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A Specification of a New Pattern of Shape Grammar in Architecture of Today's houses Case study: Qajar houses in Tabriz and Tehran

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Abstract

Statements of problem: Given the rapid changes in architecture, promoting the quality of life cannot necessarily respond to human needs. Residents of modern buildings are often dissatisfied with their living spaces; despite the development of facilities, modern buildings are not more beautiful and human-oriented than the past buildings. Architecture has been almost declined to a shelter or a demonstration of individual styles and moved away from its true status. This article tries to find out why residents of modern buildings are usually dissatisfied with their living spaces and why they have lost their natural and emotional reactions to their habitation. This article aims to define a new pattern for a contemporary house using shape grammar based on the essence of architecture of Qajar houses.

Given the physical and semantic features of Qajar houses in Tehran and Tabriz, this article proposes a model for today's houses. Hence the following objectives are addressed:

- How to explain the new pattern using shape grammar
- How to create sub-shapes in Qajar houses in Tabriz and Tehran
- Understanding the meaning implied in various shapes of Qajar houses in Tabriz and Tehran

Research method: Based on qualitative methods, this study employs shape grammar for data analysis. The shape grammar is a manufacturing system leading to a design based on a collection of shape-rules and operates by this algorithm. An algorithm is a process which has outputs derived from instructions or rules that run on a set of data. These rules are identified through phenomenological interpretation of the Qajar houses using Max Van Manen's method. In this article, the phenomenological inquiry is based on the experience of living in 4 Qajar houses. Outputs are also newly created patterns.

Conclusion: In the process of shape grammar, the data of 4 houses is analyzed. Sub-shapes are derived based on the location of spaces in these houses; the shape-rules are defined by Van Manen's phenomenological method. The rules are made through interpretation of in-depth interviews with people who have experienced living in selected houses. Ultimately, "the link with environment, happiness and relaxation" and "separation from everyday life" are main concepts reflected in spaces such as Eyvan (semi-closed space), basement, landscape, Hashti (entrance to each building and spaces) and Shahneshin (a room usually twice as high as other rooms in the house).

In fact, these spaces are the rules of shape grammar and the algorithmic process results in new patterns in the tree decision.

Keywords: *Qajar houses in Tabriz and Tehran, Shape grammar, Max Van Manen's phenomenology.*

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Problem statement

What happened to the life that now seems to go elsewhere, which was continued and completed through architecture? What appears today is getting rid of yesterday and all its meanings and experiences. Of course, the experiences of attending various monuments implicitly create differences between the buildings. However, this perception depends on particular circumstances of users, their personal taste, influential factors and so on, but sometimes a large group of users with a variety of cultures and social backgrounds find a building pleasing. Considering that the desire to reside is an underlying characteristic of human behavior (Rapoport, 2012: 101), this article seeks to understand why the residents of today's buildings are not mostly satisfied with their living spaces and have lost their natural and emotional responses to their place of residence, in regard to our history and oriental culture. The goal of this thesis is to propose a new model for a contemporary home based on the teachings of the Qajar era. The Qajar architecture sought to approach the taste of people and create a vital space; on the other hand, although it faced new issues which raised a kind of tendency towards foreign monuments, it did not deny traditions. Therefore, this study attempts to recognize the relationship between spaces in some houses in Tehran and Tabriz and propose a pattern for these houses using the shape grammar based on the semantic application of language of shapes and the formability rules. Understanding the past patterns of housing can be a pivotal step towards a better future. This discussion is significant in terms of both theoretical and practical aspects. From the theoretical point of view, it is possible to read and analyze the shape grammar theory in historical houses, which can be pursued elsewhere in Iran; the practical aspect is associated with design programs and activities in Iran.

