CHAPTER 1

1 INTRODUCTION

The term ‘Pedagogy’ deals with the art and science of teaching, education and instruction methods. Architectural pedagogy has further to deal with nurturing the exploration, enlightenment and critical thinking. The current formal architectural pedagogy of teaching, training and instructional methods in architecture under the formal university degree method is relatively new. However the practice of process of knowledge transfer/teaching, learning/practicing as present, in the traditional is practiced from times immemorial in our ancient buildings and some have reached the zenith in design development of their concept to a supreme level of execution. This dissertation explores the conceptual ideas of traditional Indian architecture and investigates possible means of communication from conceptual ideas to completion into physical reality. Architectural pedagogy of Kalayani chalukya temples is studied in the context of how the temple builders conceived the geometrical forms of temples and variety of distinctly different configurations achieved is explored. Also the process of conveying these ideas of complex geometry is achieved from master builder to all the sculptors and craftsmen for construction is explored through its pedagogical means. It also explores the possible methods of pedagogy that were used to transfer architectural ideas from master architect to disciple, other architects and even to craftsmen on site. The first step in this process should be to understand what tools were used to convey the design – drawings, prototypes, geometries, through a thorough investigation of diverse architectural forms of traditional temples.

For the purpose of this investigation of pedagogical tools, the typologies of buildings selected is the traditional Indian temple as they represent their form creation purely for the form sake. The other typologies of ‘Shelter’ is a product of interaction with its ever changing various determinants- which primarily consist of people, place and time and "need" based. Each of these determinants with their sub components like climate, culture, resources and ethos of time etc., produce a vast variety, responding to ever changing 'needs'. Perhaps what distinguishes from these shelters is the form tangible responsive approach to highly abstract thoughts like symbolism, power, spiritual and metaphysical ideas. And at times it may be beyond visually perceivable physical characters like sanctity of the place or certain mythological associations. Thus the selection of "Indian temple" forms the main object and
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the focus of the study. The objective of investigation is not to look merely at the chronological evolution of them into the ultimate physical manifestation but to look at them as physical entities conceived by their creators through experimental tools of visual communication. Physical forms that were conceived in solid stone, planned, cut into smaller elements, pieces of stone and were assembled to create structures of very high geometrical complexity. This study investigates these ideas from the perspective of the "Sthapathis", the master creators of the temples, and their teams of stone carvers of varying skills. It is an attempt to relook at these architectural manifestations from the very primary information that they possess on their very surface than interpretation from secondary sources.

This approach requires an in-depth investigation of the existing structures in totality before finalising the tools of investigation such as plans, elevations and sections which are primarily the modern tools of communication for execution. As we are not completely aware of the exact tools they used, the best approach would be to record these three dimensional details in totality, free from observational bias and with minimal errors - as there is bound to be a great difference between conceived original geometry and perceived resultant geometry. Great care is taken in recording this data with all its complexities of form resulted from the process that generated it. Certain aspects of deformation occurred either due to varied fineness of execution or destruction/deterioration caused by natural or man-made forces over a period of time is overlooked to reach to the actual conceived geometry. Available technologies like laser scanning, photogrammetry, infrared scanning and few state-of-the-art hybrid techniques were devised and used to minimise the errors of data collection. In each case, the most appropriate approach was adopted for different contexts of field studies.

The case examples to understand these concepts were taken from the 9th to 12th century CE. This period witnessed a very high degree of experimentation in the form generation of Indian temples observed from the case examples that are examined during the study of this research. As the number of these examples is very high, typical representative models which exhibit a distinct characteristic deviation from the conventional examples were selected. In addition to this, the typological studies of most common examples were taken up. The approach is to look from the smallest component to the whole structure rather than the piecemeal method of selective components. Some distinct examples of components are also included to examine conception of form to communication and then execution.
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The study concludes with findings of form generation concepts in Indian temples as generative geometrical derivations. The guilds of artisan's constant search for newer configurations led this study to explorations beyond the conventional nomenclature based derivatives. The study also demonstrates the simplified instructional capability of Indian genius while creating highly complicated visual entities. It examines the self-replicating form generative approaches and yet giving a fair deal of freedom of expression for individual artisan, a personal space to innovate within the framework of larger predetermined plan. The approach is an attempt to decode the possibly used in process of achieving three dimensional forms with subtle changes resulting in a variety of configurations. The study examines the form generative algorithms using modern computational medium and relates it to the same form achieved with simple codified instructions. As there are remarkable similarities in results obtained from both these methods, a new approach of understanding architecture purely from form generative techniques and their subsequent possible applications in architectural pedagogy, opens up.

