ANALYSING SEYFI ARKAN ARCHITECTURE WITH SHAPE GRAMMAR

ERDİNÇ SEL

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ABSTRACT

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Sel, Erdinç

Master's Program in Design Studies

Advisor: Asst. Prof. Dr. Lâle BAŞARIR

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This thesis aims to examine Seyfi Arkan's residential buildings and find out if there is a common language between these buildings. In this context, the buildings designed by Seyfi Arkan throughout Turkey are chosen as the research field. The buildings are examined in terms of plan organisation, geometry, and spatial organisation. It has been discussed whether there is a typical topological and geometric pattern among the selected architectural works. This discussion is based on the shape grammar method. Colouring, space size calculations and comparative percentage calculations of space volumes were made on the plan to support the data obtained in the shape grammar. As a result of these data, topological relations and dimensional analyses within the structures were obtained. As a result of the discussion of the analyses obtained, it has been determined that the percentages among the housing structures are close to each other. At the same time, it has been observed that this study may lead to more profound future research relating to a better understanding of Seyfi Arkan architecture.

Keywords: Architectural Language, Shape Grammars, Modern Architecture, Seyfi Arkan Architecture.

ÖZET

SEYFİ ARKAN MİMARLIĞININ BİÇİM GRAMERİ İLE İNCELENMESI

Sel, Erdinç

Tasarım Çalışmaları Yüksek Lisans Programı

Tez Danışmanı: Dr. Öğr. Üyesi Lâle BAŞARIR

Ekim, 2022

Bu tez, Seyfi Arkan'ın konut yapılarını incelemeyi ve bu yapılar arasında ortak bir dil olup olmadığını görmeyi amaçlamaktadır. Bu kapsamda Seyfi Arkan'ın Türkiye genelinde tasarladığı mimari yapılar araştırma alanı olarak seçilmiştir. Yapılar plan organizasyonu, geometrisi ve mekânsal organizasyon açısından incelenir. Seçilen mimari eserler arasında tipik bir topolojik ve geometrik desen olup olmadığı tartışılmıştır. Bu tartışma, şekil dilbilgisi yöntemine dayanmaktadır. Şekil gramerinde elde edilen verileri desteklemek için plan üzerinde renklendirme, boşluk boyutu hesaplamaları ve boşluk hacimlerinin karşılaştırmalı yüzde hesaplamaları yapılmıştır. Bu veriler sonucunda yapılar içerisinde topolojik ilişkiler ve boyutsal analizler elde edilmiştir. Elde edilen analizlerin tartışılması sonucunda konut yapıları arasındaki yüzdelerin birbirine yakın olduğu tespit edilmiştir. Aynı zamanda, bu çalışmanın Seyfi Arkan mimarisinin daha iyi anlaşılmasına yönelik gelecekte daha derin araştırmalara yol açabileceği gözlemlenmiştir.

Anahtar Kelimeler: Mimari Dil, Biçim Gramerleri, Modern Mimari, Seyfi Arkan Mimarlığı

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I want to thank my dear parents, Sevim and Hasan SEL, who stood by me in every trouble during my school life and supported me at every stage of my life, and my little friend and nephew Egemen.

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LIST OF ABBREVIATIONS

SG	: Shape Grammar
LR	: Living Room
K	: Kitchen
R	: Room
B	: Bathroom
C	: Circulation
SR	: Stockroom
SC	: Staircase
M	: Method
M.0	: Beginning Method

CHAPTER 1: INTRODUCTION

1.1 Thesis Subject

Seyfi Arkan, also known as Atatürks's architect, as one of the pioneering architects of the new Republic of Turkey, has been the subject of research from several approaches. As a result of the research, it has been seen that the works done for the architect Seyfi Arkan are on certain subjects. These studies concerned being an architect of the Republican period and applying modern architecture in Turkey. This study it is aimed to look at the architecture of the Republican period analytically within the framework of Seyfi Arkan structures. In this context, it is aimed to look at Arkan architecture from a different perspective. For this reason the shape grammar method was used to understand its architectural language. However, his architectural production has merely been explored in terms of plan schemes that would lead to understanding a possible pattern underneath Arkan's space-making preferences. This research integrated shape grammar methods to document topological and geometric relations existing in Seyfi Arkan's plan layouts.

