ADAPTATION OF BUCA HOUSE PLAN TYPOLOGY THROUGH SHAPE GRAMMAR

ERDEM ERGİN

Master's Thesis

Graduate School
Izmir University of Economics
İzmir
2020

ADAPTATION OF BUCA HOUSE PLAN TYPOLOGY THROUGH SHAPE GRAMMAR

ERDEM ERGİN

A Thesis Submitted to
The Graduate School of Izmir University of Economics
Master Program in Architecture

İzmir
2020

ABSTRACT

ADAPTATION OF BUCA HOUSE PLAN TYPOLOGY THROUGH SHAPE GRAMMAR

Ergin, Erdem

Architecture Master's Program

Advisor: Assoc. Prof. Dr. Güzden VARİNLİOĞLU

August, 2020

This thesis aims to create contemporary housing plans through the adaptation of traditional housing plan features. In this context, the Buca region of İzmir has been selected as the study area. It examines the plan features of Traditional Turkish Houses and focuses on the Traditional Buca House. It examines the work plan fiction in terms of space organization. In order to achieve this adaptation, it investigates modern houses in an exploration of the concept of modern life. It proposes an adaptation of traditional residential properties to create a modern residential type. This process involves the use of shape grammar computational design method. This study reveals the traditional Buca House space organization plans, and also the standards needed for modern lifestyles.

Keywords: shape grammar, traditional house plan, Buca House, architectural language, space organization

ÖZET

BUCA EVİ PLAN TİPOLOJİSİNİN BİÇİM GRAMERİ UYARLAMASI

Ergin, Erdem

Mimarlık Yüksek Lisans Programı

Tez Danışmanı: Doç. Dr. Güzden VARİNLİOĞLU

Ağustos, 2020

Bu tez, geleneksel konut planı özelliklerinin uyarlanmasıyla çağdaş konut planları oluşturmayı amaçlar. Bu bağlamda İzmir'in Buca bölgesini çalışma alanı olarak seçer. Geleneksel Türk Evleri'nin plan özelliklerini inceler ve Geleneksel Buca Evi üzerinde odaklanır. Çalışma plan kurgusunu, mekân organizasyonu özelinde inceler. Günümüze adapte edebilmek için modern yaşamın tanımını araştırır ve modern evleri inceler. Geleneksel konut özelliklerini modern yaşama uygun yeni konut tipine adapte eder. Çalışma bu işlemi biçim grameri hesaplamalı tasarım yöntemi ile yapar. Çalışma sonucunda Geleneksel Buca Evi mekân organizasyonu kurallarına sahip ve modern yaşamın standartlarına uygun plan tipleri ortaya çıkar.

Anahtar kelimeler: Biçim grameri, geleneksel konut planı, Buca Evi, mimari dil, mekân organizasyonu

ACKNOWLEDGEMENTS

I would like to thank Assoc. Prof. Dr. Güzden Varinlioğlu for her support in all stages of my thesis. Her inspiring guidance, valuable knowledge, and motivating talks have always been a source of encouragement and determination for me. I feel privileged to be an advisee of her. I am grateful for all the precious time she devoted to me in my thesis.

I would like to thank my dear family who supported me with the sacrifices they have made for me throughout my life and my dear wife, who is always my motivation source.

Erdem Ergin

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF ABBREVIATIONS

TTH	: Traditional Turkish House
TBH	: Traditional Buca House
SG	: Shape Grammar
NBH	: New Buca House
TOKI	: Housing Development Administration of Turkey
DPT	: State Planning Organization
CA	: Cellular Automata

CHAPTER 1: INTRODUCTION

Turkish House book of Cengiz Bektaş (1996, p. 9) begins with an eighty-years-old master's question on one of his trips to Anatolia to get to know the home culture of the author. “How do you design the work?” According to the master's answer, if a person has decided to build a house in the Antalya region, he will send a sack of wheat to the master's house. The master thus understands that the person wants to build a house for him. If the master wants to do the job, he accepts the wheat. Thus, the relationship between the two families starts to get to know the master family. The master gets information about the economic situation of the employer, family structure, number of children and plans. The employer also informs the master of his wishes by showing them a known sample. When Cengiz Bektaş asked the master, “What if he shows something bad?” he is surprised by the answer:

> *“There was nothing bad to show.”* (Bektaş, 1996, p. 9)

Turkish Geography has a rich culture of construction techniques and space organization (Bektaş, 1996). Why are the typologies of houses emerging in today's Turkish geography different from the knowledge and cultural values of the past? How are the traditional home typologies suitable for modern life created by defining these differences? The thesis examines the plan organization of the Traditional Buca House built between the end of the 18th century and the beginning of the nineteenth century in the Buca region of Izmir.

1.1. Buca House

The eastern shores of the Mediterranean have long been called the Levant. This word comes from the French word *lever* and the Latin word *levare*, which means “the rising of the sun” (Akkurt, 2004). Over time, it refers to the coastal parts of Anatolia and Syria, Greece and Egypt, and the Middle East after the 16th century. The states established by France, which invaded Syria in 1918, are called “The Levant States” (Bilginperk, 1999). Since the international maritime companies used the name *Levant* in the 16th century, the Europeans working or representing them were called Levantine. Over time, this term referred to all the Europeans who were born and raised

in the Ottoman country. Cities such as Izmir, Istanbul, Alexandria, Thessaloniki, Beirut, where the Levantines settled, were suitable places for trade with their strategic importance, convenient climate, safety, and peaceful situations (Akkurt, 2004).

Levantines migrate to Anatolia for commercial purposes from Italy, France, Malta, Spain and Catalonia in Europe. This community coexists with the Ottoman people and culture. For this reason, Levantines were important for Izmir to become a European city at the end of the nineteenth century. Levantine residential architecture includes both Levantine culture and Traditional Turkish House (TTH) forms and characteristics. It reflects Europe as architectural style, construction techniques and material and TTH as space organization (Erpi, 1987). This study examines the selected houses of Levantine families and the Buca house with shape grammar method.

Sedad Hakkı Eldem studies with the classification method, Gülen Çağdaş studies with computational methodologies and TTH architecture (Güzelci, 2012). This study analyses the architectural language of the Traditional Buca House, its specific context and the traditional architecture of the Buca region. On this basis, this study investigates the architectural importance of Levantine houses in terms of Levantine culture and TTH. The theoretical results of this study are based on defining the relationship between Levantine culture and traditional Turkish architecture. The study examines this relationship with the shape grammar previously used by TTH houses by Gülen Çağdaş (1996). Compares space organizations over the main floor plans of the houses.

1.2. Shape Grammar

Shape grammars are graphical production systems that provide a formal mechanism for creating compositions based on shapes and spatial relationships between them. Specifying methods to replace certain parts of the shapes with other parts achieves these production systems (Liew, 2002). In the calculation put forward by Stiny and Gips in 1972, the concept of shape grammar is defined as a class of production system based on the first shape and the rules of transformation that can be applied in recursion. A shape consists of a finite collection of unlabelled points, lines, planes, areas, or solids. There are two types of shape grammar: analytical and original. Used to describe and analyse historical styles such as analytical grammars, Chinese ice ray lattice design

languages (Stiny, 1977), Palladian villas (Stiny, and Michael, 1978), Hepplewhite chairs (Knight, 1980), Japanese tea rooms (Knight, 1981), Frank Lloyd Wright's Prairie houses (Koning, and Eizenberg, 1981) and Queen Anne houses (Flemming, 1987), among others. In contrast, the original grammar relates to the production of new and original designs. For example, Çağdaş (1996) draws a shape grammar map and produces self-contained algorithms. Thus, in addition to previous examples of an analytic function, computer-aided design tools can create original designs. In 1983, using a situation that focused on the transformation of Frank Lloyd Wright's Prairie houses into Usonian houses, Knight (1981) showed how changes in basic grammars explain stylistic evolution in art and design.

Over the past thirty years, a few scientists who have used the grammatical concept of morphology have studied the concept of stylistic evolution and introduced the idea of grammatical transformation. These include Knight's (1981) seminal work on the transformation of Wright's Prairie houses to Usonian houses, Chase, and Ahmad's (2005) design hybridity calculation, and Eloy, and Duarte's (2011) adaptation of existing house types to meet contemporary needs, Duarte, and Coutinho on Alberti's (2011) classical Portuguese architecture and Benrós, et al. (2018) on the phenomenon of hybridity in architectural languages.

Çolakoğlu (2001) evaluates the traditional home fabric in Bosnia and Herzegovina in terms of morphology and proposes a methodology for the design of contemporary homes based on *hayat* houses in 2001. In a local context, Çağdaş (1996) presents parametric shape grammar rules to develop TTH using sets of shape rules to be renewed. Torus (2011), with home plans, a city of Mardin in Turkey's southeastern border runs as private. On a larger scale, Dinçer et al. (2014), for public housing with the relationship between designers and users that require an innovative approach for producing variations multifamily residential housing in Turkey proposes to increase the efficiency of the use of computational tools.

This thesis is mainly concerned with the use of shape grammar to describe the influence of local Buca houses architecture in the context of the Buca region in traditional Turkish architecture. The reason why shape grammar is used in this study

is that there is no study on Traditional Buca House (TBH). The absence of any research using shape grammar in TBH reveals the originality of this study.

1.3. Methodology

Shape grammar is a method used to analyse space organizations and to generate new types of plans. There are studies focused on Traditional Turkish House. Çağdaş (1996) makes a general analysis about TTH. Çolakoğlu (2001) studies Bosna Houses, Güzelci (2012) studies Amasya Houses and Torus (2011) studies Mardin Houses. This study examines Buca Houses. Studies on the house in the Buca region do not analyse with shape grammar. Previous studies define the plan organizations and schemes of Buca House. In addition, studies classify the structures according to their physical properties and not to mind the TTH relationship (Güzelci, 2012). In this study, examining the Buca houses classified according to the Traditional Buca House type with the method of shape grammar increases the originality of the thesis.

The thesis creates the plan type of New Buca House in five steps. Firstly, examines the traditional Turkish House plan types, features and space organization. Secondly, it examines the local Buca House plan types and space organization. Thirdly, examines the plan types and spatial organization of TOKI houses, which are the current housing types in Buca. Fourthly, analyses the local Buca House plan types with the shape grammar. Fifthly, the thesis adapts the plan features of TTH to New Buca House plan types and transforms them into modern housing types with the parameters of the existing area calculations.

1.4. Chapters in Brief

The first part of the thesis describes the study as a theoretical background, defines the problems and determines the goals (Figure 1). It also examines the residential structure, cultural identity and local definitions through the literature.

The thesis examines the housing definitions and examples within the scope of the theoretical background in the second part. The study examines the TBH structures that have TTH characteristics in the determined Buca region. It focuses on changes and

features from the past to the present. In addition, this section examines the space organization charts of modern house. The study compares Buca House with modern living standards in this section.

In the third section, the study explains the shape grammar method for the work of New Buca House (NBH). It makes literature review and definitions within the theoretical background of the method.

In the fourth section, the study brings together the shape grammar of NBH and the space organization data that emerge because of the standards brought by today's life. After this process, traditional space organization charts and plan typologies suitable for modern life occur.

In the fifth chapter, the study discusses the thesis results. The study examines the mutual relations between housing and culture. It also evaluates the effects of daily life on space organization and housing type and makes predictions about future studies.

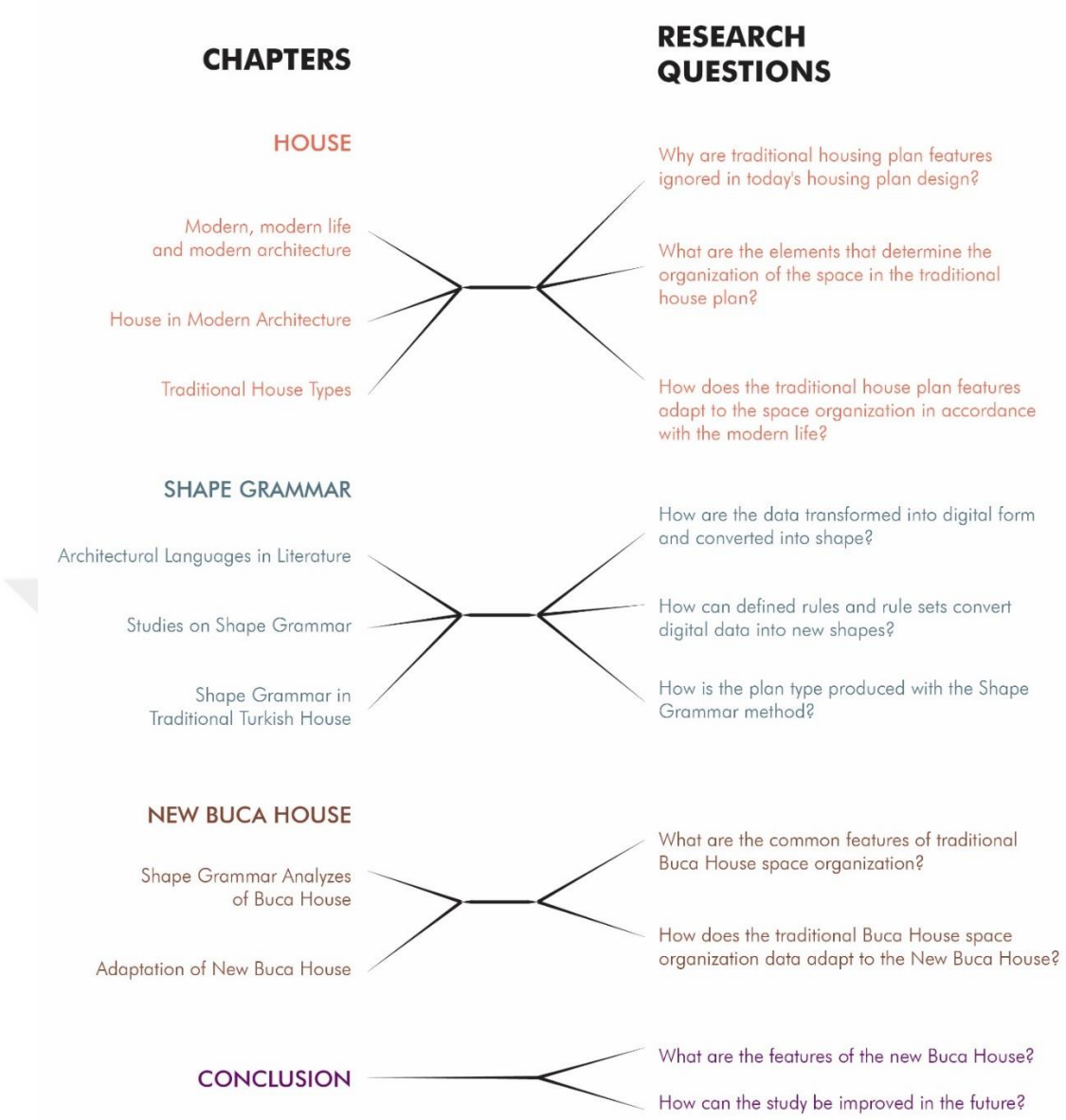


Figure 1: Chapters with Research Questions Diagram

CHAPTER 2: HOUSE

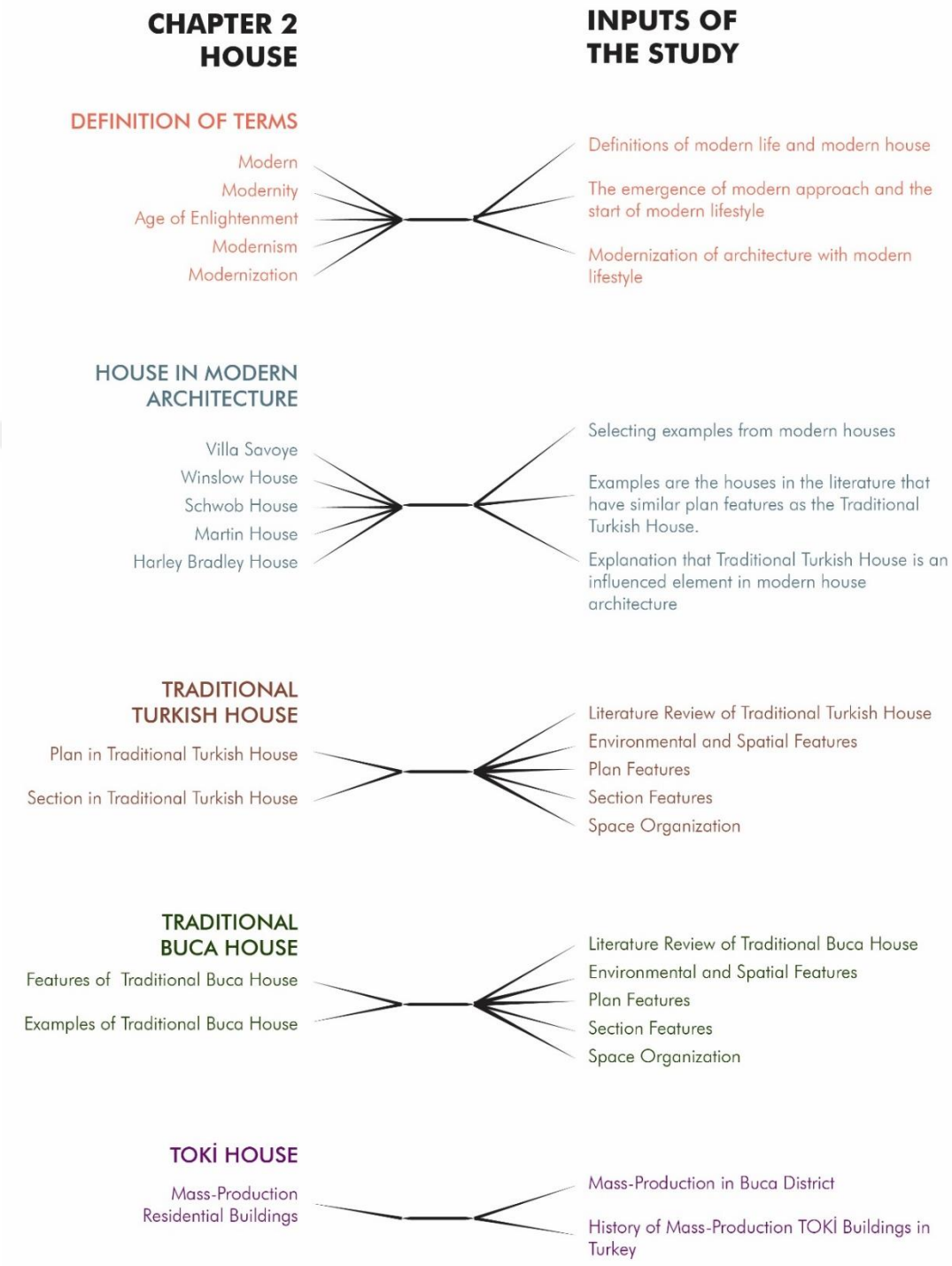


Figure 2: The Study Diagram of Chapter 2

In the 21st century, architects design the plan types and space organizations of the houses used according to the needs of the modern era. However, the approach and design of the house changes. The study explains the modern concept and the modern era to explain the reasons for this development (Figure 2). In this section, the examples selected to describe modern architecture are classified as those with similar characteristics to TTH in the literature (Kahya, 2017). The study focuses on TTH after examining examples of modern architecture. The thesis examines the types of plan and space organization within its scope. The study then narrows the focus and examines traditional types of housing in the Buca region. Thus, the study explains the target area of the thesis. The thesis examines TOKI housing types as the most frequently used housing type in Buca today to use in the next plan adaptation phase. TOKI takes the area calculations of the spaces from the housing plans. Thus, the study analyses the areas of spaces that need modern life.

2.1. Definition of Terms

The study focuses on adapting the traditional type of residence to the standards of modern life. In order to realize the adaptation process, it defines the modern concept and examines its relationship with tradition. The study examines the definitions and relations of modern and modern derivative concepts. It describes the effects of modern approach on residential design. It then establishes the link between modern and traditional. Thus, the study explains the act of adapting traditional to modern.

2.1.1. Modern

The etymological origin of the modern is Latin. It consists of the words *modo* and *hodie*. Latin *modo* means recently, now or fashion. *Hodie* means today. The literature defines the word modern as the fashion of the day in Latin. The term first appears in the form of the Latin *modernus* in the 5th century (Bağce, 2004). This information shows that the modern approach is not a new concept that has emerged in recent centuries and has been discussed since the 5th century. In the literature reviews of the 20th century and beyond, the word modern refers to the transition between the old and the new.

The main feature of the modern is that it creates a structure independent of previous traditional systems. Thus, it defines what is old and what is new. Berman (1992) divides the formation process of modern thought into three periods. In the first period that started with the 16th century and continued until the beginning of the 18th century, people begin to perceive modern life as new. The second period begins with the birth of modern society because of the 1789 French Revolution. Those who became a modern society during this period, including the nineteenth century, know what it means to live materially and spiritually in non-modern worlds. In the third period that started with the 20th century, the modernization process dominates most of the world. Despite great advances in art and thought, expanding modern society is increasingly divided into segments with different languages and ideas (Berman, 1992).

2.1.2. Modernity

The universal, innovative and pioneering features of the modern concept constitute the first criteria of transition to modernity. The literature defines modernity as the lifestyle in which humanity has recently changed along the line of development, and especially the cultural value and social relations that European society after the Renaissance and Enlightenment periods gained (Demir, and Acar, 1992). However, if this is taken as a historical process and beginning, modernity is the social life and organization forms that emerged in Europe in the seventeenth century and then spread all over the world (Giddens, 1992).

According to Tanyeli (1997), modernity is the state of individuals who try to change the conditions of existence with consciousness. There is no such consciousness in the pre-modern era and the pre-modern information infrastructure does not include the problem of cultural change. Cultural change is always present. Society and individuals cannot realize that they are changing (Tanyeli, 1997).

According to Heynen (1999), the most important feature of modernity is criticism. Humankind argues that he can manage his destiny using his mind and make sense of the world and the universe through rational methods. Mind and human are central elements. With the decline of religion from social life, the salvation of humans and science is essential. Modernity assumes that man will increase his knowledge of nature

and himself by using his mind. Thanks to its ever-increasing knowledge, human beings can rebuild a society for their benefit (Heynen, 1999).

According to Hermann Bahr (1890), modernity takes a romantic approach. *Zur Kritik der Moderne* (1890) talks about bad living conditions such as poverty, sickness and pollution that emerged under the influence of the Industrial Revolution. It indicates dissatisfaction with this transformation. Along with these issues, the origin of architecture and debates about New Architecture arise. Hermann Bahr speaks of modernity as an effort that has not been adopted outside the individual. Defines the individual as a phenomenon that life abandons. Le Corbusier (1923) defines modernity as establishing new things, breaking with traditions. According to Habermas (1994), modernity is not based on anything other than itself. While forming its principles, it does not base the main facts such as tradition, religion and culture.

The thesis study, which aims to adapt to the housing plan type suitable for modern life, examines the concepts of modern and modernity. The emergence of the modern and subsequent modernity approach defines the effects that determine modern life (Bağce, 2004).

2.1.3. Age of Enlightenment

Modernity is not a period of limited and precise definitions. It is a historical flow based on reason. Transition to modernity is a result of important revolutions and interactions. One of the most important of these is Newton's scientific revolution. Newton discovered the Universal Weight Law and lays the foundation for a new worldview (Berman, 1992). Newton argues that only mathematics can express the truth and the universe and empirical tools and inductive methods can explain that nature. Humanity understands the importance of individual gains in the Age of Enlightenment. In order for a person to be fully liberated, their talents and creativity must emerge. Since humanity is a self-sufficient being, it rejects any outside intervention or policy that limits its actions (Berman, 1992).

The idea of enlightenment forms the intellectual infrastructure of modernity. It is also a result of the Renaissance and Reform movements (Cengizkan, 2002). Therefore, it

requires an evaluation in connection with the Renaissance and Reform processes. Innovations such as the discovery of the new world and the invention of the compass lead to changes and new insights in all European social institutions. The emergence of a rational thinking structure changes people's worldviews, beliefs, desires and social lives. Thus, rational thought puts the individual at the centre because of medieval religious discourse and sovereignty relations. Galileo opposes the church and declares the only real understanding of the world centred. It reveals a solar-centred understanding of the universe. Thus, instead of theological knowledge, mathematical data begin to be used to explain the universe.

2.1.4. Modernism

Modernism corresponds to a certain moment of modernity. Although there was no consensus at the beginning of modernism, in the nineteenth century, Hegel described modernity with a new age. Hegel's ideas are about progress and the individual. The enlightenment, which evokes the last period according to the term Hegel, begins with the French Revolution. According to Hegel, the task of philosophy is not to look at the past and the future, but to look at the present and eternity.

The terms modern and modernity come together with the concept of modernization. The literature defines modernization as a tendency towards constant enlightenment under the leadership of science and reason.

According to Weber (2015), there is a clear link between Western rationalism and modernity. Weber says that modernization does not mean rationalization. For Weber, modernization may include rationalization. Weber links the development of modern society to this rationalization process. New structures of society are determined through the organizational center of the capitalist enterprise and bureaucratic state apparatus.

Modernization takes place under the influence of economic relations and state mechanisms. Traditional life begins to unravel under the influence of state and capitalism. This inter-rational rationalism does not fully affect modernization. However, traditions and norms change (Swartz, 2015).

New city types and typologies emerge with modernism. Urban plans, hospitals, prisons, multi-storey and elevator commercial areas, shopping malls are emerging. The development of modernization accelerates with new production techniques. Steam engines increased production possibilities and facilitating the production of main materials such as iron, steel and glass have a positive effect on acceleration (Berman, 1992).

At the beginning of the 20th century, issues such as establishment of central authority, increase in production and formation of national identity gained importance. The development of the idea of modernity leads to the contrast between historical values and rationalism. Rational norms gain value. The 20th century is an important breaking point for the circulation of architectural knowledge. With the development of photography and visual recording systems, the photographs of the buildings reach many people in a short time. Thus, it gains importance in terms of architectural aesthetics and fame (Berman, 1992).

In the 20th century, the question arises, "What should be the new language of the new architecture?" Le Corbusier (1923) talks about the organization of the city in his book Contemporary City. It recommends the use of cars and elevators. In addition, Fuller recommends mass-produced homes this century. Another group suggests completely mobile cities. Wright proposes a hierarchical solution with Broadacre City and technological tools. However, he does not believe in being single-centred and cares about the individual. The discussion of architecture in the 20th century is the content of the new language of the new architecture. It should emerge to an architectural surface. The school that tells important things about the form, Bauhaus emerges. Bauhaus aims to combine design with the possibilities of the machine. The school provides design and formatting training based on common aesthetic values in different arts. As a result, it aims to develop a new architectural perspective and support the new requirements of the period.

Between the years 1920-1930, structure types discussions arise. Constructors choose to design lightweight structures. According to them, the three elements of the new architecture of the new century should be lightness, simplicity and transparency. Indicates that this form is against vehicles, not form. Le Corbusier (1923) takes a

different approach with five points of architecture. For example, asymmetry is more important for Bauhaus. Le Corbusier cares about the fourth dimension and indoor experience. He develops projects by working with a filmmaker. Likewise, Le Corbusier's five points of architecture adopts new approaches such as free planning of the ground floor plan, tape windows, roof gardens and free facade identification.

Space is an important element in modern architecture and shape grammar method. The features and perception of the space give character to the plan setup. Some of the spatial definitions in the literature are as follows:

- Space is the place that separates people from the environment to a significant extent and is defined to continue their actions. (Hasol, 2008, p. 344)
- It is possible to consider the space in various ways. It is a stage in which all actions are carried out. It is also the whole of the relationships that living things establish with each other. It is a multi-dimensional perception and experience. It is a whole with life and cannot be considered separately (Demirkaya, 1999).
- Space is the main actor in architecture. (Zevi, 1957, p. 22)
- According to Bruno Zevi, architecture is the interior where the design lives and experiences. In summary, it is part of the area covered. As he believes, it's not just a series of heights, widths, and depths (Özer, 2004).

According to Lefebvre (1984), it is necessary to understand what is new from the word modernity and what innovation indicates. It is a magnificent, temporary, self-proclaimed and applauding adventure. At the same time, modernity, which compensates for the stagnation and dilemmas of everyday life, cannot deprive itself of the passion for adventure. Lefebvre defines consumer society as bureaucratic manipulation of daily life. Therefore, past and tradition are forgotten. Thus, a local lifestyle arises.

At the end of the nineteenth century, artists and architects tried to protect their work from traditional influences. The approach of the architecture, which appeared with form and function, was dominant. Therefore, choosing materials with simple and clear lines has become an important design criterion, avoiding unnecessary decoration. All

these changes are taking place in the world is likely to affect the modernization process in Turkey. In this modernization process, the family structure of the society and the life of the individual are also affected. Traditional Turkish family in Turkey to discuss the modern family issues should be examined. At least three generations live together in the traditional Turkish family structure (Bektaş, 1996). These can be listed as mother, father, child and grandchild. Thus, the family shares the difficulties in living conditions. Sekam (2010) defines this family type as extended family. In the extended family, it becomes easier to transfer cultural accumulation between generations. The structure of society remains local. The family-type brought by modern life can be defined as a single-family (Sekam, 2010). The transfer of cultural heritage in this type of family is more limited than in the extended-family.

According to Küçükerman, the house is a restrictive and protective living environment where living things can meet their needs such as shelter, protection, hiding and privacy (Küçükerman, 2007). In the first definition, it examines not as an architectural, but as an element of natural balance. Different examples in the literature mention the relationship between user and practitioner.

According to Kuban (2013), the house is the joint product of the user and the practitioner in terms of concept and structure. The carpenter, stonemason and other craftsmen combine their skills to create the house according to the wishes of the users. Thus, it reflects the common mind and aesthetic tendencies of the society.

The study describes the modern understanding of life by explaining the modern. It defines the development of modern house types and the formation of space organizations. It aims to create an infrastructure for modern home and modern life definitions to be used in the continuation of the thesis. In addition to modern life, family structure, people's working systems, transportation systems and social life also change over time. Because of all these parameters, the study shapes traditional home types around a modern house type.

Users expect the house to adapt to modern living standards. Architects design housing plans suitable for changing living conditions. Thus, the approach to abandon tradition, which is a requirement of the modern approach, also manifests itself in housing design. New types of housing are emerging in modern architecture. The study focuses on TTH and TBH. For this reason, the study chooses house examples in modern architecture according to this scope.

2.2. House in Modern Architecture

Leading architects and their works, who played an important role in the formation of modern architecture, set the stage for the formation of the architecture of the period. In modern architecture, the designer aims to make life easier for the residential user. For this purpose, the designer establishes visual and audio connections between the main spaces and side areas. In this way, it aims to ensure that the user's actions in the space are healthy and efficient (Özer, 2004).

Two of the new approaches in twentieth-century architecture are directly related to space organization. The first is free planimetry, which allows the formation of free space. The second is a functionalist plan that differs according to the actions in the space. In this approach, the space sections can be of varying size and hierarchy depending on the functional provision. Alexander Klein is one of the pioneers of this approach (Burkut, 2014).

In this section, the study describes houses similar to traditional Turkish houses as plan features in the literature. It compares the houses under the headings of plan, sofa location, and center point and space organization (Figure 3). On the sofa location row, in all plans, the sofa is at a point connecting all the spaces in the main floor plan. The diagram defines that the central point of the main floor plan is located in the sofa. When examining the analysis of the work space organization, it determines the presence of the sofa as the central element.

