Cultural Continuity in Vernacular design: Role of shape grammars

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Abstract

Vernacular architecture is termed an 'anonymous'', spontaneous',' rural'', and indigenous form of architecture. Cultural, geographical, climatic, and ethnic factors have influenced the formulation of different vernacular architectural styles across the world. Vernacular architecture is an indisputable heritage resource that needs to be promoted and preserved. Issues such as industrialisation and globalisation of modern construction techniques pose a serious threat to the continued existence of vernacular architecture in contemporary settings, such as the role of shape grammar, a tool used in logical argumentative methods in architectural research to bring cultural continuity to vernacular design through an interior architecture perspective. Shape grammar is a rule-based formalism that is used in architecture and design. The research methodology includes the shape grammar generation of a vernacular prototype and an analysis of the methodology. The shape grammar formulation includes architectural documentation of the typology and formulation of rules from the documented plans. This study analyzes the scope of shape grammar in bringing the cultural continuity and generative aspects of shape grammar into vernacular design, using the case of vernacular residential typologies of Kerala, a state in India.

Introduction

The vernacular architecture of a region can be conceptualized as a synthesis of cultural heritage and climatic adaptations specific to that area. The regeneration of vernacular architectural styles demonstrates the potential to revive and include cultural heritage in present-day architecture. The inclusion of cultural heritage and climate-responsive elements in contemporary designs will help to generate sustainable designs.

This study explored the scope of shape grammar in expediating the design process for regenerating vernacular architectural typologies. This study focuses on the vernacular architectural typologies of Kerala, a state located in a warm humid climate region of India. The courtyard is considered to be one of the design elements that evolved in Kerala's climate-responsive architecture and culture. This study attempts to decode mana/illam, a traditional courtyard house typology of Kerala, using shape grammar.

The generated designs follow grammar rules specific to the design of mana/illams and are based on the cultural authenticity, functionality, and climate responsiveness of the prototype. By employing shape grammars to regenerate Kerala courtyard houses, designers can significantly reduce the time required for design iterations, that is, accelerate the designs, resulting in more efficient and contextually appropriate solutions. This encourages dialogue between tradition and modernity, fostering the continuation of cultural heritage, while addressing contemporary living needs and sustainability concerns.

Methodology

Figure 1 illustrates the research methodology employed in this study. This Research methodology consisted of three phases. Phase I begins with a literature review of Kerala's vernacular courtyard residence typology mana/illam and vernacular housing typology of the Nampoothiri Brahmins in Kerala. These were wealthy landlords who followed a patrilineal inheritance system. The households in their community were situated in Nampoothiri gramams, across Kerala. Thus, Thirty-six samples of mana/illam across Kerala were identified using random snowball sampling (Figure 2). The criteria for sample selection were as follows:

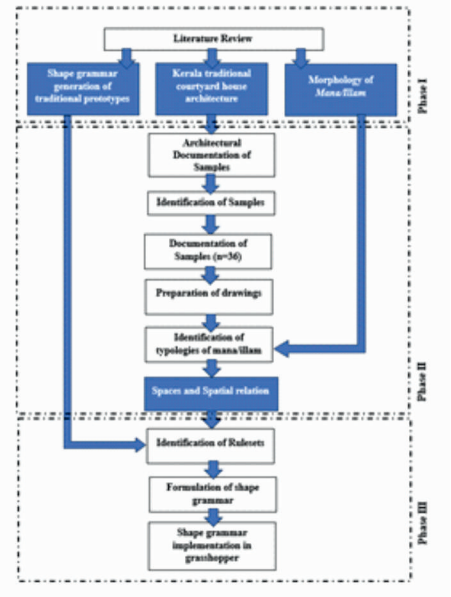

Figure 1. Methodology

1. samples should be older than 100 years

2. The samples should be with less alternation in their layout

Phase II of the research started with architectural documentation of the identified

samples. The space-activity relationship and spatial proximity within the mana/illams were identified using the generated drawings of documentation. Based on observations of the spatial relations and proportions, a twenty-stage grammar with sixty-eight rules was formulated in phase III. The methodologies of shape grammar generation and interpreters were studied using a literature review in Phase I

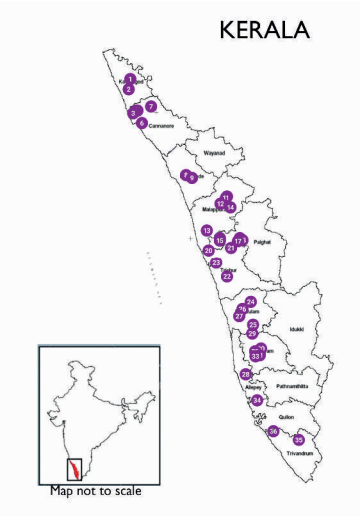

Figure 2. Location of Selected Samples

Results and Discussion

About The Typology

The Namboothiri Brahmins of Kerala were Sanskrit, Veda, and Ayurveda scholars. Namboothiri Brahmin's life is imbued with the concepts of purity and impurity concerning the stages of life and rites of passage. The primary purpose of their rituals is to maintain the status and prestige within the caste hierarchy and to protect the family from impurities that threaten the household from inside and outside(Schildt, 2012). The placement of spaces within a mana/illam is purely based on ritualistic lifestyles. The spaces of the house were situated around the courtyard and had the importance of orientation. Figure 3 shows the plan for the Nagancheri mana in the Ernakulam district.