Temples, over the centuries, have been the epicentre of religious, cultural and social activities in India - their designs constantly evolved over a period of time. In all its complexity, Indian temple architecture varying from location to location has been affected by various factors such as time, patronage, available material and so on. In spite of their differences, a basic similarity bound them together.

Many of these varying forms depending upon the factors that contributed in shaping them have achieved a high degree of refinement over a period of time with continuous experimentation and improvisation. These variations in temple design development at times gives an indication of a high level logical sequencing in terms of the construction practices that were employed by various guilds responsible for their execution. Majority of the scholars who dealt with Indian architecture have analysed the temples as a combination of plans, elevations, and roof plans *(eg Ananya gandotra "Indian temple architecture, Analysis of plans elevations and roof forms - 2011). The other schools of thought have tried to correlate with old texts and shastras as they describe emanatory cosmic hierarchy, mandalas, vastus, and yanthras. "Scholarly attitudes to these texts range between an uncritical assumption that traditionally these texts set the rules for making buildings and sculptures, thereby holding the key to understanding them, and complete denial of their utility, on the basis that they were probably composed by Brahmans who were cut off from practical experience. The truth must
lie somewhere in between” (Hardy, Drāviḍa Temples in the Samarāṅgaṇasūtradhāra). Thus use of tools like 2D drawings in the way of the present architectural communicative tools or use of mere text based analysis to examine complex Indian temples which are a high degree of three dimensional configurations seems insufficient for a holistic understanding.

In Indian temples, the profiles of horizontal courses constantly change refer Figure 1-1. Therefore to definitely pin point or identify a particular course as the principle plan is subjective. A temple has several levels where marked variations occur and to analyse a particular course for form derivation is failing to understand the temple in totality. In terms of elevations the popular standardised description using the components like – *Kuta, Sala, Panjara* and its sub variants give a hint of composition refer discussion on Figure 4-1. This description alone may make it difficult to predict the variations in configuration, largely due to fact that by altering depths of the individual components and subsequent overall form

![Figure 1-1 Part plan showing all the courses and mouldings of Siddeswara Temple of Haveri. The lines of courses below are shown in dotted lines.](image)

Artisans working on these temples forms experimented new options which the researcher had found during the documentation in his case studies. It is interesting to know and observe how such ideas were generated, conveyed and executed with precision to create complex, geometrical configurations. Majority are done in dry exposed masonry using stone layers with very little margins for error in contrast to plastered masonry construction systems. Taking these aspects into consideration, this research aims to view temples to find out if there was any simplified coded instructional system that was evolved from the perspective of a stone cutter (as the temples taken for study are of stone construction). The texts which were used has been too general to explain all the variations
From the process of conceiving a complex three dimensional temple form to breaking it to a series of simplified instructions that can be conveyed to artisans of various calibre there must have been some simpler pedagogy and instructional methods which are not observed and not been fully researched. Can one assume that many ideas that were adopted from one region to another were influenced and passed on from generation to generation, only through oral traditions, intelligent conversations and gifted skilled hands worked effortlessly to mould the current wonders? Was there a simpler systematic understanding to this form generation? In every case a method that explains the generation of the entire three dimensional form of the temple needs to be understood. In other words, to examine the pedagogical practices explored by the ancient Indian traditions a systematic study of the forms that they are represented is needed. Then only we can attempt to decipher the principles of pedagogy that gave to a system that allowed experimentation as well as adherence.