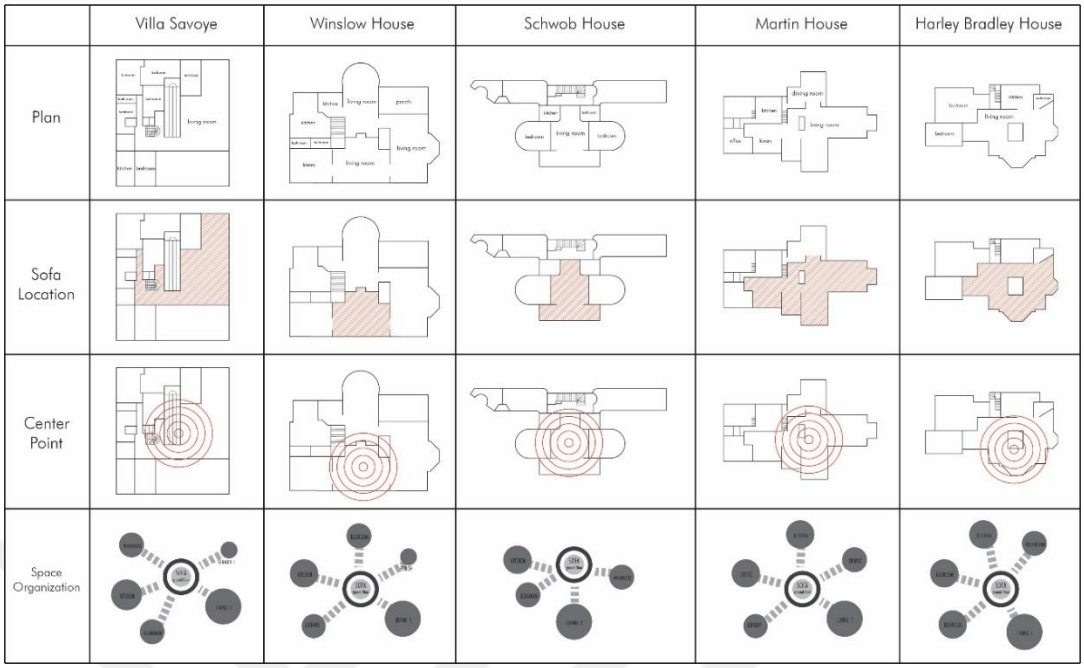


Figure 3: Space Organization Features of Selected Modern Houses

2.2.1. Villa Savoye

Le Corbusier designed Villa Savoye in Poissy, France in 1929 (Baker, et al., 1987). Under the influence of the industrial revolution and mechanization, Le Corbusier (1923, p. 54) advocates, "Home is a machine for living". He believes that the perfect design and application concept in the production systems of the period should be in architecture.

"Nobody can ignore the aesthetic approach of the modern industry. Construction and machine designs are proportionate, more robust and different in material. Indeed, some of these machines and houses are real works of art. This includes the number and layout." (Le Corbusier, 1923, p. 89)

In summary, Le Corbusier's point of view argues that the relationship between human and home should change. Mass production targets a more social life with housing. In this case, he states that social life will be healthier and more moral with the machine body.

Le Corbusier (1931) describes the principles of modern architecture with five elements. The pilots, vertical carriers that separate the building's mass from the ground, show that the building belongs to modern architecture. It makes free plan design with the space organization designed independently from the carrier system. Likewise, the facade design is independent of the carrier. Horizontal band windows are common elements in the facade. Finally, Le Corbusier aims to regain the natural space lost in nature with the garden it positions on the roof.

Le Corbusier prefers basic materials for the standardization of modern architecture. The use of materials is mostly concrete, glass and metal. The dominant colours are brown on furniture, black and grey on windows and doors, and white on the walls (Le Corbusier, 1931).

Designed as one of the main examples of Modern Architecture by Le Corbusier, Villa Savoye has many common principles with the TTH. It is, therefore, an important example of this study. The building has two floors and the entire ground floor is defined as the service areas, entrance and living spaces as in the organization of the TTH. The first floor, the main floor, consists of spaces arranged around the hall. Spaces are plain and useful. According to Kortan, it is possible to compare Villa Savoye's principles with Turkish architecture (Kortan, 1992).

"There is never an approach to repeating the forms of the past. Wide eaves and tile roofs, not bay windows, perhaps the most important tradition of Turkish architecture is in this structure: being innovative and contemporary." (Kortan, 1992, p. 270)

2.2.2. Winslow House

Frank L. Wright designed William H. Winslow House in 1893, is in Illinois, USA. This house is Wright's early example of modernism (Kahya, 2017). There is a central element in the space organization of the house. This element is similar to the sofa at TTH. The name of this central place in modern architecture is the living room. This area provides inter-room relations. Kitchen, library and porch spaces are connected with the living room. Vertical and horizontal circulation elements are also associated with the living room.

There is a living area separated by steps at the entrance of Winslow House. This place is similar to the *eyvan* in TTH as it is related to the sofa. Another similar point is the large padded seating arrangement in the corner of the living room. This area is a few steps above the ground.

2.2.3. Schwob House

Le Corbusier designed the Schwob House and Auguste Schwob built this house in Switzerland in 1916 (Kahya, 2017). European architectural literature defines this house as the Turkish House (Kortan, 1992). Unlike the Le Corbusier style, there are no tape windows and horizontal facade elements.

When the space organization of Schwob House is examined, it is one of Le Corbusier's early free-plan experiments. Space organization defines the hierarchy between rooms. The living room on the ground floor is the central element. The living room connects the spaces. Thus, TTH shows similar features to the sofa.

Le Corbusier uses the Domino system. This system consists of concrete slabs supported by a series of thin pillars and stairs on the sides creating an open floor plan that expands the structure. In addition, the purpose of this system is to design houses that are more cost-effective and easier to manufacture.

2.2.4. Martin House

Frank L. Wright designed Martin House in 1903 in New York, USA (Kahya, 2017). When examining the general features of the house, a strong horizontal plan and wide-eaves roofs draw attention. The study defines a central area when the organization of the space is examined on the plan. This area is the living room. The role of the living room in the organization of the space and its position in the plan is similar to the sofa at TTH. Sızak (2007) explains the similarities between the plan scheme of Aynalıkavak Mansion and that of Martin House. The spaces are connected with the middle sofa. There are common living areas, service areas, garage and warehouse on the ground floor. There are private rooms on the upper floor (Sızak, 2007).

2.2.5. Harley Bradley House

Frank L. Wright designed The Harley Bradley House in 1900 (Kahya, 2017) by Frank L. Wright. The building is in the state of Illinois, USA. It is one of Wright's Praire style designs. When examined as a mass, it displays an impressive stance with its wide eaves, wooden mouldings and eye-catching frames. Indoor spaces are bright and spacious.

The study examines the organization of space and defines the relations between spaces. Spaces are connected to each other with a central element. This element is the living room. As in the other four examples in this section, the living room in this example is similar to the sofa in TTH (Sızak, 2007).

Bradley House, also Sedad Hakkı Eldem mentioned, shows that TTH affected Wright. When the drawings in Wasmuth Album are examined, the location of the main living area, interior decoration, window sizes and relationships reflect the interior design at TTH (Sızak, 2007).

2.3. Traditional Turkish House

According to Sedad Hakkı Eldem, Traditional Turkish House (TTH) is a type of house that has been formed in the Rumeli and Anatolian regions within the borders of the Old Ottoman Empire and has continued for five hundred years and is characterized by its features (Figure 4). Despite different and regional developments, Eldem explains that the main Turkish civilization that forms the Ottoman house is the life and home culture (Eldem, 1968).

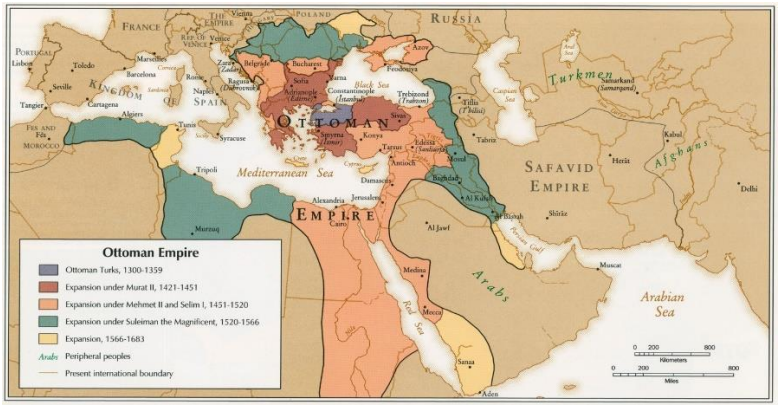


Figure 4: Ottoman Empire Map (Source: Norman, 1993)

According to Cansever, TTH is the structure implemented in Anatolia with a light wooden skeleton building technique that carries the traces of the nomadic cultural tradition. It is widely applied in a wide geographical area in the Balkans, Caucasus, Caspian Region and Crimea within the vast borders of the Ottoman Empire (Cansever, 2002).

According to Kuban, TTH is a type of residence that has been responding to the needs of the Turkish people for centuries, showing the shape and plan characteristics that are suitable for the traditional Turkish family's life culture and traditions (Kuban, 1976). Küçükerman focuses on TTH history. It examines lifestyles from the nomadic period to the settlement period and beyond (Bozdoğan, 1995). Küçükerman discusses the formal and conceptual relationships between the room and the tent (Figure 5). It examines the space elements in TTH. Explains spatial hierarchy and relationships in detail. The study examines how TTH interacts with natural, physical and economic factors (Küçükerman, 2007).

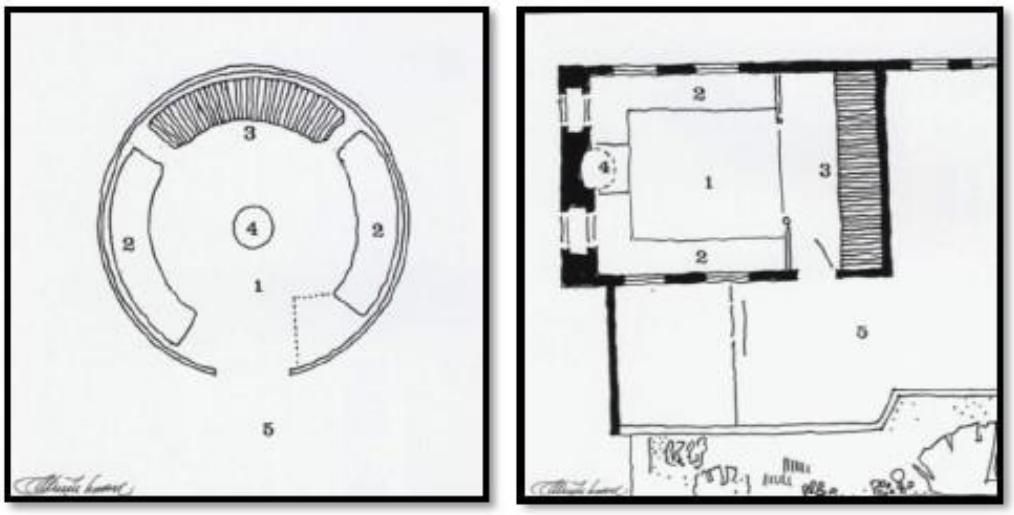


Figure 5: Tent and room (Source: Küçükerman, 2007)

Sözen and Eruzun's study examines the environmental and cultural conditions that determine the formation of TTH. It explains the house units consisting of room, sofa, service area and floors. The study describes the development of house types including sofas, outer sofas, inner sofas, middle sofas. It explains the regional distributions of TTH in Anatolia and Rumelia (Sözen, and Eruzun, 1992).

The foundations of the TTH culture are based on the time spent in tents in nomadic communities in the Central Asian steppes. It improves the life of the tent by following the multi-purpose usage features. Therefore, even today, there are cases when such rooms can meet human needs (Eruzun, 1986).

In nomadic Turkish culture, tents are called *otağ*. Each tent is the only place that meets housing needs. According to Cansever (1994), the concept of the room comes from independent living units of *otağ*. He advocates that this structure of TTH was created by meeting the rooms. The rooms are in integrity with their independent assets. The oldest example of TTH is the type of plan created by combining two rooms. The oven room is functionally similar. This is because both are designed and formatted specifically for multi-purpose use (Cansever, 2002).

2.3.1. Environmental Features of Traditional Turkish House

Tent life is reflected in settled life in TTH formation. Practical and rational solutions attract attention. The design develops from the inside out. TTH is based on human size and scale movements. It also takes into account the topography and environmental conditions in the preparation of the space organization and structural system.

TTH positioning seems to be unplanned at first sight, but settlements taking into account environmental factors. It settles on the slopes to prevent damage from water. On slopes, TTH is arranged so as not to hide each other's view (Figure 6). Thus, mutual respect arises. It also efficiently directs sunlight to the home.

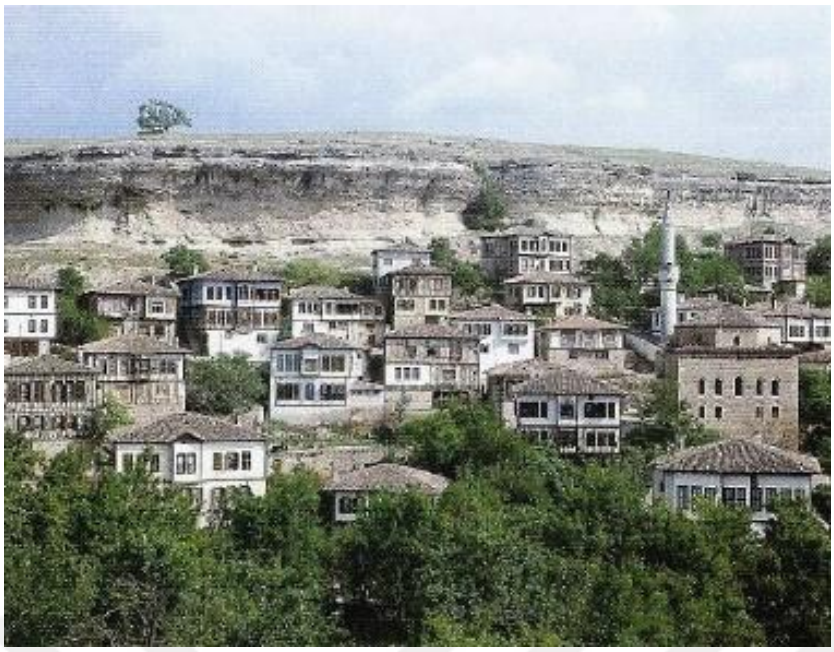


Figure 6: Positioning of Traditional Turkish House (Source: Günay, 1999)

Generally, there are symbolic structures of the city such as fountains, schools, places of worship and baths around them, and the settlements of these structures differ between regions. These differences create local settlement characters (Eyüce, 2005). The slope, pavement material, dimensions of the streets are designed for a person and a load-bearing animal. The urban fabric has been enriched with dead-end streets and private roads. The orientation of the streets and houses in different directions makes each house an independent element (Cansever, 2002).

When the topography aspect of TTH is examined, it is seen that the ground floors change according to adaptation. Regardless of the topography, upper floors are standard. The features of the ground floor have regional differences according to environmental conditions. Because of this situation, differences occur in TTH ground floor plans (Küçükerman, 2007). When the study examines the cross-sectional properties, it determines that the mezzanine floor of the TTH is ventilated from the ground floor and the upper floor. Thus, it provides the natural air conditioning of the summer room. According to Altıner, and Budak (1997), TTH is a wooden structure traditionally separated from the natural ground, suspended from wooden posts and heavy stone walls. He also defines TTH as a cubic geometry based on irregular walls (Altıner, and Budak, 1997).

TTH is compatible with nature and respects the environment due to its structure. The fact that the structures do not interfere with each other shows the importance of privacy in the home. Elements such as inner gardens and birdhouses are the result of the habit of living in nature (Cansever, 1994).

2.3.2. Spatial Features of Traditional Turkish House

TTH, in its most basic form, is a single storey. However, the number of floors increases with users' needs and time. However, the main floor is unique and is the top floor of the house (Eldem, 1968). The main floor rises to get lighter and dominate the view. The ground floor is not a living space. There are functions such as barn, storage, haystack on the ground. In some neighbourhoods, the ground floor is associated with the street for commercial functions over time. However, it is generally without windows. There is a mezzanine floor between the ground floor and the first floor. The height of this floor is lower than the main floor. This coat is suitable for daily use and winter. They have few windows and are smaller than the main floor windows. These intermediate floors have gained importance since the nineteenth century and are regarded as the main floor with their height and plans. However, the most important floor is on the top floor (Eldem, 1968).

When the facade character of TTH is examined, there are two different types of the facade. The facade associated with the street is inward and closed. The need for privacy plays an important role in the formation of the street front. Facing the garden or courtyard, the facade is more transparent than the street facade. Thus, the balance between internal and external is maintained (Bozkurt, and Altınçekiç, 2013).

2.3.3. Plan in Traditional Turkish House

According to Sedad Hakkı Eldem, the main element that constitutes the spatial setup of TTH is the sofa. Sofa is the central unit that connects the rooms. If one side of the sofa is open to the outside, it is called an *eyvan*. It is an important feature that distinguishes TTH from European houses. In addition to creating a connection between rooms, the Sofa is used as a meeting and ceremonial area for users. Eyvan is added to the plan chart with the outer sofa.

After this planning, there are plan types that include inner sofa and middle sofa. Eldem classifies the plan types of TTH (Figure 7). TTH plan types are without sofa, outer sofa, inner sofa and middle sofa (Eldem, 1968).

Figure 7: House Types of Traditional Turkish House (Source: Eldem, 1968)

2.3.3.1. Without Sofa

In TTH, there is no connection between rooms without sofa plan type. Each room is arranged separately. This plan is seen in buildings surrounded by walls in the garden. The number of floors may increase. In this case, a staircase in the courtyard provides access to the upper floors.

2.3.3.2. Outer Sofa

TTH in outer sofa, the connection between the rooms is provided by common space. This intermediate space is a sofa. The fact that the areas directly related to nature such as courtyards and gardens have a sharp connection with the interiors throughout the four seasons affect comfort. The sofa, in this case, is an important factor in maintaining the balance between outdoor and indoor (Küçükerman, 2007). Sofa is a nice place to cool off on hot summer days. It acts as a buffer as a dry area in cold and rainy days in winter.

2.3.3.3. Inner Sofa

Inner sofa is the most common plan type seen in the Traditional Turkish House. All rooms are connected to the sofa. Sofa is the central element of space organization. It is the most useful plan type as it is suitable for use in all seasons. When the space organization is examined, the plan is used efficiently. Thus, this plan type is more economical than other plan types. It is common in crowded cities and towns. The sofa in the plan with an inner sofa is the most valuable place of the house. On one or both ends of the sofa, there are places known by special names such as kiosks and seki. These places have the function of sitting and gathering (Eldem, 1968).

2.3.3.4. Middle Sofa

Middle sofa is a specialized type of inner sofa. Eldem classifies this type as a different plan type. Plans become square with the definition of sofa. Room, cellar, kitchen, *eyvan* and stairs are arranged around the sofa. Sofas initially have sharp corners. But then the corners are broken to get octagonal, polygonal or oval shapes.

2.3.4. Section in Traditional Turkish House

When the floors are examined in TTH, the ground floor is the service floor (Figure 8). On this floor, there are service areas, interior garden, living and courtyard. The mezzanine is like a buffer between the ground floor and the first floor. The main floor is located upstairs. If possible, the attic is used for seasonal needs. There is vertical continuity from the bottom up in the department (Küçükerman, 2007). In addition, it creates a rich cross-sectional character with its wide eaves on the TTH roof, bay windows on the main floor and architectural dimensions compatible with neighbouring structures.

The thesis study covers the space organization and plan geometry of TTH. There are no sections, facades and three dimensions in the continuation of the study. Relations between floors are defined through the plan using vertical circulation elements.

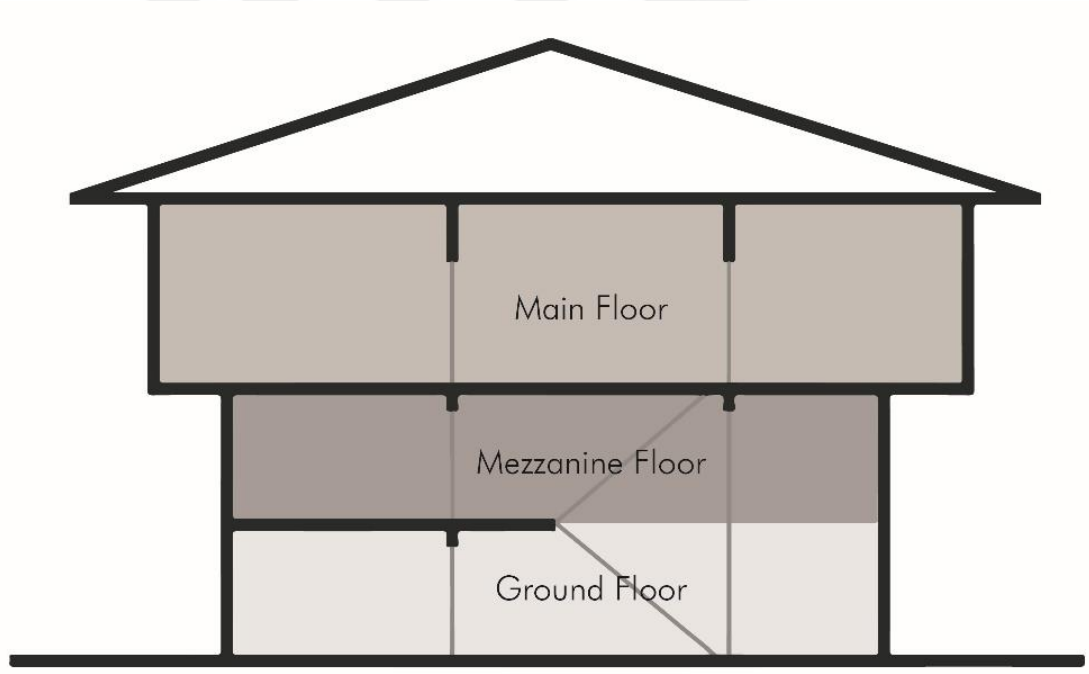


Figure 8: Section of Traditional Turkish House (Source: Eldem, 1968)

2.4. Traditional Buca House

There are European groups in Izmir at the end of the nineteenth and the beginning of the 20th century. It is possible to see the influence of European culture in daily life. At the same time, Ottoman culture is dominant in the city. Therefore, it can be said that

the city has Eastern and Western characteristics. European society between these periods is examined in two groups. The first group is Europeans who are foreign to Ottoman culture for commercial, administrative, cultural and religious purposes. The second group is called the Levantines (Akkurt, 2004).

Countries on the eastern Mediterranean coast are identified with the word *Levant*. Communities living in these regions are called Levantine. According to Erpi, Levantines are Europeans who came to Izmir for commercial purposes and created a common culture by marrying local people (Erpi, 1987).

Levantines engaged in trade and migrated to Anatolia to trade with merchants from European countries. Some of them are born and raised in Anatolia. This community lives a common life with the Ottoman people and culture. For this reason, Levantines are important in expanding the trade network of İzmir and becoming a city with Western culture at the end of the nineteenth century (Akkurt, 2004).

Diversity in the social structure also affects cultural and physical settlements. It causes the formation of religious, cultural and socio-economic regions in the city plan. In the literature review, the city of Izmir was an Eastern Mediterranean port city in the 17th century (Akkurt, 2004). Starting from Pagos Mountain, it spreads to the Izmir seashore. There are Turkish, Jewish-Armenian and French-English-Dutch-Italian, respectively, from the slope of the mountain to the coast. These different groups constitute the differences and cultural diversity in urban structuring.

Before the 1763 Izmir Fire, European community houses were located on Frenk Street, which developed parallel to the Harbour of İzmir (Figure 9). After the fire, Levantine groups settle in different parts of İzmir (Pınar, 2001). Thus, the city centre expanded. The typology of the surrounding settlements is different from the central housing types. Large gardens and well-kept houses attract Levantines' attention. Then the population in Bornova, Buca, Pınarbaşı, Seydiköy, Karşıyaka, Göztepe and Karataş regions are increasing. The dock area is the region where Levantines live the most after the fire. Levantines are moved to Bornova and Buca settlements.

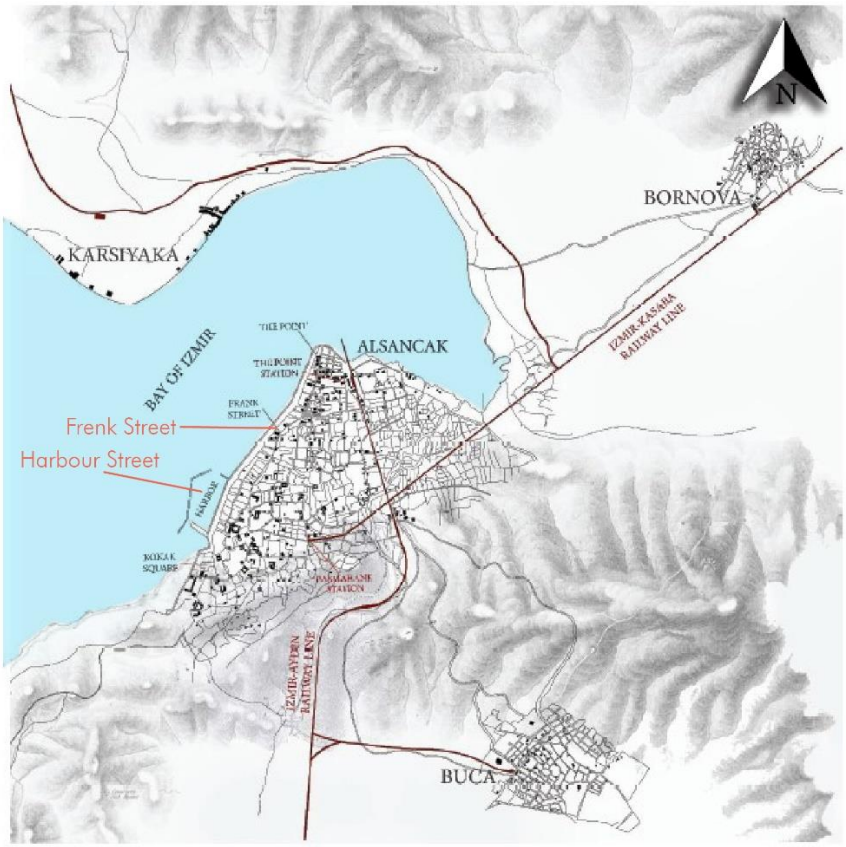


Figure 9: Map of İzmir (Source: Sandi-Zayek, 2014)

The name Buca comes from Greek language (Akkurt, 2004). This means v*uzas* or *bovios*, which means a small village on the edge. It is located in the northeast of Izmir. The city centre and the suburban order are together in Buca. Street layouts are in the city centre. However, building typology consists of suburban buildings. Erpi (1987) mentions that the physical development of the Buca settlement is from north to south. When the historical features of the settlement are examined, it can be said that the architectural constructs, material types and system features belong to a western architectural approach. The density in the residential areas is in the living areas of the Levantines. There are household typologies according to the income scale. High-income groups have large gardens and rich homes with landscaping. Middle and low-income groups have houses with a grid layout (Erpi, 1987).

When the demographic structure of Buca is examined in the late nineteenth century, in addition to the Levantine group, the migration of Muslim groups from the Balkans is also important. After the Balkan War of 1912-1913, Buca became a settlement affected by the 1922 stock exchange. Thus, it had a demographic structure that

resembled the multinational structure of the Ottoman Empire. This multinational structure causes differences in housing typologies to emerge. The house type reflecting the Ottoman life culture, which is also mentioned in the TTH definition, shows itself here.

2.4.1. Features and Examples of Buca House

Erpi examines the people living in Buca in two groups. These are Levantines with high economic level and local people with low economic level. House types are also two groups in line with this economic classification. The first is the houses where the locals live, which are the same as the plan and space organization. The study defines these houses as the local Buca House. These houses constitute the general features of the city texture of Buca. Plan charts develop on a similar template. The building types repeat themselves within the urban texture. This is due not to architectural aesthetic anxiety, but the needs program. The space organization of the houses is formed according to this program of needs. Secondly, Levantine mansions, which differ from the first group in terms of organization of facade, plan and space. Such houses have different plan and space organizations. Because they are few and differ from each other, Buca does not affect the urban texture.

2.4.1.1. Local Buca Houses

In local Buca houses, the entrance is usually higher than the road level. It provides this height with stairs between eighty centimetres and hundred centimetres. Space organization identifies entrances from the ground floor or through the garden. The basement under the ground floor generally has a warehouse function. However, according to topography, in some cases, users use the basement as a living area. In these examples, the basement entrance is not inside the house, it is from the basement door located below the ground floor entrance. The basement floor generally has windows to get light and fresh air from the outside. There are iron bars on the windows (Köseoğlu, and Korkmaz, 2011).

The local Buca House emphasizes the entrance by enclosing the ground floor niche raised by stairs. This height is formed by a threshold in some examples and three steps

overflowing in the street in some examples. It defines the landing and the door in front of the entrance door. The sofa, where the entrance is connected, connects the rooms on the ground floor. The sofa in Buca House has the same meaning and function as in the Turkish House. Sofa is the most used element of the house throughout the day (Erpi, 1987).

Similar to TTH, plan typology in Buca House is shaped according to the place of the sofa in the plan and its relationship with the outdoor space. The rooms and the street gate are connected with the sofa. Vertical circulation elements are on the sofa. Erpi (1987) defines the plan types as; middle sofa (a), side sofa (b) and outer sofa (c) (Figure 10).

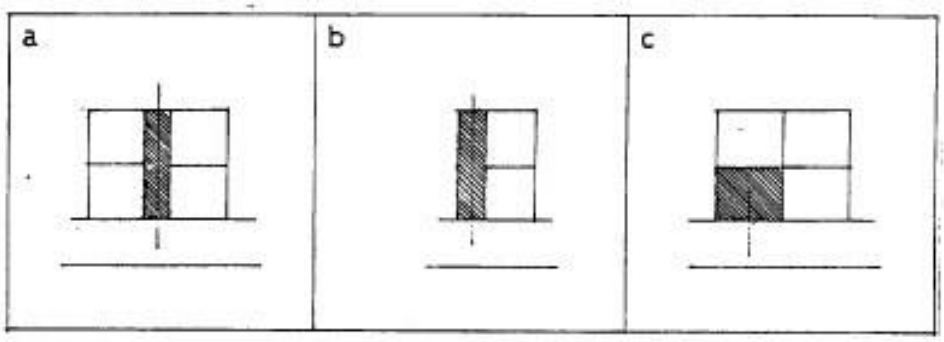


Figure 10: Sofa Types of Buca House (Source: Bilginperk, 1999)

In space organization, the entrance floor is usually the outer sofa or the side sofa. Some examples with a two-storey asymmetric plan feature the ground floor exterior sofa. In these examples, the upper floor has the feature of a middle sofa. The layout of the sofas affects space organization and the facade. In single and double storey symmetrical structures, the sofa is in the middle. The space organization also defines the table as the living room. Wet areas are located together and generally in connection with the outside garden. The rooms lined up around the sofa have no functions separated by certain definitions. All rooms have functions such as bedroom, living room. Bedrooms are upstairs as the privacy level is high. This space organization may change due to user needs and seasonal conditions (Erpi, 1987).

2.4.1.2. Levantine Mansions

Erpi classifies the types of housing in the residential architecture research in Buca. According to this classification, the majority of the buildings show similar characteristics to European culture in terms of materials, construction technique and architectural style (Erpi, 1987). Thus, Erpi thinks that the structures examined are the residences of Levantine and wealthy Greek families. This shows that Levantine Mansions differ from the local Buca House in terms of architecture and materials. The study mentions in the following sections that the local Buca House and Levantine Mansions are similar in terms of space organization. The study explains the sample Levantine Mansions with their features in the literature before analysing the space organization (Figure 11).

