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ANALYSIS OF SHAPE GRAMMARS IN THE CONTEXT OF CREATIVITY

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Abstract

The subject of creativity in architecture; scientize architecture design efforts came with rational and irrational aspects of the field of architecture with a discussion of the case has been questioned creativity. When considered in the context of the architectural design process creativity; problems in an area that is not defined exactly and then expressed as a solution to this problem, making use of cognitive mechanisms.

Together in the world of design widespread use of the Computer, Computer logic, which can easily be adapted to the computer environment that work with rule-based design methods began to come to the fore. Shape grammar is one of the rule-based design method, even the shape rules of design, which is mounted on the base by subtracting in the computer environment change, convert, or with the same logic, it is possible to create new designs.

In grammar-based design method, the relationship between forms, design builder is the basic idea. These relationships not only can be constructed based on the geometry of pure form, but also the form can be edited according to the meaning given to. Form selection and determination of the relationship between forms is determined by design problems, program and designer's review.

Rule-based alternatives to replicate both in terms of design, both of which are common characteristics and to obtain different from each other in terms of design provides conveniences. Thanks to computer technology to be transferred to a computer-based design rules and in the use of the rapid developments.

The scope of this article, by analyzing samples of shape grammars made in housing design, shape rules examined so that architectural designers the advantages issues will be investigated. In this context, shape grammar examples of theoretical and practical field of the evaluation are made through performed by will be done through analysis.

Keywords: Creativity, cognitive approach, architectural language, shape grammar, architectural design.

1 INTRODUCTION

Creativity is a complex process and it is involved in all kinds of works and activities in all affective and intellectual activities [1]. According to scientists, creativity is the achievement of original integrity that includes aesthetic items. In other words, creativity has much to do with the outcome of the process, and it is given as proof of creativity, inventiveness and problem-solving creativity [2]. Creativity is also referred to as the ability to establish connections between previously unrelated associations, thus creating new experiences, experiences, new ideas and new products in a new scheme of thought [3].

Although pre-gained information is used in the process of creativity, it is the combination of old experiences and new experiences [4]. Creativity; (Cognition, awareness, sensitivity, openness to innovation, flexibility, fluency, intuition, comprehension ability and invention) [5].

When looking at the definitions of creativity, it is seen that "new" or "innovation" features are the ability to produce useful ideas and / or products in which concepts of originality or invention are commonly used [4].

Design with the most basic definition is a thinking action. This action becomes a design product with the effect of creativity. At the end of each design process, a design product is formed and in this process points to mental activities

Like architecture, in a multi-faceted profession, there are creativity possibilities in different categories. Since Vitruvius, these categories have been differently described by various authors, but they do not show any divergent differences. The Separator (1983) examines them under three headings:

1.1 Creativity in the Space Organization

As Zevi said, if architecture is considered to be a space art, space organization is the most important category of space organization. The spatial organization refers to the characteristics of the spaces depending on the actions and the horizontal and vertical connections between them. The distance or deviation from the previous level of innovation brought about in the organization of the space is a measure of creativity in this category, taking into account the need to meet the needs of individuals or society.

1.2 Creativity in Building and Construction Systems

The creativity in this category can be defined as the introduction of a new and original technique that takes advantage of one or more of speed, economy and other aspects according to the construction and construction techniques known to that day, taking into account the requirement of meeting the needs of individuals or society.

1.3 Creativity in Expression

Creativity in the expression of excellence means innovation and originality, with the condition of meeting the social need in the composition of the external and internal form elements. Creativity in excellence can be addressed in other subcategories such as environment, geometrical properties of masses, color and texture.

2 DEFINITION OF SHAPE GRAMMARS AS AN ARCHITECTURAL LANGUAGE

The similarity of the architect to the language structure has always been one of the topics of research on design theory. In fact, the term "architectural language" refers to the architectural style of an architect's habits. The formation of sentences according to grammatical rules on the ground is similar in terms of organization with the formation of architectural compositions of shapes that are organized in a language (grammar) in the architecture [6].