Literature review

Research shows that in spite of the role, diversity and specific features of Iranian house, no comprehensive studies have been carried out in this area. However, despite the existence of valuable examples of various historical periods, they are subject to destruction due

to the changes in life styles, immigration and, in general, less attractiveness in Today's life; therefore, it is essential to examine our traditional houses. In the works by Iranian and non-Iranian scholars, the literature and articles about Iranian houses, the Iranian house can be investigated in six areas: space and its types, introversion and privacy, typology, pattern language, role of users in architecture and climate. Various methods have also been presented in the formulation of architectural spaces, such as the method of shape grammar which is chosen in this article. In the early 1990s, shape grammar was used to teach architectural composition to students at Harvard University, MIT, UCLA and the University of Lille. With the use of shape grammar, students were, in fact, able to apply design language in building design (Knight, 1981:174). During the decades of the 1980s and 1990s, shape grammar was used to analyze the work of Frank Lloyd Wright and Ren as well as the design of small Japanese style restaurants, traditional Taiwanese houses and Mongolian desert gardens. In this paper, these shape rules are extracted by the phenomenological method of Van Manen; therefore, it is necessary to know about the background of this method. In phenomenology, focusing on the "methodology of Van Manen" book, Dr. Elham Navab has explored the method of Van Manen's qualitative research. In the article "Using Qualitative Research Method to Understand Emotional Dimensions of the Place", the author has examined the lack of response to some of people's spiritual and emotional needs in today's architecture using the phenomenological method, aimed at the experience of people in the Shavadan cold area in the basements of the southern regions of Iran).

Research method and case studies

This research is based on the qualitative method and rational reasoning; the research method is a phenomenological interpretation of Qajar houses. The quality of Qajar houses in this article is based on a phenomenological inquiry in accordance with the

experience of living in Dar al-Khalilah and Dar al-Saltanah of Nasserri. Shape grammar is used as data analysis technique which works based on the process of applied algorithm. In fact, the algorithm allows us to eliminate the limitations of traditional methods, providing a level of complexity and control. The algorithm is a process that has outputs derived from instructions or rules that run on a set of data. As shown in Figure 1, the data are 4 Qajar Houses, instructions or rules are concepts derived from the phenomenology method and the outcomes are also new patterns derived from the process. Library studies are also the basis for analyzing and describing the contents of this research. Qualitative research addresses the interpretation of situation and emphasizes the role of researcher as an essential element in the result of research (Groat & Wang, 2010: 88). In the selection of case examples, since they should have at least one common feature, the researchers select their group based on the characteristics of houses that are open, closed and semi-closed (introverted). In other words, all the houses chosen must have a courtyard (open space), a semi-closed space (Eyvan) and a closed space. Access to the documents, presence of the spaces and perception by the researchers are additional requirements for the selection of case studies. Therefore, the Hariri House in Tabriz, Sarhang Iraj, Mirza Bozorg Nouri and Mashir al-Dawlah Pirnia in Tehran are selected (Table 1). The statistical population includes the people who have experienced the presence in Qajar houses. According to this study, 20 people (men and women) are interviewed in Qajar public places such as museums and galleries in three steps. The whole population is selected from elderly people (Fig.1).

Theoretical Foundations

• Van Manen's phenomenology as a research method

In this paper, the semantic specification of Qajar houses is based on phenomenological research method which explains the experience of living in the house of Dar al-Khalilah and Dar al-Saltanah of Nasserri.

Phenomenology research is one of the most widely used qualitative research methods. Phenomenology is the study of the individual world, the world which is experienced by us before we think about or conceptualize it, that is, the immediate experience of the world without being portrayed through theoretical prejudices and ideas. In this method, understanding the quality of Qajar house is based on the emotional importance of the place. In order to obtain this experience, which in phenomenology is referred to as the science of studying the experiences of individuals, a field study is initially initiated and then, the meaning hidden in the understanding of experience of a person is investigated within the living space. In this research, the phenomenological method is based on the methodology of Van Manen that is a qualitative analytical method. Since this research is about architecture, the overlap between the field data and the architectural context is of particular importance. Therefore, Van Manen's method is selected, which relies on establishing a deep relationship with the phenomenon. The field data about both human experiences and their focus on qualities of the environment are collected. The purpose of this phenomenology method is to correlate the phenomenon experienced by people and the description of what is encountered and experienced or touched (Seamon, 2007; Van Manen, 2006). This experience reveals the state of the environment as well as the perceptual events and movements, as they occur in the human daily life. A qualitative researcher tries to ask those who touch and experience the phenomenon to express it, which means to describe or present themselves. In the present article, two main questions are addressed in the interviews: one based on the feeling of people at the moment of being in the place; and the other based on how this experience is correlated to individual interaction with the components of environment.