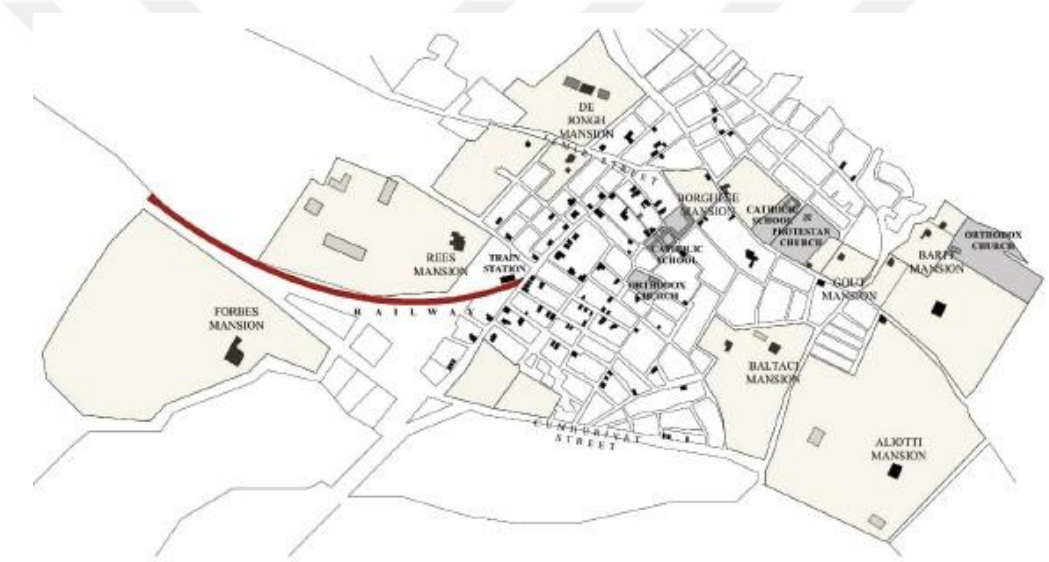


Figure 11: Figure 11: Buca Urban Texture (Source: Erpi, 1987)

a) Barf Mansion

The Barf family is an English-born family living in Buca since 1890. Barf Mansion is one of the mansions with large gardens in Buca. The mansion was built in 1900. The front and rear facades reflect an original architectural language. On the other hand, it has Renaissance effects. When the study examines the building as a mass, it states that it consists of two parts, the main structure and its outbuildings. The three-storey building has a space organization reminiscent of TTH, which has a middle sofa (Erpi, 1987). The basement, the ground floor and the first floor of the building, the basement consists of a single area. The location of the building is a large garden that allows for

a large ground floor organization. Ground floor rooms are connected to the middle sofa. Backyard, outbuildings and patio connections are provided by the service corridor from the middle sofa. Middle sofa and service corridor are also located on the first floor. Here he connects the bedrooms and outbuildings. The balcony, which is frequently seen in Buca pavilions, is located in front of the middle floor on the first floor. The stairs in the middle sofa (Figure 12) provide the connection between the floors.

Barf Mansion is created by adding an additional building structure to the TTH building. It joins the movement with elevation in the lean mass, roof and balcony ledges.

According to Erpi, space organization reflects the European shapes of interior arrangements and decorations, while it has local features with its wide balcony mass affecting bay windows, the use of fringe and lace.

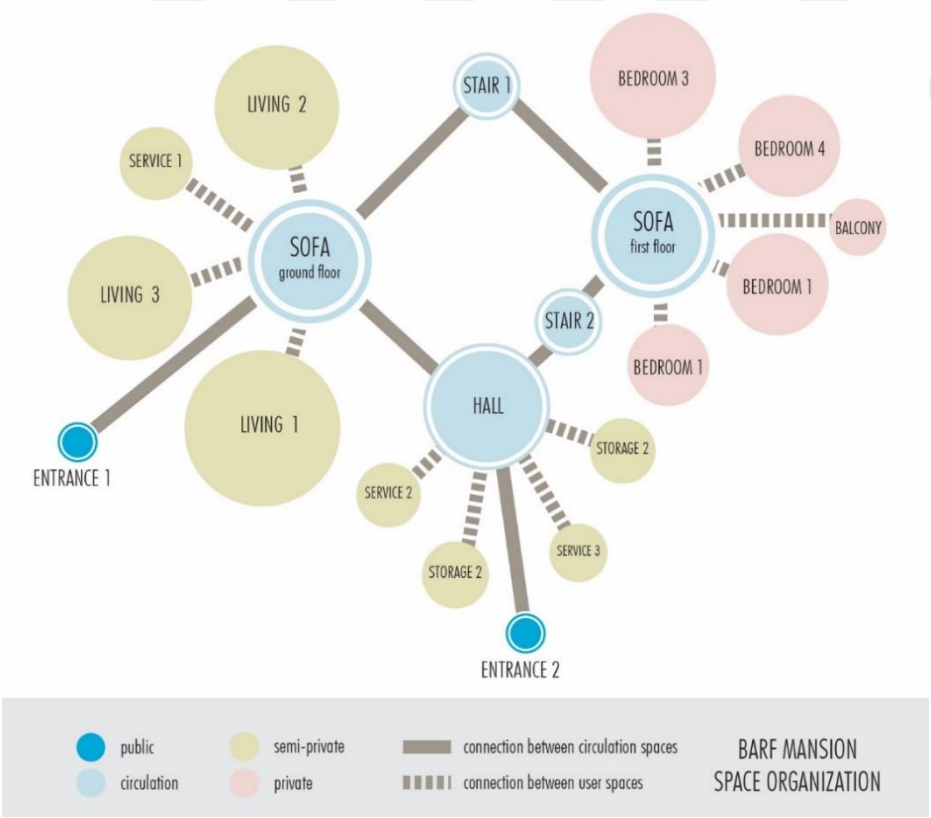


Figure 12: Space Organization of Barf Mansion

b) Baltacı (Baltazzi) Mansion

The owner of the mansion, Demostanis Baltacı, is a Greek from Buca (Akkurt, 2004). He is an important person working with Osman Hamdi Bey in the field of archaeology. When Sultan Abdülaziz arrived in Izmir in 1863, he stayed in this mansion. After these years, the building passed to another family. The 1900s used this place as an orphanage structure. Orphans migrated from here in 1922 and the structure was donated to Mustafa Kemal Atatürk. In the 1930s, the building was renovated as a school. Buca Secondary School has been used for years.

Unlike other mansions in Buca, Baltacı Mansion has Palladian-style decorations. European culture is seen throughout the structure. It is located in a large garden. Thus, the space organization compatible with the landscape supports.

When analysed massively, it is noteworthy that it is lean. In the structure dominated by symmetry, the organization of the space is symmetrical like the building mass. It consists of two floors. There is a type of plan with a middle sofa. The building creates common rooms on the ground floor. There are semi-private rooms next to the mass.

On the first floor, there are bedrooms lined up around the middle sofa. The balcony at the entrance of the building can be defined as the point where the middle floor on the first floor meets the exterior. Stairs in the middle sofa provides the connection between the two floors (Figure 13).

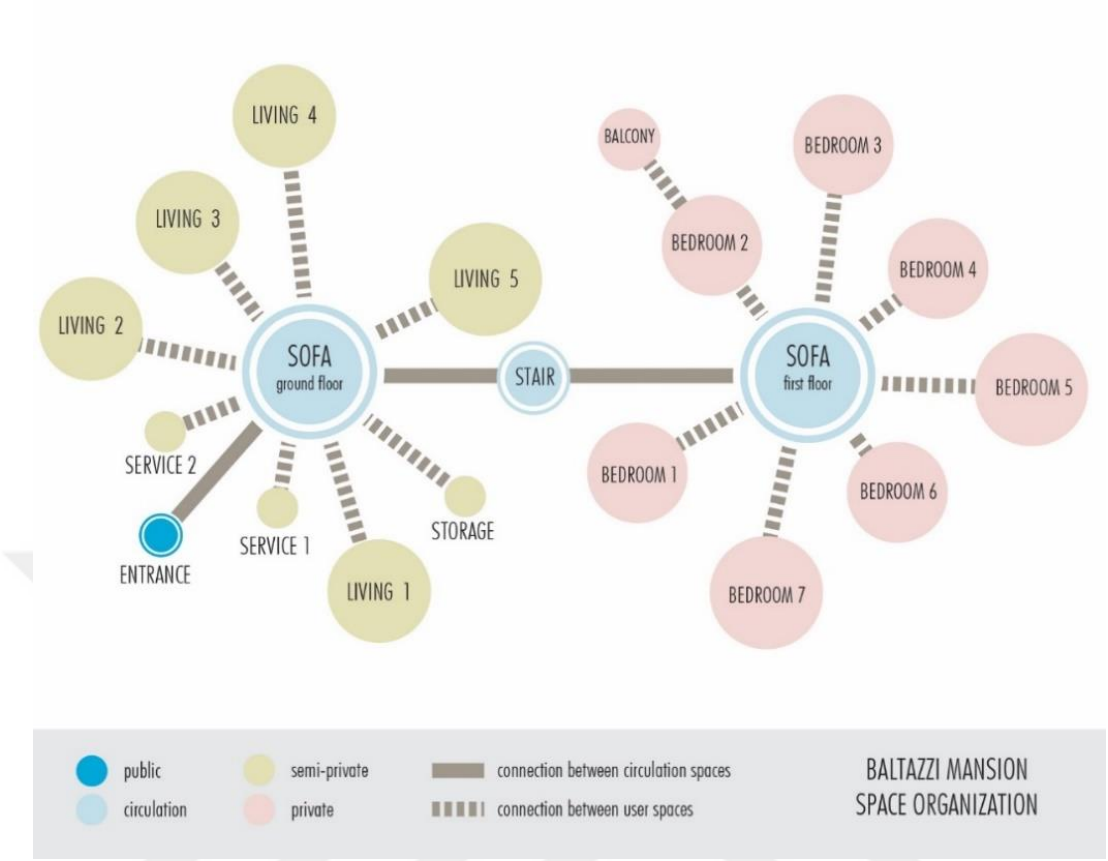


Figure 13: Space Organization of Baltazzi Mansion

c) Forbes Mansion

When the mansions in Buca are examined, the most popular is the Forbes Mansion. Because of this location and its magnificent structure. Forbes family built the building in 1908. Forbes family is one of the important families for İzmir trade and economy. After the proclamation of the republic, he left the building to Albert Whittall (Akkurt, 2004). In the 1940s, the building was expropriated and used for government affairs.

According to Erpi (1987), the spatial organization of the Forbes Mansion occur over time with additions according to the needs of the user. For this reason, some places on the ground floor are far from the sofa. Yet the space organization is similar to TTH (Figure 14). The structure is in perfect harmony with the hill on which it is located. This is also an important value. The tower is interpreted as a reflection of the

dominance of the region. The garden is quite large compared to other mansions. The literature mentions many different types of trees in the garden (Akkurt, 2004).

The outer structure is included in the structure created in a linear arrangement. The connection between these two masses is simple. The building, which has a plan type with middle sofa, consists of three floors: ground floor, mezzanine and first floor. On the ground floor, there are main common areas and service corridors. On the first floor, there are bedrooms and wet areas around the middle sofa. Movement is provided in the facade and space organization of balconies. The tower structure is defined as the resting and viewing room of Forbes.

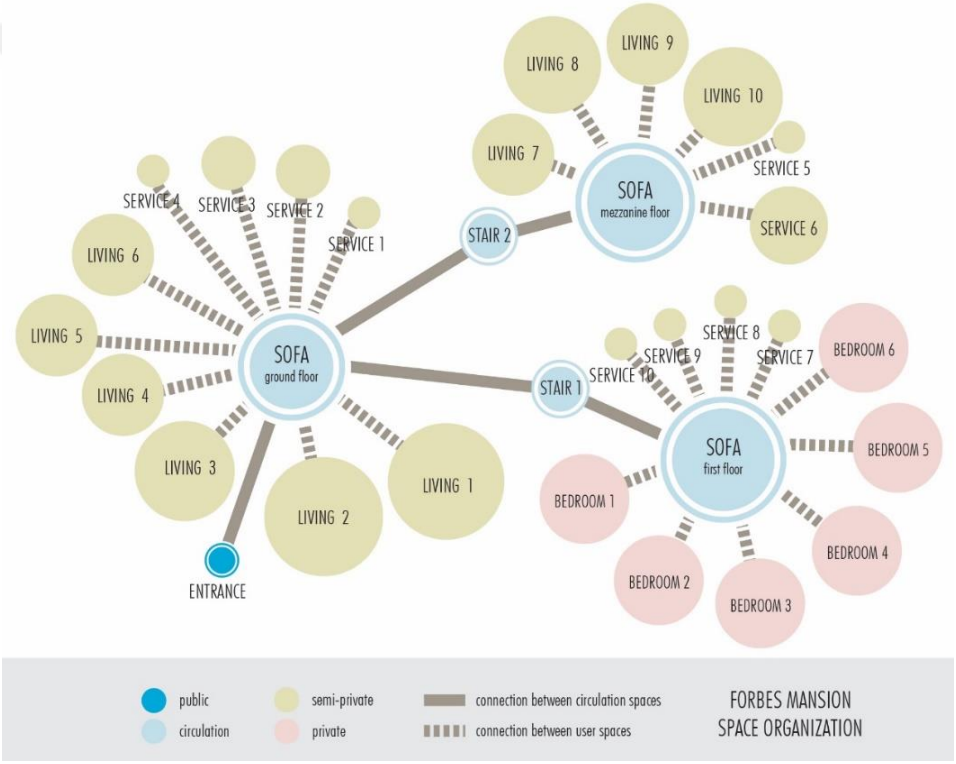


Figure 14: Space Organization of Forbes Mansion

d) Rees Mansion

The Rees family is one of Buca's oldest families (Akkurt, 2004). The construction date of the Rees mansion is the end of the nineteenth century. The architectural structure of the mansion is more rational and direct than the Forbes mansion. It stands out as a tower-like element. The influence of sovereignty in the Forbes mansion is not seen in this mansion. The outer form and inner features are splendid but modest in a simple geometric style (Akkurt, 2004).

When the mass structure is examined, it is seen that the functional differences in the interior are reflected on the facade and building mass. The main building has three floors. There are additional masses to the west and north of the building. These are the main living spaces. The annex building mass has two floors and is connected to the northwest from the structure. In addition to these masses, there is a tower to the east of the building. The structure has space organization in simple geometry. However, when the mass ratios, facade and interior elements are examined, family status indicators attract attention. It is aimed to create a monumental architecture.

When the space organization is examined, an asymmetrical order is dominant. The ground floor is similar to other mansions and consists of common rooms, middle sofa and service areas. On the upper floors, bedrooms are in a linear order. The balconies of the rooms provide mobility on the building facade.

e) De Jongh Mansion

De Jongh Mansion was built in the late nineteenth century. De Jongh family is among the protestant Levantine families of Buca (Akkurt, 2004). Part of the family lives in Buca and the other part lives in Bornova. De Jongh mansion is symmetrical unlike Forbes and Rees mansions. As in the Rees mansion, a large terrace is used to enter the building. However, the terrace is covered. This creates a portico effect.

When the study examines the mass structure, the stepped structure of the mansion determines that it is compatible with the U-shaped courtyard. The effect of the entrance porch leads to a modern perception of the building. When the study analyses the space organization, it defines that the building is three-storey. The patio on the ground floor faces the entrances (Figure 15). There is a plan type with middle sofa. The common lounge and service areas open to the middle sofa. Middle sofa effect continues on the first floor. Central staircase and main staircase and bedrooms are connected. The mass in the north, which has a linear space organization, includes service areas.

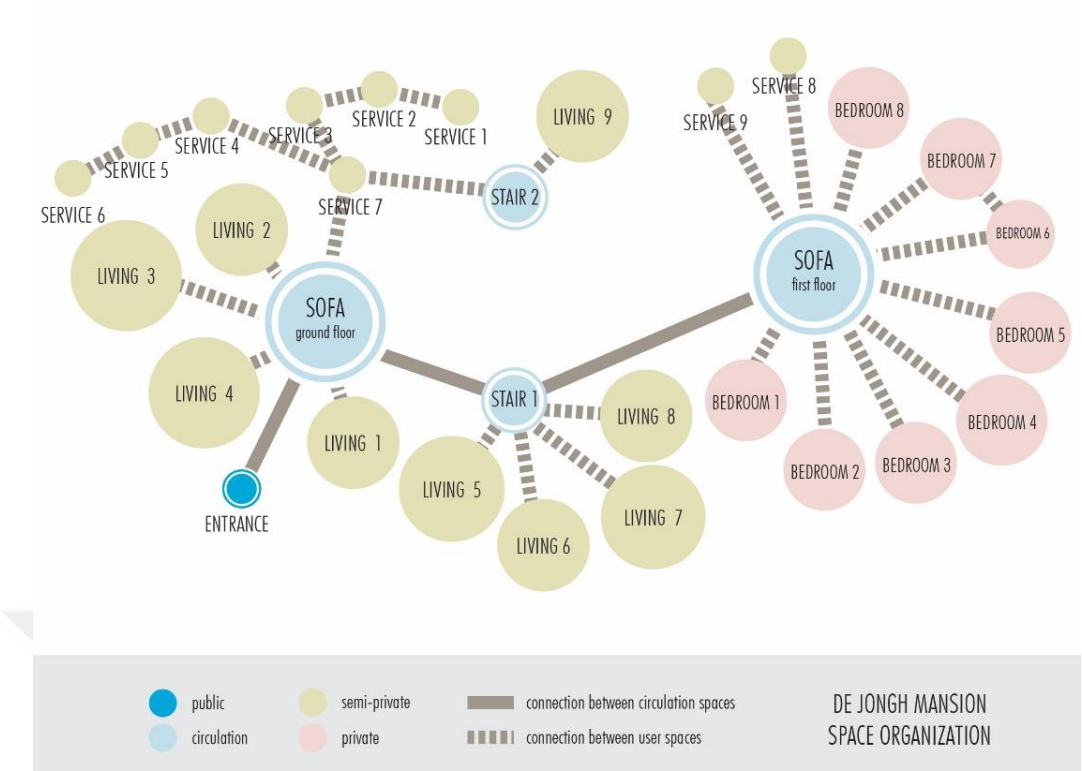


Figure 15: Space Organization of De Jongh Mansion

2.5. TOKI House Type

The physical and economic characteristics of cities vary according to the users living on them. As an example, Buca was an important commercial point on the main transportation network in the early twentieth century. Therefore, it became the settlement of Levantine merchants. In addition, local people engaged in farming and food trade live here. In the beginning of the twenty first century, Buca is on the way to become the education centre of Izmir. Due to the primary, secondary and higher education institutions in Buca, the student population increases significantly. Because of this increase, architectural urbanization develops as mass housing buildings designed according to students and their families.

2.5.1. Mass-Production Residential Buildings

In the early twentieth century, mass housing construction gained importance with the industrial revolution. The reason for this is that the cities receive immigration rapidly and intensely by the working class. This intense migration situation raises housing problems. With the influence of the modernism trend, new ideas on standardization,

prefabrication and modular design issues are formed in mass housing designs. Due to various infrastructure and health problems, studies are carried out on mass housing. Leading architects of the period such as Le Corbusier work on these models and make designs.

Another point in the emergence of mass housing structures is the need to rapidly produce a large number of houses after the Second World War. However, mass housing projects become important (Telli, 2010). As these projects increase, the architects realize that mass housing types move away from human needs and concentrate on mass housing design. Efforts to overcome the housing deficit play an important role in the formation of modernism. Along with social needs, the functionality should be met in the fastest possible and most advanced technology at the optimum level. As a result, the mass housing constructed during this period is done simply, in a modernist style.

The reasons for the emergence of mass housing construction in Turkey is different from Europe. Turkey is a class in developing countries over the same period. The most common features in such countries are income distribution difference, economic imbalance and irregular distribution of apartment blocks. A solution is sought for this distorted urbanization problem with mass housing projects.

Public housing in Turkey is aimed at low and high-income groups. The current perception of collective housing is that these houses are for individuals and families with low economic income (Pulat, 1992). Public housing projects in Turkey, begins at the end of the Ottoman period. It continues in the Republican period and proceeds in a planned manner. Yücel (2006) states these progress periods and defines the period before 1945, the period 1945-1960 and the planned period 1960-2000.

2.5.1.1. The Period Before 1945

Akaret Houses, located in the Beşiktaş district of Istanbul in 1870, is the first mass housing application. The state makes these houses for the court members. The migration that started to the cities after the proclamation of the Republic causes the

shortage of housing. Emlak Bank aims to manage this need in a planned and accurate manner.

Bahçelievler Cooperative in Ankara in 1934 is the first project of Emlak Bank. Another mass housing model implemented in the same period is the housing structures designed for workers working in İzmir, Karabük and Hereke (Pulat, 1992).

2.5.1.2. 1945-1960 Period

After 1945, migration to cities increased rapidly. Therefore, irregular urbanization and slums are manifested. Emlak Bank works to prevent this situation. However, after 1958, Emlak Bank remained inadequate economically. Levent (1947-1951) and Koşuyolu (1951) applications, housing applications are important in Turkey. Fourth Levent and Ataköy are important examples in planning land outside the city (Ersoy, 2007).

2.5.1.3. Planned Period (1960-2005)

The First Five-Year Development Plan Period (1963-1967) requires social housing standards in the public sector for small and cheap housing construction. It supports mass housing organizations. In addition, it makes tax deductions to encourage social housing (DPT Rapolar, 1963).

The Second Five-Year Plan (1968-1972) states that the state should increase the supply of housing by producing housing, providing loans, taking regulatory measures, making housing production plans. Cooperatives aim to reduce the cost of housing with measures such as mass housing, land office, public infrastructure (DPT Rapolar, 1967).

The Third Five-Year Plan (1973-1978) gives priority to supporting private entrepreneurship as well as encouraging the construction of rental housing for low economic groups, supporting social housing, cooperative housing (DPT Raporlar, 1973).

The Fourth Five-Year Plan (1979-1983) aims for the first time to include the funds allocated by various institutions for housing to the housing production and to give public lands to local administrations to produce social housing. It also enacted the Mass Housing Law No. 2487 in 1981 (DPT Raporlar, 1979). This law mainly aims at solving the housing problems of low-income people. It shows the mass housing as a solution.

Fifth Five-Year Plan (1984-1989 encourages industrial investments and housing construction (DPT Raporlar, 1985).

The Sixth Five-Year Plan (1990-1994) includes provisions for the construction of a total of one million eight hundred thirty-eight thousand homes, emphasis on social housing, reducing housing sizes, and promoting projects and technologies that reduce waste (DPT Raporlar, 1989).

The Seventh Five-Year Plan (1996-2000) aims to accelerate housing production with projects to be developed in development-oriented regions, especially in the Eastern and South-eastern Anatolia Regions (DPT Raporlar, 1995).

The Eighth Five-Year Plan (2001-2005) takes measures to prevent skewed construction and slum construction. Reproduction of lands with ready-made superstructures also covers the objectives of the plan. This plan also addresses the issues of increasing the quality of the building and the environment in housing production, protecting historical and natural texture and social and cultural values (DPT Raporlar, 2000).

Thesis study takes the space dimensions of the new plan types from the current TOKI housing plans during the plan adaptation phase. Therefore, it emphasizes the formation and historical processes of mass housing plans. Today, in Turkish architecture, mass housing is an excluded and unpleasant type of residence. However, the state in Turkey's approach to shaping public housing over the long years of planning and trials. Thus, it aims to produce housing types suitable for population and economy. By explaining the planned periods, TOKI explains that there is an input on the space dimensions parameter.

2.6. Discussion

In this section, the study describes the concept of housing, changes in housing plans in the modern age and traditional housing typologies. The adoption of the modern approach in the social structure also affects the housing plans and space organizations. Architects begin to design according to new living standards. With this change, local housing habits disappear and a uniform lifestyle begins to emerge in the society.

The study adapts traditional plan types to modern life plan types with the chapters of literature review, case analysis and computer-aided design method. At this chapter, TTH examines the local Buca House and Levantine Mansions in traditional residence types. The scope of this review is the elements that make up the space organization and plan. Thus, the study identifies the important points of the formation of space organization in traditional houses and uses it in the adaptation phase to the modern house.

CHAPTER 3: SHAPE GRAMMAR

The thesis uses the shape grammar method, which is suitable for the needs of modern life and creates house plan types with traditional space organization. Thus, it determines the method in the production of the new plan type. The chapter describes the architectural language and shape grammar method with computer aided tools. It shows the studies where shape grammar has been used since its emergence with literature review and examples. The thesis examines the works of Gülen Çağdaş (1996) for the Traditional Turkish House. According to these studies, evaluates Traditional Buca House and TOKI houses. The study creates the theoretical and technical background for the adaptation of the New Buca House plan (Figure 16).

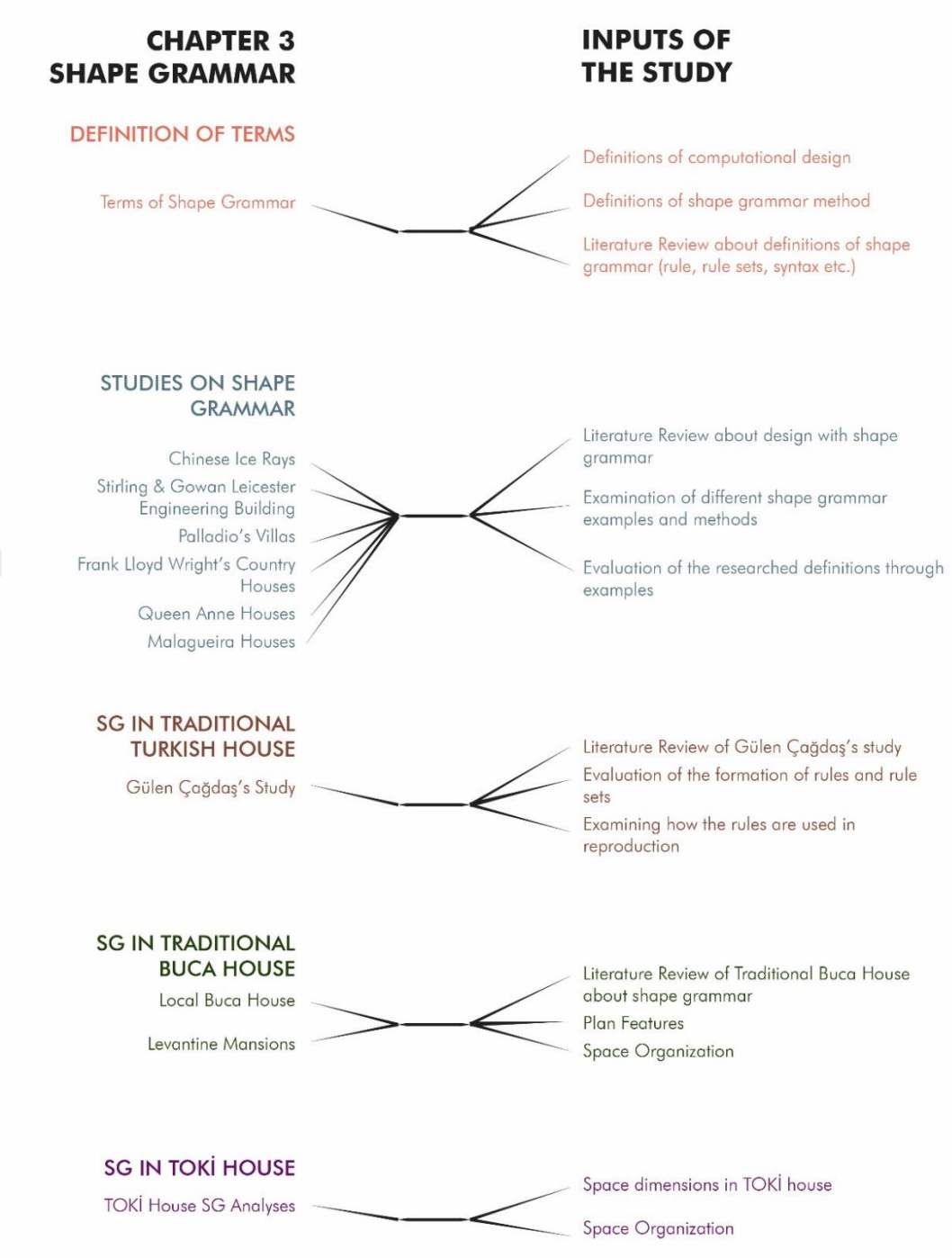


Figure 16: The Study Diagram of Chapter 3

3.1. Definition of Terms

The analytical thinking technique that forms the structure of architectural language is as old as Vitruvius (Clarke, and Crossley, 2000). Language structure, natural languages and artificial languages are examined in two separate groups. Natural languages emerge as a result of a long development process. In each generation a certain part remains constant and a small part can change. Humans invent artificial languages for special communication methods. For example, computer language, musical notes, and the alphabet. It is created with rule sets, can be easily modified and edited (Raphael, 1976)

According to Aksoy (2001), rule groups are two groups as syntax rules and semantic rules. It is a set of rules that examine the structure of the formula without considering the series of symbols that form the sentences and meanings of the language. The second is the semantic type of rule. In this type of rule, it defines the meaning of the symbol sequences that match the symbols of the language and grammar rules. In summary, expressions in natural language are expressed in computer language with words and symbols (Aksoy, 2001).

Disciplines have their own grammar rules. Architecture includes grammar rules that make up architectural languages. The main expressive tools of architecture are points, lines and three-dimensional objects, which are geometric elements. In addition, there are patterns in the language that make repetitions meaningful. These patterns enrich the architectural language. A pattern is a design in which a certain shape or shapes are repeated many times (Rowland, 1964). Charles Correa has a common example of pattern language. It is possible to see the effect of the design language in residential units or residential blocks built by Correa. He defines certain geometries as patterns and creates architectural grammar rule sets with these patterns.

The architectural language develops and repeats for a long time, creating local architecture. Local architecture is a composition created with the architectural language of the region. It is possible to analyse and repeat this language. Understanding the region's reflection in architecture, its causes and consequences is an important measure. Çağdaş (1996), while examining the local architectural language,

examines the structures, elements and rule sets that combine these units. In this compilation process, spatial components were examined by typological analysis. Creates rule sets and analyses the convergence of the components. In this way, it creates the grammar of the local language with its components and sets of rules. In order for the obtained grammar to be valid, it is necessary to define a set of rules that have properties that can produce existing examples and derivatives.

Studies in architecture are on forms. In such cases, words and verbal expressions are insufficient. Because understanding forms may not be based on simple rules as much as words (Aksoy, 2001). In Flemming's work (1987), it shows a graphical method to formulate shapes with shape grammar rules. With the set consisting of rules in X to Y shape, it can generate new form or design from the defined shapes in the shape grammar (Flemming, 1987).

Shape grammar method uses shapes to describe operations. It performs and visualizes operations with shapes. It can also characterize simple relationships and transfer them to the Cartesian coordinate system. Thus, it defines a order and rule to the shapes (Stiny, and Gips, 1972). Multiple rules come together for a specific purpose and create rule sets. Thus, rule sets can be prepared for a defined process. The defined group of shapes is the vocabulary of the shape grammar method. As in the spoken language, words selected from the vocabulary are processed with certain sets of rules and the language is created. The defined language explains shape grammar method.