The grammar of shape grammar forms, a rule-based design method. With the help of shape grammars, it is possible to analyze a design language, to understand, to derive new designs from the same background.

The shape grammar is a rule-based design method developed by George Stiny and Jim Gibs in the 70's. Although the grammatical form is limited only to forms and formal fictions, the content that corresponds to the form is expressed by means of defining the meaning. In such a view, components are not only forms, but also functional elements. Shape grammars are a system of rules for creating the language of spatial composition. The shape grammar is also necessary for the analysis of previously made designs.

Shape grammars are a rule-based design system that produces form compositions [7]. The font characters are replaced by geometric elements. Generate grammars from points, lines, surfaces and masses. The rules here are based on mathematics and geometry. Simple arithmetic operations (addition, subtraction) can be used to define rules, as well as basic Euclidean transformations such as moving, rotating, and mirroring.

Shape grammars also operate basically the same logic. The only difference is that the characters come in two and three dimensional shapes. For example: *aaababbb* can be defined as [8]:

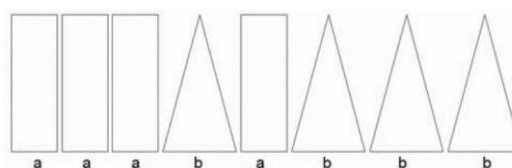


Figure 1. The formal representation of the phrase "aaababbb" [8].

Shape grammars are treated in two ways. The standard is the grammatical shape and the other is the parametric shape grammars. In standard format grammars, the format pair is separated by an arrow. The format to the left of the arrow is the format to which the rule applies; The figure on the right shows the state of the form after the rule is applied [9]. Unlike standard shape grammars, rules that derive forms in parametric shape grammars are defined as rule diagrams. In this case, it is mentioned that the shapes are dependent on the line lengths and the openings between the lines and they are variable. In the standard shape grammars, a fixed spatial relation is mentioned, while in parametric shape grammars, spatial relations are changed [9].

3 EXAMPLES OF FORM GRAMMAR IN ARCHITECTURAL DESIGN

In this study, the housing samples made with the shape grammar were examined and the comparison of the studies which were revealed in terms of the shape grammatical rules applied to the houses was made.

3.1 Palladio Villas

Stiny and Mitchell [10] have developed a shape grammar that forms the ground floor plans of the Palladio Villas in order to define the architectural style of Palladio. This study is the first research on the analysis of grammar of residential architecture. Analysis of the Palladio Villas is an analytical grammar analysis of the first architectural structure. As the day-to-day and computer technologies evolve, these villas can be redone by computers (Figure 2), [8].

