2 EARLIER WORKS ON ANALYSIS OF INDIAN TEMPLE ARCHITECTURE

The various aspects of Indian temples are studied from different scholars like observed from the study of scholarly works of such as Percy Brown (Indian architecture, Buddhist and Hindu period 1956), K R Srinivasan, (Temples of south India 1982), J C Harle (The art and architecture of south Indian subcontinent 1994), Satish Grover (Architecture of India, Buddhist and Hindu volume 2 1980), Krishna Deva (Temples of India 1996). Most of these works deal with descriptive approach of forms and distinct stylistic aspects of the temples. Among these scholarly work Professor Adam Hardy’s explanation of form development (the process of adecularity, adecular density, proliferation and fragmentation from a central emphasis movement, staggering, diagonal continuity / alignment, abstraction and assimilation) help us in understanding of the form conceptualisation of temple from the point of form composition Figure 2-1.

Hardy's work in formalizing various components and their configuration to describe a temple composition both horizontally and vertically in the format of kuta, sala, panjara, kuta stambha, panjara stambha, kuta aedicule, panjara aedicule is noteworthy refer Figure 4-1. Also the decorative features/ external treatments like nasis, gavakshas are highly illustrative. Hardy also emphasized his study on Karnataka Dravida architecture in a very intensive manner, from the perspective of development of various schools with respect to time. Professor Hardy’s highly illustrative approach as a marked deviation from the earlier descriptive approaches. His work illustrates various compositions, their variations and simplified descriptive analysis. His classification of temple plan typology based on their geometrical configuration and subsequent form resolution from over all idea to micro detailing further provides a detailed understanding of temple architecture. His study is the basis for later research development.

Inspite of Professor Hardy’s comprehensive work in terms of covering vast examples and dispensing detailed descriptive compositions, there lies a huge research gap when it comes to converting these concepts into physical reality/ course by course geometrical
variations and possible instructions for construction of any temple. To that extent an understanding of the generative principles of temple form is still elusive.

Figure 2-1 Components of Karnataka Dravida temples and broad classification of plan geometry

source (Hardy, Indian temple Architecture)

Michael Meisters’ (Meister) works explains the conceptual beginning of the vastu purusha mandala and acknowledges its influences and stages of early development. He also elaborates its relevance/irrelevance at later stages. His observations about the vastu purusha mandala

“When the great temples were built after the 9th century and still stand, the drawing of the vastupurushamandala has become an architectural rite. Certain temples before the 9th century however do suggest that some sort of an equation between plan and mandala is valid”. (Meister) Vastupurushamandala is a prognostication, a forecast and tonic of the contents which will be built up in the temples, but that ‘does not imply an identity of the actual plan of the temple with the mandala.” (Kramrisch)
Meister’s work deals with various proportion systems and to a greater extent, reveals the details of course level plans and their interpretation. It increases the three dimensional understanding of the form with detailed illustrations of different typologies and to a certain extent it identifies the key courses.

Dhaky (Dhaky), Meister (Meister), and Hardy (Hardy, Indian temple Architecture) contribute in a great way to develop a nomenclature, classification, identification of typologies and to a great extent, the proportion systems employed in the temples. But majority of these analyses were based upon two dimensional drawing, obtained by manual measurement systems. At times, the use of two dimensional drawings have certain limitations when it comes to the detailed investigation of complex three dimensional geometries as these drawings give information at one horizontal layer or strata (course) only.

2.1 Geometry in Indian Tradition- Concepts and Texts
Before investigating the detailed physical models of temples, it is necessary to understand the genesis of these ideas. Most of the earlier scholarship point towards the *sīlpaśastra*s, the canonical texts that talk about various configurations of a temple plan based on the *vastupurusha mandala*. The 64 square grid of *vastupurusha mandala* prescribed in texts for temple construction seems to have served as a basis for many earlier temples developed before the 7th century. (Meister)

![vastupurusha mandala](source)
According to (Meister) the basic grid of the vastupurusa, and the deities that inhabit it, are relatively short and schematic. The fundamental idea is quite clear: a construction site is like a person (purusa, also perhaps a ‘soul’) with weak and strong points laid out at precise junctures of its organism. The builder should take careful account of this fact if the building is to ‘live’ a healthy life. Similarly, a map of deities signifies that different areas will be more or less appropriate for specific purposes. However it is very difficult to apply this logic to a precise ground plan of the temple.