However, to make such study has to be based on primary observations of actual built examples. To do that on a pan Indian or pan-region level would be highly impossible in the span of a dissertation. Therefore it is important to start the exploration in a specific period of history of a specific region.

1.1 Research Objectives

- To identify approaches applied in form generation of Indian temple Architecture through the examples of Kalyani Chalukya period.

- To verify the form generative principles from study of temple forms.

  - to decipher a method that could help in form generation as a design tool which can be used in form generation process to construction detail.

  - to compare the theoretical computed models with actual existing buildings for the possible pattern similarities that may exist to verify the deciphered model

- To identify a possible communication tools used in translating ideas, and principles to instructions in construction of temples.
1.2 Scope And Limitations

The scope is restricted to geometrical study of temple forms, from part to whole and predominantly to the exterior forms with specific focus on the development of "moola prasada" and the vimana and "Shikaras" / "vimanas" over them including the pillars.

Unlike the existing scholarship which is based upon the study of plans, elevations and roofs in two dimensionality, this study is entirely based upon high precision three dimensional data using state-of-the-art technology, laser scan, photogrammetry, and infrared applications. The study depends on primary data alone. Details like iconography, directional symbolism, epigraphy and other allied studies are not part of the focus areas. However, the study acknowledges that they are all integral parts for the development of an understanding of Indian temple architecture which is manifested in many metaphysical and deeply rooted philosophical aspects of Indian traditions. Thus the study is restricted only to tangible, physically measurable aspects of the temple form.

As the study is based upon high precision of primary data which is not available readily, a hybrid attempt of different typologies is used. Using computational skills, the results of the forms generated through this study consistently match with the various typologies developed by the artisans. However, the study does not claim that these exact computational methods were employed by them. There might have been be simplified knowledge systems developed by the traditional craftsmen to achieve the same results. An attempt is made to conclude at possible and probable tools that might have been use during the past. This is not a historical study. It is based on a specific aspect at of a specific period of history.

1.3 Research Questions

The following questions are kept at the back while attempting the analysis through the study:

- What are the form generative concepts developed and the process of transmitting these ideas to a physical reality?
- What kind of learning and teaching processes involved by these master builders/architects/ Sthapathis/ sutradharas/ sculptors/ artisans/ stonecutters to each other?
- Do the temple builders use any form generating methods which are codifiable / self generative in the process?
To answer these above questions

* A complete three dimensional information needs to be acquired without much of observational bias.

* Course wise information needs to be recorded and analysed to examine whether each course directs the subsequent course until its termination.

* A pattern of constructional process needs to be identified, if there is any, which can be adopted to derive various formats to create or understand diverse temple models.

1.4 Case Study Areas

Case study areas are selected from the most experimental stage of Indian architecture, viz. 9\textsuperscript{th} to 13\textsuperscript{th} century. (Foekema) The region of Northern Karnataka is a confluence of various traditions of temple building - Dravida, Nagara, Vesara. Also the region has ample representatives of various dynasties of Early Chalukya, Rastrakuta, Kalachuris, Later Chalukya and few Hoyasala structures are also taken. It is observed that the region not only demonstrates examples of the above mentioned typologies but also demonstrates certain hybrid varieties in the form of wall miniatures.

The period of Kalyana Calukyas between 978 – 1189 (Foekema), has been identified as the most significant period during which a vast number of temples depicting various known typologies and a few newly developed configurations were produced. The temple architecture developed under Kalyana Chalukya dynasty (sometimes called Later Chalukyas or Western Chalukyas) is concentrated in the present northern Karnataka, with present Basavakalyan as their centre.