As mentioned, Van Manen's method focuses on how individuals have experienced the phenomenon based on six steps. The first two steps refer to the design of research question, the selection of participants and the

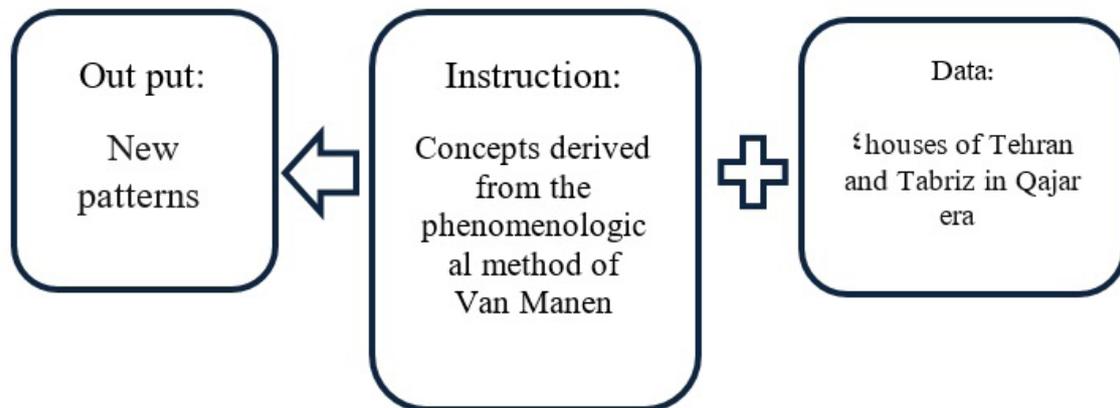
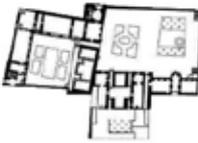
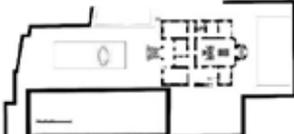


Fig. 1. Algorithmic design grammar. Source: authors process in shape.

Table 1. Selected houses. Source: authors.

Picture	Elevation	Plan	Name	
			mirta bozorg noori's house	1
			hariri's house	2
			sarhang iraj's house	3
			pirnia's house	4

personal judgment in order to illustrate the phenomenon. Hence the themes are interpreted through follow-up interviews with the participants and, thus, the main

gathering of data; the third to sixth steps are associated with data analysis. This methodology is a process in which the researcher relies on direct perception and

themes are discovered. The extracted themes and the words used for phenomenological writing must lead the reader towards an extraordinary perspective.

The steps of Van Manen's methods are as follows:

1. Turning to the nature of our favorite phenomenon (which has engulfed us in the world); in this step, the researcher would explore the human experiences in the context where the experience was gained. In this step, the researcher will raise the research question.
2. Examining the experience as we have lived it, not how it was conceptualized; this step involves collecting documents including the experience of researchers about the phenomenon being studied.
3. Evaluating the main themes that characterize the phenomenon studied. The main question in this step is what constitutes the nature of this experience. The researcher's purpose at this stage is to evoke the fundamental meanings of experience.
4. Describing the phenomenon using writing and rewriting art; at this stage, the researcher uses interpreted concepts to compile notes recorded during the analysis of data and descriptions that he had in mind from the stage of reading.
5. Having a strong and targeted relationship with the phenomenon.
6. Setting the context of the research by considering the components and the whole (Navab, 2013: 67).

The interview within a safe environment can create a good atmosphere for dialogue between the researcher and the participant, which should be established and maintained throughout the interview. Interaction in the interview is realized in the context of a positive relationship between the researcher and the interviewee. This interaction plays an important role in finding the concepts that are eventually derived. In this type of research, the text or data are simultaneously collected and interpreted (Laverty, 2003: 19).

Accordingly, in this study, the interview is set up to understand and interpret the case studies in accordance with Van Manen's methodology. What people recognize in these homes firstly is the stress relief; the emphasis on silence is also an introduction to the phenomenon of "tranquility". The participants find peace in the green

area and the water in these houses.

