CHAPTER 5

5 P-N-P METHOD FOR GENERATING COLUMN FORMS

To understand the p-n-p method explained in the previous chapter and its application from the elemental level to overall form generation, a series of components of temples were taken up for test. Professor Adam Hardy’s explanation of the means of expressing movement which describes the form generative approaches holds good to understand various methods of thinking processes in form generation. The principles of projection, staggering, splitting and bursting of boundaries (Hardy, Indian temple Architecture) can be applied for form generative logic at an element level. Principles of progressive multiplication, expanding repetition, pictorial representation and gyration can be understood as overall compositional principles of a total form of a temple.

Figure 5-1 Form creation of a typical stambha/column of Kalyani Chalukya temple using projection principle and p-n-p method and comparison with scanned 3D details.

5-2 Form creation of a typical stambha/column of Karnataka Dravida temple using p-n-p method
To examine the application of these principles in derivation of a typical kuta-stambha, the principle of projection is applied and the results compared with actual model of the column. The overall form of the process does not match though in principle, the two dimensional representation looks the same. The principle of staggering is explained graphically with projection principle ref Figure 5-1. Whereas the image 5-2 the form generation is done with path profile method. The result achieved by p-n-p method is close to the final outcome of the form.

Professor Hardy’s observation is of staggering – ‘a form creation by projections that creates staggering with offsets or step like serrations. The stepped bulging of surface growing out in stages suggests expansion as in the staggered or expanding square plan. Multiple projections in conjunction with multiple embedding or interpenetration can convey a multiple emanation, either unidirectional, like the unfolding of a telescope or in four or more directions. Closely serrated edges may create the impression that a form is vibrating as if with inner energy.’ (Hardy, Indian Temple Architecture: Form and Transformation -the karnataka dravida tradition 7th to 13 centuries)

Karnataka Dravida temples demonstrate innumerable variants including the popularly known “lathe turned” columns of which were very popular from Kalyani Chalukya period to Hoyasala period. Many of the micro parts of these columns resemble the mouldings of temple superstructure. A wide range of foot prints of them resemble the plans of full-fledged temple's mulaprasada including staggered orthogonal, and stellate variants.

The traditional Shilpa sastras prescribe 30 different types of column designs that are found in Karnataka (Anuradha). Many of the names mentioned are of the orders like Rudrakantha, Eeshakantha, Chandrakantha, Suryakantha, SimhaKantha, Gajapada, Vyalapada etc., whereas many of these refer to certain deity or mythical animal and one may vary from dynasty to dynasty and guild to guild in interpretation of the components/ dimensions. Wherein some of the typologies like vruttha pothika, taranga pothika, pushpa pothika can be related with possible geometrical connotation of the column. The term "Taranga" means waves and in graphical equivalent terms to match are offsets. The terms like pushpa can be attributed to stellate configuration where as vruttha to circular configurations. The other terms which refers to the vertical segments of the columns are described as adhistana/ peetha, danda, kumbha, mandi, phalaka, pothika. The
subcomponents of these and the geometrical or figurative components vary from style to style or even from temple to temple. However these verbal descriptions may not be sufficient for a definite form connected to the said typology. The interpretation of these terms may give a generic description but not unambiguous instructions to derive a form.

To examine these process of form creation with reference to definite parameters that give a very unambiguous instructions that can create a variety of columns exclusively different shapes are selected. These columns were 3D scanned and very accurate three dimensional data is obtained. After obtaining the precise 3D data the path are derived by slicing them at various horizontal levels and vertically through the centre to arrive at profiles.

A careful observation and comparison of these profiles reveal that the generic pattern of all these columns are same irrespective of their total shape. These different shapes are achieved by employing the different paths for profile movement. The analysis restricted only to primary geometry of the columns, and figurative sculptures and surface details like floral pattern, were not taken into consideration.

This study does not claim that all the components of a temple are achieved by this process alone but majority of the forms can be derived using this method in combination with other form generative approaches. This method gives only the basic geometrical configuration. The additional details like figurative sculptures, surface level treatments etc. have to be omitted. In a given element, the paths may vary from one level to other level generating different configurations.
5.1 Case example 1 – Columns of Galageswara temple of Galaganatha village

Figure 5-3 Screen shot of 3D scan data of central column of Galageswara temple of Galaganatha.

A three dimensional scan of the internal columns of the mantapa are acquired using state of art three dimensional scan technology (Figure 5-3). By slicing it vertically, the profiles were extracted and by slicing horizontally at various levels, different paths are extracted.