The Western Chalukyas who ruled the major parts of present Karnataka and parts of present Andhra Pradesh from their capital of kalyan developed an architectural style known today as a transitional style. This style linked the simpler versions of early Chalukya works to highly complex Later Hoyasala examples. The present scholarship calls it Karnataka Dravida and some of the canonical texts describe a variety called ”vesara” literally means a mule (or hybrid), another term of Misraka (literally means mixed). It is this very hybrid nature which poses a relatively higher degree of challenges to conceive and convert into reality as the degree of experimentation is beyond the conventions. Thus the choice of this category is quite apt to test the various theories of form generation and its execution process.
The majority of their works are distributed in the present region of Haveri and Gadag districts. The region which is a confluence of a northern, southern and western cultures of India represents a different eco-cultural region ranging from rich river valleys to semi-arid plains. The region has an abundance of natural building material of stone of different categories ranging from soft chloritic schist, hard granite stones, sandstones, quartzites and basalt. The region also has a variety of examples ranging from small shrines, large temple complexes, few memorial temples, a variety of stepped wells to temple tanks. Thus this region, having a diverse geopolitical, climatic range proves to be an ideal choice for the relevance of this study.

Following temple complexes were surveyed using different survey techniques which are disused in chapter 3 and few specific examples of columns, plinths, sikharas and overall temple forms data were used for further investigation.

1. Temples of Badami, Aihole, Pattadakkal
   a. Yellamma temple
   b. kunthi gudi
   c. Durga temple
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d. Ladkhan temple
e. Sangameswara temple
f. Bhoothnath temple
g. Mallikarjuna temple
h. Someswara temple

2. Bagali Kalleswara temple, Bagali
3. Kedareswara temple, Balligavi
4. Nagareshwara temple, Bankapur
5. Siddeshwara temple of Chavadanapura,
6. Dodda Basappa temple, Dambala
7. Jappina Bavi, Dambala
8. Gadag Saraswathi temple
9. Gadag thrikuteswara temple
10. Galaganatha temple of Galageswara, Haveri
11. Hanagal, tarakeswara temple
12. Haveri Siddeswara temple
13. Hire singanagutthi, yellamma temple,
14. Hire Hadagana halli, shiva temple
15. Ittagi Mahadeva complex
16. Karkala chaturmukhs basadi, Karkala
17. Kollur, saraswathi temple
18. Kubbattur, kaitabeswara temple, kotipura
19. Kuruvatti Mallikarjuna group of temples
20. Lakkundi group of temples
   a. Nanneswara temple
   b. kashivisweswara temple
   c. Brmha Jinalaya
   d. Manikeswara temple
   e. Muskina bavi
21. Lakshmeswara group of temples
22. Mudabidri group of temples
23. Sannathi group of monuments
24. Sirwal group of temples
25. Sudi group of temples

Of these 25 groups of temples a selected few are used for analysis in this report which are of typical representatives of the typologies of the era. The case examples selected for detailed discussion from these examples are filtered into distinct typologies based upon their form such as orthogonal, stellate, semi stellate categories. Some of the examples, which exhibit distinctly different forms are selected for discussion to check the veracity of proposed parametric design method in this report.

1.5 Research Methodology

To arrive at the answers to the questions, a standard methodology consisting of literature survey, physical survey and data generations techniques, creation of a 3D virtual model mesh, analysis of the mesh to decipher the underlying geometry and finally a proposition of a generative model and its testing for accuracy and veracity was attempted. The question of communicative model was attempted to be answered in the form of highly informed conjectures (as there was no data that could be found to conclusively prove that this is so) from the field data and the details of construction.

This study used a variety of methods and techniques to arrive at the results. It was necessary to review the earlier works on temple forms to understand the concepts and classification with respect to:

- Geometry as described in Indian traditional texts and concepts
- Studies identifying the temple typologies and their components

There is also needs to define the geometry as a result of observation of built structures and as derived from texts and concepts for the purposes of this study. (conceived and perceived geometry.)