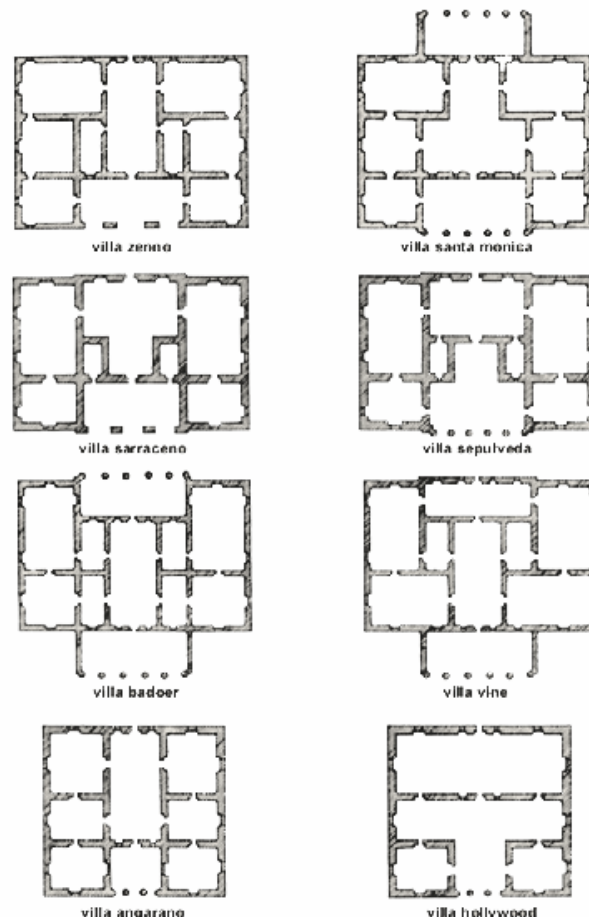


Figure 2. Original and hypothetical Palladio Villas [11].

Stiny and Mitchell have eight steps in the production process. At each stage, the rules are set for situations that may occur. This parametric form of grammatical work, which constitutes the plans of the villas of Palladio, may only be a partial description of the architectural style of Palladio. A more comprehensive work is needed to fully define the style. For example, this study does not give information about the facades or elevations of villas. The two-dimensional shape grammar reflects the

characteristic features and shapes of the villas. The characteristic features and shapes of villas allow classification to be made between villas with similar characteristics. Within the grid, the specified grid can produce alternatives that do not exist but can occur [10].

Both Stiny's analysis and the rules written in the first four books of Palladio have been transferred to the CAD environment. In this way, first two and then three-dimensional models were created and output was taken (Figure 3) [12].

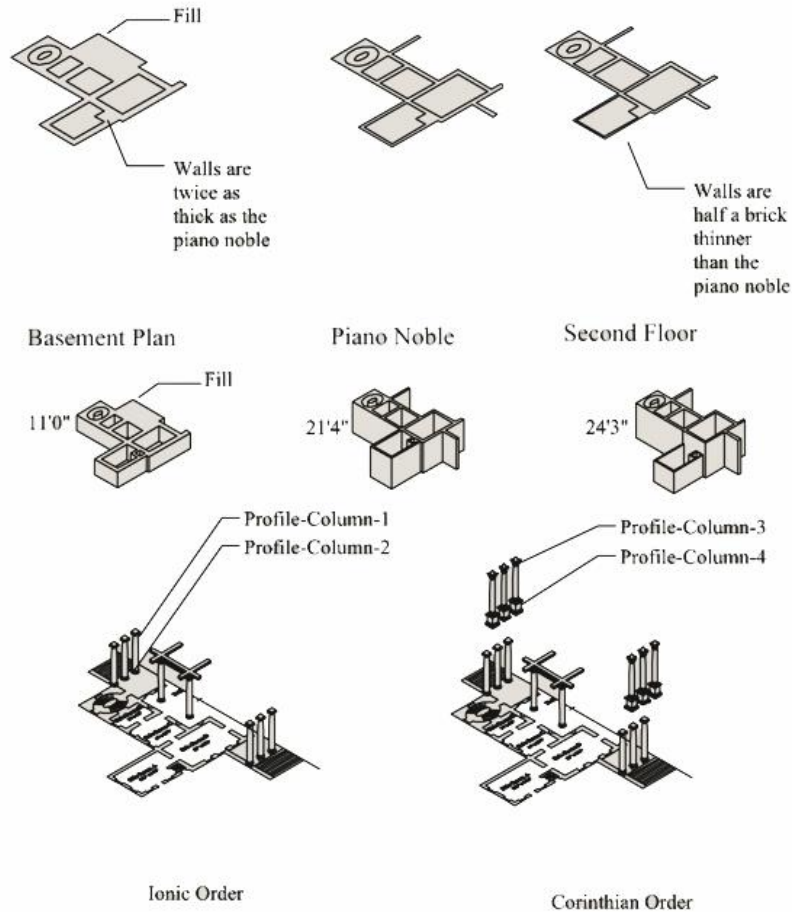


Figure 3. Three-phase reproduction of villas [12].

