CHAPTER 4

4 GENERAL PRINCIPLES AND METHODS FOR FORM GENERATION IN KALYANI CHALUKYA TEMPLES

When we look at the vast variety of temples which, in principle, belong to certain typologies like Nagara, Dravida, Vesara, Phamsana, Vallabhi and their sub-variants like Latina, Bhumija, Sekhari etc., there seem to have considerable differences in its form, scale, details, but there definitely is a common pattern. To analyse them from the perspective of the fundamental approaches of form generation through means of composition and perhaps a simplification of expression with respect to the composition following analysis by Prof Hardy (Hardy, Indian temple Architecture). For analytical reasons the approach of deciphering a Dravida or vesara which has distinct accentuation where each tala can be codified and each moulding and their variants in the space and time can be classified in a possible codification in k- s -p and their sub components or each mouldings ref Figure 4-1

However none of the authors completely agree upon that they were used as formulae of expression by the creators of these temples. In the absence of a clear and unambiguous graphical representative drawings or instructions the most reliable source of the information is temples themselves. As these temples are the result of a great deal of geometrical expression traditional knowledge–a systemic study of layer by layer or course by course dissection of them could throw light on the generative logic

Figure 4-1 Composition description in codification to notations used. Source (Hardy, Indian temple Architecture)
Hardy identifies these subtle aspects in his Karnataka Dravida temples "For certain types, a widespread principle of variation in pillar design is to vary the plan shape, the horizontal cross-section, from one pillar to another, and between different parts of the same pillar” (Hardy, Indian temple Architecture)

Though the variations are very high we often see very few drawing representations used by the artisans. However there are some diagrams that are found in some of the temple sites in the forms of cross sections of Pitha, mouldings and part plans at various levels. It triggers a fundamental question- were these patterns recognisable and understood as codes of an algorithm or method in explaining a particular configuration of forms?
4.1 Form generation through parametric approach - path and profile (P-n-P) method - a proposal

The general attributes of form are understood as line, shape, space, colour, texture, time and movement, and an articulation or manipulation of them as additions, subtraction and multiplication. A recognisable recurring pattern can be understood as system.

The temple forms and their components under the study is found to have following geometrical attributes from the observation from field investigations and reconstruction of computer generated models.

a. Orthography: Clear adherence to vertical and horizontal lines

b. Symmetry: Axial symmetry of overall form and symmetricity at each component

c. Layering: Division of whole form into horizontal layers in each tala from sikhara to peetha.

d. Sub layering or stacking: Basic mode of construction principle is horizontal stacking of stone slabs (in the form mouldings) one above the other in a interlocked dry masonry without usage of any mortar joints.

e. Each layer of stone having a vertical external profile which are aligned a internal vertical line.

f. A faithful adherence of the profile (vertical section) of a strata or layer perpendicular to an external path at all instances.

g. Internal volume of the garbhagriha of the temple being cuboidal irrespective of its external form and is small in volume, compared to the overall size of the temple, structurally a temple is no more than stacking of horizontal layers of stones.

From these principle it was possible to think of a simple system of a set of principles to generate a geometric form. The 3D forms could be generated in following ways

1. Revolution around an axis (like in pottery or lathe turning) with a circular base

2. Extrusion- as in pug mills and it can be used in cylindrical forms only

3. Movement of a profile along a path- a profile can be used as a vertical template which can moved extruding along a horizontal path
Below is a method of form generation through movement of a profile along a path that could be attempted. There are many applications in software field of this technique of defining one element moving against another. Simplest one is the two dimensional graph when value of Y moves along Axis X. In 3D, the profiles are usually understood as along vertical plane and it is moved in a designated path in horizontal plane. It is actually movement of one profile against another, but a path is understood as a complete loop generally. This method is one of the fundamental approaches for form creation. For instance a profile moving in a designated path creates a form if they are in different planes and move in relation to each other as reference. (Examples of pottery, lathe turning etc. However pottery and lathe turning are predominantly confined to circular path.) Any variation in simulated either a path or the profile, creates varied forms. Radio waves, spread sheets and other forms are also analysed by the concept of path and profile. In simplest 3D form, we are actually dealing with two parameters, a path and a profile, interacting with each other. The following sketches demonstrate this in 3D objects.

The first two methods are suitable in creation of simpler objects but they have limitation in creation of large complex objects in large complex like temples. Yet they can be thought as a conceptual tools to conceptualise an overall form. The third method is more appropriate and has universal application.

![Figure 4-3 Creation of various three dimensional forms using the movement of the same profile (vertical parameter) with a movement along different paths in a designated direction of movement (horizontal parameter)](image)

To demonstrate this principle we have used a common profile A and varying the paths (1-circle, 2-hexagon, 3-12 sided, 4-square, 5- floral) one achieves distinct forms as shown in ref figure.
Figure 4-4 Variants created with fixed path and different profiles

Figure 4-5 Variants created with fixed path and different profiles
The variations in forms can also be brought about by using the same path with varying profiles as demonstrated in the figures as well.

Fig 4-6. p-n-p method in varying profiles in creation of same object.

In the above two examples path different profiles a- profile through the outer edge of the stellate conical object three profiles are generated by slicing it. Red- profile of object through inner corner to centre, green - profile of the object from an outer corner to through centre and blue- from an intermediate point through the centre as shown. It is understood that all the profiles are not identical and their base length varies. Though the profiles are different
the forms created through the movement of the path creates exactly identical shapes. This process can be explained through the following diagram.

