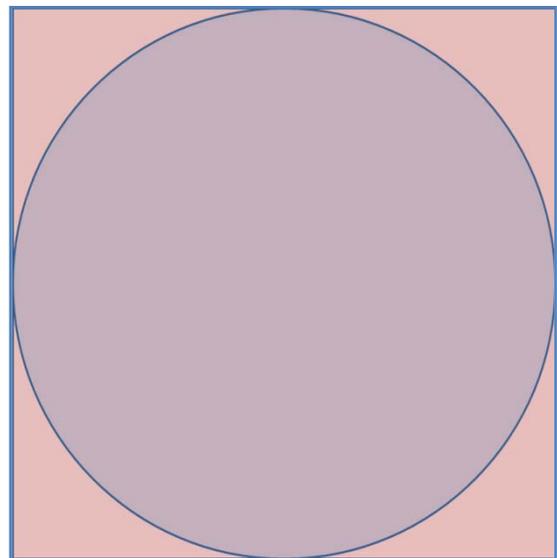
#### 4. Geometry and its Application

In Hindu thought, number is considered an expression of the structure of the universe and a means of effecting the interplay between the universe and man (Michell, 1977, 1988). When numbers are given shape and form, geometry comes into play. To be able to impart the symbolic meanings to the mind of the observer through the eyes and brain, there was a need to establish a certain geometry which will attract the eyes and arouse the brain. To be able to convey these meanings through form, a strong relationship had to be developed between form and meanings in a decipherable language. This relationship that develops between forms and their meanings within the Hindu temple is essential to its function as a link between the gods and man (Michell, 1977, 1988).

The basic plan form of any temple is built upon the *Vastu Purush Mandala*, which is a square, representing the earth. It also symbolises order, the completeness of endless life and the perfectness of life and death (Michell, 1977, 1988). In the foundation of any Hindu temple, cosmos is embodied by laying down the diagram of *Vastu Purush Mandala* on a selected ground. This divine diagram reflects the image of cosmos through its fractal qualities (Md Rian I, et. al., 2007). The Mandala can be considered an ideogram, while the temple is the material manifestation of the concepts it embodies (Trivedi, 1993).

The square symbolises order, unequivocal form, the celestial sphere and the absolute. The circle on the other hand

represents movement, and therefore time. The square and circle, by their very nature, are constant, but the rectangle is not. The square, with its potential to include competing elements, when enclosing a circle represents the dimensions of both space and time. As the cosmos is represented by the circle symbolically, the process of making an architectural model of the cosmos involves the representation of a circle in a square grid in two-dimensional construction and of an ellipsoid (the cosmic egg) in a cubical grid in three-dimensional construction. A process of descritization of all curved forms is necessitated by this need to represent them in a square grid, which results in the typical jaggedness of the temple plan (Trivedi, 1993). The transformation of circle to square and square to circle is not one which can be explained through Euclidian geometry. It needs an intricate understanding of the nature and geometry of natural forms. The process by which natural elements gain their unique form can be applied to the temple structures to find the underlying theme. The application of this algorithm to the temple construction gives it the remarkable appearance.



**Figure 3:** Square and Circle Superimposed; Symbolising the earth and the cyclical time

The superimposition of the square and the circle is significant considering their individual symbolic meanings (Figure 3: Square and Circle Superimposed; Symbolising the earth and the cyclical time). Both of these when put together acquire the properties of order and movement. Also, this superimposition depicts the celestial sphere and the Absolute, with respect to time; where eternal time is also the smallest moment. This proves the involvement of circle with square, with respect to the temple concept and philosophy. The most impressive aspect of the temple representation is that it occurs both at the level of the part as well as the whole in a recursive fashion mirroring the Vedic idea of the microcosm symbolising the macrocosm at various levels of expression (Kak, Space and Cosmology in the Hindu Temple, 2002)

Nevertheless, this form of geometry, i.e. Euclidian Geometry, does not suffice to generate the process of development of the structure of the temple. It does not help to describe the form of the Hindu Temple and its embodied depictions of dynamics, movement, tension, order and

harmony. Fractal geometry, though, has been found to be able to explain most of the forms and patterns in a temple complex.