3.2 Frank Lloyd Wright's Country Houses

In this study, the 3-dimensional parametric shape grammar developed by Koning and Eizenberg includes the rules of formation of the formal order that Frank Lloyd Wright has designed, and allows to reproduce them using these rules.

Using the language and grammar structure revealed by analysis of 11 rural houses, new rural houses were produced. In the shape grammar produced, three dimensional rectangular prisms are used as lingual words. These blocks represent the spaces within the house voluminously. Although the heights of the blocks are the same, the width and height measurements vary. The place and presence of the fireman plays a key role in the formation of houses. There are 18 rules in the production process that starts after the placement of the fireman. In the study, 89 different country houses were produced by applying these rules [13].

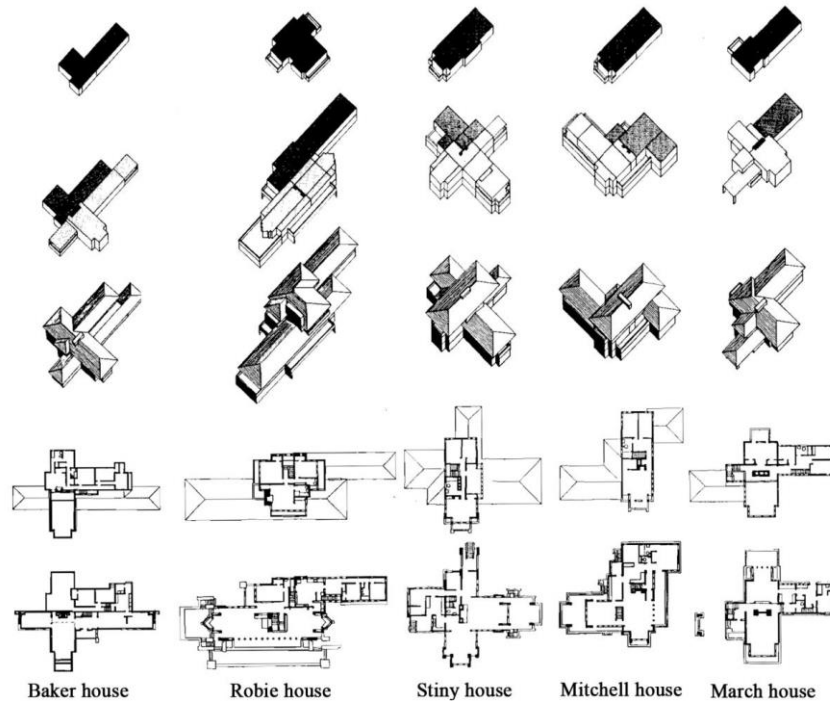


Figure 4. Existing and manufactured country houses [13].

3.3 Traditional Turkish Houses

Çağdaş [14] has developed a parametric shape grammar that produces plans for Traditional Turkish Houses. The houses that form the basis of grammar are the Turkish Houses built in Anatolia and Rumelia in the past 500 years. The fact that the plan compositions in the Traditional Turkish Houses are based on specific spatial relations forms the basis for the development of the shape grammar.

Shape grammar work on traditional Turkish Houses consists of two parts. In the first part, two dimensional parametric shape grammar was used to analyze the plans formally and syntactically. In order to be able to define the approaches and principles in the creation of the plans, a scheme diagram was formulated [14]. In the second part, the grammatical form of the parametric method which produces the plan for the Traditional Turkish Houses is introduced. Productive shape grammar, an 8-stage production process that produces inner and outer sofa plan types using the shape rule schema developed in the first part is defined. Traditional Turkish Houses with internal and external sofas can be produced by applying the rule sets of the shape rule scheme to a certain level (Figure 5).