Shape grammars suggest patterns based on shapes and spatial relationships between them. A graphical language links specific figures with other parts (Liew, 2002). There are two types, analytical and original shape grammar. Chinese Ice Rays, Stirling & Gowan's Leicester Engineering Building, Villas of Palladio, Frank Lloyd Right Country Houses, Queen Anne Houses, Malagueira Houses, Traditional Turkish Houses, and Traditional Amasya Yalıboyu Houses are examples of studies on shape studies (Ergin, 2020). This thesis examines the formal grammar of Seyfi Arkan architecture.

1.2 Aim and Scope

This thesis aims to examine Seyfi Arkan's architecture using shape grammar methods. Within the scope of this thesis, residential buildings were examined and it was aimed to see whether there was a common language between these buildings. Public

buildings are excluded from the scope of this study. The reason for this situation is the search for a common language in structures. Searching for a common language among many buildings with the same space types will provide more accurate data. In this context, the building type containing standard space units in the buildings was selected and analyzed. For this reason, the most suitable building type for these analyzes, housing projects, was focused on. Local architectural examples designed by Seyfi Arkan were analyzed.

Seyfi Arkan is one of Turkey's pioneers of modern architecture (Cengizkan, İnan, and Cengizkan, 2012). He received training from notable names in contemporary architecture around the world. To make a brief explanation about the architect Seyfi Arkan, who is the subject of the thesis, Arkan, who was born in 1904, lived during the most productive period when Atatürk was alive (Alsaç, 1978). As a result of examining the resources available today, it has been seen that there are many of our architects who have lost a lot of data. In addition, in light of the data obtained, Arkan's architecture aimed to be both modern and combine traditional sources (Güral and Yücel, 2007). Social housing, villas, government offices, pavilions, communal areas, etc. are available.

He won the Çanakkale Martyrs Monument Competition and was sent to Germany to receive an education in Europe (Sayar, 1992). The project of Seyfi Arkan won first place in the Çankaya Foreign Ministry Competition, which was opened in 1933-1934. Adopting Atatürk's new understanding of Turkey, his holistic perspective, and the new image of the country, the Foreign Office became the residence icon of the Republic in those years (Güral and Yücel, 2007).

Arkan not only gravitates towards modernism but also designs its buildings with creative and complementary spatial approaches. He has always tried to combine universal values with national values in his structures. According to Arkan, modern architectural space is a space where another life can be found in every corner at every

step, and that will create different feelings in every different detail (Cengizkan, İnan, and Cengizkan, 2012).

1.3 Methodology

In this study, which aims to investigate the existence of the Seyfi Arkan architectural language, the shape grammar method was used. Shape grammar is based on shapes and relationships between shapes. With this method, compositions based on shapes are created, and it is a graphical production system. In shape grammar, the design language takes place by certain rules. Along with these rules, there are changes, derivations and reproductions between the parts of the design (Liew, 2002). Shape grammar is defined as a production system based on the first shape. Transformation rules are applied to the first shape by recursion (Duarte, 2001).

The figure constitutes a finite collection of untreated points, lines, planes, or areas. There are two types of shape grammar, analytical and original. The original grammar is used to create a new and original design (Erdem, 2020).

In this context, the reason for choosing the selected residential buildings is to analyse the building type that includes standard space units Seyfi Arkan has architectural works in many building types. However, it has been seen that the most suitable building category to be examined within the scope of the thesis is residential-type buildings. For this reason, different housing types were analysed and compared among themselves.

Within the scope of the thesis, fundamental studies on residential architecture Analytical studies were carried out for 22 projects of Seyfi Arkan's Architecture. Nine private property-type structures, five apartment-type structures and eight social housing-type structures designed by Seyfi Arkan are examined. Out of these 22 projects, only housing projects were sampled, and a housing grammar and plan scheme

was produced. At the same time, spatial relations, spatial geometries, and square meters were examined in these buildings.