Stiny and Gips, defined shape grammars (SG) in the 1970s. It aims to describe design languages and produce the new. Accordingly, it explains the shape grammars in a rule-based structure and to a certain degree in an algorithmic structure (Aksoy, 2001). Stiny (1972) mentions the Kindergarten shape grammar through Froebel's structure. With this method, it creates a new production alternative in architectural design.

According to Stiny, five main parameters are required for a new shape grammar. These are as follows: vocabulary to define language and express, space organization relationships, shape rules, initial form and shape grammars. This study creates these parameters in order to be able to adapt the house plan type with the shape grammar. Therefore, it refers to the five main parameters of Stiny.

According to Noam Chomsky, SG is similar to the structure of the sentence defined in linguistics. In this approach, the sentence is created with certain symbols. And this is a grammar where symbols define rules by creating arrays and patterns. Based on this approach, the alphabet used by SG consists of forms. It organizes these shapes with defined rule sets (Stiny, and Gips, 1972).

According to Knight, SG is a set of shapes that define the design language. With these figures, rule sets are prepared. Designs created with rule sets are reproduced with shapes in the SG dictionary. The starting form is determined and the design is made by applying the rule set (Knight, 1981).

Birgül Çolakoğlu divides SG into two groups. They define them as formal SG and informal SG. It is seen in formal SG computational design systems. She uses forms defined by calculation during design. Formal SG determines the parameters and constraints at the beginning of the design process. Based on this information, it defines rule sets. Rule sets revealed formal features of design objects. Formal SG is a form of design that requires multidirectional thinking (Çolakoğlu, 2001).

In summary, SG differs from other productive designs in that it works with geometry-based units, not abstract alphabets and symbols. This feature is important for its use in an area where visual design is important, such as architecture (Torus, 2011).

Stiny carried out the first analytical SG study in 1977. The focus of this study is the Chinese ice ray models and the designs made with these models. Numerous compositions can be designed with simple rule sets. Since the same SG is used, all designs have the same style (Stiny, 1977).

The first SG analysis in the field of architecture is made with Palladian Villas (Stiny, and Mitchell, 1978). The rulesets of this grammar are derived from the work of Andrea Palladio (Wassell, 2008). Rule sets are adapted to villas and controlled repetitions occur. These repeats are proof of the presence of SG. Later on, the method develops with the works of Çolakoğlu's Sarajevo Hayat House (2001) and Jose Duarte's Alvaro Siza (Knight, 1981).

Stiny, and Gips (1980) talk about various methods when determining rule sets. These are listed as follows:

- Identifying all the elements in the set and collecting them in a catalog (Bloch, 1979).
- Identification of one of the elements in the set and the operations to obtain the other elements from this element (Steadman, 1973).
- Indicating the production method of the elements of the set by presenting a computer program (Krishnamurti, 1982).
- Indicating the production method of the elements of the set by presenting the grammar (Stiny, and Michael, 1978).

According to Stiny, the format grammar method is to communicate and produce by using shapes instead of words, form rules instead of grammar rules. The study examines examples of morphology in the next section. While choosing these examples, it gives priority to those focused on traditional architectural and cultural heritage issues.

3.2. Studies on Shape Grammar

In SG studies, forms turn into analytical data according to certain rules. It then transfers this data to the computer environment. It is quick and easy to define, change and produce new variations in a digital environment (Stiny, and Gips, 1972). SG provides the opportunity to limit and control this process with rules. It produces variations by repeating the rules at various stages. These repetitions result in unpredictable design products. The rule, parameter and number of repetitions are directly proportional to the number of different design products. This is very valuable for designers. In addition, there are no restrictions on the scale. It is possible to create unlimited design products with the opportunity to work in a regular manner. There is many ways to examine designs with deductive and inductive methods.

Examples of SG showing traditional and architectural models are; Buffalo bungalow design (Flemming, 1987) Japanese tea room design (Knight, 1981), Queen-Anne style home designs (Flemming, 1987), Taiwan traditional home designs (Krishnamurti,

1982), courtyard home designs (Aksoy, 2001). SG examples that model the design language of an architect for a certain period of time: Palladio's Giuliani Frigerio Villa (Stiny, and Michael, 1978) Wright's Prairie style home (Koning, and Eizenberg, 1981), Architect Glenn Murcutt city church designs (Buelinckx, 1993) and Belerko mass housing designs (Sağlamer, and Sanly, 1995).

These sample studies are based on a certain basic idea. The sample studies create the alphabet with the shapes and define the shape grammar method using rulesets. The study examines the examples with this idea in the literature review in detail. After examining the examples, he focuses on the example of the Turkish House of Çağdaş's form grammar. This study is taken into consideration as the thesis studies plan types similar to its scope. It determines the seamless and different aspects of this study and transfers the results to plan adaptation of NBH.

3.2.1. Chinese Ice Rays

Traditional Chinese window lattice systems (Figure 17) have a special layout. This scheme consists of rule sets and controlled repetitions. Stiny analyses the Chinese ice rays with the SG approach (Stiny, 1977). When the Chinese ice rays are examined, five main rules emerge. The basic principle of the rules is to divide the created shape and create new shapes.

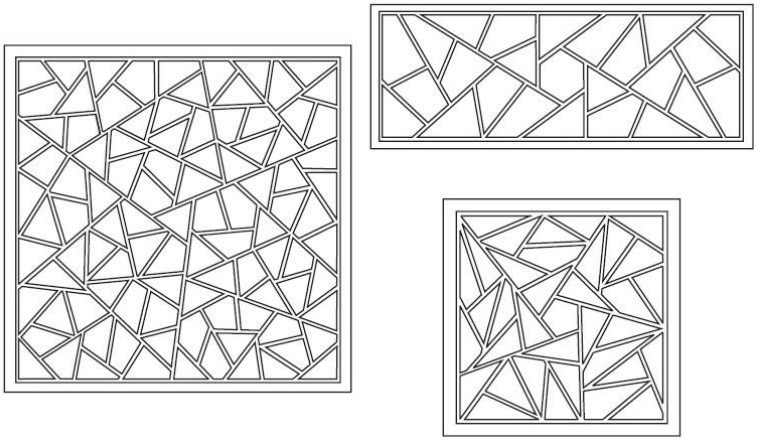


Figure 17: Chinese Ice Rays (Source: Stiny, 1977)

The first rule is that the form used initially, the triangle divided by a line. It waits for a triangle and an irregular rectangle to form after splitting. It also aims to ensure that

the areas of the two shapes formed are close to each other. Apply the second and third rules in irregular rectangles. It aims to produce a triangle and a pentagon with a line dividing the quadrilaterals. Stiny uses the fourth rule from the first three rules in pentagonal rules. Creates a rectangle and pentagon using a line that divides the pentagon. This creates a repeatable set of rules. The fifth rule is related to the dot symbol. Defines the elimination of the dot symbol that has existed since the beginning. The following sequence can be followed to produce a new Chinese ice ray (Figure 18):

- The first rule applies to the rectangle, the starting shape. Thus, two rectangles with areas close to each other are obtained.
- The second rule applies to the resulting shapes. Thus, a triangle, two rectangles and a pentagon are obtained.
- The third rule applies to the pentagon. This process continues and new product is emerging.

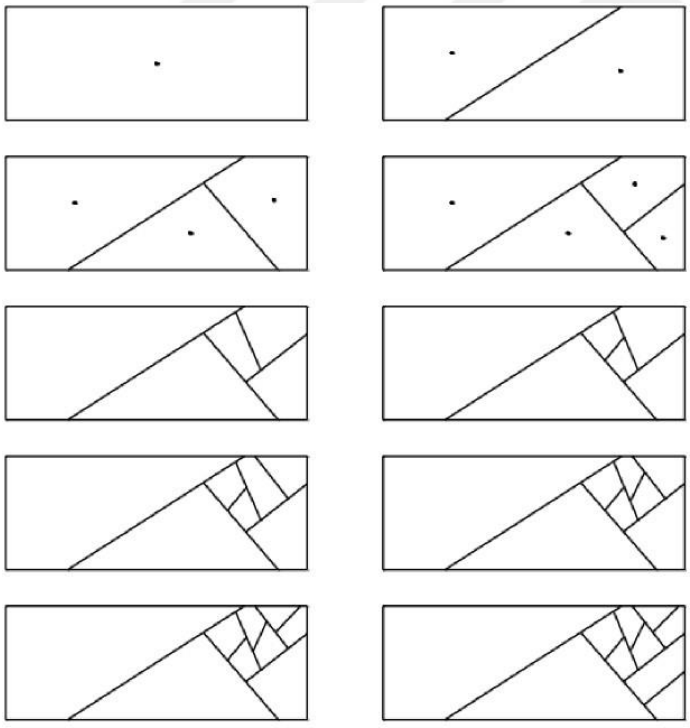


Figure 18: Rules of Chinese Ice Ray (Source: Stiny, 1977)

3.2.2. Stirling and Gowan Leicester Engineering Building

Stirling and Gowan Leicester Engineering Building takes a different approach for SG (Wojtowizc, and Fawcett, 1986). In this structure, the architect designs the composition instead of reproducing the forms. It aims to design completely new forms by creating the SG structure (Figure 19). Stirling and Gowan's Leicester Engineering Building has nine geometric components in its design. Variations of these components lead to many different compositions (Wojtowizc, and Fawcett, 1986). In this case, there is a need for parameters and restrictions that can keep variations under control. Therefore, rules merge. It aims to reach the design closest to expectations with these rules. These rules are as follows:

Rule 1: The heights of the forms create a hierarchy. Higher forms should be placed in sub forms.
Rule 2: Geometric shapes with the same number of surfaces can touch each other.
Rule 3: Axial geometric shapes that make right angles to each other can be woven.
Rule 4: In addition to rule two, geometric shapes with different surface numbers cannot be contacted.

The rule set offers a more limited variation than other SG styles. However, Stirling and Gowan's Leicester Engineering Building is one of the most efficient SG variants as a design technique (Wojtowizc, and Fawcett, 1986).

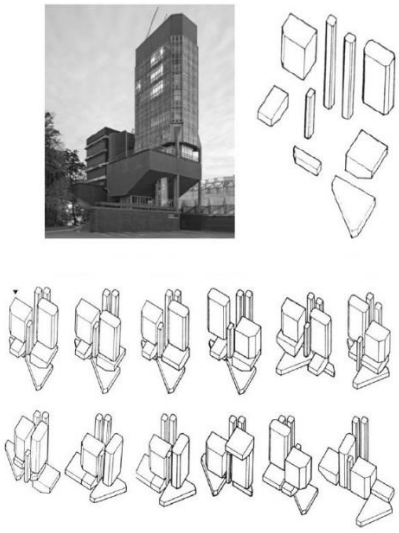


Figure 19: Leicester Engineering Building (Source: Wojtowizc, and Fawcett, 1986)

3.2.3. Palladio's Villas

Architect Andrea Palladio is an important Renaissance architect who lived in the same period as Mimar Sinan. Uses cubic volumes and simple facade designs. The roots of hundreds of thousands of houses, churches and triangular buildings in half columns with symmetrical facades are also based on the designs of Andrea Palladio. It is one of the most imitated architects in history (Güzelci, 2012). Stiny, and Mitchell (1978) are working on the ground floor plans of Andrea Palladio's buildings. They develop SG by analysing the ground floor plans of the villas. One of the most important features of this study is that it is the first research on GH analysis in residential architecture. Each stage determines the rules. Thus stages such as rooms, entrances, doors and windows occur (Figure 20). Palladio's villas identifies a specific part of Stiny and Mitchell's SG study. Since this study focuses on the plan, it does not give information about the facades and partitions. This study provides the classification of the properties, forms and similarities of the villas.

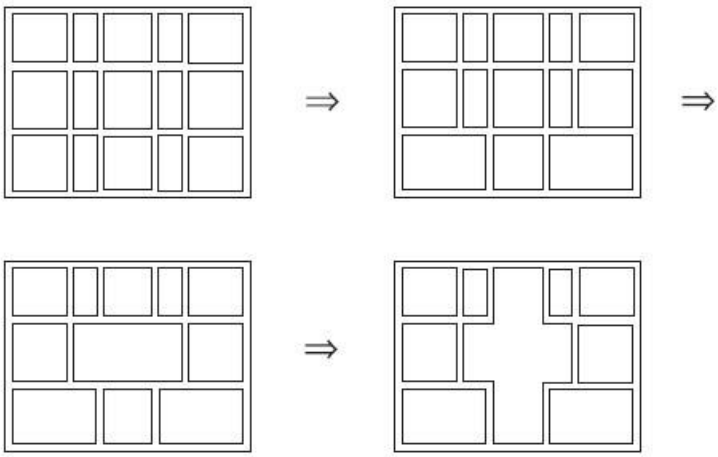


Figure 20: Palladio's Villas (Source: Stiny, and Michael, 1978)

3.2.4. Frank Lloyd Wright's Country Houses

Koning, and Eizenberg (1981) perform SG analysis on country houses which Wright designed. This analysis reveals the rules of country houses and three-dimensional parametric SG forms (Figure 21). In this regard, it aims to reproduce country houses. The study describes the structure of SG by analysing eleven of the country houses. SG uses three-dimensional prisms as its basic form. With Prism, he builds alternative spaces at home.

Koning and Eizenberg produce three new country houses: Stiny, Mitchell and March. These houses include the layout and principles of Wright's huts. However, the formed house forms are different from previous country houses. Thus, Koning and Eizenberg develop a parametric SG that produces Wright's huts. This SG and country house layout can be shown in several variations (Koning, and Eizenberg, 1981).

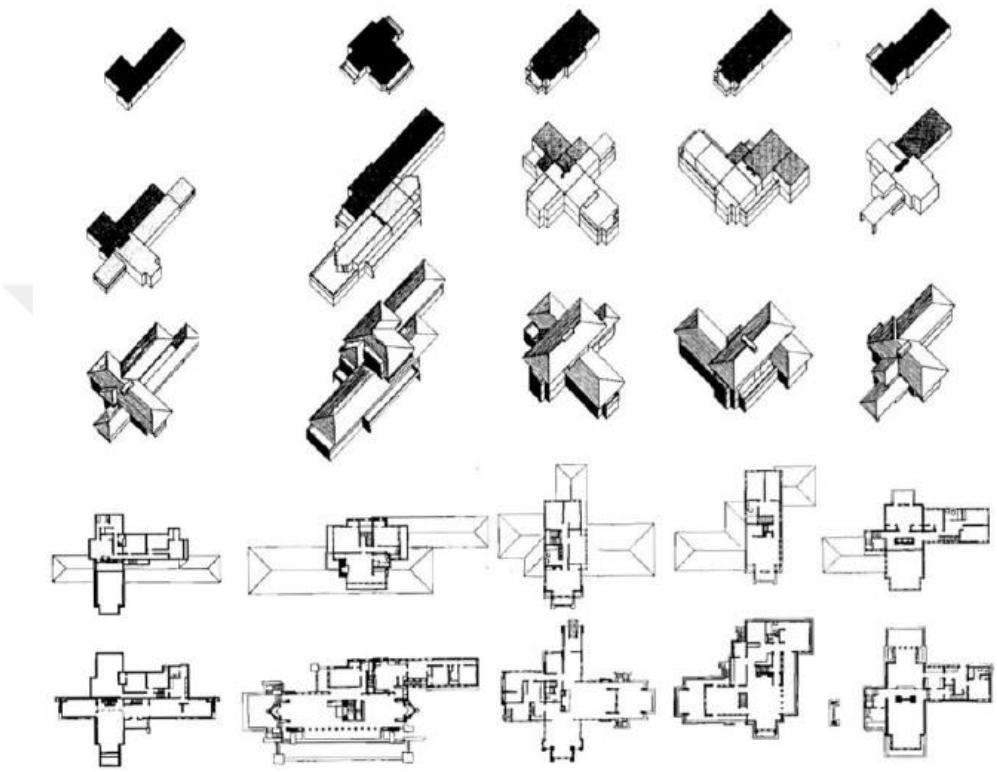


Figure 21: Frank Lloyd Wright's Country Houses (Source: Koning, and Eizenberg, 1981)

3.2.5. Queen Anne Houses

Queen Anne Houses are the productions of a local architectural movement in America. This architectural trend appeared at the end of the nineteenth century. Ulrich Flemming (1987) describes an SG for Queen Anne homes. It aims to analyse the local architectural process between SG and 1880-1910. This study is that it is the first research in which spatial relations moved from the plan to the third dimension. Therefore, SG in the study consists of two stages. The first step is to produce a two-

dimensional plan, as in most SG studies. The second stage is the part where the drawing of plan mapped in a three-dimensional system (Flemming, 1987).

SG products are similar to Queen Anne Houses. The number of variations increases with the use of different geometry and architectural elements (Figure 22). However, the relationship and formation of the houses remain the same. Thus, properties are preserved while alternatives occur with SG.

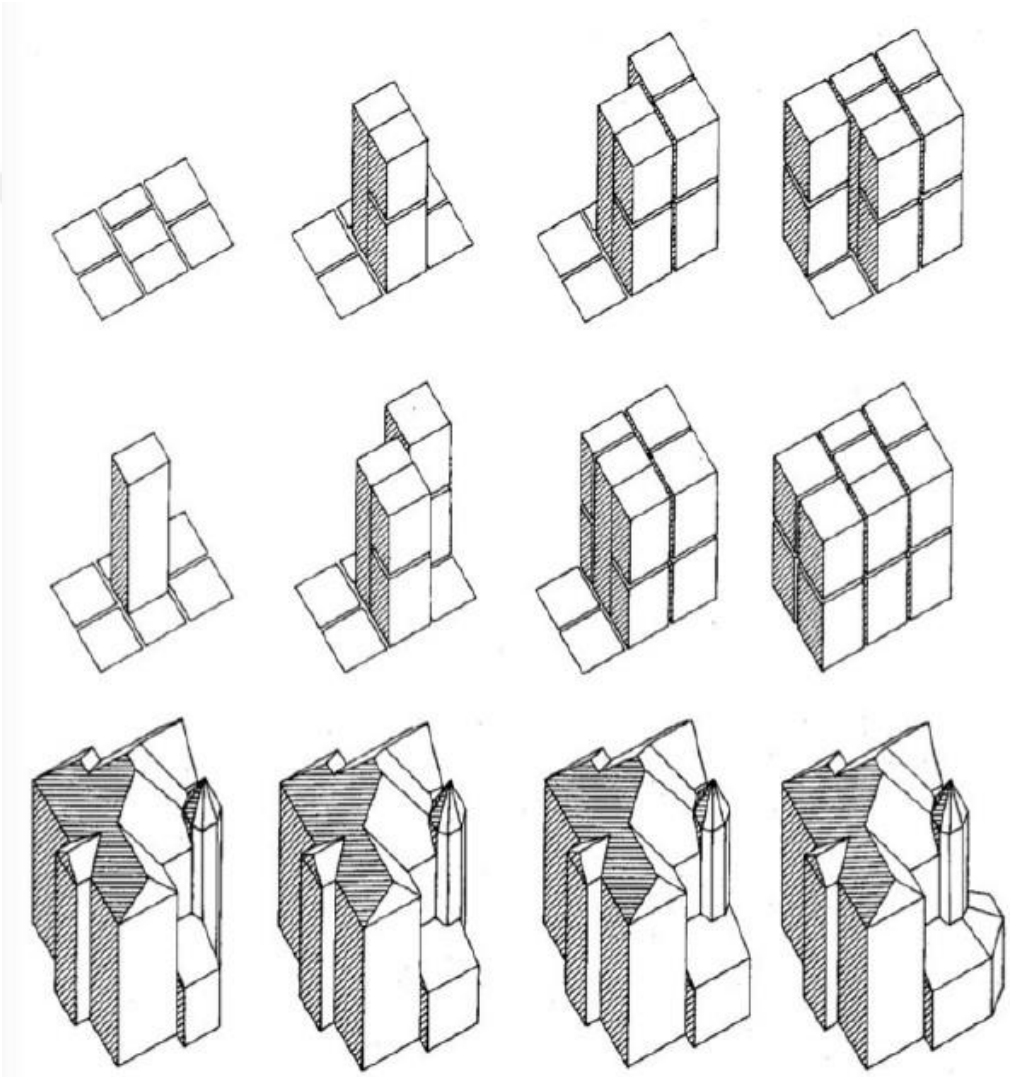


Figure 22: Queen Anne Houses (Source: Flemming, 1987)

3.2.6. Malagueira Houses

Jose Duarte (2019) analyses Malaguiera Houses which Alvaro Siza designed. Converts to program language with specific parameters. It then creates rule sets and produces houses with the same design language (Figure 23). Because the architectural design language is suitable for working with the shape grammar method, Duarte's study is similar to this study.

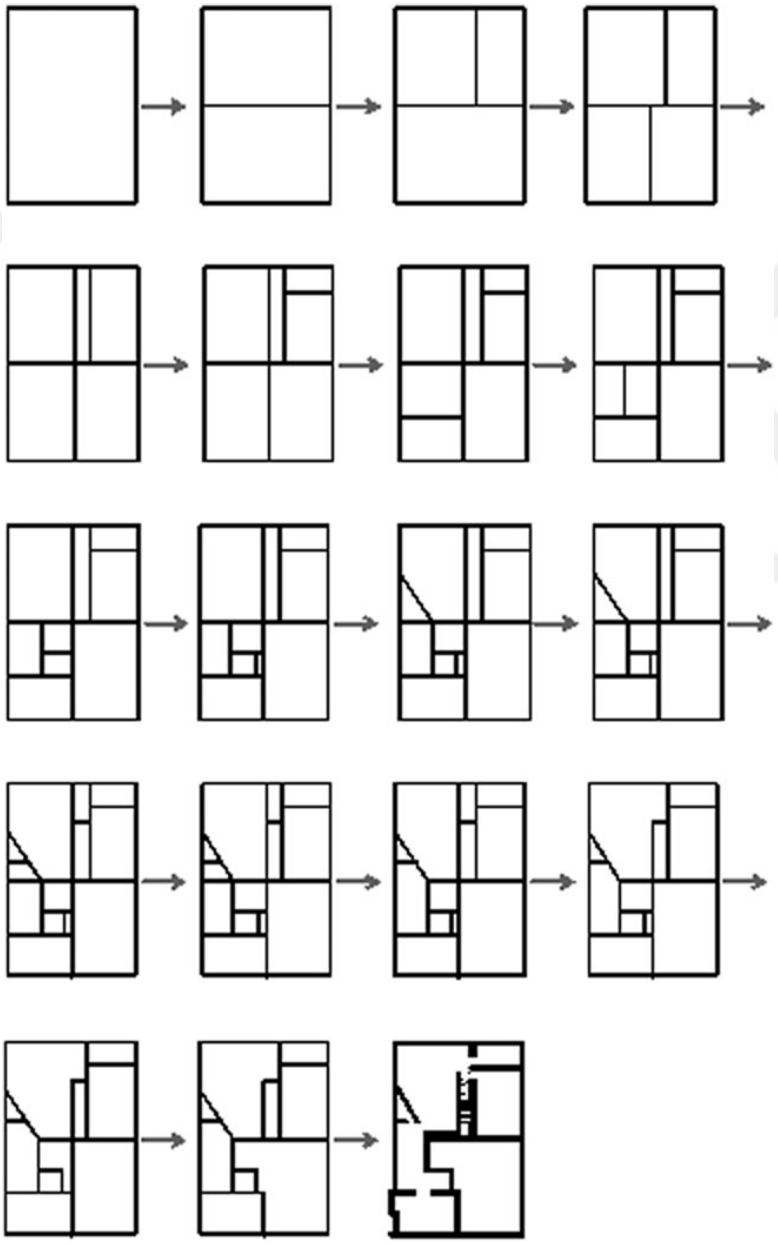


Figure 23: Malagueira Houses (Source: Speller, et al., 2007)

3.3. Shape Grammar in Traditional Turkish House

One of the main works of SG based on Traditional Turkish House (TTH) is the work of Gülen Çağdaş (1996). She analyses the geometric and spatial properties of contemporary TTH. It aims to develop a parametric SG that produces plans for TTH. This analysis is based on Eldem's (1968) plan type classifications. Such plans are; without sofa, outer sofa, inner sofa and middle sofa types. Focusing on Inner and outer sofa plan types, Çağdaş is working on this type of two-dimensional parametric SG.

Çağdaş's TTH study consists of two parts. The first part is the analysis part. She examines two-dimensional parametric SG and TTH plan and shape features and defines the approaches and principles in the formation of plans. It prepares SG rules according to these definitions. In the second part, it produces a plan with SG prepared for TTH. It defines an eight-stage production process that produces internal and external table types using rule diagrams. It checks the stages with the specified parameters. Thus, TTH can produce plan types (Çağdaş, 1996).

Defines the formal and space organization in contemporary, schematic, rule diagrams, parametric SG and TTH plans. These rule charts convert TTH's features, principles, and approach into analytical data. Thus, TTH acquires a definable, repeatable and applicable design language (Çağdaş, 1996).

Güzelci (2012) made a shape grammar study on Amasya Yalıboyu Houses. In this work, he adds to the rule sets of Çağdaş and creates his own shape grammar method. It works on twenty houses and defines an eleven-stage rule set (Figure 24). The first eight of these rule sets belong to Çağdaş.

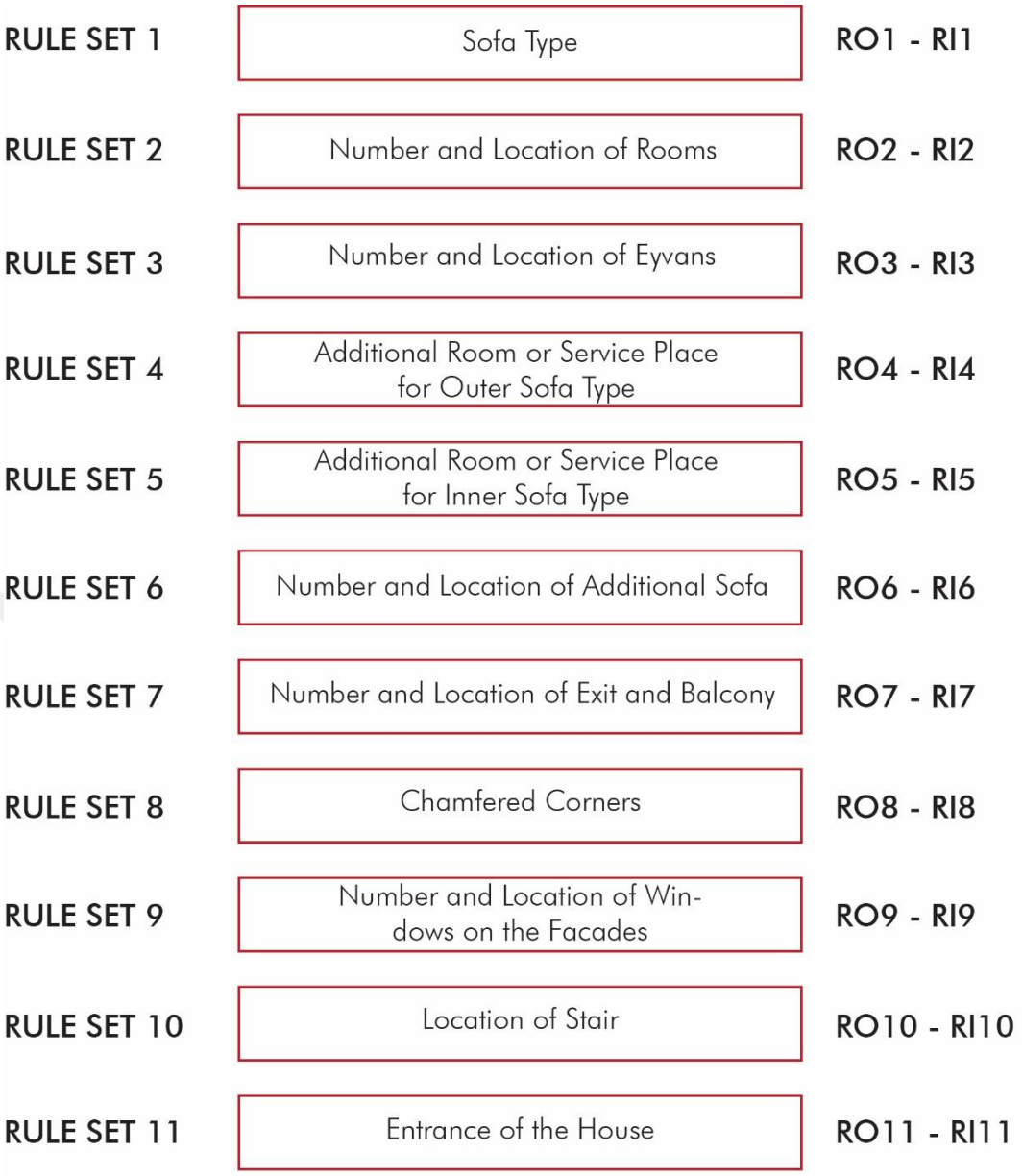


Figure 24: Rule Sets of Traditional Turkish House

Rule Set 1: Determination and positioning of sofa type.

Rule Set 2: Determination and positioning of the number of rooms.

Rule Set 3: Checking whether there is an eyvan, determining the number and place.

Rule Set 4: Checking whether there is an additional room or service place in the type of outer sofa plan, if available, determining the number and location.

Rule Set 5: Checking whether there are additional rooms in plan type with inner sofa.

Rule Set 6: Checking whether there is an additional sofa, determining the number and place.

Rule Set 7: Control of exit and balconies and determination of their location.

Rule Set 8: Checking for chamfered corners.
Rule Set 9: Determining the type, number and location of windows on the facades facing the river.
Rule Set 10: Checking whether there are stairs, determining the type and location.
Rule Set 11: It is in the form of determining the way of entering the house.

Çolakoğlu (2001) examines the traditional residence type Hayat Evi. This type of house is in the classical Ottoman style in Sarajevo, in the eighteenth and nineteenth centuries. *Hayat* is the central element in the space organization of homes in this study. This element is in contact with the garden and controls the transmission of sunlight to the spaces. Çolakoğlu's study has a design strategy for shapes. She aims to produce new Hayat House plan types by using shape grammar. This production consists of four stages. In the first stage, she analyses the Hayat House and she defines the smallest unit of the space organization. In the second stage, she produces the primitive house from this unit. In the third stage, she determines the house types and types with the variations of the shape grammar. She chooses between the variations that occur in the fourth stage and improves the chosen house. In the production process of Hayat House, Çolakoğlu uses shape grammar to create certain parts of the form. It develops the rules accordingly. After determining the rules, it creates new plan types by repeating the rule sets.

The calculation processes used in this study are based on Çolakoğlu's Hayat House study (2001). She uses a shape grammar to produce the primitive types of homes in Sarajevo, identified as the Hayat House. The process is as follows. First, the primitive Hayat house uses a number of existing designs to define rules (Çolakoğlu, 2001). It produces three primitive life house types A1, A2 and A3. One of these types is a house type located in the center of the living space on both floors. Çolakoğlu chooses A1 to increase detail. It applies the production principles of the shape grammar and generates the subtype of A1. Sub A1 variations then develop with different rules and parameters. Thus, the variation reaches maturity.

Dinçer, and Tong (2014) work on the concept of mass housing. The study makes the definition of mass housing as a large-scale and dynamic environment where the individual and social needs of different users are met. He argues that the mass housing productions made so far did not meet this definition due to parameters such as mass production and standardization. It draws attention to deficiencies in the design process. As a solution to this, it specifies the concept of mass personalization. This is a process and enables users to participate. According to Pine (1993), functionality depends on computer aided design. As knowledge in digital technology increases, its use in architecture becomes widespread. Thus, the use of mass customization increases. Adaptive customization, collaborative customization, transparent customization and cosmetic customization are examined in four groups. Adaptive customization is suitable for mass housing designs (Niemeijer, et al., 2010). This model, in which production is standardized, gives users the right to choose and change. This work develops within this model.