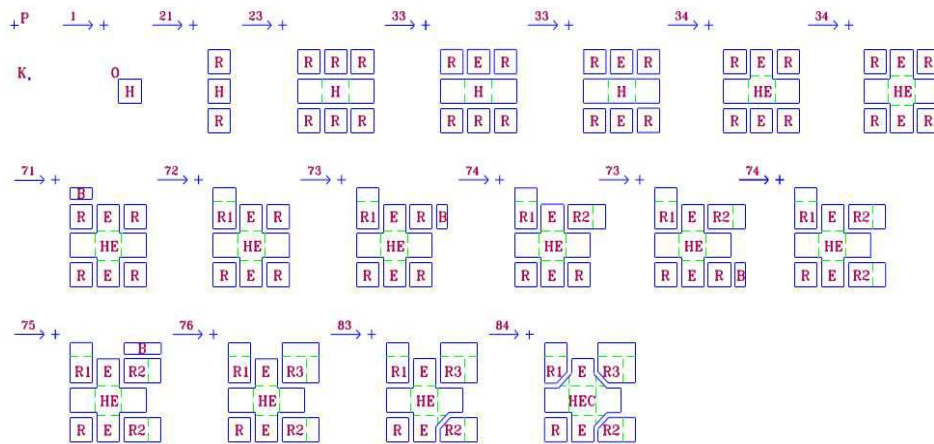


Figure 5. Example of plan production for traditional Turkish house [14].

3.4 Malagueira Houses

The work of Duarte[15] is that Alvaro Siza's formal analysis of the Malagueira Houses is reproduced by means of an expert system in the computer environment. Designed on 8x12 areas, it is a total 1200 housing project with a number of bedrooms ranging from one to five. The greatest feature of the project was the opportunity for users to intervene in their homes (Figure 6, Figure 7).

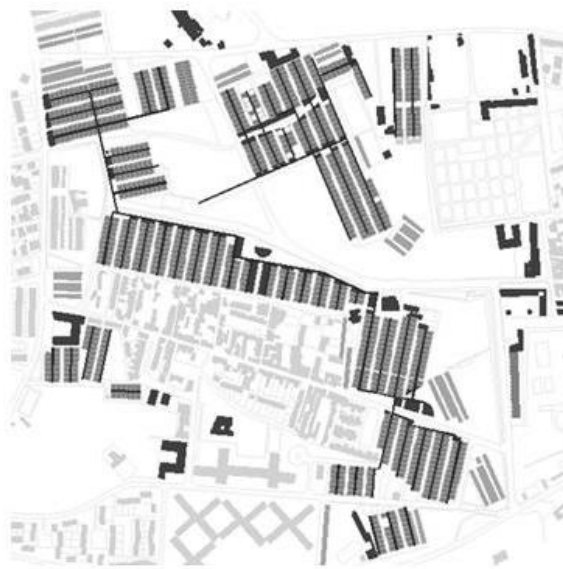


Figure 6. Malagueira Houses site plan [15].

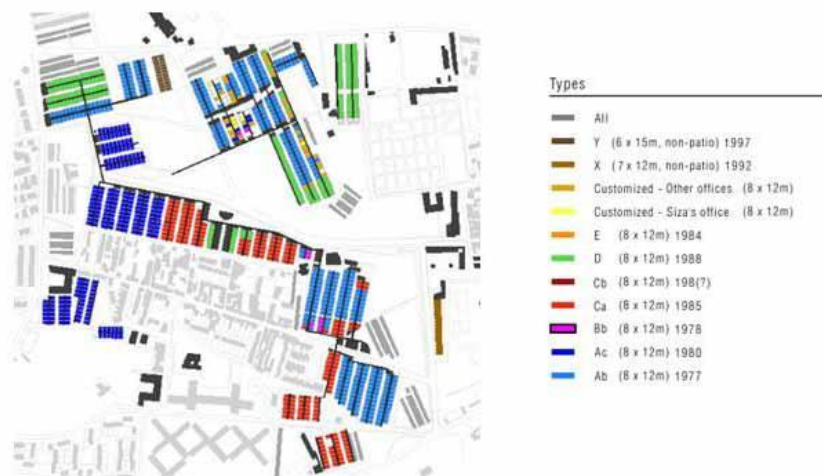


Figure 7. Site plan analysis by type [15].