To support the interpretation of shape grammar, the geometry of the buildings, their dimension, and the arrangement of the space was also analysed. These analyses were made by grouping the housing structures among themselves. Therefore, a common language is investigated by mutual reading between these groups.

CHAPTER 2: SEYFI ARKAN AND ARCHITECTURE

Arkan was born in 1904 and died in July 1966. He completed his architectural education at Galatasaray High School. He continued his education at the Academy of Fine Arts. He received training from the architect. Vedat Tek. The national architectural movement aims to apply contemporary architecture to traditional Turkish architecture (Alsaç, 1978). In short, this trend aims to be both modern and combine traditional sources. In addition, it enables national architecture to rise to world standards (Güral and Yücel, 2007).

After graduation, he came first in the Çanakkale Martyrs' Monument competition. In 1929, he continued his education in Europe with a scholarship from the Ministry of Education (Sayar, 1992). Between 1930-33, he was a student of Poelzig in Germany. However, his ability to express his art in architectural practices is related to the education he received from Poelzig. Poelzig describes Arkan as "an architect with exceptional technical knowledge and a high sense of art" (Güral and Yücel, 2007). As a result of Arkan's education in Germany, traces of the historicist design he adopted were erased from his buildings (Aslanoğlu, 1992).

Arkan returned to Turkey in 1932 and started his career. Seyfi Arkan is one of the first architects of the Republican era. He was successful because of an architectural competition he participated in. In 1933, the Çankaya Hariciye Köşkü was a competition, and Arkan won this competition. After winning the competition, he designed other essential projects. He built the Çankaya Mansion for M. K. Atatürk. As a result of Atatürk's satisfaction with Arkan, he also participated in many projects. As a result, he was called the architect of Atatürk.

The years at the peak of his career were 1932-38. However, with the death of Atatürk, a decline is observed in his career because of political attitudes, architectural discourse and practices that turned from modernity to nationalism. Therefore, the modernist style

was losing its importance in Turkish architecture. However, his design quality does not decrease in some of his projects.

After Atatürk's death, state support for Seyfi Arkan decreased. In the same period, it increased the dominance of Sedad Hakkı. Movements to return to national architecture have started not only in Turkey but also in Europe. For this reason, the 2nd National Architecture Period started in Turkey. Arkan continued to build his buildings, but his visibility in the architectural media declined. No matter how many problems he faced until his death, he did not compromise on his modernist style, architectural works and building efficiency. Arkan's modernist understanding of architecture can be found in his works. However, classicist and local elements draw attention to some of his works. Local ingredients can be seen in the external kiosk. Classical pieces can be seen in Salih Bozok's house (Güral and Yücel, 2007).

The fact that Arkan isolates himself from taking on duties and responsibilities at the Academy does not mean that he did this on purpose (Izgi, 1997). Arkan's professional originality is that he never gave up on the modernist trend. Another work of Arkan, which emphasises his originality, is the booklet "1933-56: Seyfi Arkan and His Works", which he published to promote himself professionally, as Tanyeli states (Arkan, 1956). Arkan played an active role in the development of early Republican architecture. Arkan became a state architect with an understanding of the Republic. It is also known as Atatürk's exceptional architect. Community centre buildings, state structures and presidential mansions constituted his important and institutional works. His architectural style is related to the administrative system belonging to the period in which he lived (Cengizkan, İnan and Cengizkan, 2012).

Seyfi Arkan was a famous architect between 1930-1940. Between these dates, he signed many architectural structures. Arkan has done modern architecture, aiming to make architecture for society. It was not successful at first. However, while other architects of his time used the existing system, Arkan aimed to create a new culture in which the society would live (Güral and Yücel, 2007). In addition, he set an example

for new architects and paid attention to new images in his works. Arkan includes modernism in his works (Güral and Yücel, 2007).

