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### IN SEARCH OF THE HIDDEN PLANNING GRID OF TRI-RATHA TEMPLES OF ODISHA

Rinku Parashar\*<sup>1</sup>, Dr Abir Bandyopadhyay<sup>2</sup>

<sup>\*1</sup>Department of Architecture NIT, Raipur, India,

<sup>2</sup>Department Architecture NIT, Raipur, India

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#### ABSTRACT

The architecture of India is rooted in its history, culture and religion. Indian temples represent one of the great architectural traditions of the world. The first Hindu temples were built from rock cut caves which were later converted into the free standing structures at the advent of Gupta architecture around 4th & 5th century. Out of the different typology of temples found in India, Kalingan style of temple architecture can be observed in Odisha. The temples found here, shows a homogeneous characteristics with a continuity, from (6th to 16th century A D). Various studies have been carried out on Odishan temples in different areas and many literature also discuss about these temples details but method of construction of these temples is obscure. In the earlier period anthropometric dimensions were used which not relevant to the present day measurement system and the interpretation of the texts is also not possible . So in present paper, an effort has been made to find out the probable grid, of the plan form of the triratha temples existing in Odisha, in the modern system of measurement in relevance to the canons.

**KEYWORDS:** Odisha , planform, tri-ratha temples, grid, modern unit of construction

#### I. INTRODUCTION

The first Hindu temples were built from rock cut caves which were later converted into the free standing structures at the advent of Gupta architecture around 4th & 5th century. The early medieval period was marked by a remarkable development in art and architecture, with distinct style originating in northern and southern India, commonly identified as “Nagara” and “Dravida” style. Apart from these three styles, the inscriptions in Amruteshvara temple at Holal (Karnataka) dated 1235 AD, mentions a fourth style, as the “Kalinga” style of temple architecture (Das, 1994). This Kalingan style of temple architecture can be seen in the temples, found in Odisha. The temples found here, shows a homogeneous characteristics with continuity, from the very beginning i.e. from (6th to 16th century A D).

##### 1.1 Odishan Temples:

These temples depicting “Kalinga” style of architecture can be broadly classified into three types the “Rekhadeula”, “Pidhadeula” and the “Khaharadeula”. The “Rekhadeula”, are further sub classified into the “Tri-ratha” (external wall with 3 offsets), “Pancha-ratha” (external wall with 5 offsets) and the “Sapta-ratha (external wall with 7 offsets) type spread out in Odisha, mainly Bhubaneshvar The present paper discusses a methodology and analyses followed for finding out the planning grid of the plans of the “Tri-ratha” temples, which would have been followed, when these type of temples were constructed. The plan of these temples had only the “Garbha-Griha”, which indicated that in earlier stages of the development, of the temple architecture in Odisha, the construction of “Jagamohana”(an assembly hall, in Hindu temple architecture) was not in practice.

#### II. PROCESS OF ANALYSES:

For the study of “Tri-ratha” type of temples, three samples were selected viz. Laxmaneshvara temple, Bharateshvara temple and Satruganeshvara temple. On site measurement of the temples were taken and their areas and the perimeters were calculated after drafting the plans. The basic rule for making the plan of the temple was that, “it should be a square” as mentioned in the Canons( Bose 1932). The external dimensions of

each temple were measured and the difference observed for making them as square. Then the internal dimensions of the “Garbha-Griha” was taken for further analyses and the same procedure was followed to make them a square.

### 2.1 Relation with the Canons

From the literature survey, it was observed that, anthropometric measurements were used in designing of the temples. Shukla, (1995, pp 208), specifies that “Angula”, “the standard unit of measurement”, was about 3/4th inch, which is equal to 190.5 mm. Shukla, (1995) also specifies that there are three kinds of “Angulas”, namely; “Uttama”, “Madhyama” and “Kanistha”. Thus the measurement of “Angulas” varied from case to case, and there is no absolute unit of measurement. Further the “Angulas” were subdivided as “Yavamadhyas”, according to which, the measurement of 1 “Angula” varies from 142.86 mm to 190.5 mm. These, of course, are rough estimates of the dimension of an “Angula” in the metric system of units. It can safely be conjectured that, the dimensions of an “Angula” might have varied from 130 mm to 200 mm. So, while selecting the grid of the temples a conjecture based observation was done and the range of the dimensions from 130 mm to 200 mm was found suitable to be taken as the measurement of 1 unit, which is referred hereafter as “grid”.