## 5. Fractal Geometry - Application and Importance

"... the dynamic formal structure of Indian temples shows irresistible analogies with certain metaphysical ideas recurrent in Indian thought: of the manifestation in transient, finite multiplicity of a timeless, limitless, undifferentiated yet all pervading unity; of the identity of this oceanic infinitude with the all-containing infinitesimal point; of finite things as fleeting transmutations of the infinite momentarily differentiated, then sinking back into unity, in unending cycles of growth and decay." (Hardy, 2007)

The existence of the phenomenon of self similarity in the natural world has been observed and known since antiquity, but its mathematical understanding and the process of arriving at it began with Mandelbrot's work in 1977, even though the credit should be shared by various mathematicians and philosophers for their contributions during the twentieth century which made this possible. The fractal dimension is a statistical quantity that gives an indication of how completely a fractal appears to fill space, as one zooms down to finer scales (Xiaoshu Lu, 2012).

Fractal analysis is being increasingly used for analysis in various fields including medicine, psychology, urban form and architecture. These developments include refinement in the software usage for computing fractal dimension, which

is a measure of the roughness and degree of details. This, when applied to the field of temple architecture enhances understanding of the structure geometrically. In particular, Anderson and Mandell (1996) argue that human evolution in a fractal world has required "the incorporation of fractal structures as well as fractal processes, and these in turn would be integrated into sensory systems, recognition, memory, and adaptive behaviours" (Joye, Architectural lessons from environmental psychology: the case of biophilic architecture, 2007).

The role of fractal geometry in the construction and physical manifestation of the Hindu temple has not been fully understood until recent developments in the field of fractal software helped in the partial understanding of the deep relationship between them. The fractal characteristic of an architectural composition presents itself in this progression of interesting detail as one approaches, enters and thus uses a building (Bovill, 1996). This represents a progression of observation from across the street to inside a room. The idea that temple architecture has a progression of detail from a large to small scale is accepted. But, fractal analysis provides a quantifiable measure of the progression of detail, also quantifying the mixture of order and surprise in a rhythmic composition (Bovill, 1996).

In many practical applications, temporal and spatial analysis is needed to characterise and quantify the hidden order in complex patterns; fractal geometry is an appropriate tool for investigating such complexity over many scales for natural phenomena (Xiaoshu Lu, 2012).



**Figure 4:** Sun Temple, Modhera; Fractal development of form is profound

Although employed in various fields in different roles, fractal geometry has been applied particularly in architecture as a language which translates the beauty of complexity as well as the ideas of architects (Thomas, 2002) into visible dynamics (Figure 4: Sun Temple, Modhera; Fractal development of form is profound). It also reflects the process of universe and its energy through the buildings

(Jencks, 1995). Hindu temple is one of the best examples of those fractal buildings which were constructed in the past, long before the birth of fractal theory and manifested the religious cosmic visions (Jackson, 2004). In his paper, Md Rian, et. al., evidence the deep relationship between fractal geometry and the deepest truth in Hindu temples. Trivedi pointed out that there exists a striking resemblance of temple

forms to images based on fractal geometry. Countless temples exist all over India... which could be viewed as three dimensional structures based on fractal geometry (Trivedi, 1993).

There are various methods to evaluate the fractal dimension, among which the box counting method is suitable for measuring the fractal dimension of the elevation of buildings, mountains, trees or any objects which are not true fractals (Md Rian I, et. al., 2007). This measurement of the fractal dimension helps in quantifying the beautiful mix of *order and surprise* in a structure. This contributes in forming the appropriate heuristics in the human minds, and therefore setting the stage for higher and clearer understanding.

## 6. Discussion - Integration of above mentioned ideas

The most remarkable aspect of the relationship of fractal geometry and Hindu temple architecture is that, not only does the physical manifestation of a Hindu temple confirm to the geometry of fractals, but also the theory behind fractal geometry, i.e., the fractal concept is parallel to the concept and idea of temple and its philosophy. The parameters of replication in multiple iterations, self similarity, dynamics and complexity at varying scales are the ones that render Hindu temples fractal-friendly, therefore, forming the base for fractal analysis in the Hindu temple.

The literature in this regard, addresses how fractal geometry can be applied to the underlying concept and the physical manifestation of a Hindu temple to arrive at the final form. These studies ignore the aspect of 'symbolism' which is evident in a temple complex. It holds a very important position in the overall concept as well as the symbolic representation of the 'ultimate truth'.