Seyfi Arkan went to Berlin after completing his education in Turkey. During his education in Germany, he worked on housing projects. These studies formed the basis of his projects in Turkey (Akcan, 2005). Seyfi Arkan's architecture has adopted the Western style and has been evaluated as an architecture that references the International Style (Dündar, 2008).

He did not write his architectural thought and works. Therefore, manuscripts, drawings and projects were not saved. However, as a result of the research, it was seen that Arkan produced many architectural works with different functions between 1933 and 1956 (Dündar, 2008).

Arkan has an integral complementary design approach. He has designed from object scale to building scale. Arkan attaches importance to building, the most minimal design object, and building-outdoor complementarity. Arkan's complementary design approach has kept the space in the palm of his hand down to the smallest detail (Wigley, 1998).

In some of the literature studies, it was seen that only a formal reading was done about Arkan. It has been observed that there is no effort to the differences between Arkan's architectural works (Dündar, 2008). In addition to being an architect who constantly participates in competitions, Arkan has produced many projects (Sözen, 1984). It has been seen that he made designs that were advanced and different from the period he lived in. It has also been said that structures with different functions reflect these differences (Alsaç, 1976). One of these structures is the Zonguldak Social Housing project, which has been studied in the literature. This project has national and international characteristics. The buildings were compared to the social housing project in Germany, but the designs of Arkan were seen. Arkan's social housing project in Zonguldak has solved a current problem. Therefore, it is an important project.

However, it has been said that these social housings are not original and should not be considered Turkish architecture. The reason for this situation is shown in the example of Cubism in Turkey (Özer, 1961). Metin Sözen and Mete Tapan said that Seyfi Arkan's architecture is a design that exactly repeats western architecture (Sözen and Tapan, 1973).

Seyfi Arkan responds to different functions in his architectural works. The complexity, diversity and contradictions seen in early republican architecture are also seen in producing modern spaces with different designs by Seyfi Arkan. Seyfi Arkan architecture has been depicted as western architecture-centred in the history of architecture. This is because it is likened to Le Corbusier, Mies van der Rohe and Walter Gropius in western architecture. After all, Arkan architecture also includes white, plain, cubic masses and volumes (Dündar, 2011).

Arkan did not just gravitate towards the modernist movement. At the same time, he designed his buildings with creative spatial approaches. The traces of the modernist movement can be seen in these designs (Boyacıoğlu Dündar, 2008). According to Arkan, modern architectural space is where another life can be found in every corner at every step, creating different feelings in every detail. There is no trace of his teacher, Poelzig, in Arkan's definition of modernist space. Arkan is simply a modernist architect, as always stated. However, he applied modernism in taste and aesthetics. Arkan attaches more importance to universal values than national values. Still, he tries to combine universal and national values in his works (Güral and Yücel, 2007).

In the Arkan architectural structures examined within the scope of the thesis, it is seen that the criteria of conformity to the geography in which they are produced, economic production and not reducing the spatial quality for economic production are critical factors. In Arkan architecture, it can be said that production is easy, spatial setup is simple, but spatially quality structures are designed (Dündar, 2011).

According to Bozdoğan, the home concept should be simple and valuable. This home concept is a family home designed as a sheltered area with clean, aesthetic, and comfortable factors (Bozdoğan, 1998). It is seen that classical construction techniques were used in several worker housing projects produced by Seyfi Arkan in the mid-1930s. As a result of the typological examination of the social housing area in Adana, it is seen that the houses have a minimum size and an economical design that adapts to the region. Arkan's lodging project in Zonguldak is the largest of these social housing projects. The project has been likened to social housing projects designed by the Germans. The Germans' designers and the methods that combine individual and common areas are seen. In the Arkan social housing project, it is seen that the concept of a single house maintains its importance. At the same time, it is seen that villa modelling is used in Arkan's design, albeit in small sizes, against the German building design consisting of interconnected building units (Bozdoğan, 2012).