Meister took up the task of verifying the relationship between the vasthupurusha mandala and actual roof plan temples with his documentation of few examples taken from 7th century to early 10th century temples of Nagara style and concludes that

"it is very clear that few of the early 7th century central Indian Nagara temples have certain reference to 64 sided square with its horizontal layer at a specific level. Whereas the same principle could not be applied to the other temples across time and regions. What can be agreed upon is the subtle similarities or differences in terms of projections from its centre to corners that is time and again experimented by the
earlier works on analysis of indian temple architecture

builders. It is also not very clear whether this approach holds good with more complex and multi cellular temple" (Meister).

In the recent time Mattia Salvini has translated the traditional text *Samarangana sutradhara* an encyclopaedic work, attributed by tradition to the Paramara king Bhojadeva (11th century), and collecting a vast number of subject matters under the general heading of Vastu. According to Salvini it is probably incomplete in the available manuscripts containing huge body of Sanskrit verses like a *Purana*, a treatise on architecture and even with a discussion on making flying machines. "(Salvini).

Salvini opines "a large part of temple description are extremely schematic and would allow for remarkable variation in terms of how one may see that scheme. No precise picture of the decorative elements come through and in several cases we find repetition of the very same scheme, with minor permutation when applied to a different type.... if these chapters were indeed intended to have a linking with actual building practice, it is likely that a good deal of oral explanation would have been necessarily attached to text" (Salvini).

Further Hardy points out that some scholars accept the texts as a complete to produce an understanding to the entire geometry of temples while some completely deny that of any such utility and also that these texts were by Brahmins who were cut off from practical experience. "Anyone wishing to follow the *Samarangana sutradhara* faithfully in the design of Dravida temples would find his aim complicated by ungainly proportions, contradictions, and occasional solecisms. Yet deeper logic of the geometries of these temples are based on underlay on arithmetical in Dravidia temples" (Hardy)

According to Hardy the translations from the Sankrit into English are very few (Acharya 1934, Dagens 1985). After Ram Raz (1839), after that there have been virtually no informed translations into drawings of textual instructions for temples until Hardy (2015). Thus the predominant body of reference has been through the works of Dr Adam Hardy. One of the biggest gap in indian temple architectural studies is translation or interpreatation of traditional texts into drawings or codeified visuals

Studies of Indian temple geometry (Datta) have tried to demonstrate the correspondence of canonical descriptions of constructive geometry with the base plans of surviving monuments. However, as these temples were built in dynamic, changing cultural, physical and sectarian contexts, the actual practice of this knowledge was the subject of wide
experimentation over several centuries within regional schools of temple building [Meister 1976; Meister 1979; Hardy 2002]. Thus, while the shastras (canonical texts) may have been prescriptive, a multitude of interpretations and variations were possible within the canonical rules.

2.2 Typologies and Components of Temples

Dravidian temples were used to be classified by in a simple division of northern and southern traditions, the former typified by curved spires (śikhara), the latter with stepped, pyramidal towers. James Fergusson, classified them as Indo-Aryan and Dravidian styles (Fergusson 1876). recent scholars use the terms Nāgara, and Drāviḍa (relating to the southern country)” (Hardy, Indian Temple Typologies).

The general terminologies which are popularly described in broad description as Nāgara, Drāviḍa and Vesara which are abundantly demonstrated during the period of Kalyani chalukya period with innumerable examples from Karnataka, where, between the eleventh and thirteenth-centuries, masons demonstrated knowledge of temple architecture from far flung regions, especially in the miniature shrine models that they carved over niches in temple walls.