The *Vastu Purush Mandala*, geometrical basis of the Hindu Temple plan, is the result of fractal iterations. Arnheim, in his book, 'Art and Visual Perception', describes intricately the hidden fields of forces within the square where each side of the square applies force towards the centre. Thus increasing the number of squares in a *Mandala* helps the diagram to contain the (cosmic) energies more concretely where the field of forces is increased in a fractal manner. These restored energies in the *Mandala* radiate outwards to the physical world eternally from the centre. With time, the final shape of *Mandala* turns into a complex matrix through various transitional stages. In these stages, plans of some earlier temples evidence that the fact of radiating cosmic energy took the main role for amending the basic shape of *Mandala*. Interestingly, it turns out in some cases that the process of amendment is nothing but the fractal iteration of *Mandala* (Md Rian I, et. al., 2007).

The well-controlled zigzag plan of the temple creates the vertical visual rhythm, accentuated in the elevation through its sharp recessions and projections, whereas the horizontal friezes on the elevation create the horizontal rhythmic growth upward (Md Rian I, et. al., 2007). In the *shikhara*, the amalgamation of the form of lotus blossom and that of mountain has been frozen into the form of multiple recursive archetypes (Md Rian I, et. al., 2007).

As discussed earlier, the circle depicts the endless cycles of time, the wholeness and the consciousness due to its never-ending shape. Each iteration starts from the intersection between a side of the diagonal square and the last iterated line, and stops at the intersection between grid line and the circle. This iteration stops at the corners of the square. Hindu cosmology, manifested in the plan of Hindu temple two dimensionally, was also manifested in its elevation but three dimensionally and more symbolically (Md Rian I, et. al., 2007).

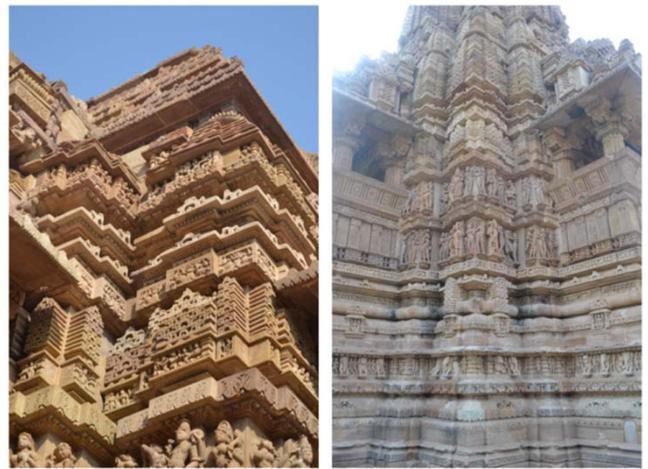
Looking at a well known and well researched Shiva temple of India, the *Kandaria Mahadev Temple*, Khajuraho, in the light of the previous discussion, it is brought about superficially, that these Hindu temples confirm to the idea which is a beautiful combination of the religious faith, geometrical achievements, understanding of human comfort and aesthetics, how human beings perceive (psychology), fractal geometry and its concept, knowledge of cosmology and its philosophy, and most importantly, symbolism.

In the case of *Kandariya Mahadev temple*, the main tower above the sanctuary is repeated at its four sides and the same process of repetition is continued in each newly born smaller tower, and again this process repeated in the last newly born smaller tower. At the same time smaller towers are repeated on the body of main tower in which the whole tower attains such an arrangement where one can easily feel the whole in a part within another part (Md Rian I, et. al., 2007). In the *Nagara shikhara*, the application of a recursive procedure, applied in three dimension, makes the high tower of the *shikhara* throw forth diminutive multiples of its own shape in high relief, each one and all of them subordinated to the bulk of the total *shikhara* (Trivedi, 1993). Placing of the smaller towers on the elevation is such that the peaks of each smaller tower pointing towards the summit of main central tower, makes the impression of unity in infinity towards cosmic axis. Another significance of such arrangement of smaller towers on the *shikhara* of *Kandariya Mahadev temple* is the man's perception for seeing the whole body of *shikhara* in its self-similar parts from any location of view (Md Rian I, et. al., 2007).