Cellular Automata (CA) is a group of cells that occur over time by rules about local neighbourhoods in a particular grid system (Wolfram, 1984). There is an evaluation in studies such as urban design, zoning and building masses where neighbourhood relations can simulate social effects (Singh, and Gu, 2012). Dinçer et al. (2014) develops a digital tool that evaluates user preferences with CA in mass housing and produces alternative housing plans and facade designs according to this information. The purpose of this tool is to support decisions taken in conjunction with traditional design processes. Determines the design of the housing type according to the user input. CA manages the design criteria of residential blocks, spatial units and facade elements and offers alternatives.

The method followed by the scope of the study is similar to the rules and sets of rules in the shape grammar study by Çağdaş (1996). The aim of the study of Çağdaş is to present a parametric shape of grammar for the language of TTH. It defines the common aspects of the houses and states that the components form a parametric shape grammar. The shape rule scheme he created according to TTH characterizes the formal composition aspects of historical buildings (Çağdaş, 1996).

Çağdaş works on Turkish House plan types defined by Sedad Hakkı Eldem (1968). It offers analyses that define the word elements and space organization of these houses. Eldem (1968) says the following about the properties of Turkish Houses; all these types have common features, which are always present in every example. The most important of these features is the plan of the house. This determination is the starting point of Gülen Çağdaş.

As explained in TTH in the second part of the thesis; it is usually a single storey. Although there is more than one floor, the main floor is always unique. When the number of floors increases, users use the ground floor for auxiliary functions. In cases where there is a mezzanine floor between the ground floor and the first floor, the mezzanine floor is used for shelter. In his contemporary work, he considers the main floor plan. Important elements of the main floor are rooms, sofas and stairs (Eldem, 1968). It ignores some details of the house plan to facilitate shape grammar definitions. Therefore, it shows the spaces as polygons in the plan layout (Çağdaş, 1996).

Çağdaş (1996) takes the types of Eldem as basis while preparing the rule sets (Figure 25). She defines rule sets according to the types of plan without plan, outer or inner and central plan. Without sofa plan type is the most basic type of TTH. It consists of rooms on top of each other and a circulation area in front of it. This area is in the form of a balcony. In the outer sofa plan type, there is a connection space between the rooms. This covered place is actually open. As the construction techniques and economic situation get stronger, they will be covered. In some plan types, there are recesses called eyvan between the rooms. Some types have kiosks as an add-on at the ends of the rooms. Çağdaş (1996) adds the eyvan and kiosk elements, it is formed in the shape of L and U. Inner sofa plan type is the improved version of outer sofa plan type. Both sides of the sofa are surrounded by rooms. In the Middle sofa plan type, all sides of the sofa are covered with rooms. It can be oval or spherical. Between the rows of rooms there is an eyvan. Plan variations occur with the number and location of the eyvan.

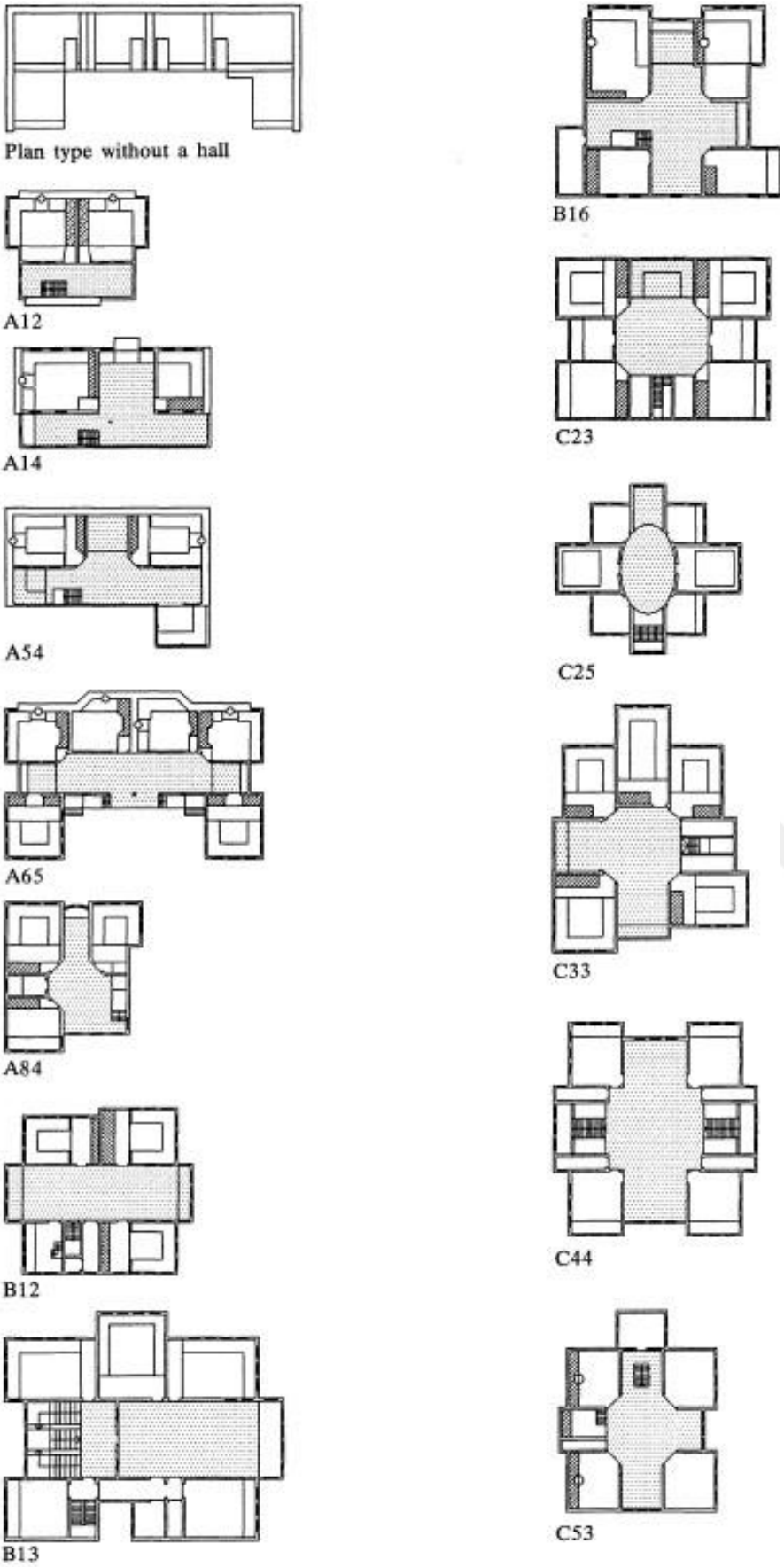


Figure 25: Some plans of Traditional Turkish Houses (Source: Eldem, 1984)

Çağdaş (1996) prepares a grid in his work to define the rule sets and guide the production process. She defines the spatial relationships between shape grammar rule sets and grammatical word elements. In these rule sets, the topological configurations of the blocks are placed on the grid to be determined. Afterwards, the rules are applied sequentially according to their characteristics and form the plan types. Contemporary defines the parametric shape grammar according to these rule sets.

Another reason for the study to be defined on the grid is to prevent spaces from intermingling. Borders are needed in order not to weaken the relations between the spaces during the organization of the space. Grid provides control of spaces and represents spatial relationships (Figure 26).

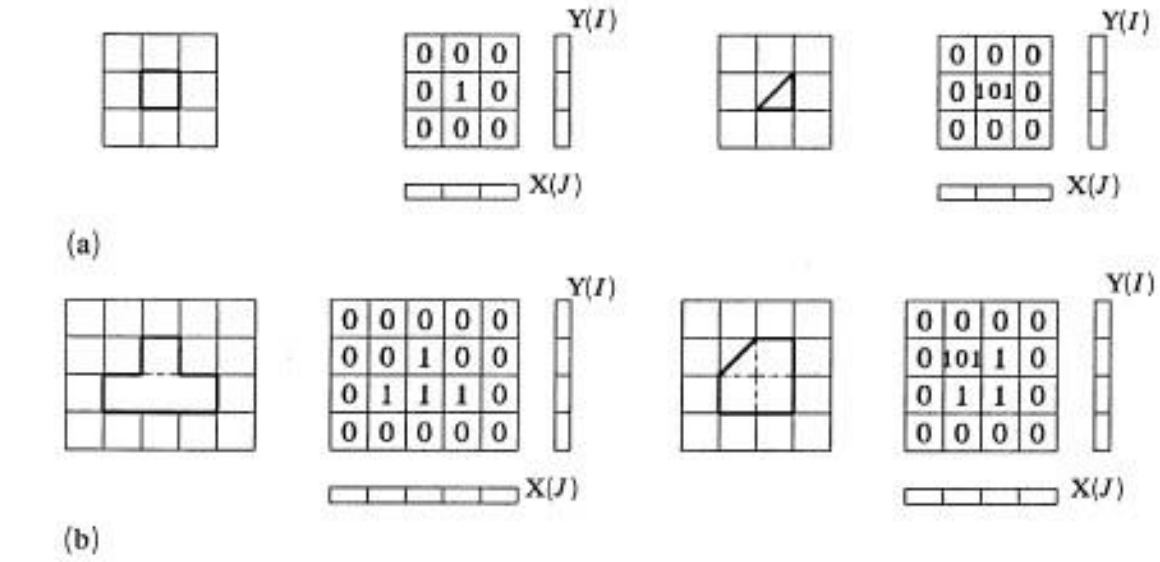


Figure 26: (a) Polygons, and (b) Topological configuration of subshapes in polygons (Source: Çağdaş, 1996)

In the TTH study, the first shape of the grammar is a labelled point (K) placed in a coordinate system. The production process begins with the sofa represented by a shape whose upper-left corner corresponds to point K and progresses by applying the shape rule scheme. The main word elements in this shape grammar are rooms and sofas with special extensions. According to Stiny, two-dimensional shape grammars can be used in plan compositions (Stiny, and Gips, 1972). The vocabulary elements in this grammar are determined as blocks that define the locations in TTH.

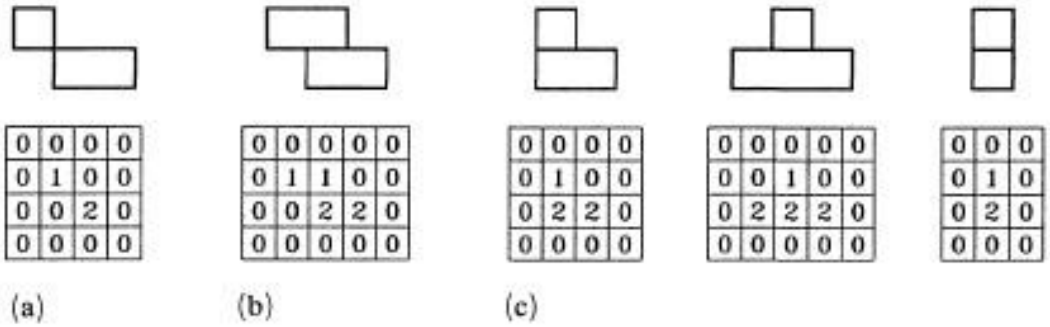


Figure 27: Spatial relations between spaces: (a) corner relations, (b) partial relations, (c) complete relations (Source: Çağdaş, 1996)

The grid system defines the blocks and spatial relationships that make up the specified grammar (Figure 27). Thus, it becomes easy to interfere with the computer. Information must be symbolically and graphically defined for representation. Graphical and abstract definitions of word elements can be combined with the grid system. Thus, it can examine the blocks symbolically via the coordinate system. The first element of the grid is the upper left corner of the coordinate system and the last element is the lower right corner. Grid elements are integers.

Çağdaş (1996) defines two sets of rules for the TTH shape grammar.

- Rule sets of plan types with outer sofas (Ron)
- Rule sets of plan types with internal sofas (RIn)

Çağdaş (1996) defines the first rules (RO1, RI1) of both groups as the initial rule. The upper left corner of the shape grammar rule schema, which specifies the first rule, is the first form consisting of the K point. The (x1, y1) coordinates belong to this point. The right side of this scheme consists of a parameter polygon with a corner at points (x1, y1), (x2, y2), (x3, y3) and (x4, y4) and point O. After applying the first rule, the label K and O changes. Thus, the first rule is not applied again. RO1 and RI1 rule sets shape the core of the plans and define the starting shape with the sofa labelled H (Çağdaş, 1996).

RO2 and RI2 rule sets define the rooms around the sofa. The first rules of these sets (RO21 and RI21) show the exact relationships between the sofas and rooms. For example, in these rules, sofa length and room length are equal. These shape rule charts refer to plan types, each of which has room. RO22 and RI22 rules show the exact relationships between rooms and sofas aligned to one side. RO23 and RI23 rules additionally show full relationships, except for harmonization relations between sofas and rooms. The shape grammar uses these shape grammar rules iteratively to create plan types with increased sofa length and multiple rooms, as in the rules of RO22, RO23 and RI22, RI23. These shape rules add rooms to one or both sides of the sofa. Sofa length also increases in line with this change. The tag in the figures to the right of this rule diagram defines the letter M, the termination of the process with the letter F, or the continuation of the process with the letter O. For example, if the shape is marked with the letter F, the room insertion rule does not apply. If the shape is labelled with the letter O, the room addition rule is applied (Çağdaş, 1996).

RO31, RO32, RI31, RI32 rules position eyvan in the corner, RO33, RO34, RI33, RI34 rules eyvan consecutively between the rooms. When these rules come into effect, they mark the table with the HE tags. Rule sets RO4 and RI4 position the additional sofa (SH) in front of the predetermined room. When these rules come into effect, they mark the sofa with the HS tag. RO51 rule defines the kiosk (K) on the sofa and RO52 rule defines the kiosk (PK) foreseen on the sofa. If the user wants a kiosk on both ends of the page, it applies RO51 and RO52 rules twice. RI61 rule defines the lower room (SR) at one end of the sofa (Çağdaş, 1996).

RO71, RO72 and RI71, RI72 rules add division in front of a room or eyvan. The protruding rooms produced by these rules are marked with the R label and the eyvan with the E1 label. RO73, RO74, RI73, RI74 add the rules next to the corner room. RO75, RO76, RI75, RI76 rules add the partition both to the side of the corner room and to the front. Expanding rooms with RO73, RO74, RI73, RI74 rules are marked with the R2 tag. The rooms expanding with RO75, RO76, RI75, RI76 rules are marked with the R3 tag.

RO8 and RI8 rule sets define rooms with bent corners. RO81, RO82, RI81, RI82 rules in these rule sets show the bent corners of the rooms on one or both sides of the

additional sofa. RO83, RO84, RI83, RI84 rules show the bent corners of rooms located on one or both sides of an eyvan, respectively. RO85 and RI85 show the bent corners of the rooms between the additional sofa and the kiosk. RO86, RI86 rules define bent corners of rooms located on the edge of an eyvan and a kiosk. Rooms with bent walls are marked with RC tag and sofa with HC tag.

Contemporary indicates the choice of sofa type as the starting point of the design. Rule sets develop around the sofa that determines the type of plan. It produces TTH plan layouts and space organizations in eight stages.

- Selecting and placing the sofa type
- To determine the number and layout of the rooms.
- To determine the number and settlement of the eyvan.
- If there is an additional sofa, to determine the number and placement.
- Determining the number and placement of kiosks.
- Checking the presence of the lower room.
- Determining the number and placement, if any, of the compartment.
- If there are bent corners, determine the number and placement.

As a result, the parametric shape grammar in the study of Çağdaş explains the formal rule schemes and the formal organizations of the main floor plans in TTH. Its grammatical structure is from the bottom up and contains plan elements such as sofa, room, eyvan, kiosk, and lower room. Since the sofa type determines the plan type of the house, the polygon representing the table is the first shape of the grammar. This parametric shape grammar has a productive structure. By combining multiple plan types, it can obtain plan layouts such as mansion and palace.

3.4. Shape Grammar in Traditional Buca Houses

The thesis makes a shape grammar study in the Buca House case. The language used by Sedad Hakkı Eldem (1968) for TTH is the architectural language of this study. Working defines Buca House as the subset of the TTH cluster. Erpi (1987) and Akkurt (2004) work with the plan elements, plan types and space organizations of Buca

Houses. Unlike the Buca House title in the second part of the thesis, this section describes the types of plan with a grammatical perspective. The thesis classifies Buca Houses under two main titles as local Buca Houses and Levantine Mansions. The New Buca House shape grammar developed in this study is based on the layout of the local Buca Houses. Some details of house plans are ignored to simplify the definition of grammar. Defines work plan items as sofa, room, eyvan, kiosk and stair sections.

3.4.1. Local Buca Houses

The local Buca House is usually a single storey. The ground floor is eighty centimetres to one hundred centimetres higher than the garden level. In cases where there is a basement under the ground floor, the basement is for storage. However, depending on the topography features, there may also be living spaces in the basement. In such examples, the basement entrance is not inside the building. It is provided from another entrance at the lower level than the ground floor entrance (Erpi, 1987).

The study focuses on the main floor plan while examining the types of plans. The main floor is the ground floor in the local Buca House. The main element of the space organization on the ground floor is the sofa. The entrance is at the end of the sofa. The rooms are lined up around the sofa. Turkish House is similar to the space organization.

3.4.2. Levantine Mansions

Levantine Mansions differ from the local Buca House in architectural style and material. The local Buca houses generally have single floors. And it is located in a crowded urban texture. Each of them is like an element forming the texture. However, Levantine Mansions are located in large gardens as a single building. They are generally positioned as periphery of urban texture. It has two or three floors and has a mezzanine floor (Akkurt, 2004).

The study focuses on the main floor plan while examining the plans in Levantine Mansions. In this type of house, the main floor is the ground floor. The main element of the organization of the space is the sofa. The entrance and rooms are lined up around the sofa. Traditional Turkish House is similar to the space organization (Erpi, 1987).

Since there are larger houses than the local Buca House, the number of items in the organization of the space is also higher. The study focuses on sofa, entrance, room and vertical circulation elements. Therefore, the organization of the place simplifies in the analysis schemes.

3.5. Shape Grammar in TOKI House

The study adapts the local Buca House plan type to the standards of modern life. It focuses on the space dimensions of TOKI Houses. Thus, it obtains places suitable for the needs of modern life. The reason for this study to make this analysis from TOKI houses is that the optimum space dimensions in accordance with today's living standards are in TOKI plans. The local Buca House user and TOKI user are similar in economic level. Thus, TOKI parameters are useful for the New Buca House plan.

TOKİ houses are in the form of duplicate apartment plans in a multi-storey apartment. In the house plan, the space organization is the rooms that settle around the corridor. This type of residence, which differs from the traditional Turkish House, is similar to the mass housing projects developed in modern years. The sofa in the Traditional Turkish House leaves its place in the hallway in this plan. TOKI's house uses the living room for activities such as sitting, gathering, dining on the sofa. In the new Buca House plan, the sofa is included in the plan again and adapts to the Traditional Turkish House plan type. While the study creates the space organization charts, TOKI makes its revisions as the final stage according to the space dimensions.

3.6. Discussion

Shape grammar provides the identification of undefined areas in the design process by putting rules and defining them, and the method of producing new units using these definitions. The main philosophy of the shape grammar is that the whole is something different from the sum of the parts (Aksoy, 2001). What sets this difference is the rule sets. Production results that do not comply with the rule sets are worthless to the designer. It is the ones that are suitable for development of variations that reproduce in accordance with the precious rules. The examples examined in this section are the studies of people who lead the shape grammars in the literature.

The study explains how the shape grammar emerged and the examples used in the Traditional Turkish House after explaining its examples in the literature. The study prepares the fourth chapter of the thesis with this explanation. Defines rule sets and shape grammar method prepared by Çağdaş (1996). Thus, New Buca House also defines the basis of shape grammar rule sets used in plan adaptation. The study makes definitions about the space organizations of the local Buca House and Levantine Mansions. Thus, it determines the space organizations desired to be achieved in the plan adaptation.

In this section, the study explains why TOKI houses are examined in order to obtain the parameters of space dimensions suitable for modern life. This review defines the dimension revision, which is the last stage of plan adaptation. After these definitions and literature review, the plan adaptation study that is suitable for modern life but has a traditional space organization begins.

CHAPTER 4: NEW BUCA HOUSE PROJECT

The project aims to produce New Buca House (NBH), which can be adapted to the mass housing plans according to the local Buca House plan type and shape grammar. The study defines the shape grammar and rule sets for the local Buca House. This section describes these grammar and rule sets (Figure 28). The analysis section examines the work of the local Buca House in the literature. It prepares the shape grammar rule sets used in the production stage according to these analysed houses. NBH plan layouts emerge with shape grammar rule sets prepared and developed in the final of the section. The study revises the space area measurements in the plans according to the measurements in TOKI plans. Thus, it obtains plan types equivalent to the flats that can be used in normal floor plans in mass housing projects.

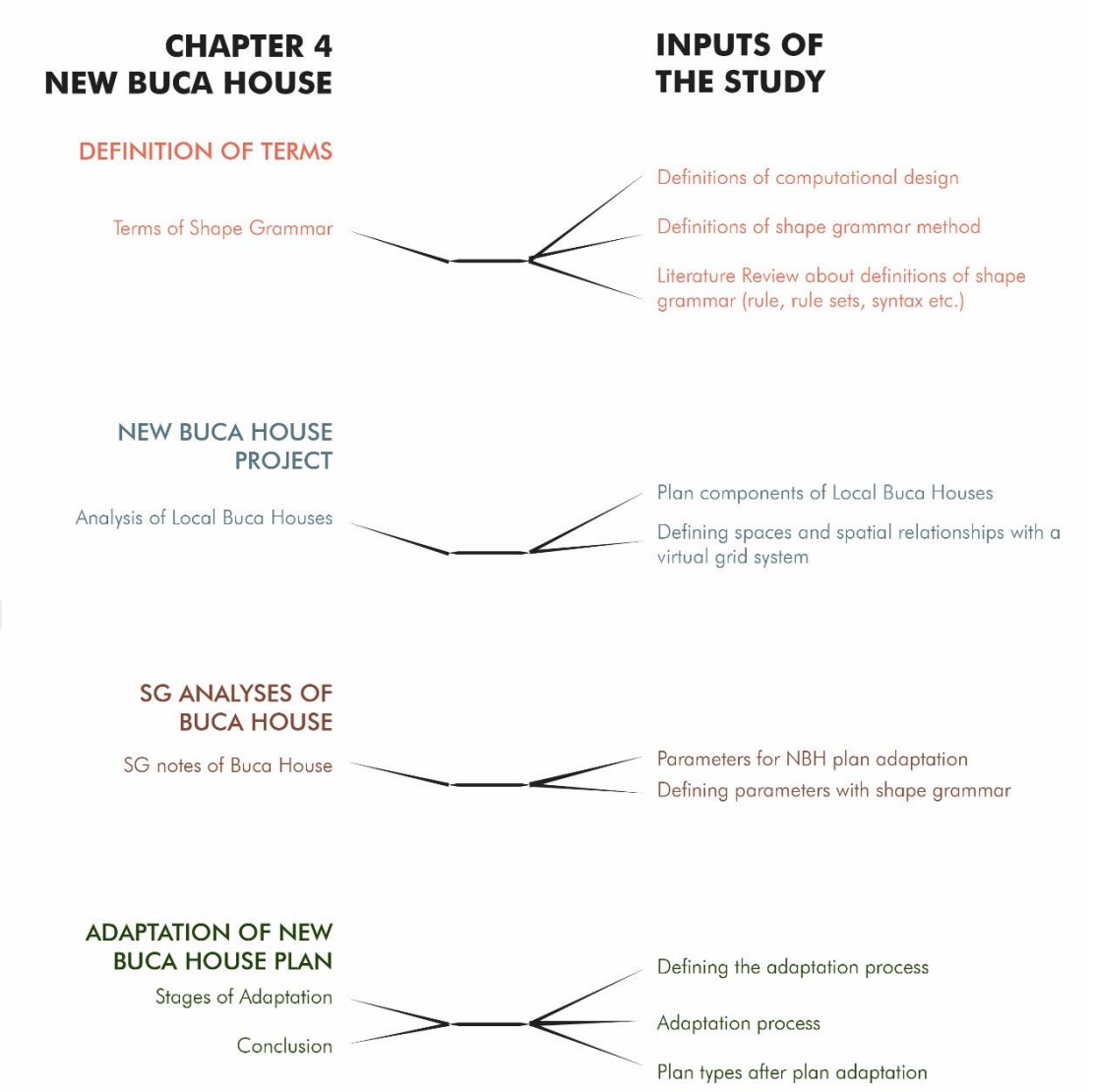


Figure 28: The Study Diagram of Chapter 4

4.1. New Buca House

As explained in the housing section of the thesis, the local Buca Houses show similar typological features with the TTH architecture. It is the basic element of the local urban texture of Buca (Erpi, 1985). The study analyses the local Buca Houses with the shape grammar rule sets developed by Çağdaş (1996). Due to differences in plan layouts, the study redefines some sets of rules.

Çağdaş (1996) works on the shape grammar study on the plan of the main living level of TTH. The NBH project aims to solve basic spaces in a single storey plan type. For

this reason, it focuses on single floors from the local Buca Houses. Thus, the project can create houses suitable for today's conditions.

The main elements in the space organization of TBH; entrance, sofa, room, additional room and additional sofa. The study analyses the spatial organizations of the houses chosen after the literature review. This analysis focuses on the main floor plan of the house. It shows the relations of the elements that make up the main floor plan with each other and with the sofa on a diagram. In the next stage, the study defines the rules and rule sets for producing the main elements in TBH, as in Çağdaş's (1996) study. This explains the rule sets for working as pseudo code. The study shows the implementation of the rule sets in stages. Thus, it clearly defines the production of the new plan type. It compares the new plan type that emerged at the last stage with the plan type of the sample house and evaluates the similarity. The study concludes that if the space organization and plan type are similar, the shape grammar method is successful.

4.1.1. Analysis of the Traditional Buca Houses

Çağdaş (1996) determines the rule sets at the first stage in the TTH analysis. In these rule sets, it divides the plan types into two groups as inner sofa and outer sofa. The first rule of both plan types is the starting rule that determines the plan type. The starting form (A) is located in the input section of the rule and its coordinates are defined as (x1, y1). The coordinates (x1, y1), (x2, y2), (x3, y3), (x4, y4) defines the polygon labelled O with the output section of the rule. The first set of rules is applied. Then point A becomes point O. Thus, the first set of rules cannot be repeated (Çağdaş, 1996).

TBH mostly have examples of inner sofa plan type. But this study also defines rule sets for outer sofa plan type examples. After applying the first rule, there is a selection for rule sets (IR) suitable for inner sofa plan type and rule sets (OR) suitable for outer sofa plan type (Figure 29).

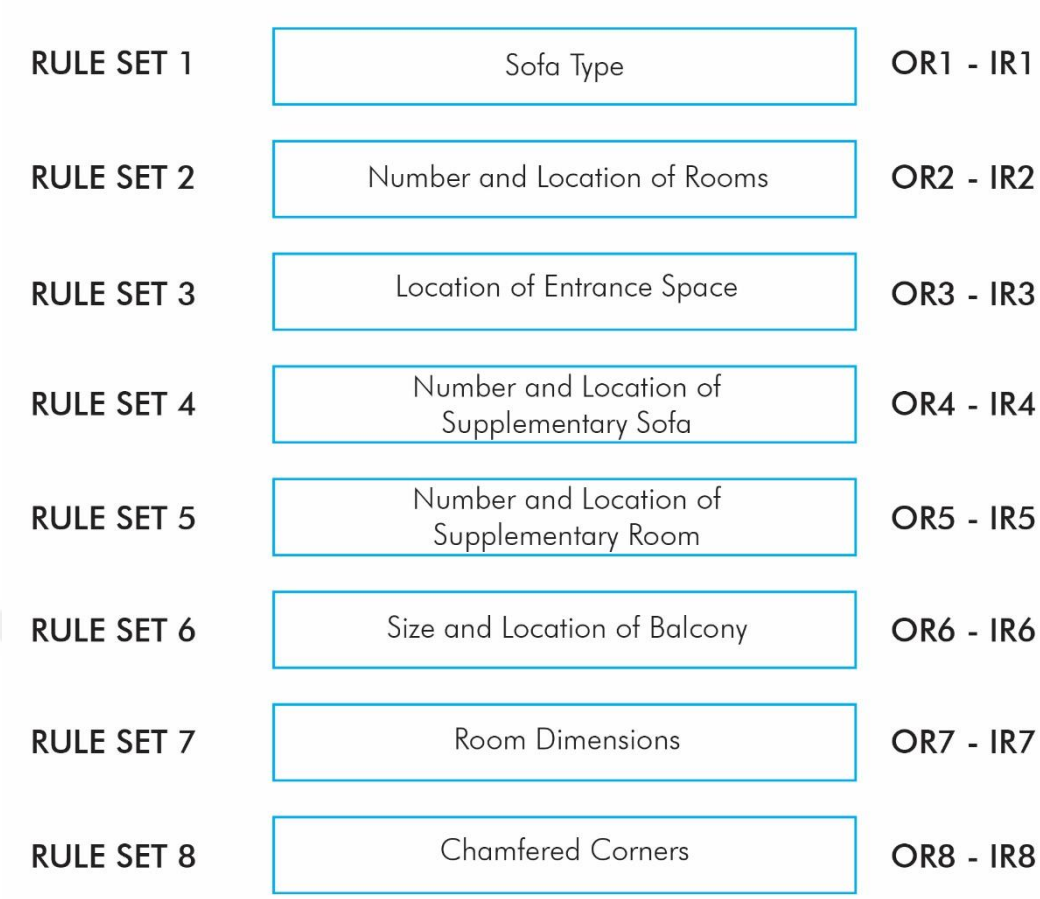


Figure 29: Rule Sets of New Buca House Project

As in the study of Çağdaş, the first set of rules defines the sofa type. In the next step, the study sets up the rule sets to define the relationships between the auxiliary spaces and space organization. It defines the number of rooms, room types and space organization around the sofa with the second set of rules. The study labels this ruleset as IR2 in inner sofa plan type and OR2 in outer sofa plan type. Rule sets specify variations in their subheadings in the fourth digit of the tag. For example, the study affects the first variation of the second rule in the outer table plan type as OR21. The value in the fourth digit is the variation value. As the variation value increases, the number of rooms and the relationship of the rooms with the sofa changes.

In Çağdaş's study (1996), the various values of the second rule sets are defined as 1, 2, and 3. Variation numbers 1, 2, 3 increase the number of rooms and determine the placement of the rooms. These variation values are common in inner sofa and outer sofa plan types.

The third rule sets are related to the eyvan in TTH. Defines the placement, size and relationship of the eyvan with the sofa (Çağdaş, 1996). The study uses the entrance space in TBH instead of eyvan. It takes this revision into account when defining and applying third rule sets. The entrance in the local Buca House is one of the important places that define the house. It plays a role in determining the house types and shaping the local housing texture. The third rule sets show the placement of the entrance space in inner sofa plan type and outer sofa plan type and its relationship with the sofa.

In the inner sofa plan type and outer sofa plan type, the rule defining that the sofa is related to the entrance is IR31 and OR31. IR31, IR32, OR31 and OR32 rules place the entry in the corner of the row of rooms. IR33, IR34, OR33 and OR34 rules place the entrance between the rows of rooms on the back of the house.