As well known as Nāgara and Drāviḍa, common terms in lists of temple categories are Vesara, Bhūmija, Kaliṅga and Vārāṭa. Vesara, implying a mule or hybrid, and Bhūmija, made up of levels (bhūmīs), are terms that describe form, while Kaliṅga (Orissa) and Vārāṭa (Vidarbhā or Berar in present-day Maharashtra) denote geographical origin. A temple type is often associated with a particular region, but the primary concern is the formal category(Hardy, Indian Temple Typologies).

Thus according to Dr Hardy the classical temple architecture of are mainly of two languages of architectural systems. "The Nāgara and Drāviḍa languages are typical of northern and southern India respectively, though neither is confined exclusively to the region in question". They are referred more as architectural orders roughly but not in the same sense as in the western classical "orders". Therefore referring them as 'language' as an appropriate term, in that each has a 'vocabulary' and 'grammar'. However, there were also other types outside these systems especially those of temples of wood found in mainly in the regions of Himachal Pradesh and Kerala "Nevertheless, the Nāgara and the Drāviḍa, in the sense proposed here, dominate the picture" (Hardy).
The diverse temples created through the Nagara and Dravida systems or languages are further classified, such as in Nāgara modes are the Latina, the Valabhī, the Phāmsanā, the Shekhari and the Bhūmija. "The other names have been gleaned from within the texts by recent scholarship, figuring predominantly in western Indian texts, yet nonetheless useful terms for more general application. Drāvida temples also take different shapes which may also be classed as modes, although the basic way of arranging the components in stepped tiers remains the same" Adam Hardy (Hardy).

Though the general understanding by many scholars that the origins of Hindu temple are in the early architectural expressions of Buddhist architecture and the refinement of it is only happens in early 6th century ACE (Hardy, Indian temple Architecture). In the recently excavated Buddhist site at Sannathi 2nd century B C E it is amply evident that the proto Nagara and proto Dravida examples can be seen represented in its relief works. ref image below of the interpretation of Sannathi relief panels reflecting a matured phase of Dravida configuration and accentuation¹

One can see a fairly matured Dravida configurations of temples in terms kuta aedicule, panjara aedicule and stambha aedicule ref Figure 2-4 which distinctly demonstrate the refined Dravida examples are seen in the 1 temples of late 7th CE onwards. Thus multitier religious edifices were conceived as early as 3rd century B C E and even the bass

¹ Note: The author has worked as principle investigator of "conservation management of
relief represented in the panels of Sannathi stupa depicts the builders awareness of pictorial representation in orthographic pattern. (Rao)

![Diagram](image.png)

Figure 2-5 [Drāviḍa shrine forms: a. to c. early forms developing from alpavīmā, d. to g. a further range of types in the Drāviḍa tradition of Tamil Nadu, h. to k. progressive transformation in the Karnāṭa Drāviḍa tradition.]

For a general understanding of form and composition of a typical Dravida or Vesara typology temple ref(Figure 2-5)by Hardy gives a clear understanding of typical components and their progressive adecular multiplication both in vertical and horizontal directions. It could be traced that these variations are of logical extrapolation and fairly a logical sequencing of form, space and even the details. These structures are practiced by a
specialised guilds and the knowledge system they possessed and was deeply embedded in the very physical forms that they created.

The variations in typologies not only restricted to the overall built form of a typology it even reflects on the typology of its sub components like kuta, sala or stambha. Refer figures below where the distinct variations of each component even at moulding level like kapota or jagathi of a typical kuta aedicule within a region undergoes a drastic transformation from early Chalukyas to later Chalukyas, ref (Figure 2-6). Thus nomenclature each moulding like kapota, kumuda or jagathi may be acceptable with respect to its position as a course but not exact shape of its section. This shows that the textual description of various components and their position were generally understood, there is no explanation as to how the variations in the design and their proportion took place. It also proves that all the parts/ components were codified for a long time use, but imagined and transferred to the masons in different time periods and regions. This aspect further gets complicated as no study could find the existence of diagrammatic instructions like drawings and details. In this context it becomes much more of a need to explain in a simple text form creating technique which can cut across various typologies.