**Figure 5:** Sky-Soaring Shikhara, Khajuraho

The beauty of *shikhara* lies behind the proportions of the arrangement of replicas (Figure 5: Sky-Soaring Shikhara, Khajuraho). In Hindu temples the repetitions of the towers are not arbitrary, but follow certain rules and proportions for the comfort of the society as well as geometrical congruence with the universe. Its proportions have deep significance; because only if the temple is constructed according to the mathematical system properly, it can function in harmony with the mathematical basis of the universe (Md Rian I, et. al., 2007). This when elaborated further, can also be said to be functioning in harmony with the mathematical basis of our brain. Hagerhall et. al. (2004) have performed a more systematic enquiry into the relation between aesthetic preference and fractals. These unique fractal characters on the body of the *shikhara* above the sanctuary of Kandariya Mahadev temple are born by the process of iteration from a single central tower which is known as *unipratiti* (Md Rian I, et. al., 2007). Fractal pattern of the plan of Kandariya Mahadev temple, replicas of detailed towers, and rhythmic growth of horizontal friezes, create a harmony of fractal characters in the whole complex (Md Rian I, et. al., 2007). The existence of such a general program of proportional relationships, independent of absolute size, enables the same procedures to be repeated in gradually diminishing sizes in correspondingly smaller grids, theoretically up to infinity (Trivedi, 1993). Sudden discrete transitions are preferred to the continuous blending of forms. These jagged, fractalized shapes, impart a dynamic vibrant visual quality suggestive of outward expansion to the overall form of the temple (Figure 6: Laxman Temple, Khajuraho, the emanating structure of form and sculpture is evidently noticed here.), which is perhaps the reason for their preference (Trivedi, 1993). Together, all these operations create the total temple form - teeming with complex detail, vibrant, dynamic and self-similar - like the cosmos it is supposed to represent (Trivedi, 1993).



**Figure 6:** Laxman Temple, Khajuraho, Symbolically-Emanating Universe

In the *Dravida* style of architecture, the smaller shapes are aligned in a definite pattern at each horizontal level, the repetition of these shapes at each band forming a kind of garland at each level (Trivedi, 1993), but this style is beyond the scope of this paper.

The upper part of the ceiling of the *mandapa*, called *vitana*, (Figure 7: Temple Ceiling, Khajuraho, the emanating structure of form and sculpture is evidently noticed here) usually portrays an expanding Mandala, depicting self similar worlds arranged concentrically (Trivedi, 1993). Each bloom from a single (lotus) bud is stratified by making a level difference. These differences in levels and the concentric floral patterns make a pattern for the spiritual journey to the unity of infinity (Md Rian, 2007).



**Figure 7:** Ceiling of Temple, Khajuraho, Symbolically-Emanating Universe

Even the smallest details of the temple carry the concept of creation. Naked eyes go to the tiniest details up to some level, but the story or the images of the gods; where mythology plays an important part; makes a passage of spiritual journey for the 'third eye' -power of imagination-to perceive what is further towards infinity.

In a footnote [Summerson] cites James Fergusson's observation, in his pioneering work of 1876, that 'everywhere ... in India, architectural decoration is made up of small models of large buildings' (Hardy, 2007). Hardy reinforces the idea of self similarity and depiction of the same attribute across different scales, by mentioning that aedicules are not just ornaments, but the basic unit from which most Indian temple architecture is composed (Hardy, 2007). A temple design is conceived as containing numerous smaller temples or shrines, arranged hierarchically at various scales, embedded within the whole or within one another (Hardy, 2007). As Summerson puts it; 'The aedicule unlocks door after door'.

These examples put some light on the implementation and manifestation of the concepts and ideals emphasized by Hindu philosophy for the construction of the temples, so that correct impact is made on the human mind.