The fourth rule sets are related to the additional sofa (Çağdaş, 1996). This rule positions additional sofa between rooms. Thus, it helps to expand sofa and increase the variety of plan types. IR41 and OR41 rules add a half-unit sofa extension about the sofa. IR42 and OR42 rules add full unit sofa extension about the sofa.

The fifth rule sets relate to the additional space added to the sofa (Çağdaş, 1996). This rule places additional space in the sofa area. Thus, the sofa area reduces. The total area of the rooms increases. IR51 and OR51 rules add a half unit additional space to the sofa space. IR52 and OR52 rules add a full unit additional space to the sofa space.

One of the common points of TTH and TBH is bay window. Sixth rule sets are used to determine the location and size of the protrusions (Çağdaş, 1996). IR61 and OR61 rules add a half-unit bounce associated with the sofa. IR62 and OR62 rules add a half unit overhang associated with room spaces.

The seventh rule sets are the rules that determine the dimensions of the rooms (Çağdaş, 1996). It adds a division to the rooms by the spatial features of the rooms and the needs program. IR71, IR72, OR71 and OR72 rules add partitions to the back or front of corner rooms. IR73, IR73, OR73 and OR74 rules add partitions next to corner rooms. IR75, IR76, OR75, and OR76 rules add partitions both to the side of the rooms and to

the front. The study uses these rules when determining the dimensions of the space. Thus, it reaches the desired dimensions.

The eighth rule sets ensure that the corner points in the sofa are bent at an angle of fourty five degrees. This geometry, which is common in TTH, is obtained by the eighth rule set (Çağdaş, 1996). IR81, IR82, OR81 and OR82 rules show the bent corners of the rooms on one or both sides of the annexe. IR83, IR84, OR83 and OR84 rules show the bent corners of the rooms on one or both sides of the entrance. IR85, IR86, OR85 and OR86 rules show the bent corners of the rooms between the entrance, the additional sofa and the additional space.

Çağdaş (1996) shows the rule sets in two separate tables on the matrix as inner sofa (Figure 30) and outer sofa (Figure 31) types.

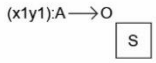
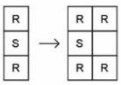
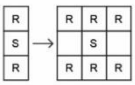
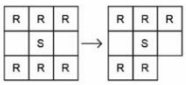
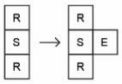
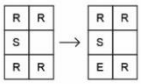
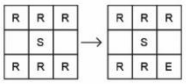
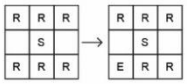
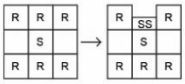
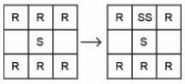
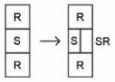
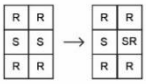
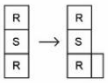
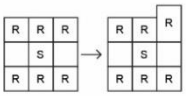
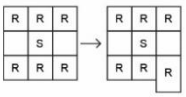
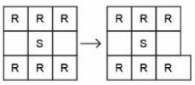
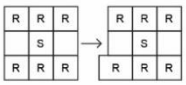
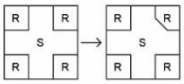
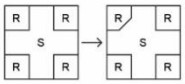
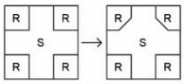
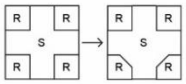
INNER SOFA RULE SETS	VARIATION 1	VARIATION 2	VARIATION 3	VARIATION 4
RULE SET 1				
RULE SET 2				
RULE SET 3				
RULE SET 4				
RULE SET 5				
RULE SET 6				
RULE SET 7				
RULE SET 8				

Figure 30: Rule Sets Scheme of Inner Sofa

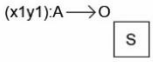
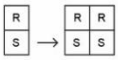
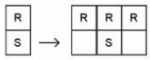
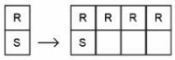
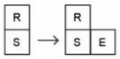
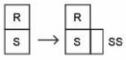
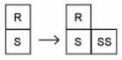
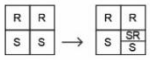
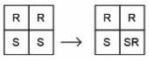
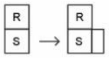
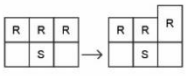
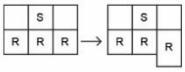
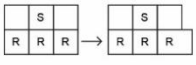
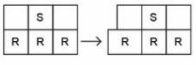
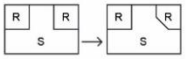
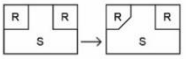
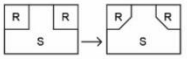
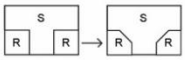
OUTER SOFA RULE SETS	VARIATION 1	VARIATION 2	VARIATION 3	VARIATION 4
RULE SET 1				
RULE SET 2				
RULE SET 3				
RULE SET 4				
RULE SET 5				
RULE SET 6				
RULE SET 7				
RULE SET 8				

Figure 31: Rule Sets Scheme of Outer Sofa

4.2. Shape Grammar Analysis of the Traditional Buca House

The NBH project revises the shape grammar rules defined by Çağdaş (1996). The study analyses the plans of eleven houses with the shape grammar method by using the information of TBH, which have been previously studied on different topics in the literature (Figure 32-42). It shows these analyses as work output. In the analysed samples, the main floor is considered as the ground floor. Thus, it performs space organization and shape grammar analysis only on the ground floor. The study prepares space organization charts to define the relations between spaces in the plan layout. This diagram shows the hierarchical status and connection points between the elements in the space organization. When the study examines the common properties of the analysis outputs, the parameters for NBH plan production reveal.

- The entrance area is above the garden or road level. It is recessed into the house.
- Sofa, as in TTH, is the central element of the space organization. The plan is formed around the sofa.
- According to the classification of plan types, inner sofa plan type is more common in TBH. Due to the small size of the plots and crowded urban texture, the outer sofa is useless.
- The entrance space is at the starting point of the sofa.
- Plan geometry often includes 90-degree angles.
- Since the ground floor is designed as a raised floor, there is a basement usage where the land is suitable. The basement floor is a valuable place for home users.
- The connection between the rooms is through the sofa.
- The main circulation elements such as the entrance area and stairs are on the sofa.

When the study examines the common features and implications of plan types, the necessary parameters for NBH plan production reveal. The study defines the types of plan produced; shape grammar rules used in the analysis of sample structures. Afterwards, TOKI organizes new plans with area calculations and parameters taken from plan types.