The first aspect of the methodology was to look at the relevant knowledge available. Therefore, review of available literature is to be made, with respect to classification of temples based on the forms and determining the parameters that distinguishes them from each other. Secondly, this study looks at the temple forms from constructed examples. The method is of selected case studies of Kalyana Chalukyan temples only. To analyse the form of case
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study temples, a study of methods used for recording for three dimensional form analysis was made. Specifically:

- Manual recording methods
- Laser techniques
- Photogrammetric techniques

These methods are not new, but already been used. From this study, most appropriate survey method was identified. It is a hybrid survey techniques specifically applicable for documentation of Indian Temple Architecture visa-a-vis form studies. These methods and their merits and demerits are described elsewhere in the report. From the survey, three dimensional data were collected and analysed to understand the form generative principles and the logics embedded in them.

Using computer aided recording and creation of 3D mesh exact temple forms were recreated virtually and a possible method was identified in describing and generating temple geometry. This method of description is identified as ‘path and profile’ * form generative method. Further the principle was tested in distinctly different typologies of temples and their components in columns, roof sikharas, plinths, overall buildings – of distinct typology and other components of temples.

The forms generated by path and profile technique was further tested against with actual geometry to check for similarities/ anomalies. Evidence was also collected from sites to corroborate the path and profile method. This included the study of line drawings/ marks on the temples.

From this understanding of generative principles embedded in temple geometry, the study further looked into the details of construction and an analysis to identify the possible and probable methods by which pedagogic communication and constructional instructions were handed out to convert concepts to forms and further to construction over long periods. The earlier research has not found any drawings illustrations in the traditional texts like 'samaranganasutradhara'.

1.6 Plan of this Report

Apart from this introductory Chapter which defines aim, scope, limitations and overall research methodology, this report is presented into ten Chapters. The second chapter critically reviews the earlier works of architectural analysis and their interpretation from the perspective of its form generations. The study has focussed primarily on the probable linkages and the scholarly attempts of looking at temple architecture from canonical texts and typological / nomenclature issues. To understand the typological approaches the primary resources are from Dr Adam hardy's detailed investigations were agreed upon for the purpose of nomenclature. Also this chapter looks at the lacunae in observational biases of looking at temple architecture through 2 dimensional drawings. The chapter deals with some of the earlier scholarly works which took predominantly plan elevation, roof plans as derivations from diagrams such as *mandalas*, and other sacred geometry as determinant and their applicability/inapplicability in form generational aspects of temple geometry.

Chapter 3 deals with alternative observational data and reviews the documentation techniques such as laser scanning, photogrammetry, and hybrid techniques of three dimensional data acquisitions of temples. It deals with methods of data processing to get accurate 3D meshes of temples. The chapter also reviews the application's accuracy and derivation of orthographic projections of temples, fairly accurately for analysis of temple forms.

Chapter 4 deals with form generative principles through parametric design and checks for possible pattern of generative principles. a definite pattern that uses two planes named as path and profile and form generation by dynamic movement of profile in a designated route of path is identified. The principles are applied to parts of temples and checked for verification of possible application.

Chapter 5 checks the form generation of different columns of Kalyani Chalukya temples by creating column models by path profile and verifies whether the results match with acquired 3D meshes of the columns by comparing them orthographically and by superimposing on each other, and the results were concluded. Chapter 6 checks the form generation of different plinths and *sikharas* of Kalyani Chalukya temples by creating them using path and profile and verifies whether the results match with acquired 3D meshes of the plinths and *sikharas* with generated models by comparing them orthographically and by superimposing on each other and the results were concluded.
Chapter 7 checks the form generation of different and orthogonal base configuration examples Kalyani Chalukya temples by creating them using path profile and verifies whether the results match with acquired 3D meshes of them with generated models by comparing them orthographically and by superimposing on each other and the results were concluded. Chapter 8 checks the form generation of different stellar configuration examples Kalyani Chalukya temples by creating them using path profile and verifies whether the results match with acquired 3D meshes of them with generated models by comparing them orthographically and by superimposing on each other and the results were concluded.

Chapter 9 deals with possible interpretation of few terms of traditional texts as principles of form generation and verifies them as possible means of communicational tools in terms of form creation and constructional instructions and concludes the findings. Chapter 10 discusses the findings of the research and conclusions are derived.