Scholarship has associated several meanings with Hindu temples: house of God, heavenly palace or city of God, mountain, cosmos (Hardy, 2007). This is significant because if these connections are lost, then the final imagery for interpretation is not formed, hence deceiving the idea of construction. This is where fractal geometry comes in to help understand, decipher and interpret the temple in its magnificence. Some authors hypothesize that the proposed fractal nature of the human mind and brain can illuminate the creation of fractal artwork. Essentially, such art should be understood as an exteriorisation of the fractal aspects of brain functioning (Goldberger, 1996). As he puts it, "The art work externalises the maps and the internal brain-work... Conversely, the interaction of the viewer with the art form may be taken as an act of self-recognition". Nikos Salingaros mentions in his paper (1998), that buildings satisfying certain rules are sub-consciously perceived as sharing essential qualities with natural and biological forms, and as a consequence, they appear more comfortable psychologically (Salingaros N., 1998). From a study of natural entities Salingaros concludes that the scaling relationship between these elements should obey the ration of 2.7, to be aesthetically pleasing (Joye, Fractal Architecture Could Be Good For You, 2007). Scaling coherence, which is the basis of fractal geometry, is a major feature of Temple Architecture (Salingaros N., 1998). The ratio of 2.7 walks along the lines of fractal geometry and supports the argument.

It becomes evident from the above discussion that the various relationships established, through fractal geometry, are not manifested with similar physical appearances, but similar aesthetic appeal. This is because the algorithm or process used to develop the physical arrangement is similar.

## 7. Conclusion

The need to relate all these streams of thought and study is to be able to demonstrate that even though the integrated whole doesn't form a part of imparted knowledge of a person, the concept and idea manifested, does impact the human mind in the way discussed above. This fact is due to the philosophical connotations of the various strategies and

tactics employed in its construction, which meets not only the human eyes but the intellect, and touches it deeply.

This paper, therefore, attempts to provide a point of view for the reader and observer, by integrating various streams of thought and presenting a new perspective. It is advocated that the primitive, but beautifully complex, and satisfying form of these temples has been arrived at; not through the use of complex computer algorithms, generative of structures; but by intuitive processes, giving a fair idea of human intrinsic affiliations, satisfying intellectual needs.

It is estimated that, had fractal geometry not been used in the physical manifestation of the temple philosophy, it would have been difficult to impart the knowledge intended by temple construction. Every element in the temple structure, the *prasada*, the *shikhara*, the finial, the sculpture on the exterior and interior walls, the jagged plan form and the appearance in totality, take help of fractal geometry; within the perceivable scales; to promote their idea and concept. The implementation of fractal geometry ensures that the underlying structure resemble the structure found in nature and hence provides the temple with its aesthetic appeal.

It has been noticed that, not only does the physical manifestation follow the principles of fractal geometry, but also the idea of construction, i.e., the concept of the temple and its philosophy, is akin to the concept of fractal geometry and fractal progression. This, points towards the conception that even though the formal theory of fractals had not been developed; like today; at the time of temple construction, the concept existed in the minds of the priest and *sthapaty*. This concept is in tune with the cosmological and philosophical theory attested by the temple structure. This attempt has been directed, not so much, towards creation, or recreation, of a temple form, but focus has been on the process for arriving at these forms. The use of fractal geometry in the construction and design of temples is evident, but the question raised here is, 'why?'. This can be answered by analysing the cosmological and philosophical requirements the temple structure aims to fulfil symbolically, alongside the theory of fractals. The author's work here, centres on the establishment of the mediatory role of fractal geometry and its theoretical application, in the relationship of the philosophical concept and the physical manifestation of a Hindu temple.

It should be noted that this article has touched upon the concept theoretically, and suggests the possibility of the existence of this relationship. This project can succeed with a trans-disciplinary approach, where every subject is given importance and analysed through fractal lenses. 'The human mind has first to construct forms, independently, before we can find them in things'. - Einstein

## 8. Acknowledgements

The photographs and diagrams are courtesy the author.