In this study, houses were subdivided and deciphered. Houses are generally designed as clusters - building units - on 8x12 areas. When we look at the houses, it is seen that the houses in the same group are gathered together and clustered. Later experiments were carried out. According to the desired purpose, the derivations were made randomly to the computer and then tested to obtain various inputs for the designers [8].

Siza's architectural approach and the Malagueira Houses shape grammar were very clear. This is because Siza's architectural design language is prone to shape grammars (Figure 8).

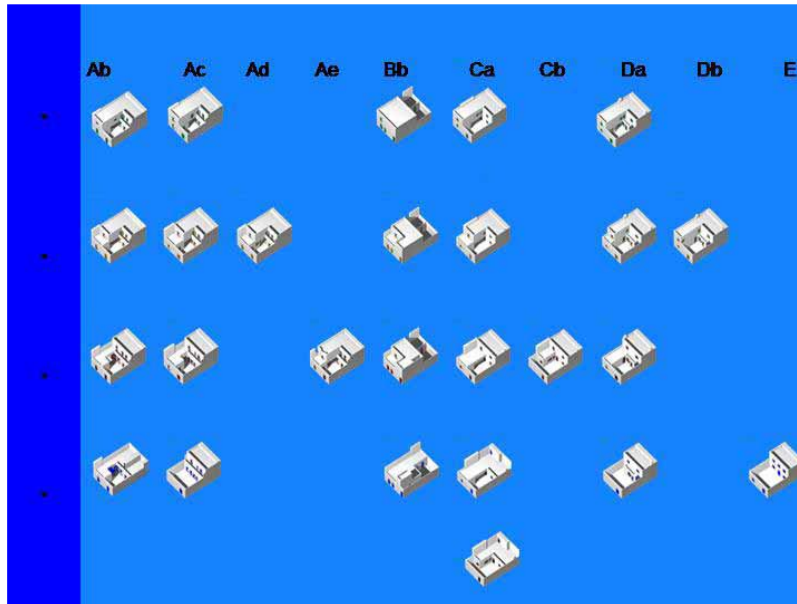


Figure 8. Derivation grammars of units [15].

3.5 Life houses

Çolakoğlu produced new and contemporary housing types for his life in the region by analyzing and analyzing the life houses of Sarajevo in Bosnia, which are examples of classical Ottoman architecture. In this study, he used shape grammars to produce both analysis and synthesis, the original design.

Living in a traditional language, the House has followed three steps in the process of producing new, contemporary housing prototypes. In the context of this study, firstly, it was aimed to create simple life houses by using inspected spatial relations and traditional texture forming words, secondly to produce subtypes within the rules of their own form and finally to reinterpret the relations (Figure 9) [16].