According to the interviewees, the houses include spaces such as Hashti and Basements that seem to separate man from everyday life. Most of the participants prefer big rooms, including the Shahneshin, with the visual aspects representing a joyful atmosphere. The close relationship with the environment and nature implies an interactive understanding and close link with the house and creates an intrinsic connection to the environment that is found in the interior of the Eyvan. The preferences of these houses to the other include the messages of natural elements, being in the ground, being simple and so on. The findings of this study show that the level of home-based efficiency correlates with the ability to meet the emotional needs of people at home. Due to the fact that such spaces are missed in houses today, such studies require more attention and human needs such spaces. The results of these interviews indicate that the meaning of these architectural places in the context of positive psychological factors is closely balanced with the needs. The researcher should collect reliable data in several ways, e.g. returning to the interviewees after formulating the study's meanings, so that the researcher's perception would be consistent with their statements. The themes are analyzed and categorized based on the categorization of meanings and the repetition of these common concepts amongst the interviewees. In order to better understand Table 2, the comments and opinions of the interviewees are displayed in the right column. In the middle column, the concepts extracted from these statements are listed and in the left column, the spaces of the house are evaluated in this analysis.

B) Shape grammar as a research technique

Shape Grammar is based on the language form and rules and a deployment system which leads to design. This is a method of deriving complex shapes from simple elements. The term is generally subdivided into the two forms of visual and computational data. In the computational component, the organized group of expert system produces geometric shapes (Tepavcevic & Stojakovic, 2012:170). Shape grammar also refers to visual design, as mentioned. In this sense, shape grammar represents the world of form not through the imposition of

the teachings and complexities, but through practical means at that point of time. The most unique feature of shape grammar is the ability to set a finite number of rules and shapes while allowing the production of an infinite number of design solutions. In addition, shape grammar is used as a tool for generating complex forms from simple shapes (Stiny, 1976: 187).

Shape grammar has four parts:

1. Sub-shape
2. Shape relations
3. Shape rules
4. Desired form

In Shape grammar, forms combine with the shape rules to manufacture a set of designs with desirable characteristics (Stiny, 1980:343-351). Certainly, the revision of space elements and relationships requires the definition of coordinate system to provide an accurate geometric basis.

Analysis of findings (design using shape grammar)

Regarding the algorithmic process of shape grammar, which is resulted from the application of rules in the data acquired, it is necessary to extract sub-shape of the selected houses firstly. Therefore, the three main elements of the studied houses are identified. These three elements are: courtyard (open space), closed space and semi-closed space (Eyvan). In Table 3, which shows the basic forms, each space is represented by an open space (Fig. 2).

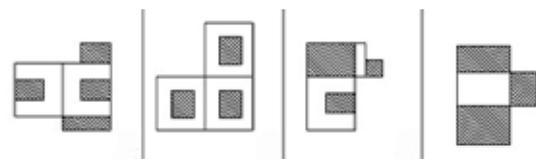


Fig. 2. Basic forms in the houses. Source: authors.

Based on these three elements, the plan includes three modes: single courtyard, double courtyards and complex. This research is focused on the complex mode.

In Table 3, the sub-shapes of the four houses selected in the first column are titled D11, D21, D41 and D61. In the first row, there are concepts extracted from the interviews by Van Manen’s method and spaces; in fact, in the algorithmic process, these spaces are the same as instructions. In this table, each space is added to the sub-shape and represented by a code. For example, in the D12 code, the base of the Hariri home is added to the basement space.

In the rules (RNCs) specified in Table 4, R represents the closed space, C represents the courtyard, B indicates the basement, E represents Eyvan, L represents the green sign, H indicates Hashti, Sh indicates the Shahneshin and W represents the water. RNC22 is the law which converts the courtyard into a “courtyard with two constructed facades”. According to RNC24, “the courtyard with two constructed facades” is converted into a “courtyard and two rooms” (Table 3,4).

Table 3. Set of sub-shape in the plans of selected houses. Source: authors.

	Separation from everyday life		Link to the environment				Relaxation of body and mind		Happiness
	Hashti	Basement	One Eyvan	Two Eyvans	Three Eyvans	Four Eyvans	Two Landscapes	Landscapes and water	Shahneshin
Hariri's house	 D11	 D12	 D13	 D14	 D15	 D16	 D17	 D18	 D19
Sarhang iraj's house	 D21	 D22	 D23	 D24	 D25	 D26	 D27	 D28	 D29
Mirza bozorg noori's house	 D41	 D42	 D43	 D44	 D45	 D46	 D47	 D48	 D49
Moshirodole pirnia's house	 D61	 D62	 D63	 D64	 D65	 D66	 D67	 D68	 D69

Table 2. Remarkable statements, extracted themes and spaces Source: authors.