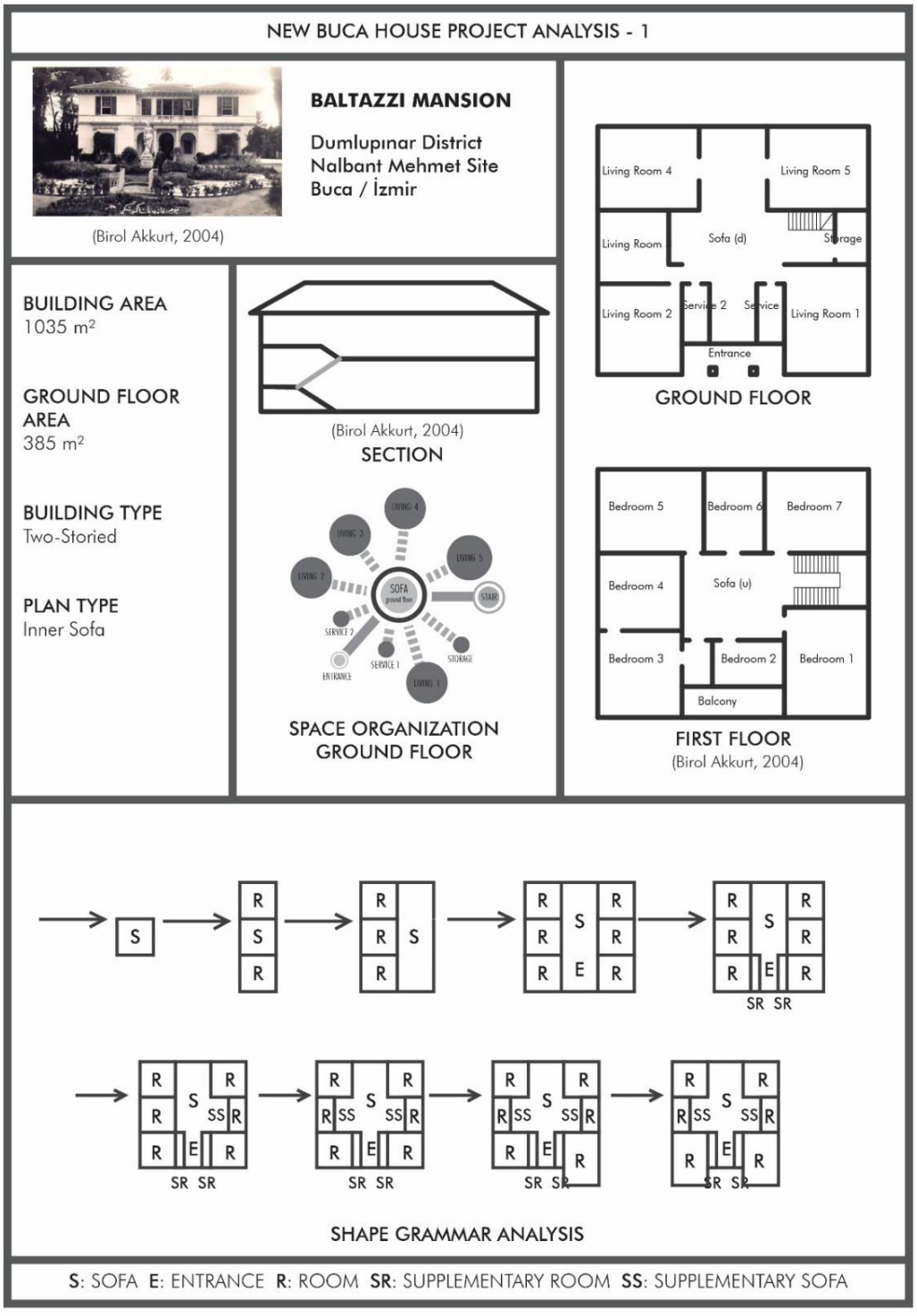


Figure 32: Baltazzi Mansion Analysis Paper

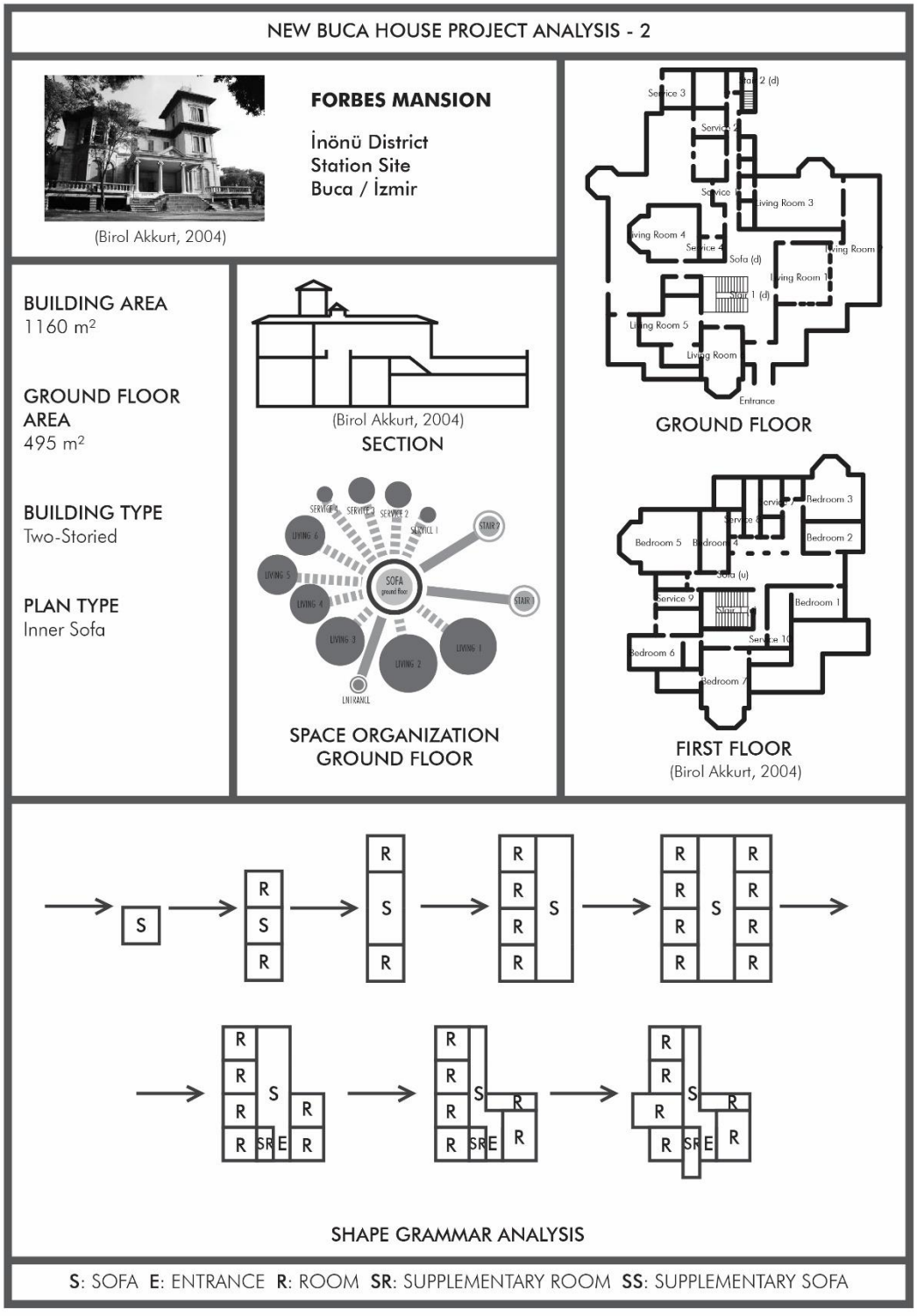


Figure 33: Forbes Mansion Analysis Paper

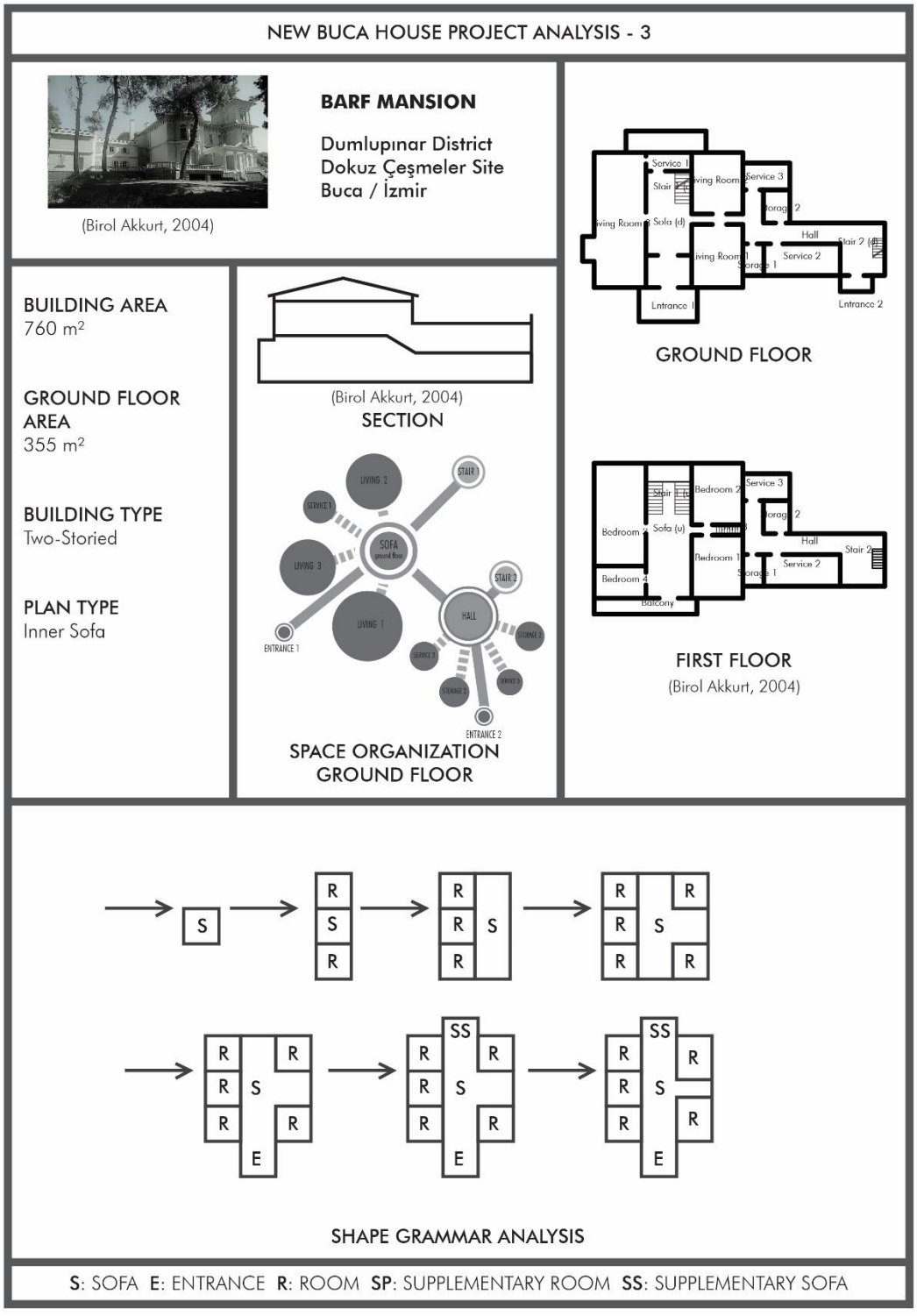


Figure 34: Barf Mansion Analysis Paper

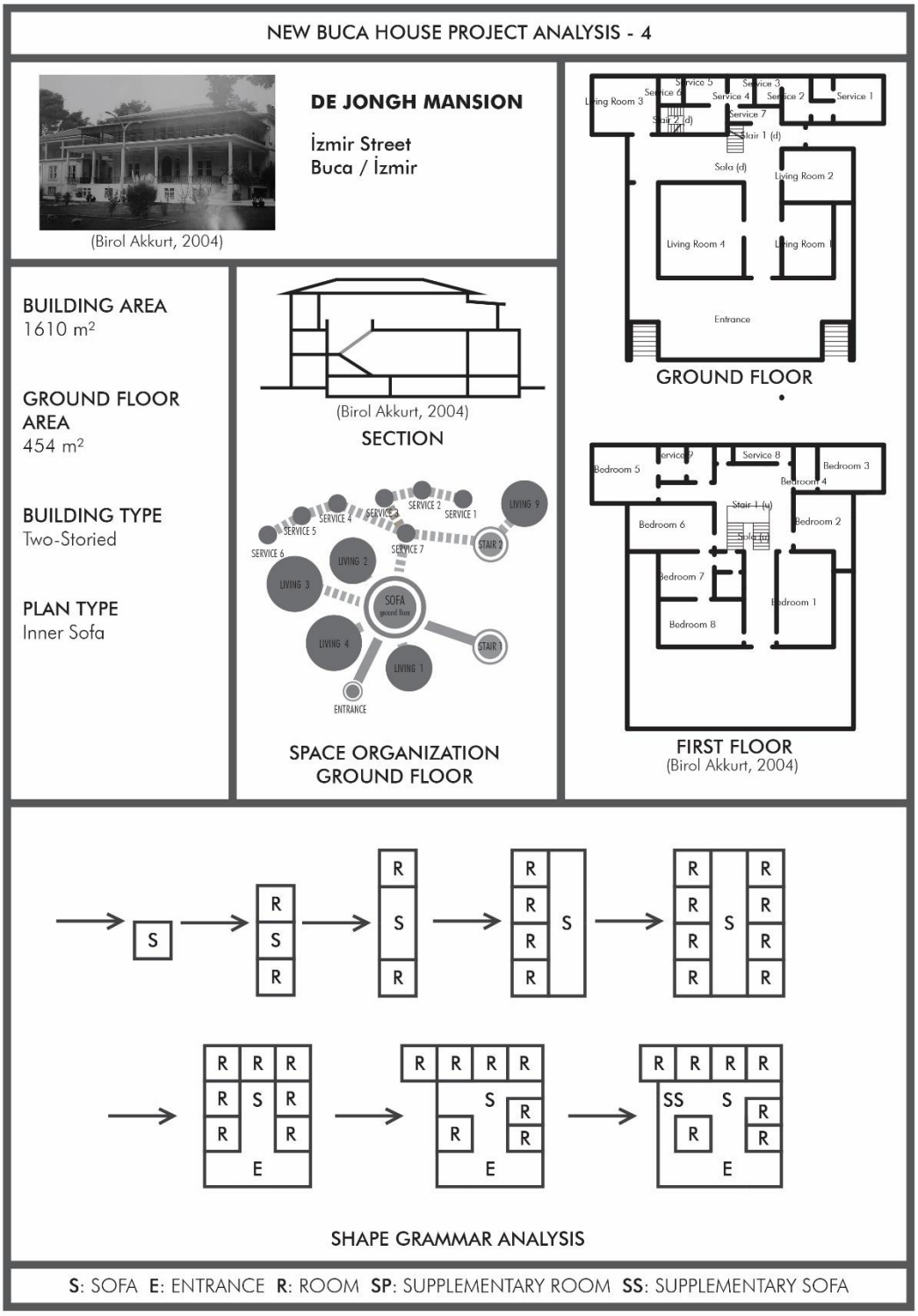


Figure 35: De Jongh Mansion Analysis Paper

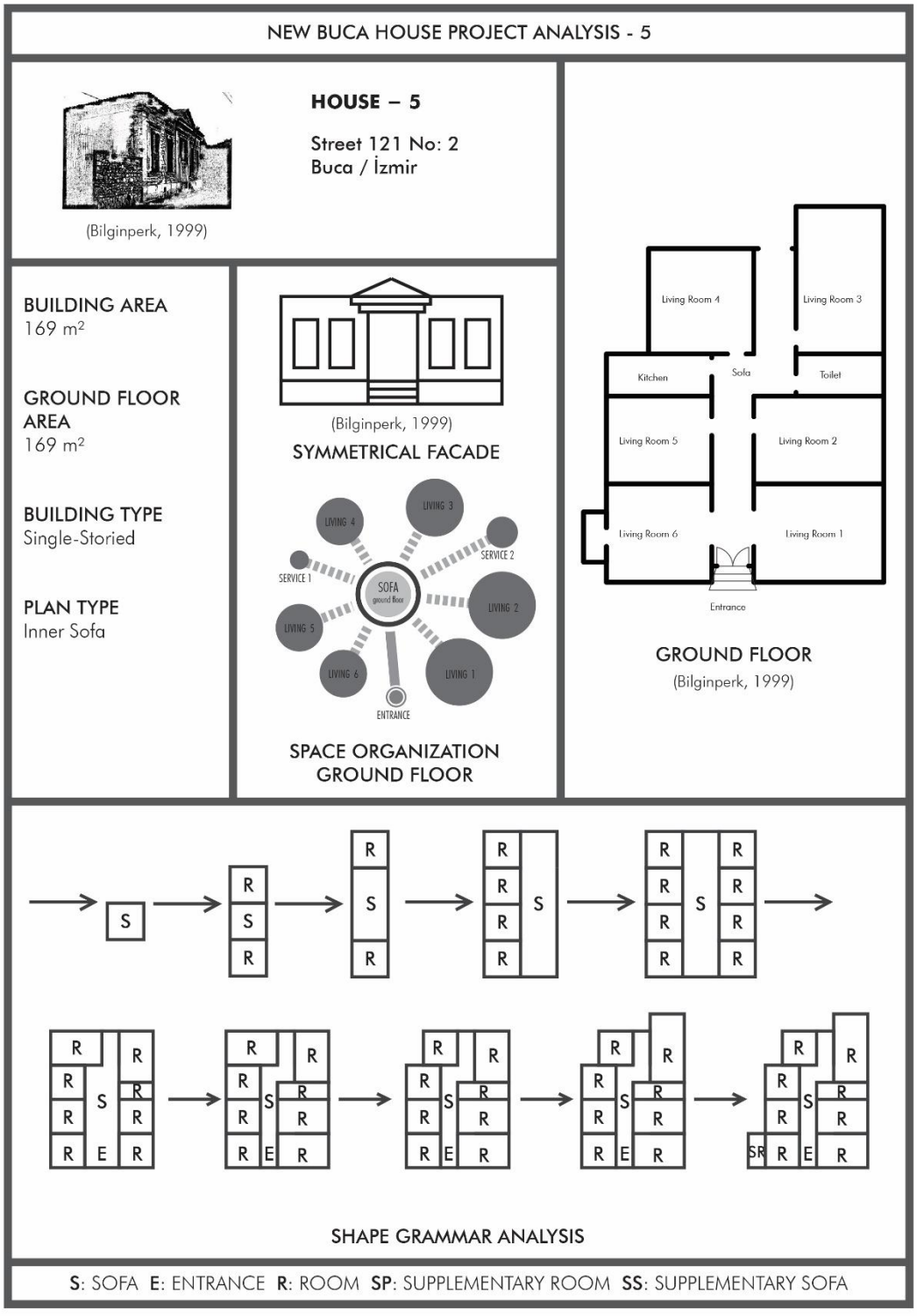


Figure 36: House 5 Analysis Paper

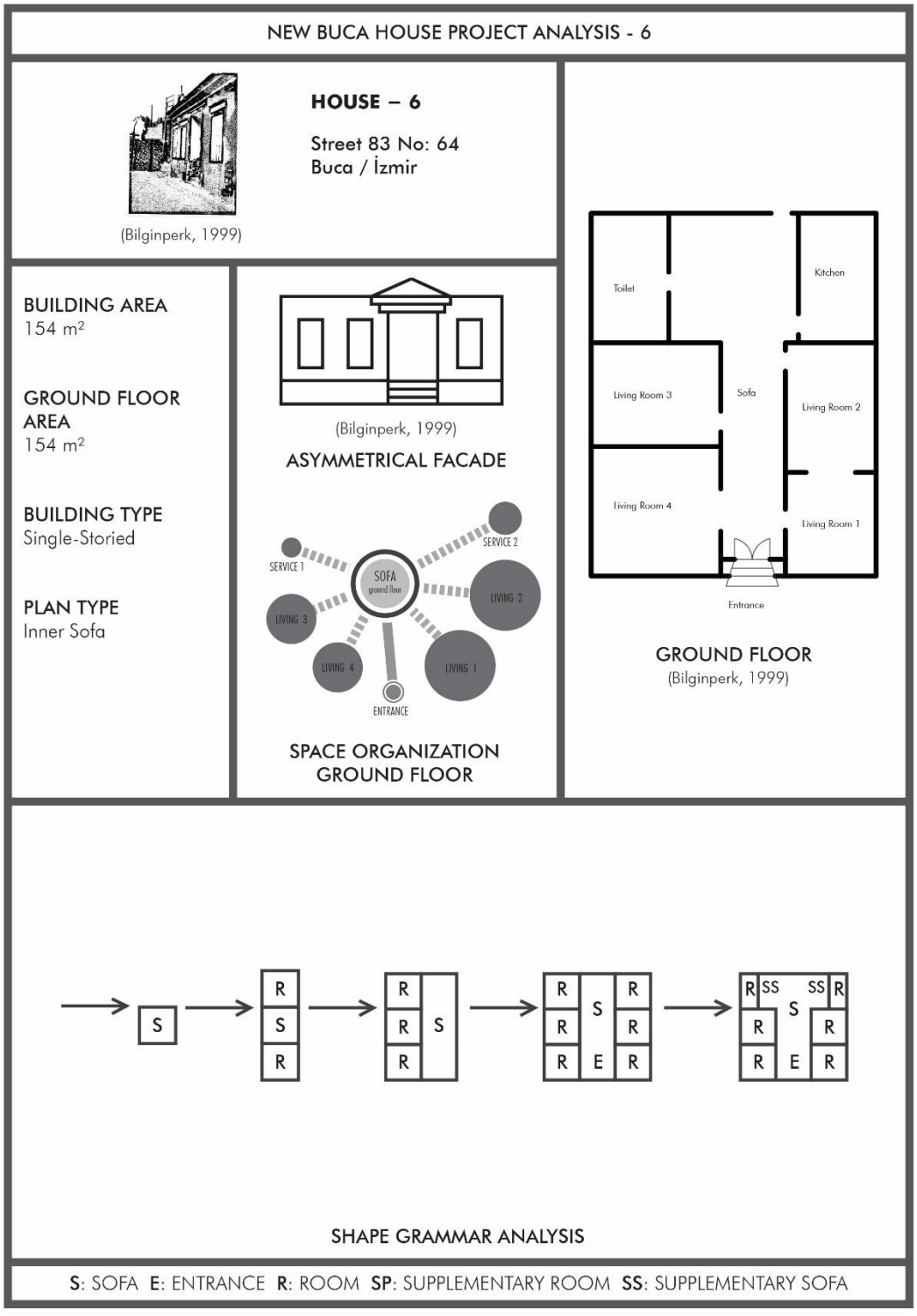


Figure 37: House 6 Analysis Paper

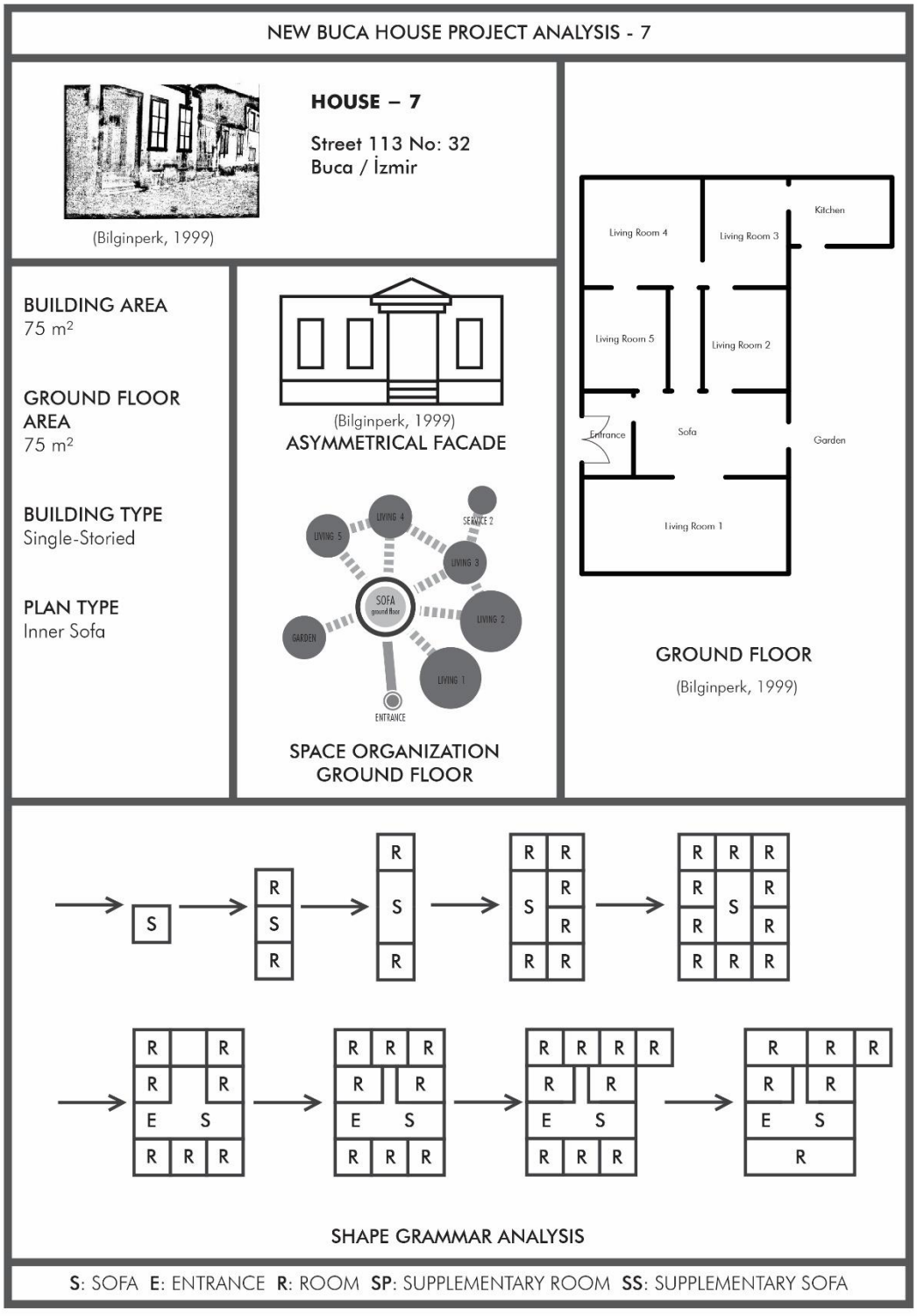


Figure 38: House 7 Analysis Paper

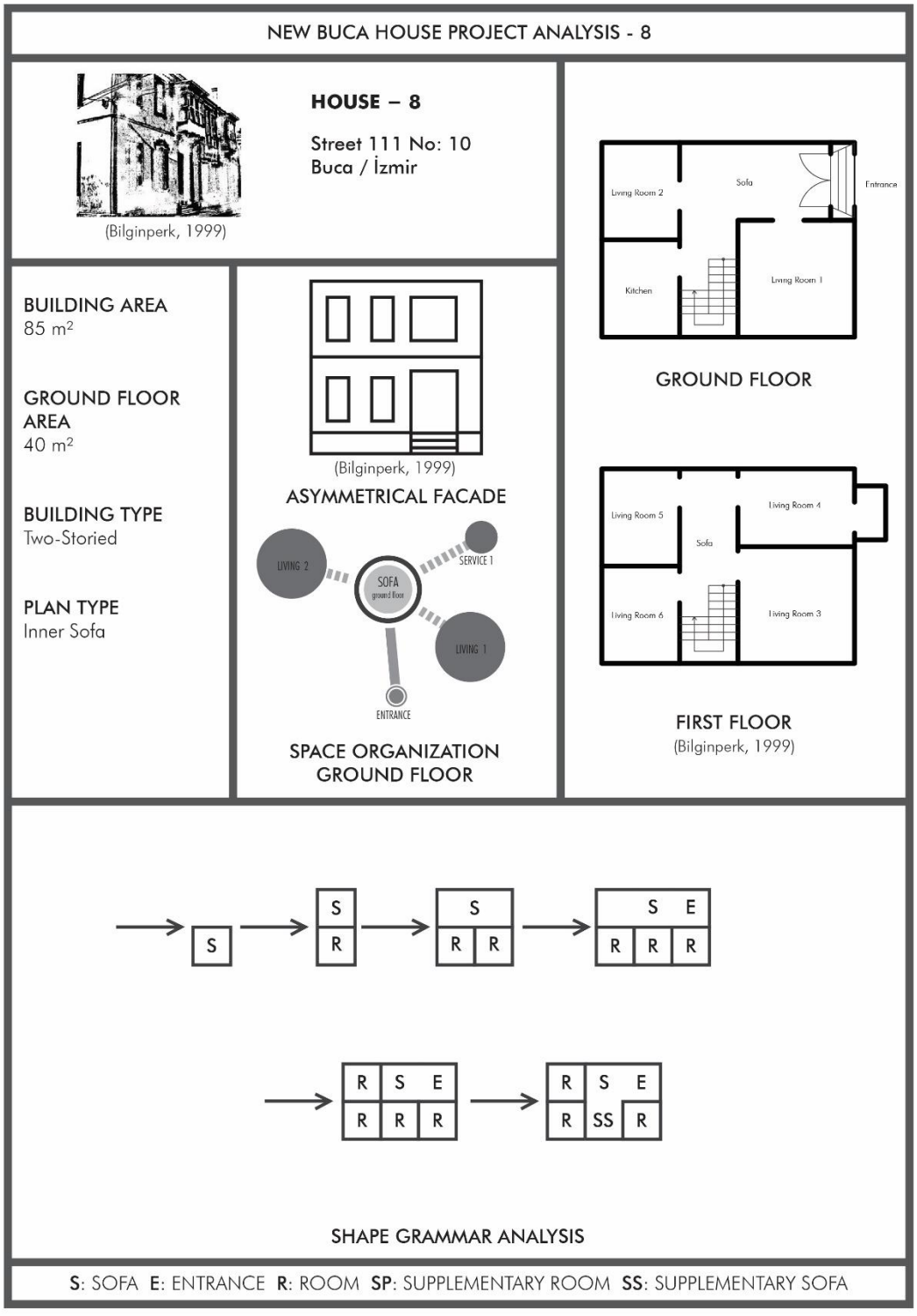


Figure 39: House 8 Analysis Paper

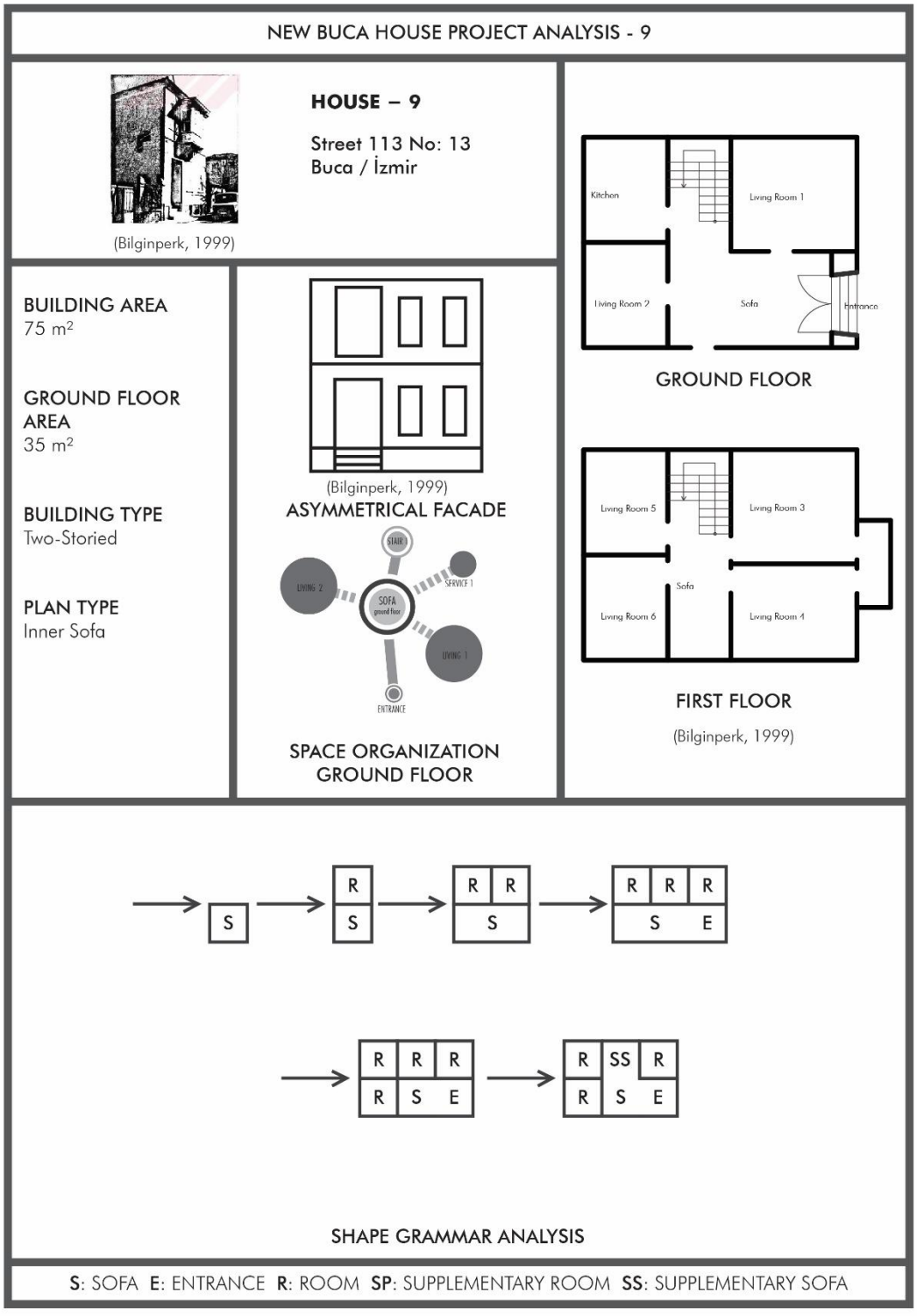


Figure 40: House 9 Analysis Paper

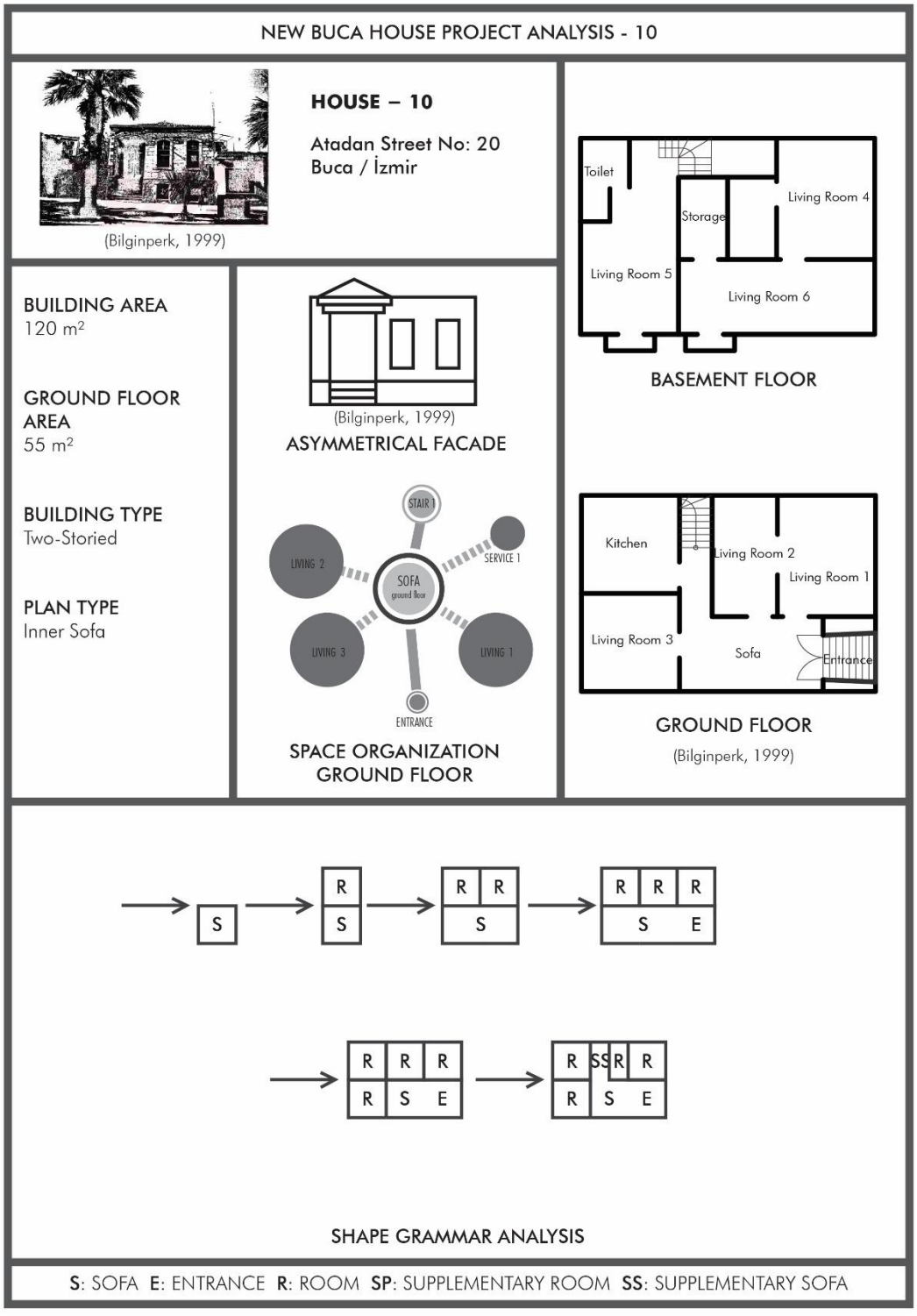


Figure 41: House 10 Analysis Paper

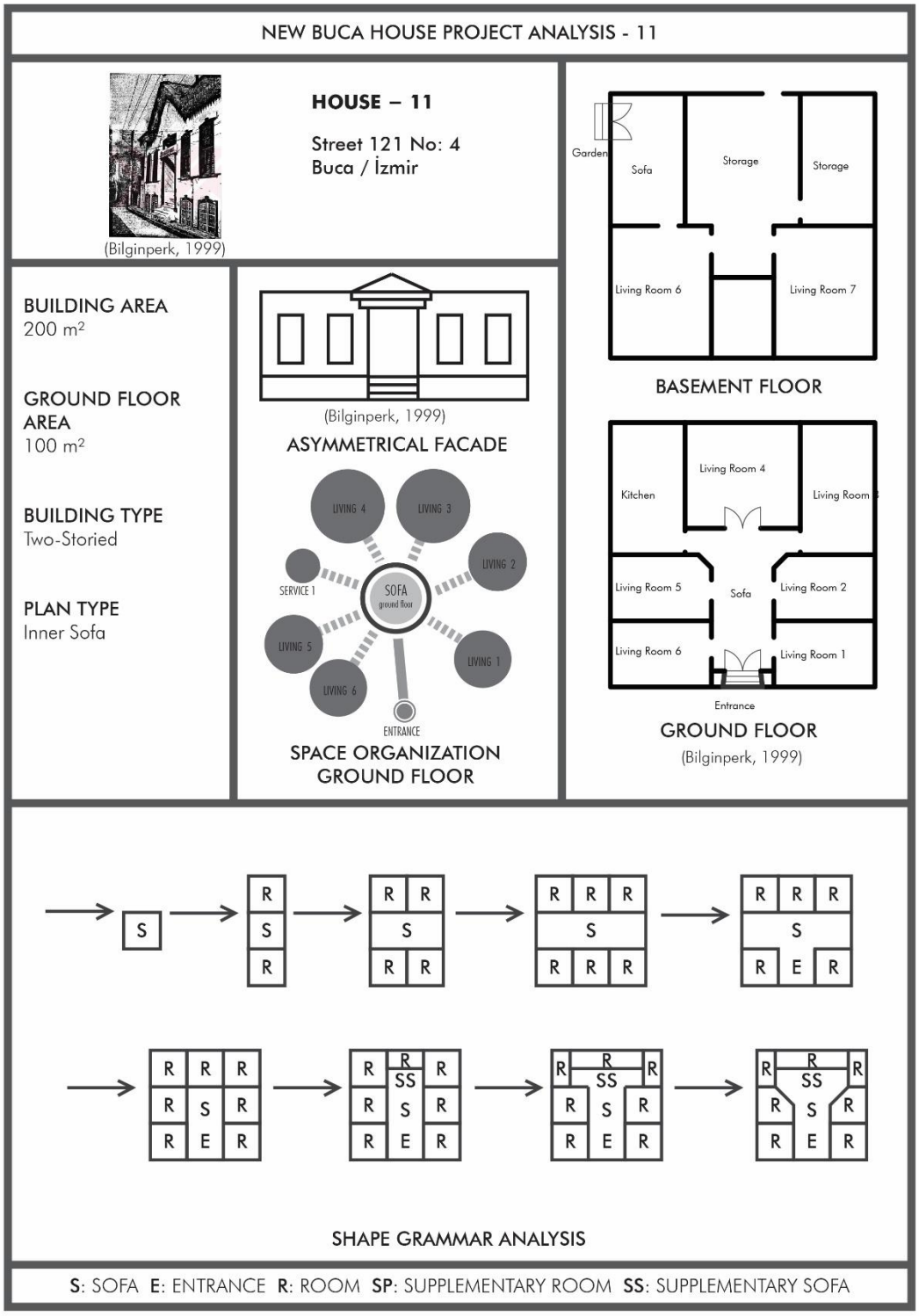


Figure 42: House 11 Analysis Paper

4.3. Adaptation of New Buca House Plan

Important elements of the architectural language of TBH are sofa, room, entrance, additional sofa and additional room. The analysis study examines these elements through eleven sample houses. It also examines space organization and defines inter-space relations. It then produces NBH plans with the inferences from these analyses. This production takes place in eight stages. These stages are similar to the shape grammar rule sets that Çağdaş (1996) defined. However, the study revises in line with the features of TBH. By applying the eight rule sets in different combinations, new variations occur with a local language space organization. The study uses the area calculation parameters obtained from TOKI analysis in the seventh stage. Thus, in the local Buca House grammar and space organization, the area standards of today formed plans (Figure 43).

The summary of the eight stages described in the previous section is as follows:

The first stage defines the sofa type. The production of the plan begins with the placement of one-unit sofa element.

The second stage determines the number and layout of the rooms. The design continues and completes this stage according to the specified number of rooms.

The third stage defines the location and property of the entrance. Çağdaş (1996) describes this stage for the eyvan settlement in TTH. However, NBH study revises this rule. Thus, it defines the entrance space.

The fourth stage defines the location of the additional sofa space. Additional sofa can be between the rooms, at the end of the rooms or in the corner. It helps expand the sofa and increase diversity in plan production.

The fifth stage defines the additional space added to the sofa. This stage places additional space inside the sofa. Sofa space decreases and additional space is added to the plan.

The sixth stage adds to the plan layout. Determines the location and size of the bay window.

The seventh stage includes the rule that determines the dimensions of the rooms, which is an important element in the layout. This stage regulates the room dimensions. Based on the area parameters, according to the results of TOKI analysis, it makes the plan sizes suitable for today's houses.

The eighth stage concerns plan geometry. It makes the table useful by breaking the sharp corners inside the sofa with an angle of 45 degrees on the plan. Obtains bent corners.

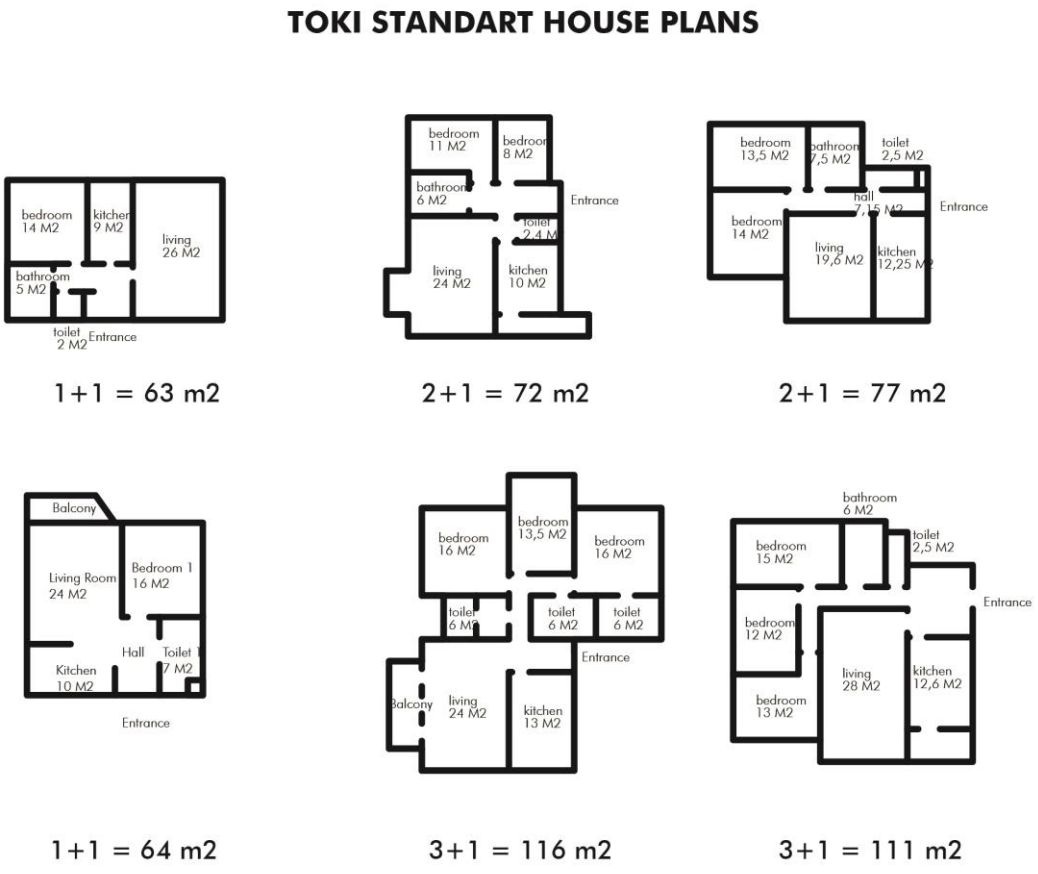


Figure 43: TOKI Standard House Plans (Source: Yıldırım, 2012)

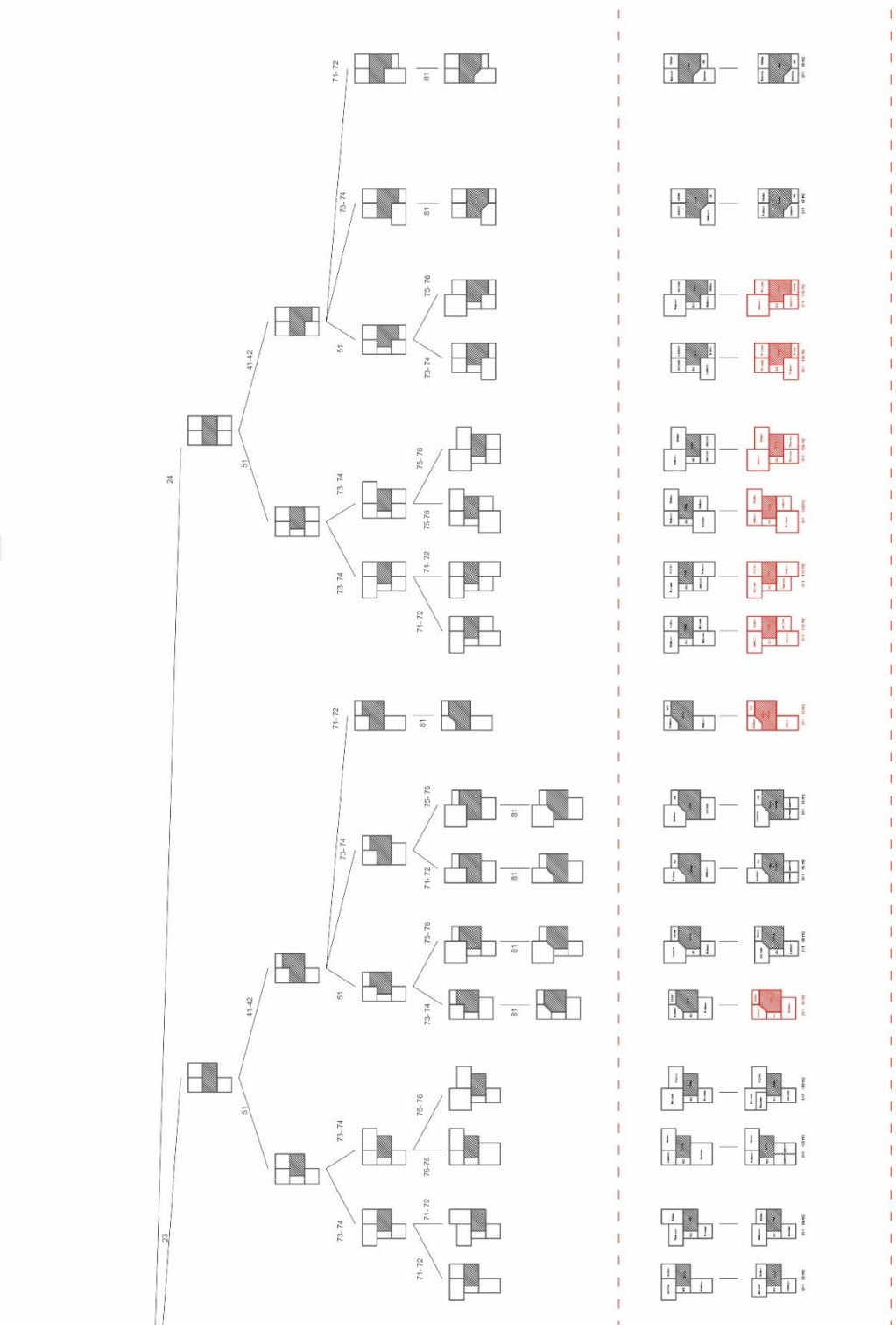


Figure 44: Generating of New Buca House Plan Schema - 1

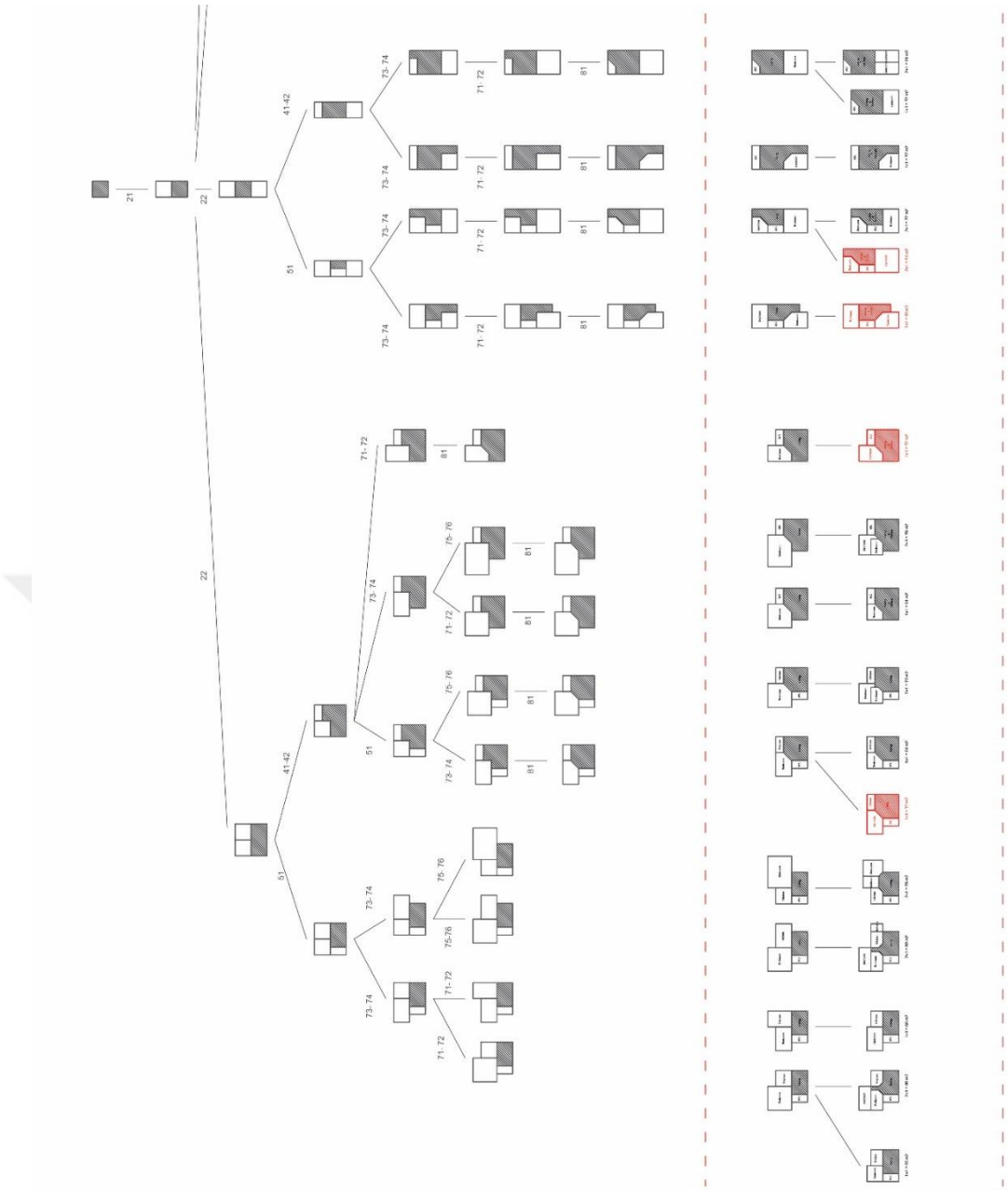


Figure 45: Generating of New Buca House Plan Schema - 2

The starting element in the plan production work is the sofa. In the plan production scheme, the sofa is the determining element. The study uses elements such as sofa, room, additional room and additional sofa in the new plan production. The production work provides the relationship between the entrance space and the sofa in Buca House. It takes this relationship into account when creating the space organization in the new plan type production (Figure 44-45).

The study prepares the sofa layout variations after determining the sofa type. The next step after the sofa layout variations is to determine and position the number of rooms. In the next steps, the work includes the relations related to the space organization and the auxiliary staff to the plan. Thus, the plan types emerge independently of the area calculations.

The study adds the area calculations obtained from TOKI analysis to the production scheme for the emerging plans to acquire spatial features appropriate to the present day. Thus, it is possible to produce, use and apply for plan types. The plan types shown in red are the ones that have kept their form while passing through the TOKI area calculations phase. These types are suitable for today's conditions. These plan types take the final form of TOKI area calculations unchanged after the shape grammar study. These result product plan types show that the study was successful.

The NBH study helps the local architectural language and cultural heritage in Buca to adapt TTH plan types to new housing plans by preserving today's residential space standards. The results of the studies examined in the literature review of the thesis consist of geometric data. This work is to adapt the plan type by taking the standards of modern life into consideration. Thus, it produces applicable plan types. This feature of the study reveals its difference from the studies examined in the literature review.

CHAPTER 5: CONCLUSION

User parameters are always important when it comes to house design. House design is formed according to the cultural characteristics and lifestyle of the users. Thus, housing typologies define social identities. The society that changes over time also changes the types of housing. Buca region, which is the scope of the study, is one of the regions affected by this change. The region preserves the historical housing texture, but new plan types independent of traditional plan types cover the area. The reason for this is that traditional plan types cannot adapt to today's living standards.

The study examines traditional housing plan types in order not to lose Buca's historical texture and cultural heritage. The focus of the study is plan and space organization. Facade, section and urban texture features are not included in this study. The study makes the plan type analysis by using shape grammar method. In shape grammar method, it follows a similar way to Çağdaş's (1996) study. The study determines the elements that make up the TBH plan by deducting and diagrams the relations between these elements with space organization diagrams. Then, the study inductively arranges the elements that make up the plan into the grid system. It adapts the traditional house plan features to the new house plan by using the rule sets prepared for shape grammar method. After the space organization stages are completed, it analyses the area calculations of the spaces in the plan to adapt to today's standards. The study makes the analysis with the data received from TOKI. Thus, the plan types formed are suitable for modern life. The plan types that emerge as a result of the study both meet the needs of the user and prevent the deterioration of the historical texture by protecting the cultural heritage.