Within the scope of the thesis, it has been examined that Seyfi Arkan buildings have similar plan features. This enabled the shape grammars to be read clearly in the structures. The home Sofa position constitutes the central point as a building element that provides horizontal circulation. A Sofa is a place that unites all spaces in all plan types. The Sofa is seen as the central element in the buildings examined within the scope of the study.

CHAPTER 3: LANGUAGE AND ARCHITECTURAL LANGUAGE, RULE-BASED DESIGN

3.1 Language and Architectural Language

In 21st-century architecture, buildings are designed to suit the needs of the modern age. These designs are made according to the types and approaches of the buildings (Kahya, 2017). This study analyses the structures of Architect Seyfi Arkan, who chose the modern approach as his design model and adapted it to his country. This study describes the residential buildings and contemporary architectural examples built in various parts of Turkey designed by Seyfi Arkan.

In the study, after examining the modern architectural building, it is investigated whether the building groups comply with a specific rule or not. The scope of the thesis, plan and space organisations, geometric sequences, and proportions are focused on. The study examines the similarity between architect Seyfi Arkan's residential buildings. At the same time, the data is to be obtained because this study aims to form a basis for future studies.

In the formation of modern architecture, essential architects and works created the architecture of their periods. In contemporary architecture, residences aim to make the life of the users easier. For this reason, connections are established between the primary and side spaces. These connections can be visual and auditory. As a result, it is ensured that the space movements are efficient by the user (Özer, 2004).

Louis Sullivan, Frank Lloyd Wright's mentor, was America's first great modern architect. Louis Sullivan mentions that behind every façade, the identity of the person who designed that façade is hidden. This constitutes the concept of architectural language. Each design reflects something from the designer's life. For this reason, each design has different effects on users in a way that the designer could not foresee. And at the same time, despite its complex structure, every architect tries to create a design

philosophy and put forward a set of rules that he will use in his designs. The design language is trying to develop his style. The problem with this theory is how these principles are reached, how they are supported and accepted, and how they are applied (Aksoy, 2001).

Aldo Rossi said that design is to choose (Aksoy, 2001). According to Rossi, the architect acts within his unique selections, apart from any economic, technical and organisational impact. There is no abstract architecture. It cannot be an abstract building. Every window, every door, and every section of the façade must be determined concretely. Every building has a message regarding location, size, shape, articulation, structure, and material. These messages show that architecture represents and communicates personal choices and decisions. When we look at it this way, each building is a unique expression. Therefore, it is a linguistic act (Fischer, 2001).

In the movements in the 80s and 90s, people were not aware of the effects of the chosen materials, constructions, and forms on people. The concept of "semiotics" was used for the first time in 1690 by John Locke in his work titled "Essays Concerning Human Understanding" and later in Ferdinand de Saussure's "General Linguistics Lessons," published in 1916. This concept has been one of the methods used to seek answers to meaning-making phenomena in architecture. This concept is a branch of science that strives to make sense of the relationships between semantic (forms and the relationship between them, meaning), syntax and pragmatic (relationships between icons and their users) entities with themselves and with other entities (Fischer, 2001).

The foundations of linguistics date back to Plato and Aristotle. Linguistics is the most essential and comprehensive communication system. This science describes architecture, structure, process, and rules. As architecture has a language, language also has architecture (Coseriu, 1970). However, when adapting linguistic studies to architecture, the similarities and differences between them should be considered.

3.2 Similarities and Differences between Language and Architecture

Every language is unique and unique. This is just like every architectural work being original and unique.

- There are different kinds of products in linguistic production (newspaper, theatre advertisements etc.) and architectural production (garage hospital construction etc.).
- There are different styles in both areas. There are styles such as classical, romantic, and expressionist in literature. There are styles such as gothic and renaissance in architecture.
- Spawning and decomposition times can be slow, sometimes taking centuries.
- In both of them, studies such as separating and associating their elements have been made. From this, he concludes that both types occur spontaneously.
- There are social and ideological effects of information systems. This situation can be explained as dialects in the language. In architecture, it can be described as the German Renaissance and the Italian Renaissance (Fischer, 2001)
- Language is not tangible, but architecture is tangible.
- Language is abstract, and architecture is concrete.
- Language takes place in the time dimension in practice. Architecture is included in the space dimension.
- The primary function of language is communication. The first function of architecture is to create space. (Lorenzer, 2000).