Spaces of the house	Main themes	Important statements by the interviewees
	Separation from everyday life	Getting away from everyday life Unique - Simple
Hashti-basement		
Courtyard-water element	Relaxation of body and mind	Comfort Being comfortable
	Happiness	Liking the house
Shahneshin		Hope to have such a space in your home
	Link to the environment	
Eyvan		Natural air flow Natural coolness

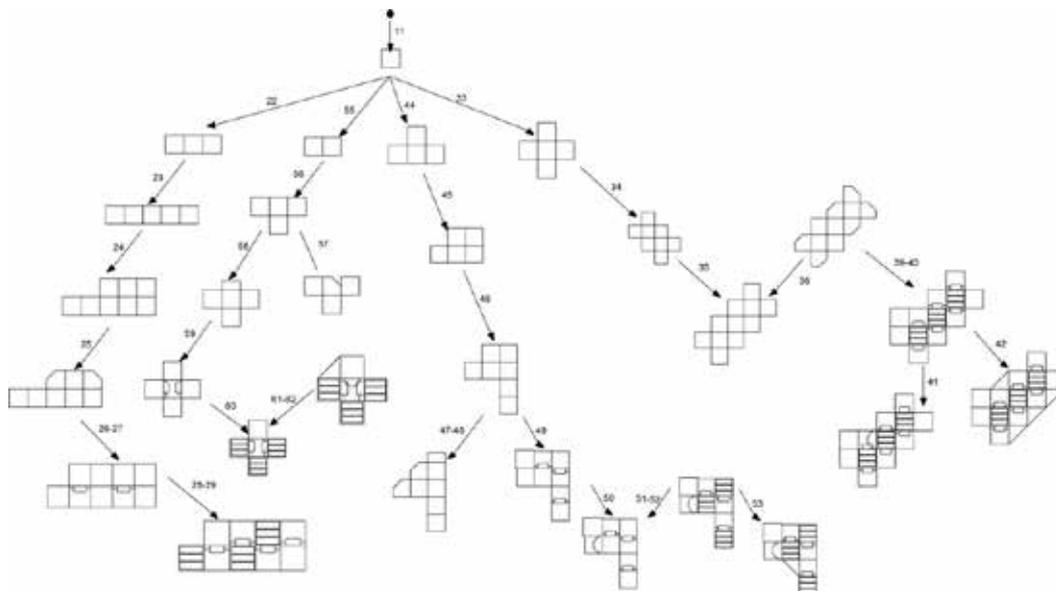


Fig. 3. The decision tree of selected houses and reaching the final model. Source: authors.

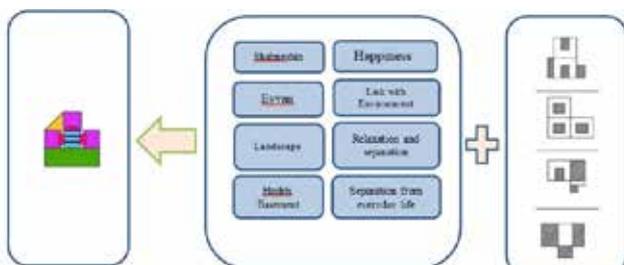


Fig. 4. Algorithmic process of shape grammar (Right: the research data or sub-shapes of the four houses. Middle: the concepts extracted from Van Mannen’s phenomenology in order to understand the experience of living in the houses and spaces. Left: patterns derived by the shape grammar). Source: authors.

Table 4. Selected house rules. Source: authors.

The table displays 50 house rules (RNC 27-76) arranged in a grid. Each rule shows a sequence of shapes representing the growth of a house plan, with arrows indicating the direction of expansion. The shapes are composed of letters H, R, C, and B, representing different spatial elements. The rules are organized into five columns and ten rows. The first row contains RNC 27, 28, 29, 30, 31. The second row contains RNC 32, 33, 34, 35, 36. The third row contains RNC 37, 38, 39, 40, 41. The fourth row contains RNC 42, 43, 44, 45, 46. The fifth row contains RNC 47, 48, 49, 50, 51. The sixth row contains RNC 52, 53, 54, 55, 56. The seventh row contains RNC 57, 58, 59, 60, 61. The eighth row contains RNC 62, 63, 64, 65, 66. The ninth row contains RNC 67, 68, 69, 70, 71. The tenth row contains RNC 72, 73, 74, 75, 76.