Figure 2-6 Generally accepted nomenclature of mouldings (source (Hardy, Indian temple Architecture)
2.3 Recent studies of temple forms based on diagrammatic and form generative analytical approaches

Among the current scholars, Ananya Gandotra and Sambit Dutta’s work explore the use of computer and of three dimensional data for form analysis of Indian temples. Ananya Gandotra mentions that "the temple should not be studied as ground plan elevation and roof plan as it restricts us to a two dimensional perspective but to look at all three elements to gain a 3 dimensional perspective"(Gandhotra). Even though she has made a good effort to look at these aspects as a whole in 3D she falls short as she eventually comes back to 2 dimensional analyses.

Square circle square analysis [(SCS) mentioned by (Gandhotra)] demonstrates the method of establishing certain strategic points of a temple which is based on a photograph taken perpendicular to the centre (almost like an elevation). According to her the minor perspective distortions are negligible and the results are consistent in proving her SCS theory.

She analyses pictorial temple plans but does not prove that her method was used to establish a ground plan or elevation, even though she does mention that this method can be used to resolve few unresolved questions. She claims that the Square Circle Square (SCS) method can be used to analyse any temple building geometry, but applying her methods, it was found that the SCS method cannot be used to evaluate a temple form because plan varies from level to level. As these plans keep changing, it is difficult to identify a particular course profile as the basis of geometrical analysis. The idea of plan, elevation, section is predominantly a modern concept of communication of a design. It is not very clear whether the artisans of these temples used this plan-elevation-section-approach to build them.

Figure 2-7Plan Analysis of Kudva vapi temple and Brihadeeswra temple of Tanjore using the S C S method of source (Gandhotra, 2011)
From the practical point of view it's very difficult to get a reference point in the space beyond the reach of the execution team, especially the scope for margin of error is very little. Thus a fool proof system that gives least possible misinterpretations other than what is intended by the sthapathi. Perhaps the role of the sutradhara (the one who bears the thread can be interpreted as the person does the marking of the scheme or the one who draws?) seems to be very important to control this progression of volumes and coding them into manageable sections.

Another point of observation is that majority of the temples have been the subject of incremental growth, being constructed over a period of time. Thus it is difficult to determine a specific centre. The SCS theory holds no good for old temples that have been subjected to additions over centuries.

The most promising approach in usage of technology like digital modelling and rule based geometry has been taken up by Professor Sambit Dutta and David Beynon. It is a non-realistic representation of temples but an ideal adaptation of rules underlying architectonic composition. The forms of a temple are computed from generic disputation of geometry construction using rule based generation. Textual and graphic description of mathematical and geometric constructions described in the literature are codified in the form of shape rules and constructive methods to generate classes of geometry corresponding to two dimensional canonical descriptions(Sambit Dutta). Their work acknowledges the path and profile approach in horizontal and vertical plains as primary form generators. However, this is a departure from accuracy and authenticity to abstraction in an ideal laboratory of digital forms. Though advanced photogrammetry has been used it has been done so as a reference to generate a generic form than an accurate observational tool.

The models by Datta and Beynon are generated from point to point drawn lines and the remaining sectional information has to be built from these points alone. It is not very clear whether this two dimensional information has been used to analyse the multi-tiered configurations of temples. In majority of his work, the technology used is helpful to visualize buildings of a smaller scale in broad conceptual detail. For example, in his analysis of Meguti temple, the entire three dimensionality has been restricted to the upper cella of the temple with broad detail. Though he had started off ambitiously as a marked deviation from two dimensional representative geometry to the holistic three dimensional approach, he does not encash on the potential of derivative geometry nor acquires unbiased conservative, acquired
geometry. His approach is a hybrid one using base mesh/geometry of the plan from theoretical/textual/drawings done by earlier scholars and then superimposing information in the Z-axis from the calibrated photographs. In this approach, the accuracy of information would be more at conceptual than at highly detailed to analyse complex temple forms.