Figure 3. Plan of Nagancheri Mana, Ernakulam

structures (Knight et.al,2015) Many researchers have used shape grammar to decode the language of different traditional architectural styles such as Japanese tea house grammar(Knight, 1981), Taiwanese house grammar(Chiou & Krishnamurti, 1995), Turkish traditional house grammar (Çağdaş, 1996), Mazandaran vernacular house grammar (Yousefniapasha, 2016), and Indian Pol house grammar(Lambe & Dongre, 2019). Shape grammar was generated by considering the symmetry, spatial proximity, and hierarchy in the plan and form of traditional structures. The Grammar generation strategy was selected on the basis of the characteristics of the built form. Yousefniapasha generated the shape grammar of Mazandaran vernacular houses considering culture, climate, and spatial hierarchy(Yousefniapasha, 2016). Similarly, Lambe and Donge's Pol House grammar was based on the generation of the centremost space and spatial hierarchy of other spaces (Lambe & Dongre, 2019). This implies that researchers can choose the methodology of shape grammar generation based on the type of plan and form of the structure(A & K, 2020).

Figure 3 and Table 1 show that the spaces of a mana/illam are around the centroid, that is, the courtyard of the house. A detailed analysis of spatial hierarchy and spatial proximity shows that grammar generation can begin with the courtyard as an initial shape. The grammar generation methodology is similar to Pol House grammar, and Mazandaran grammar is used here. Table 2 lists the stages of grammar generation.

Table 2: The stages and their description

Stage No	Description	No of Rules
I	Finding the centre point	2
II	Generation of Courtyard	2
III	Locating the Mullathara	2
IV	Addition of passage around the courtyard	3
V	Addition of Thekkini	4
VI	Addition of Vadakkini	4
VII	Addition of Padinjatti	3
VIII	Addition of Kizhakkini	2
IX	Addition of Purathalam	3
X	Addition of Konpura	4
XI	Addition of Pooja Muri	3
XII	Addition of Kitchen	4
XIII	Addition of Vaddakke Muri	5
XIV	Division Padinatti into Pathayam	2
XV	Addition of Stair room	5
XVI	Addition of Verandah	4
XVII	Addition of Columns	7
XVIII	Placement of Main door	3
XIX	Placement of Doors	3
XX	Addition of Upper floors	3

Space Name	Sala/wing	Activity
Poomukham		Reception of guests/male entry to the house
Purathalam	East/West	Living space for males
Thekkini	South	Study and leisure activities
Nadumuttam		Courtyard
Pathayam	West	Granary or storage of utensils
Pooja muri	West/East	Prayer
Vadakkini	North	For conducting homams
Vadakke muri	North-East corner	Used by ladies during menstruation and child labour
Kizhakkini	East	dining
Adukkala	East	Kitchen
Ara	West	bedroom

Table 1: Spaces, wing and their activity

Activity related to each space is discussed in table 1 .The mana/illam is generally termed as a 'nalukett ' structure in which each block orients towards a cardinal direction(Jacob Joseph Koduveliparambil, 1997; Thampuran, 2001). The nomenclature of the blocks is as follows: 1)Eastern Block (Kizhakkini),2) Western Block(Padinjatti),3)Northern Block(Vadakkini),4)Southern Block(Thekkini).

From the selected samples, three typologies were identified in mana/illam based on the geographical diversity of Kerala. Slight differences in proportions, materials, and courtyard sizes were observed when moving from north to south Kerala.. The first category is the North Kerala Mana/Illams. This includes the mana/illams of Kasaragode, Kannur, and Kozhikode. The second category is the mana/illams of central Kerala. The third category is the South Kerala mana/illams.

Shape Grammer Generation

Shape grammar is a systematic tool used in logical argumentive methods in architectural research(Groat, 2002). Shape grammars produce designs by directly computing shapes in two or three dimensions, rather than indirectly denoting visual shapes with symbols, words, numbers, or other abstract

Implimentation of Shape Grammer Interpreters

Computer-generated algorithms transform the generated shape grammar identified in the previous task, and shapes can be generated using shape-grammar interpreters. Because of the parametric nature of the shape grammar in Mana/illam, every derivation produces a range of designs that can differ based on the values of the parametric rules. A literature review shows that the Grasshopper plugin of the Rhino is the most suitable shape grammar interpreter for generating parametric shape grammars(Al-Jokhadar & Jabi, 2020; Stouffs, 2018). Thus, Rhino-Grasshopper can be used to implement shape grammars.

Conclusion

The vernacular architecture of a region is an amalgam of user culture and climate. The mana/illam is a courtyard house typology without perfect symmetry, and all the spaces in the typology are situated around the centre courtyard. Through the examination of documented samples, three typologies were identified in the mana/illam plans, considering the regional variations. They are mana/illams of Kasaragode, Kannur, and Kozhikode; mana/illams of central Kerala; and mana/illams of southern Kerala mana/illams. The grammar generation began with the generation of the courtyard and was completed in 20 stages with sixty-eight rulesets. The formulation of rulesets considers the spatial hierarchy and proximity in the mana/illam plan and the ritualistic aspect of spaces. Thus, the grammar generation began with the generation of a courtyard through the site centre point, followed by the addition of spaces with respect to spatial hierarchy. In the last stage, verandah was added to the building core, followed by the addition of doors and an upper floor. The twenty-stage shape grammar was implemented in the Grasshopper plugin in Rhino software using the Sortal SGI grammar interpreter. The generated shape grammar can be termed non-deterministic grammar because multiple derivations are possible. Different derivations were used to create three identified typologies for mana/illam. Consequently, 16 plan types of North Kerala mana/illam, twenty-three types of Central Kerala mana/illam, and 12 types of South Kerala mana/illam were generated. Decoding vernacular architectural styles using shape grammar will help include vernacular rulesets in present-day residential designs. This study can lead to culturally and climatically responsive residential designs for a particular region. The regeneration of vernacular architectural forms will accelerate the generation of culturally responding sustainable built forms

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