As a result, this study shows that TBH has a certain shape grammar. It is possible to produce new plan diagrams with a certain shape grammar from such plans. The work determines parameters using analysis using shape grammar. It generates plan types by transferring these parameters to the computer. Future studies may detail this plan generation phase with artificial intelligence. New plan types that emerged in this way can associate traditional features with modern living standards with more inputs. As the use of artificial intelligence develops, the number and content of parameters may

increase. In addition, the resulting results can become two and three dimensional visuals with computational design methods. Thus, more efficient results can be obtained in variation analysis and selection. The study developed as a result of this can prepare comprehensive projects such as urban transformation planning beyond housing plan type production.

Another future work with the development of artificial intelligence is that the designer updates the plan production parameters according to the existing local zoning regulation rules. If local regulations directly affect the production of plans, municipalities can include traditional plan type features into the content of regulations to protect cultural heritage. Thus, with this study, regulations preserve traditional plan features. The housing plans produced afterwards support the preservation of the traditional texture. Thus, the study that started with the focus of the housing plan can grow to regional and urban scales. Cities that develop and change the form of urban texture can adapt to modern life by preserving the historical texture with this application.

REFERENCES

Akkurt, H. (2004) *19.Yüzyıl Batılılaşma Kesitinde, Bornova ve Buca Levanten Köşkleri Mekansal Kimliğinin İrdelenmesi.* İzmir: Dokuz Eylül Üniversitesi.

Aksoy, M. (2001) *Varolan Tasarım Dilleri ve Yeni Tasarım Dilleri Bağlamında Biçim Gramerleri Analizi.* İstanbul: İTÜ Fen Bilimleri Enstitüsü.

Altıner, A. T. and Budak, C. (1997) *Konak Kitabı.* İstanbul: Tepe Yayınları.

Bağce, H. E. (2004) *Modernliğin Temelleri ve İkircikli Serüveni Modernlik ve Modernleşme Sürecinde Türkiye.* İstanbul: Babil Yayıncılık.

Bahr, H. (1890) *Zur Kritik der Moderne.* Zurich: Verlags-Magazin.

Baker, G. H., Corbusier, L. and Gubler, J. (1987) *Le Corbusier: early works by Charles-Edouard Jeanneret-Gris.* California: California University Academy Editions.

Bektaş, C. (1996) *Türk Evi.* İstanbul: YKY.

Benros, D., Duarte, J. P. and Hanna, S. (2012) A New Palladian Shape Grammar. *International Journal of Architectural Computing,* pp. 521-540.

Berman, M. (1992) Modernlik/ Dün, Bugün ve Yarın. *Birikim Dergisi*, pp. 43-53.

Bilginperk, C. (1999) *Buca Sivil Mimarlık Örneklerinin İncelenmesi ve Benzer Mimari Özellikler Taşıyan Yerleşmeler İle Karşılaştırılması.* Yüksek Lisans Tezi. İstanbul, MSGÜ.

Bloch, C. J. (1979) Catalogue of small rectangular plans. *Environment and Planning B*, p. 155–190.

Bozdoğan, S. (1995) *Politics of Vernacular: The Turkish House, Nationalism and Postmodernity*. Washington, 83rd ACSA Annual Meeting, ACSA Press.

Bozkurt, G. S. and Altınçekiç, H. (2013) Anadolu'da Geleneksel Konut ve Avluların Özellikleri ile Tarihsel Gelişiminin Safranbolu Evleri Örneğinde İrdelenmesi. *Journal of the Faculty of Forestry, Vol.* 63(1), pp. 69-91.

Buelinckx, H. (1993) Wren's Language of City Church Designs: A Formal Generative Classification. *Environment and Planning B: Urban Analytics and City Science, Vol.* 20(6), pp. 645-676.

Burkut, E. B. (2014) *Osmanlı/Türk Evi Mekan Kurgusunu Modern Konut Mimarisinde Okumak,* İstanbul: FSM.

Cansever, T. (1994) *Ev ve Şehir Üzerine Düşünceler.* İstanbul: İnsan Yayınları.

Cansever, T. (2002) *Türk Evi'nin Mimarisi.* İstanbul: Türkler Ansiklopedisi, Vol. 12.

Cengizkan, A. (2002) *Modern'in Saati.* İstanbul: Boyut Yayın.

Clarke, G. and Crossley, P. (2000) *Architecture and Language.* Cambridge: Cambridge University Press.

Çağdaş, G. (1996) A Shape Grammar: The Language of Traditional Turkish Houses. *Environment and Planning: Planning and Design*, Issue 23, pp. 443-464.

Çolakoğlu, B. (2001) *Design by Grammar: Algorithmic Design in an Architectural Context.* Massachusetts: MIT Press.

Demirkaya, H. (1999) *Mekan Kavramının Tarihsel Süreç İçinde İncelenmesi ve Günümüzde Mekan Anlayışı.*Yüksek Lisans Tezi. İstanbul, Yıldız Teknik Üniversitesi.

Demir, Ö. and Acar, M. (1992) *Sosyal Bilimler Sözlüğü.* İstanbul: Ağaç Yayınları.

Dinçer, A. E., Çağdaş, G. and Tong, H. (2014) *A Digital Tool for Customized Mass Housing Design.* Newcastle, CumInCAD, pp. 201-211.

DPT Raporlar (1963) *Birinci Beş Yıllık Kalkınma Planı (1963-1967).* [Online] Available at: www.sbb.gov.tr/kalkinma-planlari/ [Accessed 25 February 2020].

DPT Raporlar (1967) *İkinci Beş Yıllık Kalkınma Planı (1968-1972).* [Online] Available at: www.sbb.gov.tr/kalkinma-planlari/ [Accessed 25 February 2020].

DPT Raporlar (1973) *Üçüncü Beş Yıllık Kalkınma Planı (1973-1978).* [Online] Available at: www.sbb.gov.tr/kalkinma-planlari/ [Accessed 25 February 2020].

DPT Raporlar (1979) *Dördüncü Beş Yıllık Kalkınma Planı (1979-1983).* [Online] Available at: www.sbb.gov.tr/kalkinma-planlari/ [Accessed 25 February 2020].

DPT Raporlar (1985) *Beşinci Beş Yıllık Kalkınma Planı (1984-1989).* [Online] Available at: www.sbb.gov.tr/kalkinma-planlari/ [Accessed 25 February 2020].

DPT Raporlar (1989) *Altıncı Beş Yıllık Kalkınma Planı (1990-1994).* [Online] Available at: www.sbb.gov.tr/kalkinma-planlari/ [Accessed 25 February 2020].

DPT Raporlar (1995) *Yedinci Beş Yıllık Kalkınma Planı (1996-2000).* [Online] Available at: www.sbb.gov.tr/kalkinma-planlari/ [Accessed 25 February 2020].

DPT Raporlar (2000) *Sekizinci Beş Yıllık Kalkınma Planı (2001-2005).* [Online] Available at: www.sbb.gov.tr/kalkinma-planlari/ [Accessed 25 February 2020].

Duarte, J. (2019) *Using Grammars To Trace Architectural Hybridity in American Modernism.* Porto, eCAADe.

Eldem, S. H. (1968) *Türk Evi.* İstanbul: Academy of Fine Arts.

Eloy, S. and Duarte, J. P. (2011) A Transformation Grammar for Housing Rehabilitation. *Nexus Network Journal, Vol.* 13(1), pp. 49-71.

Erpi, F. (1987) *Buca'da Konut Mimarisi.* Ankara: ODTÜ.

Ersoy, M. (2007) *Kentsel Planlama Kuramlarına Eleştirel Bakışlar.* Ankara: İmge Kitabevi.

Eruzun, C. (1986) *Kültürel Süreklilik İçinde Türk Evi.* Mimarlık, Vol. 89/4(236), pp. 68-71.

Eyüce, A. (2005) *Geleneksel Yapılar ve Mekanlar.* 2nd edition. İstanbul: Birsen Yayınevi.

Flemming, U. (1987) More than the sum of parts: the grammar of Queen Anne houses. *Environment and Planning B: Planning and Design*, pp. 323-350.

Giddens, A. (1992) *Max Weber Düşüncesinde Siyaset ve Sosyoloji.* Ankara: Vadi Toplum Yayınları.

Günay, R. (1999) *Türk Ev Geleneği Ve Safranbolu Evleri.* İstanbul: YEM Yayınları.

Güzelci, O. Z. (2012) *Amasya Yalıboyu Evleri Üzerine Bir Biçim Grameri Çalışması,* İstanbul: İTU.

Habermas, J. (1994) Three Normative Models of Democracy. *Constellations*, p. 117.

Hasol, D. (2008) *Ansiklopedik Mimarlık Sözlüğü.* İstanbul: Yem Kitabevi.

Heynen, H. (1999) *Architecture and Modernity.* Cambridge: MIT Press.

Kahya, L. (2017) *Modernizm Bağlamında Günümüz İç Mekan Tasarımına Bir Yaklaşım,* Ankara: Hacettepe Üniversitesi.

Knight, T. W. (1980) The generation of Hepplewhite-style chair-back designs. *Environment and Planning B*, pp. 227-238.

Knight, T. W. (1981) The forty-one steps. *Environment and Planning B*, pp. 97-114.

Koning, H. and Eizenberg, J. (1981) The language of the prairie: Frank Lloyd Wright's prairie. *Environment and Planning B*, pp. 295-323.

Kortan, E. (1992) *Mimarlıkta Teori ve Form.* Ankara: ODTÜ Yayınları.

Köseoğlu , E. and Korkmaz, S. (2011). Buca Konutlarında Mahremiyet Düzeyi. *Mimar-İst,* pp. 26-34.

Krishnamurti, R. (1982) *SGI: A Shape Grammar Interpreter: User Manual Centre for Configurational Studies.* The Open University: Milton Keynes.

Kuban, D. (1975) *Türk Evi Geleneği Üzerine Gözlemler.* İstanbul: Çağdaş Yayınları.

Kuban, D. (1976) *Sanat Tarihimizin Sorunları.* İstanbul: Çağdaş Yayınları.

Kuban, D. (2013) *Türk Ahşap Konut Mimarisi 17.-19. yüzyıllar.* 2. ed. İstanbul: İş Bankası Yayınları.

Küçükerman, Ö. (2007) *Turkish House in Search of Spatial Identity.* İstanbul: TTOK.

Le Corbusier (1923) *Towards a New Architecture.* London: Architectural Press.

Le Corbusier (1931) *Towards a New Architecture.* New York: Dover Publications.

Lefebvre, H. (1984) *Everyday Life in the Modern World.* New York: Routledge.

Liew, H. (2002) *Descriptive Conventions for Shape Grammars.* California, CumInCAD, pp. 365-377.

Niemeijer, R. A., De Vries, B. and Beetz, J. (2010) *Designing with constraints: Towards mass customization in the housing industry*, Eindhoven: Eindhoven University of Technology.

Norman, B. (1993) *Digital Commonwealth.* [Online]
Available at: https://ark.digitalcommonwealth.org/ark:/50959/q524n617h
[Accessed 2 August 2020].

Özer, B. (2004) *Kültür Sanat Mimarlık.* İstanbul: Yem Yayınları.

Picon, A. (2010) *Digital Culture in Architecture: An Introduction for the Design Professions.* Basel: Birkhauser.

Pine, J. (1993) *Mass Customization: The New Frontier in Business Competition.* Cambridge: Harvard Business School Press.

Pulat, G. (1992) *Dar Gelirli Kentlilerin Konut Sorunu ve Soruna Sosyal İçerikli Mekansal Çözüm Arayışları.* Ankara: Kent-Koop Yayını.

Raphael, B. (1976) Natural Language. In: *Thinking Computer: Mind Inside Matter.* California: Stanford Research Institute, pp. 177-210.

Rowland, K. F. (1964) *Pattern and Shape.* Oxford: Ginn and Company.

Sağlamer, G. and Sanly, S. (1995) An Architect/An Architectural Language and A Shape Grammar. *Sixth International Conference on Computer-Aided Architectural Design Futures,* pp. 453-467.

Sandi-Zayek, S. (2014) *Ottoman Izmir: The Rise of a Cosmopolitan Port, 1840–1880,* Minneapolis: University of Minnesota Press for Architecture.

Sbriglio, J. (1999) *La Villa Savoye.* Berlin: Birkhauser et Fondation Le Corbusier.

Seeman, M. (1959) On the Meaning of Alienation. *American Sociological Review*, pp. 783-791.

Sekam (2010) *Türkiye Gençlik Raporu,* İstanbul: SEKAM.

Singh, V. and Gu, N. (2012) Towards an integrated generative design framework. *Design Studies*, pp. 185-207.

Sızak, E. (2007) *Konut Tasarımına Frank Lloyd Wright'ın Yaklaşımı ve Geleneksel Türk Evi Arasındaki Karşılaştırmalar.* Yüksek Lisans Tezi. Eskişehir, Anadolu Üniversitesi.

Sözen, M. and Eruzun, C. (1992) *Anadolu'da Ev ve İnsan.* İstanbul: Emlak Bankası Yayınları.

Speller, T. H., Whitney, D. and Crawley, E. (2007) Using Shape Grammar to Derive Cellular. *Complex Systems*, Issue 17, pp. 79-102.

Steadman, J. P. (1973) Graph theoretic representation of architectural arrangement. *Architectural Research and Teaching 2*, pp. 161-172.

Stiny, G. (1977) Ice-ray: a note on the generation of Chinese lattice designs. *Environment and Planning B*, pp. 89-98.

Stiny, G. and Gips, J. (1972) *Shape Grammars and the Generative Specification of Painting and Sculpture.* Amsterdam: IFIP.

Stiny, G. and Michael, W. J. (1978) The Palladian grammar. *Environment and Planning B*, pp. 5-18.

Swartz, D. L. (2015) *Max Weber's Theory of Modernity: The Endless Pursuit of Meaning*, Boston: Ashgate Publishing Company.

Tanyeli, U. (1997) Modernizmin Sınırları ve Mimarlık. *Modernizmin Serüveni,* pp. 63-71.

Telli, D. (2010) *Konutun Toplu Konuta Kadar Evrimi ve Toplu Konut Örneklerinin İç Mekanlarının İncelenmesi.* Yüksek Lisans Tezi. İstanbul, MSGÜ.

Torus, B. (2011) *Learning from Vernacular Turkish House: Designing Mass-Customized Houses in Mardin,* İstanbul: Intercultural Understanding.

Wassell, S. R. (2008) Andrea Palladio (1508-1580). *Nexus Network Journal,* pp. 213-216.

Weber, M. (2015) *Weber's Rationalism and Modern Society.* New York: Palgrave Macmillan.

Wojtowizc, J. and Fawcett, W. (1986) *Architecture: Formal Approach.* London: Academy Editions.

Wolfram, S. (1984) Computation theory of cellular automata. *Comm. Math. Phys., Vol.* 96(1), pp. 15-57.

Yıldırım, H. (2012) *TOKİ'nin Sosyal Konut ve Lüks Konut Projelerinin Değerlendirilmesi: Ankara Örneği.* Yüksek Lisans Tezi. Ankara, Ankara Üniversitesi.

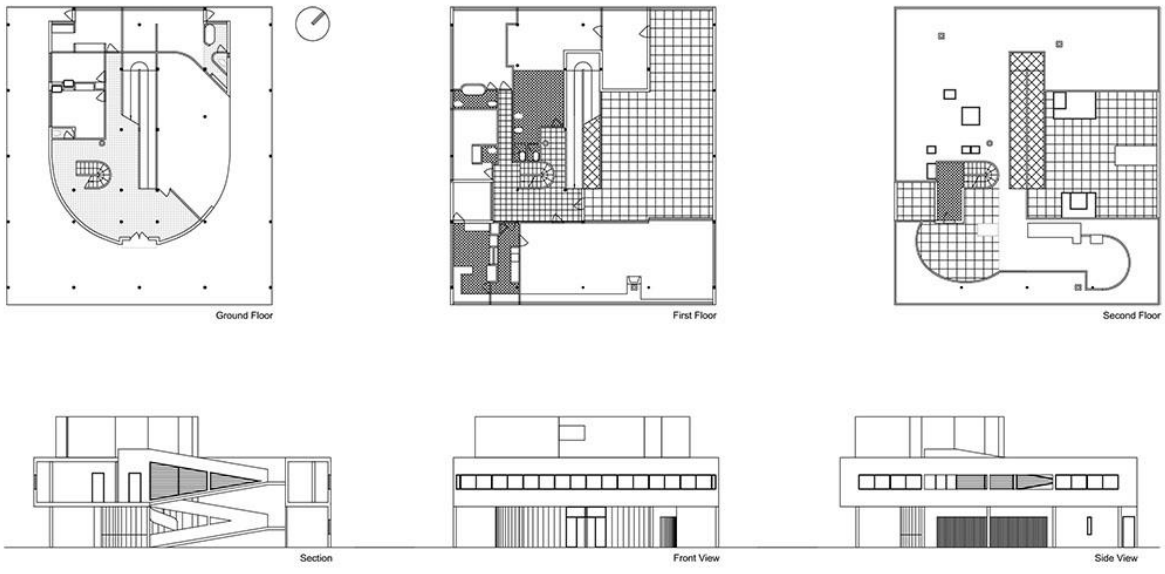
Yücel, İ. H. (2006) *Türkiye'de Bilim ve Teknoloji Politikaları ve İktisadi Gelişmenin Yönü.* Ankara: DPT.

Zevi, B. (1957) *Architecture as Space, How to Look at Architecture.* New York: Horizon Press.

APPENDICES

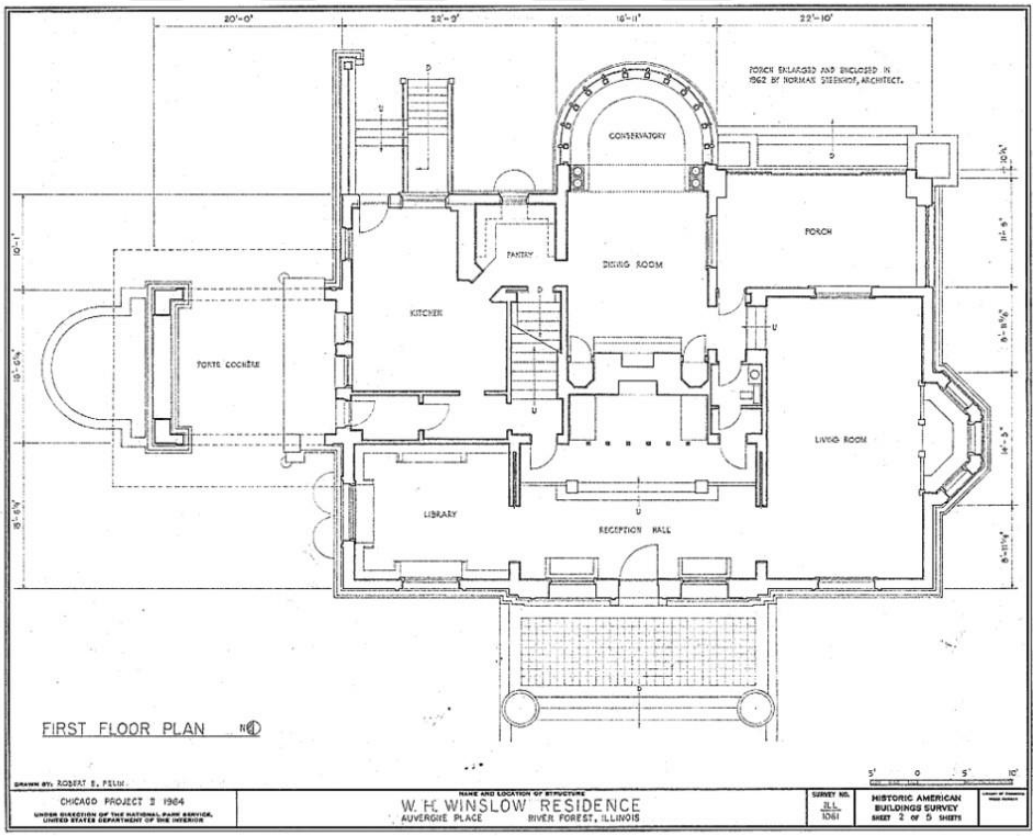
Appendix 1: Internationally Well Known Modern Villas

Facade of Villa Savoye (Source: Sbriglio, 1999)



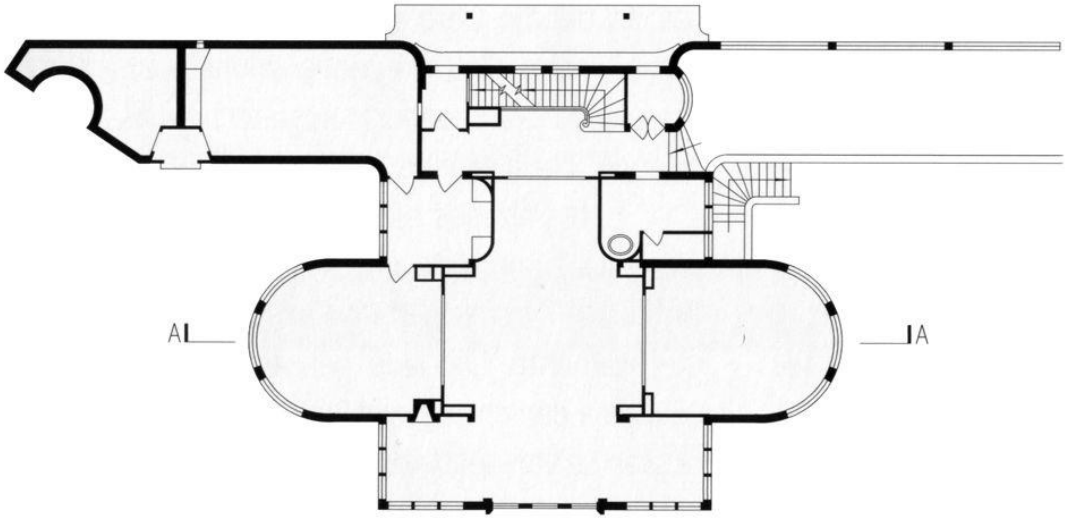
Plan and Section of Villa Savoye (Source: Le Corbusier, 1931)

Facade of Winslow House (Source: Burkut, 2014)



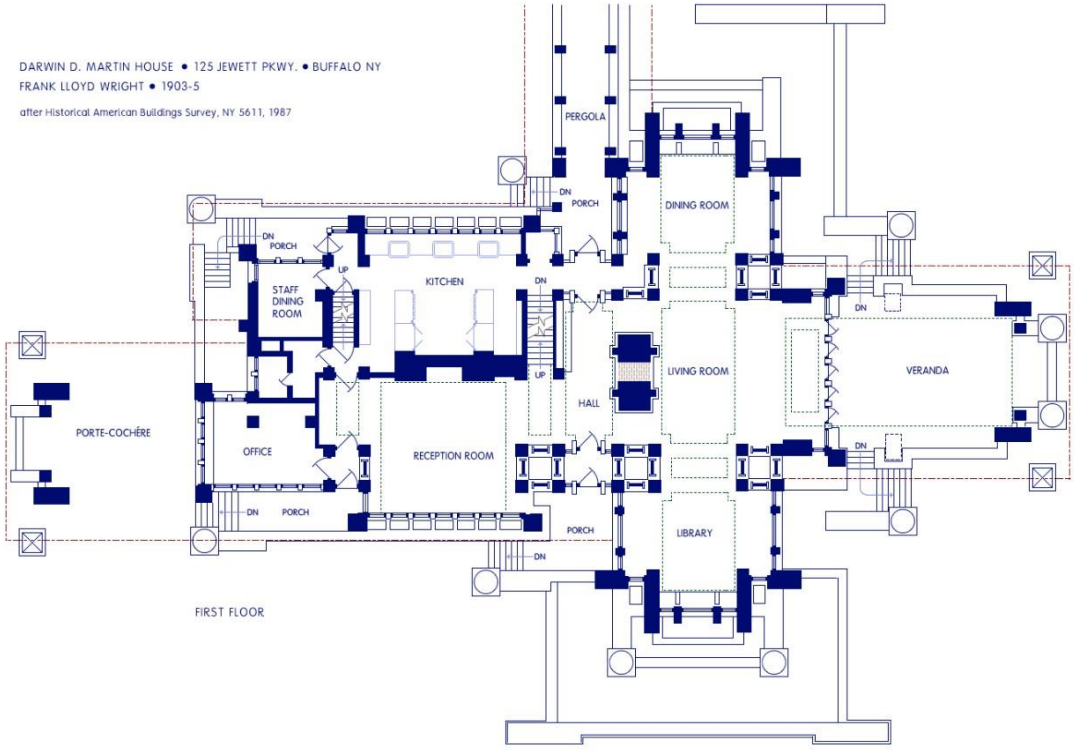
Plan of Winslow House (Source: Burkut, 2014)

Schwob House (Source: Burkut, 2014)



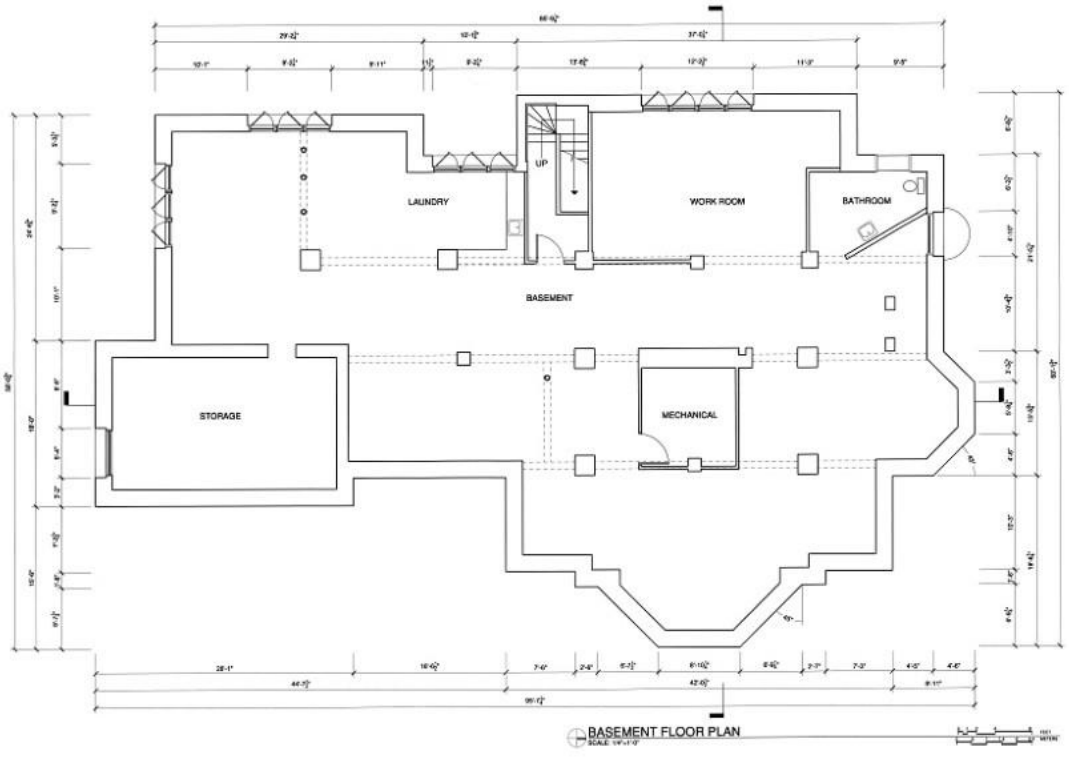
Plans of Schwob House (Source: Baker, et al., 1987)

Martin House (Source: Burkut, 2014)



Plan of Martin House (Source: Burkut, 2014)

Hardley Bradley House (Source: Burkut, 2014)

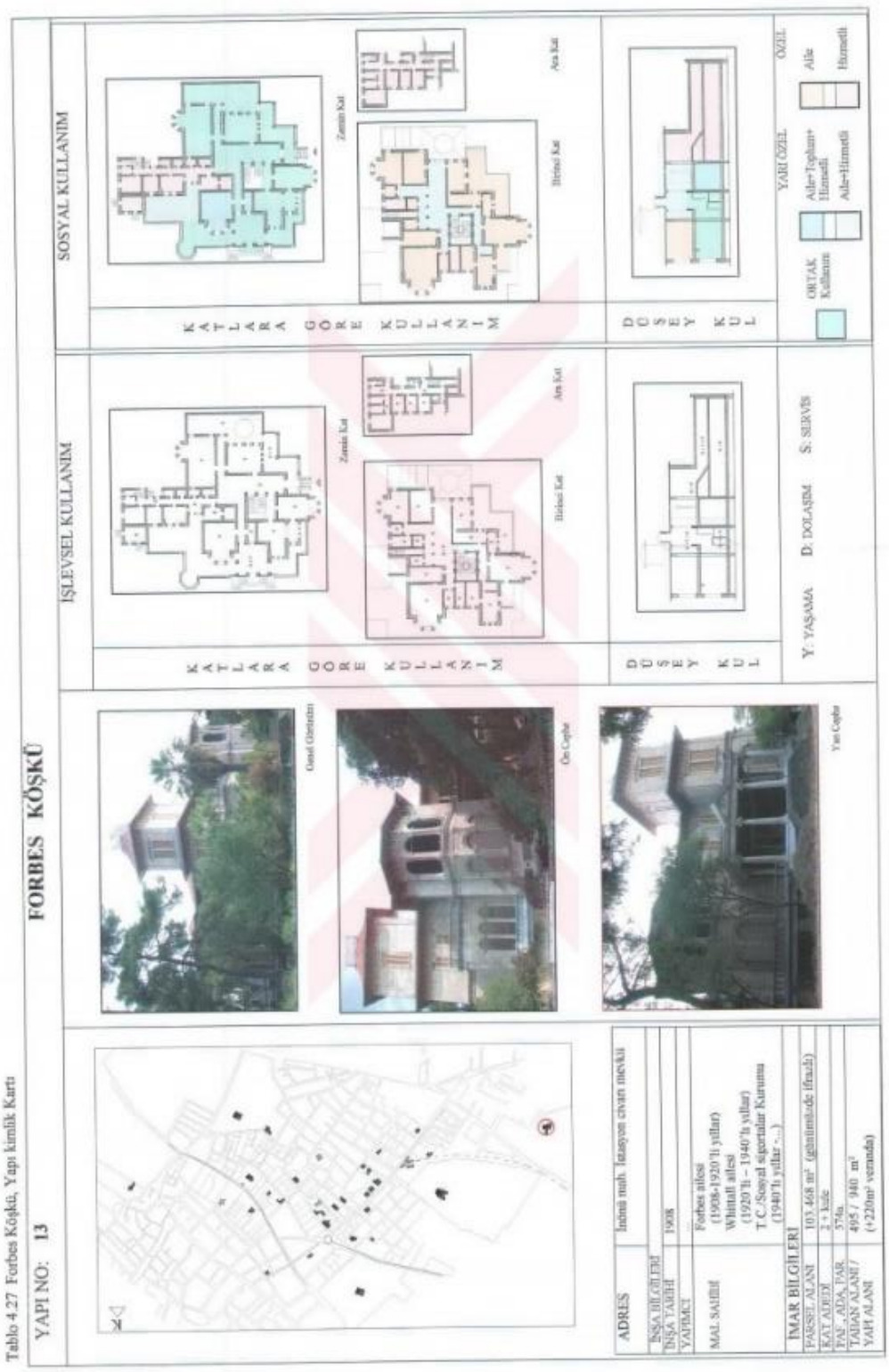


Plan of Hardley Bradley House (Source: Burkut, 2014)

Appendix 2: Buca Levantine Mansions

Barf Mansion (Source: Akkurt, 2004)

Baltazzi Mansion (Source: Akkurt, 2004)



Forbes Mansion (Source: Akkurt, 2004)

Rees Mansion (Source: Akkurt, 2004)

De Jongh Mansion (Source: Akkurt, 2004)