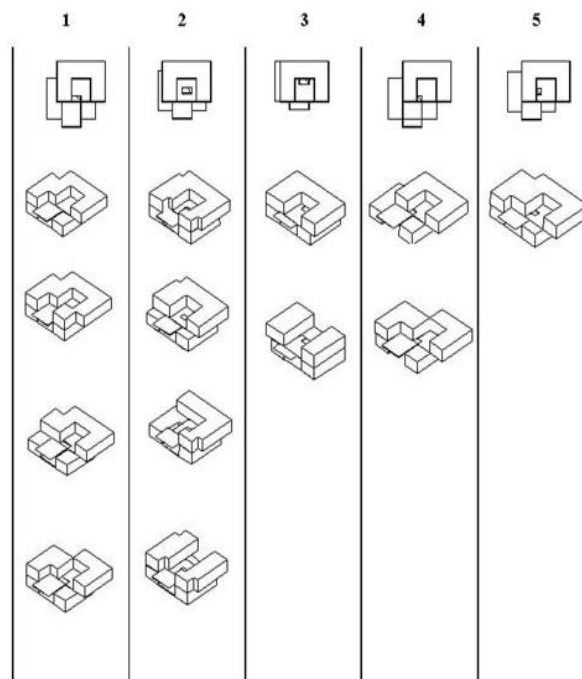


Figure 9. Development of new life houses [16].

4 ANALYSIS OF SHAPE GRAMMER ON EXAMPLES

In shape grammars, the abstract forms of rules and grammars have been facilitated to be transferred to computers. This helps me to have a very large product space with the help of the computational power of the computer. In addition, the exchange of grammars and the creation of new derivations has been accelerated and facilitated in the computer environment [8].

Analyzing and synthesizing existing forms using parametric shape grammars in order to produce new design alternatives in general in the examined housing samples, tried to produce original new designs through this. In addition, alternative designs have been produced within the framework of shape grammar and rules, and have been descriptive of everyday architectural styles.

The study of the Palladio Villas is important from two perspectives. First; We have to solve previously designed things and the second is to re-interpret them into the present technological conditions. Thus, products that speak the same language, that are compatible but never replicate, will be available. In addition, there will be a chance to complete some works that have not been completed or destroyed [8].

According to Koning and Eizenberg [13] in Wright's country houses, an existing language can be studied, understood, and new designs can be made with the same composition rules. In the scope of this study, three rural houses named Stiny, Mitchell and March were produced.

The houses produced have similar layouts and principles to those of Wright's country houses, with unprecedented types. As a result, a parametric shape grammar that produces Frank Lloyd Wright's country houses has been developed. The grammar developed as a result of the grasp of the tongue has made Frank Lloyd Wright's composition in the countryside clear and understandable [13].

At Malagueira Homes, computer-aided design and production expert system offers and visualizes home alternatives. After certain parameters are entered into the program interface, alternatives are produced in the design language of Malagueira Homes. The solutions are formed using 3D computer models or virtual reality tools. Architectural language was revealed after studying according to functions and dimensions of house types. Siza's architectural approach and Malagueira Houses can be deciphered very clearly in terms of shape grammars. The reason for this is the architect's predilection for design grammar.

The grammatical shape of the parametric form revealed in the study of traditional Turkish houses is clarified by the formative schemes of formal and syntactic organization in the plans of Traditional Turkish Houses. The formal scheme of form refers to the order and principles that are included in the design [14].

In short, it has been shown that it is possible to solve simple or more complex home plans with shape grammar, to recreate existing designs, and to obtain completely new designs with the same design language as previous houses.

When the concept of creativity is taken into consideration, it has been observed that new and / or novelty features are observed in design examples made up of shape grammars, which are rule-based design methods. The common feature of residential designs made with shape grammar is that it presents original works. Each form is grammatical and is expected to produce different results. It is not an official language that is the same for everyone, and there is no shape grammar as well.

5 CONCLUSION

Although the shape grammar is used as an analytical tool in initial studies, it has been used both as an analytical and a productive system in later research [9]. In terms of analytical properties, the model is built on changes in the structure of rules. As a producer system, the transformations it contains allow manipulation of rules to develop other tongues over known / existing tongues [17].

In the studied examples, it is seen that shape grammars can bring clarity to the rules that can solve the language of design, bring them to the genre of the language, and can make new productions by using these rules. When analyzed by the concept of creativity, it has been observed that shape grammars have the ability to obtain new and original designs.

In this context, the examples analyzed in the article were analyzed taking into account the advantages of shape grammar examples for creativity. In future works, it can be investigated how these grammatical rules are derived one by one and how they reach originality in the direction of rules.

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