Figure 5-4 Screen shot of image of acquired 3D mesh data (a), profile extraction (b), path and profile with location of intersection(c) and generated form (d) by p-n-p method
5-5 comparative visuals of screenshot of image of 3D scanned mesh of the circular column and the 3D model of column and the photograph of the column of Galageswara temple of Galaganatha

Figure 5-6 Screen shot of image of acquired 3D mesh data (a), profile extraction (b), path and profile with location of intersection(c) and generated form by p-n-p method of Galageswara temple of Galaganatha
Using path profile (c) the form (d) of the column is generated as represented in the above image ref Figure 5-4 and compared with the existing form (a). It has been found that the results are exactly identical.

Figure 5-7 comparison of the column details with (a) photograph, (b) mesh in orthographic mode, (c) orthographic elevation and (d) part mesh and part simulated 3d model by p-n-p method of the columns Galageswara temple of Galaganatha

The same profile was applied to the path of a staggered square that is extracted from the wall column of mantapa and compared with the scanned dimensions and three dimensional forms. It produces very consistent and accurate results of a high degree of similarity between both the models.
The comparative analysis of two distinctly different forms of columns was achieved by using the same profile with variation in the paths. Very few minor variations may be due to erosion, breakages were observed in shape of the mouldings. But the entire form in totality matches with the overall configuration.
5.2 Case example 2 – Nanneshwar temple of Lakkundi

Figure 5-9 Screen shot of acquired dense 3 mesh data of cluster of columns in the outer mantapa of Nanneshwara temple of Lakkundi.

To check the consistency of the results obtained using the same process, another example of the temple of Naneswara at Laukkundi has been taken. The internal columns of the temple are scanned to form a dense mesh. The distinctly different looking shapes of the columns are deduced to paths and profiles. All the profiles of the column are exactly the same where as the paths vary from stepped square, circular and staggered square in diagonal pattern to stellar pattern combined with circular edges as shown in the fig Figure 5-11
The dense mesh is then converted to planar level data, from which vertical profiles and horizontal paths are extracted.
Figure 5-12 Extraction of paths and profiles for individual column and identification of points of intersection.

Figure 5-13 Screen shot for comparison of scanned 3d Mesh(a) and p-n-p models of the form (b) for similarity.

Using the extracted path profile, the column forms are generated. These are then compared with the existing columns. It has been found that the results are almost identical. Include stellar configurations.
5.3 Case example 3 – Columns in Gadag Trikuteswara temple

Figure 5-14 Screen shot of 3D scan of different columns of Gadag Trikuteswara temple with paths and profiles extracted at various levels.

5.4 Case example 4 – Mahadeva temple of Ittagi

The Mahadeva temple of Ittagi has some of the most exquisite columns of a finest finish. The central four columns demonstrate supreme artistic exploration of a multi cusped stellar geometry. This extreme example with a very high degree of variations in vertical profile with 16 sided primary star shaped plan, each one further offseted into two more segments of staggering resulting into 64 corners.
Figure 5-15 Screen shoot of 3D scan of central column of Ittagi Mahadeva temple.

Figure 5-16 Extraction of path and profile from scan and deduction of line drawings.
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Figure 5-17 (a) extracted profile and path from scan model (b) p-n-p model (c) generated model through p-n-p method.

Figure 5-18 Process images surface generation of the column using computational method of moment of p-n-p of Ittagi Mahadeva temple's central column.

The central columns of Ittagi, Mahadeva stands as a supreme example of Karnataka Dravida column examples as a highly complex three dimensional forms which encompasses
logical derivation, advanced mathematical and geometrical precision and fineness of finish. Such geometry may not be possible without parametric based form generative understanding. The entire configuration can be explained with two basic parameters – path and profile as shown in the figure below.

Figure 5-19 screen shot image of scanned model and p-n-p generated models in orthographic mode of central column of Ittagi Mahadeva temple's mantapa.

5.5 Case example 5 – Cave 3, Badami

Though this parametric form generations were not only late Chalukyan period phenomenon, but the seed ideas can be seen in many earliest examples of early Chalukya architecture. In the example of cave number three dated by archeologists as 578 AD shows the early column development using parametric design.
Figure 5-20 Colored 3-D scan point load data of columns in cave 3, Badami.

Figure 5-21 A 3-D of the dense mesh for extraction of p-n-p methods
5.6 Inferences

From all above case examples it is very clear that the core idea of form generation is by a process close to the idea of parametric design in the making of columns of Kalyani Chalukya period. The process is generative when it comes to the core geometry concerned. The consistency with which the same/similar profile is used to generate visually distinct forms that inherently have one running idea in common. The exact process of construction or even conception might not have been the same as used with advanced computational system that are employed here. But the striking similarity between the actual forms and the generated forms indicate a possible link of similarity of thinking process. A further investigation of all other components can throw more light on these aspects. The simplicity of the instructional details of moving of two simple parameters makes the method as a possible medium of communication of a viable instruction system. In all the above cases of analyses of column creation show a very high degree of probability of using a parametric method of design, communication and execution of a highly prominent structural and decorative component of temple.