Because of these similarities, the linguistic system can be adapted to architecture. However, language principles cannot be applied directly to architecture due to differences. Linguistics does not invent a new language. It determines the derivational rules of the existing language and, as a result, reveals grammatical rules for unique formations. In architecture, the aim is not to present a new architecture. The aim here is to establish rules on existing ones. Early work on shape grammar was for analysis and critical purposes. For this reason it aims to make it visible by analysing the formal formation rules of a design language (Stiny, 1980). The art of architecture has unpredictable and multifaceted effects. For this reason he makes a kind of simplification to enable discussion, description and systematisation. In simplification,

it is often possible for complex structures to be misinterpreted or incompletely interpreted. However, this method is necessary to understand the whole.

3.3 Shape Grammar and History

The shape grammar method is used to examine the spatial organisations in the selected modern residential buildings within the scope of the thesis. A literature review and examples support the shape grammar method. The study creates a topological and geometric analogy background in Seyfi Arkan residential buildings.

The analytical thinking techniques behind the architectural language structure are as old as Vitruvius (Clarke and Crossley, 2000). Language structure is of two types. These natural languages are formed due to long development, and artificial languages are created for specific communications. Artificial languages are created with rule bases (Raphael, 1976). Rule groups are divided into two groups: syntax and semantic rule. Expressions in natural language are expressed with symbols on a computer base (Aksoy, 2001).

Each discipline has its own rules. Architecture has grammatical rules that make up its architectural languages. Architecture's primary means of expression are geometric elements, lines, and three-dimensional objects. It has been seen that Charles Correa made specific patterns in the buildings he built. It has specific geometric patterns. These patterns formed the architectural grammar rule set for Charles Correa (Rowland, 1964).

The architectural language constitutes the local architecture. This formation develops over a long period and repetitively. It is a combination of local architecture and regional architecture. Contemporary (1996) examines the structures, rules and elements while examining the architectural language. In this context, spatial components are analysed typologically. For the grammar obtained as a result of these

data to be valid, rules must be defined. Architecture is built on the form. For this reason, verbal expressions are insufficient (Aksoy, 2001).

When a study is made on the figures, the verbal expression of the rules is insufficient. Because it is difficult to express the features of the forms with words. Shape grammar rules provide a graphical way to formulate shapes (Flemming, 1987). With the set and shape grammar consisting of rules in A_B format, new builds or designs can be produced from the conditions at hand.

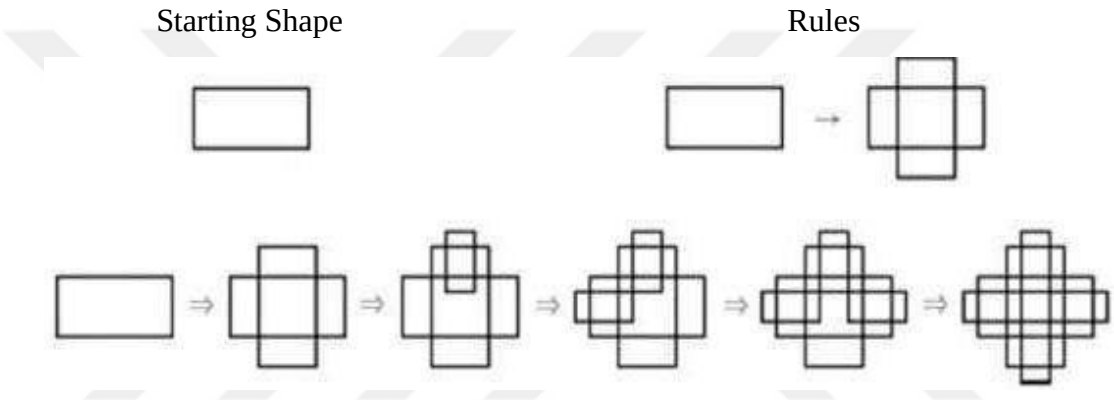


Figure 1. Applying the rule to the starting shape (Source: Knight and Stiny, 2001)