### 2.2 Finding out the Grid:

The dimensions of “Garbha-Griha” were then factorized and the factor pairs were observed, that were found to be nearing the dimensions of the conceived “grid” was then established. This “grid” was then related with the external dimensions. After this the “tentative grid” was taken for the further analysis. The dimensions were then divided by the dimension of the “tentative grid” to get the number of grids of the “Garbha-Griha”.

It is observed that in the canonical system 1/8th of each dimension was taken as the next lower dimension and this is continued till the lowest unit. For these analyses the grid was divided by 32 to match with this system of “eighths” so that the dimensioning system resonates with the canonical system Shukla, (1995). Thus the measured lengths, were rounded off to 1/32nd part of the grid. All the dimensions of the projections and sides as per .

*Table1. Showing Dimension of Deciphered “Grid” of All the Temples*

Name of Sample	Category	Overall External Dim		Internal dimension of “Garbha-Griha”		Dimension of grid Deciphered from analysis	Number of grids of “Garbha-Griha”
		L <sub>o</sub>	B <sub>o</sub>	L <sub>i</sub>	B <sub>i</sub>		L <sub>i</sub> x B <sub>i</sub>
Laxmanesvara Temple	Triratha	6120	5830	2900	2900	145	20 x 20
Bharatesvara Temple	Triratha	5040	4680	2430	2430	162	15 x 15
Satrughanesvara Temple	Triratha	5340	5020	2520	2520	168	15 x 15

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### 2.3 Validation of the grid

After finding out the dimensions from the “grid”, the validation of the was done statistically, as well as visually (histogram), using both “measured” and “obtained” set of data. So for statistically analyzing the data, to find out whether the data are significantly different or not at (95% level of significance), first normality test was

performed for both the sets of data and they were found to be not normally distributed. Then the data sets were converted to Log10 (as the values were distinct) and tested for normality same result was obtained. Thus the reason for “non-normality” was observed. Then pairs of “unique values” of the data were identified from the

entire data set and a “non-parametric” test of significance (namely Wilcoxon signed-rank test) was performed on the unique values of the data set. The “p” value thus obtained, indicated the significance of the difference between “measured” and “obtained” value of all the temples.

**Table 2. Showing Results Of Statistical Analysis Of All The Temples**

Type of Temple	Temple name	Results of “Shiparo-Wilks” Test for Testing Normality		Results of “Shiparo-Wilks” Test for Testing Normality		Number of unique values	“p” values Of “Wilcoxon-Signed Rank Test
		Original data		Log Data			
		Measured	Obtained	Measured	Obtained		
<b>a</b>	<b>b</b>	<b>c</b>	<b>d</b>	<b>e</b>	<b>f</b>	<b>g</b>	<b>h</b>
Triratha	Laxmaneshvara	0.000	0.000	0.007	0.006	19	0.179
	Bharateshvara	0.000	0.000	0.009	0.009	16	0.551
	Satrughaneshvara	0.000	0.000	0.001	0.002	19	0.378

The table shows the “p” value of all the three obtained after the statistical analysis and the it indicates that all the “p” values are greater than 0.05 which indicates that , the null hypothesis  $H_0$  stating that “there is no difference between the “measured” and the “obtained” set of data” is accepted. The pairs of unique values were then taken and the histogram was plotted for all the three temples so as to see the difference between “measured” and “obtained” values. The difference between the values as indicated by the bars was also not apparent visually. So it can be concluded that the dimension of the “grid” found out as 145 m, 162 mm and 168 mm for Laxmaneshvara, Bharateshvara and Satrughaneshvara temples respectively was correct and might have been used for the construction of these temples and was also found to match with all the offsets of the temples.

#### 2.4 Comparison of Area and Perimeter

The area and the perimeter of the new plan drafted with the obtained dimensions, was also calculated and compared with the area and perimeter of the measured plan. The percentage difference was then calculated, to check whether there is any major difference between them. It was found that the variation between the area and the perimeter was also negligible.

### III CONCLUSION

Thus from the above analyses it can be concluded that in the ancient period, a grid system was followed. Though the measurements were done based on “Angulas” but the dimension of “Angulas” varied. Today if the “Tri-ratha” temples were to be constructed, it can be done following the grids deciphered which will also be showing a sense of cultural continuity through architecture, thus avoiding chances of departure from the historical architectural vocabulary.

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