Figure 2-8 Image of Sambith Datta temple analysis source (Datta)

In analysing temple forms based on traditional techniques of manual measured drawings and photographs, many challenges arise. Primarily the extraction of information which is free from observational errors, perspective errors and the loss of information while changing manual drawings to digital formats. The primary difference occurs when these three dimensional objects are analysed with the tools of two dimensional drawings or photographs. The basic difference between conceived and perceived geometry can be understood as the geometry used by the creator and the geometry perceived by the observer. Many a times the artist who creates an object to create a visual illusion/exaggerations to create a desired effect to be appreciated from the distance. This can be understood as the difference between conceived geometry to perceived geometry. In a simpler tangible way, it can be addressed understanding the difference between photo based analysis for proportional studies and orthogonal images.
Figure 2-9 Difference between perceived and actual shapes. The difference between both images of same idol is in perspective and orthographic mode.

2.4 Chapter summary

From the literature studies it is attempted to understand temple architecture from the perspective of nomenclature, typological studies and predominantly from the perspective of its geometry. These studies help in understanding the components and the composition of the overall form of temples. From the studies of Kramrish the theoretical and the philosophical base of the temple and the sacred geometry in the form of grid of vastu is explored, and from the scholarly works of Michail Meister how these plan geometries were influential in form development of early typologies of nagara temples. However as Meister clearly concludes that these templates were applicable for basic models of particular typology and not beyond that. The significant contribution is from Dr Hardy is refinement of vocabulary of typologies, a recognisable pattern with respect to components like K S P and their sub variants and most importantly the form development studies in temple architecture in particularly to Karnataka Dravida temples.

After reviewing various attempts of sastras on traditional Indian texts and to co relate with actual temples or to arrive at some plan of a temple may be fairly difficult task due to transmission losses of knowledge in space and time. Further it poses very difficult challenge of deciphering the complex geometrical configurations these temples with enormous variations without graphical representations which are missing from these sastras. For an
artisan who intends to construct a temple requires a clear unambiguous set of instructions which are possible only by some means of graphical communications.

Another approach of arriving at form of a temple based upon typologies again can give a broad hint but may not lead to definite answers. Especially the task becomes further complicated in hybrid typologies like Kalyani Chalukya temples which combine more than one typology in one building.

It can be summed up in Prof Hardy's words "There are no universally correct terms for Indian temple forms, only terms that are more or less correct, more or less accepted, and more or less useful. Present-day scholarship has a choice between labelling types by numbers, describing them in, say, English, or using relatively correct, reasonably well-accepted Sanskrit terms that are useful for explaining what the architecture itself shows" (Hardy, Indian Temple Typologies)

Thus the basic question of how these ideas of temples were conceptualised, conceived and finally converted into physical reality remains fairly un answered either by text based approach or typology based approach. In the approach followed by Ananya Gandotra and Mahapatra a building is analysed with the help of a drawing, however it is not clear whether the sthapathis who created and executed the building used same or similar drawings to create the buildings. One may say that these are abstract approaches of understanding the geometry at conceptual level but such approaches would not be of any use in terms of execution of the buildings whose geometry keeps changing from course to course ref fig (2-10 Portion of peetha of Kuruvarthi Mallikarjuna temple, a typical Kalyani Chalukya architecture that displays a very minute variations from course to course) which require very precise instructions. Wherein approach of Sambit datta certainly points out possible parametric approach of form generation in temples, however his research does not explore the intricate course level parametric possibilities. It stops at very broad overall form level, however it opens a huge scope of possible studies in this direction.
2-10 Portion of *peetha* of Kuruvatthi Mallikarjuna temple, a typical Kalyani Chalukya architecture that displays a very minute variations from course to course