## References

- [1] Bovill, C. (1996). *Fractal Geometry in Architecture and Design*. New York: Springer Science+Business Media, LLC.
- [2] Datta, S. (2010). Infinite sequences in the constructive geometry of thenth century hindu temple superstructures. *Nexus Network Journal (Special issue)*, 471-483.
- [3] Devaney, R. L. (1995, April 2). The Sierpinski triangle. Retrieved July 17, 2014, from <http://math.bu.edu/DYSYS/chaos-game/node2.html>
- [4] Dutta, T. (2013, May). Iconography and t\Temple Architecture. (P. U. Gadkari, Ed.) *Architecture Time Space & People*, 13(5), 32-39.
- [5] Eliade, M. (1985). *Symbolism, the Sacred, and the Arts*. (D. Apostolos-Capadona, Ed.) New York: The Continuum Publishing Company.
- [6] Goldberger, A. L. (1996). Fractals and the birth of gothic: Reflections on the biologic basis of creativity. *Modular Psychiatry*, 99-104.
- [7] Hardy, A. (2007). *The temple architecture of india*. England: John Wiley & Sons Ltd.
- [8] Jackson. (2004).
- [9] Jencks, C. (1995). *The Architecture of the Jumping Universe*. London: Academy Editions.
- [10] Joye, Y. (2007). Fractal Architecture Could Be Good For You. *Nexus Network Journal* 9, 311-320.
- [11] Joye, Y. (2007). Architectural lessons from environmental psychology: the case of biophillic architecture. *Review of general psychology*, 11, 305-328.
- [12] Kak, S. (2002). Space and Cosmology in the Hindu Temple. *Vaastu Kaushal: International Symposium on Science and Technology in Ancient Indian Monuments*, (pp. 1-17). New Delhi.
- [13] Kak, S. (2005). Early Indian Architecture and Art . *International Journal of Migration and Diffusion*, 6-27.
- [14] Lethaby, W. R. (1891, 2005). *Architecture, Mysticism and Myth*. New York: Dover Publications 1891, Cosimo, Inc. 2005.
- [15] Md Rian, e. a. (2007). Fractal Geometry as the synthesis of Hindu Cosmology in Kandaria Mahadev Temple, Khajuraho. *Science Direct: Building and Environment*, 1-15.
- [16] Michell, G. (1977, 1988). *The Hindu Temple: An Introduction to its Meaning and Forms*. Chicago, London: University of Chicago Press.
- [17] Salingaros, N. (1998). A scientific basis for creating architectural forms. *Journal of Architectural and Planning Research*, 283-292.
- [18] Salingaros, N. A. (2006, 2008). *A Theory of Architecture*. UMBAU-VERLAG.
- [19] Saussaye, D. I. (1891). *Manual of the Science of Religion*.
- [20] Schorch, P. (2014). Cultural feelings and the making of meaning. *International journal of Heritage studies*, 20, 22-35.
- [21] Stierlin, H. (2002). *Hindu India: From Khajuraho to the Temple city of Madurai*. Koln: TASCHEN.
- [22] Thomas. (2002).
- [23] Trivedi, K. (1993). *Hindu Temple: Models of a Fractal Universe*. *International Seminar on Mayonic Science and Technology*, (pp. 243-258). Madras.
- [24] [www.artsjournal.com](http://www.artsjournal.com). (n.d.). Retrieved July 17, 2014, from [https://www.artsjournal.com/aestheticgrounds/the\\_role\\_of\\_censorship\\_in\\_publ/](https://www.artsjournal.com/aestheticgrounds/the_role_of_censorship_in_publ/)
- [25] Xiaoshu Lu, D. C.-C. (2012). *Fractal Geometry and Architecture Design: Case Study Review*. *Chaotic Modeling and Simulation (CMSIM)*, 311-322.

## Authors Profile

**Ar. Tanisha Dutta** is a Phd research scholar at the Department of Architecture and Planning, Visvesvaraya National institute of Technology (VNIT), Nagpur, India. Born in 1984, Dutta obtained a Bachelor's degree in Architecture in 2006 from VNIT, Nagpur, and a Master's degree in Planning, with specialisation in Environmental Planning in 2008, from School of Planning and Architecture, New Delhi, India. Having taught the B.Arch. and M.Plan students, she has retained her interest in the History of Architecture, so as to be able to pursue Doctoral Research in 'Interpreting Symbolism in Hindu Temple Architecture through Fractal Geometry'.

**Dr. Vinayak S. Adane** is a professor at the Department of Architecture and Planning, Visvesvaraya National institute of Technology (VNIT), Nagpur, India. Born in 1964, Adane obtained a Bachelor's degree in Architecture in 1986 from VNIT (then VRCE), Nagpur, and a Master's degree in Planning in 1988 from Government College of Engineering, Pune. He obtained a Doctoral Degree in 2008 for 'Enabling Framework for Sustainable Urban Infrastructure: Case Study of Indian Cities' from JNTU School of Planning and Architecture, Hyderabad. He has taught B.Arch. and M.Plan. students for 26 years and has extensive experience in research.