Summary of findings and design

Using the shape grammar, various types of space patterns

can be created in the form of sub-shapes (which are old patterns in the history and culture of this land) and enhance the richness of spatial configuration, culture and lifestyle of the people over time.

A sample of design and manufacturing process can be extracted from the decision tree. The start of the graph and design process is a point converted into space according to

RNC11 law. According to RNC22, which is in Section 5, the “courtyard” is converted to “courtyard, 2 rooms”. This space becomes the “3 courtyards, 3 rooms” according to RNC23 law. This space brings a new design with the combination of two RNC28 and RNC29 rules. The resulted form is the final product. Eventually, the branch comes up with a new layout, which is not still associated with the house schema. Infinite designs can be achieved by continuing to apply different laws to different shapes (Fig. 3).

Conclusion

From the past, “home” for man is something more than shelter and spiritual aspects are fully understood at every stage of building a house until its establishment and use; but in the present era, the qualitative and psychological needs of users are neglected and the economic interest is only considered. This emphasis on the shelter properties in housing has diminished the role of house in the identity of people (Haeri mazandarani, 2009: 80).

In prior studies, research on the Iranian house is divided into 6 categories, introversion and privacy, typology, pattern language, user’s role in architecture and climate. What this research has added to the study of Iranian house is the understanding of meaning of Iranian house in the Van Manen method; hence the use of results of Van Manen’s method in shape grammar technique is to create a new model of the traditional house. In fact, no research has ever been done to explain a new model using the shape grammar in traditional Iranian houses.

In this study, using the shape grammar method to study house spaces, an attempt is made to create a new design while maintaining the essence and meaning of traditional architecture. In the algorithmic process of shape grammar (Fig. 4), the data of four selected houses in form of dwelling complexes and their sub-shapes are depicted based on their spaces (Table 3). The set of shape rules is defined by Van Manen’s phenomenological method through in-depth interviews with individuals who have lived in selected houses, the interpretation of these interviews and the main themes derived from Van Manen’s method including “the link with environment, happiness, relaxation and separation from everyday life”

in spaces such as Eyvan, basement, green open space, Hashti and Shahshan; in fact, this process answers the 2nd question. Finally, in the process of algorithmic shape grammar, new designs are created in the decision tree.

Considering that the sub-shapes (Qajar houses) are old patterns developed within our history and culture and the intrinsic materia of Van Manan method (link with environment, joy, relaxation and separation from the daily life) express the meaning of houses, spaces created by the shape grammar also provide vast spaces in line with the culture of people and the nature of Iran. Therefore, the results of this study can be used to revitalize traditional dwellings with the help of shape grammar and contribute to the identity of housing in today’s world.

In order to better understand the decision tree illustrated in Fig. 4, the sub-shape of the courtyard (the green space marked) is transformed into a house with a courtyard and three constructed facades by applying rule 82 and 83, the Hashti and basements are added by applying the rules 84 and 85. Accordingly, a new design with the essence and meaning of traditional Qajar houses is achieved in six stages.

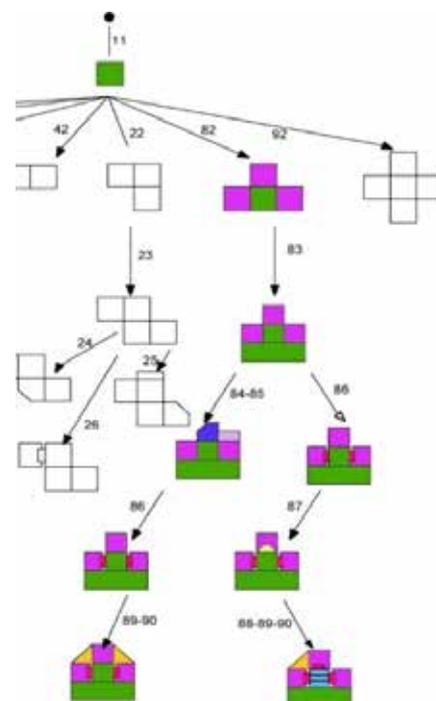


Fig. 4. A sample of the steps in transforming the sub-shape into a new design using shape grammar (open spaces: green; closed spaces: purple; semi-closed: red; basement: blue). Source: authors.

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