Figure 4-7 Diagram explaining the resultant profile from three different profiles when projected orthographically on a plane that is perpendicular to path.

In the above diagram it could be understood that, though the profiles are of different base dimensions they produce an identical profile when projected on to the plane orthogonal to the path. This explains that in Auto CAD program used for generation of the form the program uses the effective profile that is generated, which is in all the above three cases is same and thus so the resultant identical forms as the other parameters of path remain same.

The third and most important aspect of the P-n-P is the location at intersection at which these two parameters meet each other. The form varies in terms of shape and scale depending on whether the profile is interacting at top level, mid level or bottom level of the
object. For the sake of brevity, we may use the term path and profile method simply as P-N-P method throughout this thesis.

![Image](image.png)

**Figure 4-8** Creation of different physical form using same p-n-p with different point of intersection and direction.

In the above image both the p-n-p are same but the point at these two planes interacting are changed. When forms are generated by the movement of vertical plane along the horizontal plane at a specific level, the form of the object resulted is different from point of interaction. Though the objects created look similar in composition but there is vast difference in its size and shape. The products are not same objects in different scales.

The objects created in above examples using p-n-p of relatively of basic shapes like squares, circles, polygons and few combinations of them. To understand the complex forms generated using shapes which are combinations of many polygons the following model is generated
1. In the case of a simple path of a circle, p-n-p method will be same as an object resulting from revolution of a profile around a central axis.

2. A cylinder which has a vertical straight line profile as an extrusion that can also be developed as p-n-p method.

3. P-N-P is a surface development technique which include revolution as well as extrusion of profile in the movement of a path of polyline.
The form generated above has the same profile (vertical section perpendicular to path) throughout but the path (the horizontal section) at different levels as shown in the image below (a) at lower level, (b) at mid level and (c) at higher level and the profile (vertical section) remain same as shown.

Figure 4-10 Resultant form a b c d to verify whether the same form is generated by extruding the paths with their respective profile (at the intersection where both meet) the following forms are created.

Fig 4-11 variations in generated models
at a glance all the three above 3D objects may look similar but there are many differences as shown in the encircled areas. Thus an object created using path and profile extrusion approach can exhibit different paths at different horizontal levels. in another way the paths are understandable as offsets of equal distance of the path. And some of the geometrical entities (like those of minor niches may get nullified as straight lines if the offset distance is greater than the width of the niche) as shown in the image below. The blue line is the path at upper level of the 3D generated object and all other lines are offsets(equidistant lines drawn parallel to the line or polygon ) of the path. Note the offset results are different from scaling of a line or a polygon. Thus p-n-p method is also understandable as an offsetting of path along the profile.

![Image](image)

Figure 4-12 behaviour of path (a complex polyline in this case) similar to principle of offset (all lines are generated by drawing parallel to the baseline with equal distance)

### 4.2 Temple parts from perspective of p-n-p method

To understand and demonstrate the p-n-p method, various components of temples are systematically recorded using the digital 3 D technology mentioned in the previous chapter and a dense surface information/ geometry is extracted for investigation. The dense surface information is deduced to various paths at course level and profiles at vertical sections at various levels. The similarities between vertical sections wherever taken were identical barring few surface level ornamentation, erosion or material deterioration. But the core configuration in all directions of the component remains same. The course level profiles at each horizontal layer shows a range minor to significant variation.
4.3 An example of possible derivation of components of a Temple in p-n-p method

The basic visual vocabulary of Kalyani chalukya temples is composition of components like *kuta* or *panjara*, *sala*, and *stambha*. There can be many sub variants depending on the subtle treatments like staggering and treatment with *nasi*’s and intermixing of these result into many hybrid adecules. These compositions from one *tala* to other *tala* (level) are repeated in different scales progressively. There can be subtle changes in treatments of these elements from each *tala* as shown in example of Kaitabeswara temple below.

Figure 4-13 Composition of temple in terms of kuta, sala and panjara with respect to different tulas.

All above components (*kuta*, *kutastambha*, *sala*) whose compositions are product of a single profile in different paths are as demonstrated in the figure below:
Figure 4-4 Basic Geometrical form derivation of Kuta from path and profiles (extruded at top.)

Figure 4-5 Form derivation of a double staggered sala from same profile which is used for kuta but changing the path to a staggered line as shown as path at plinth top level.

However the decorative finishes like nasis, gavaksha, torana, vyalas, floral motifs, figurative elements, relief treatments, or exclusive surface treatment techniques are simply to be treated as add ons to the basic component or over all form of the temple. They cannot be derived
from the p-n-p method as they vary regionally and are subjective to each artists or sculptors expression.

Figure 4-6 Subtle additions and difference in treatment of details and staggering of path can create variety of temple components of Karnataka Dravida temple component typologies.

It has been observed many times that they are finished in-situ after assembling the basic geometrical courses. It is observed in some of the temples there is a basic block left by the masons for the sculptors to work on later. The variations experimented in different wall miniatures of the same temple show they are left to the choice of artisans and often show that personal expression of the artisans without changing the overall broader framework.
A variety of stylistic variants are achieved through varying the different moulds at various levels along with few minor changes that are done in path at horizontal plane. It is observed that within a same region different schools experiment with these subtle changes and surface treatments produce a vast and very distinct looking components. But the core principle of their form generation is same.