The word "Grammar" was used for the first time by Chomsky in a technical sense and was coined by George Stiny and James Gibs (1972) in the early 1970s. This concept formulates shape grammar to describe, create, and produce design languages. In short, shape grammar is not a rule base consisting of alphabets or symbols but a geometric-based study (Torus, 2011). These are presented to be defined with a specific algorithmic structure within the framework of rules (Aksoy, 2001). In his 1980 article, Stiny mentioned the Kindergarten form language over Froebel's building. Stiny aimed to produce a new alternative in architectural design with this method. Stiny stated that a new shape grammar needs five main parameters. These parameters are vocabulary, space organisation, shape rule, initial shape, and shape grammar (Aksoy, 2001). According to Noam Chomsky, shape grammar is similar to sentence structure. Sentences are formed with certain symbols, and specific sequences and patterns shape grammar due to rules (Stiny and Gips, 1972).

Ice-Ray shape grammar is the first application made. This was introduced to systematise the present analysis (Stiny, 1977). The second application is Palladian grammar, which analyses many architectural designs (Stiny and Mitchell, 1978). In this application, he showed that much more amorphous shapes (Terragni, Wright, Murcutt etc.) could be analysed with shape grammars. Later, Knight 1981 and Flemming 1990 created a new method by transforming grammar. This method includes processing, analysis, synthesis, and a new generation. Afterwards, the plan was developed by studying Bosnian House Typology, Çolakoğlu, Yingzao Fashi, Andrew Li, Alvaro Siza, and Jose Duarte (Knight, 1980).

In 1980, Gips and Stiny mentioned the existence of various ways to determine the sets of design objects:

1. Creating a catalogue of all the elements in the set (This method is not practical for every set. However, it may be of practical use for small sets. Steadman's rectangular division is an example of this method. Bloch later developed a proposal of Steadman to produce a catalogue of divisions up to eight rectangles (Bloch, 1979; Steadman, 1976).
2. Introducing one of the elements in the set and transformations to obtain other elements from this element (March and Steadman, 1971).
3. Presenting a computer program to generate the elements of the set (Krishnamurti, 1979).
4. Presenting a grammar for generating the elements of the set (Stiny and Mitchell, 1978).

In other words, shape grammar produces new shapes depending on a set of rules. Each shape grammar is unique and expected to produce different results. Just as no official language is the same for everyone, there is no definite shape grammar (Guzelci, 2012). However, single shape grammar can produce many shapes (Stiny and Gips, 1972; Wojtowicz and Fawcett, 1986).

3.4 Rule-Based Design and Shape Grammar

The rule-based design method is the traditional and computer-aided design method. This method has become a new topic for new research and discussion areas, especially with the rapid developments in informatics. Shape grammars are the most used rule-based design method based on shape and shape derivation. With the result of technology and software fields, research and discussions are carried out on new rule-based design methods. Since shape grammar methods will be used in the study, this method is emphasised. Shape grammars are a rule-based design method that produces shape compositions (Knight, 1981).

Table 1. The rule-based design methods:

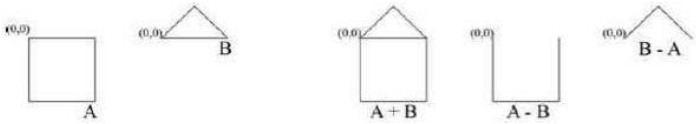
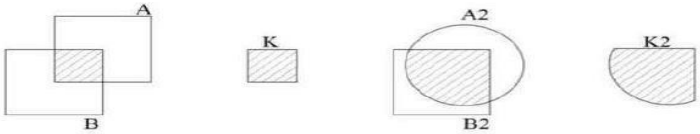
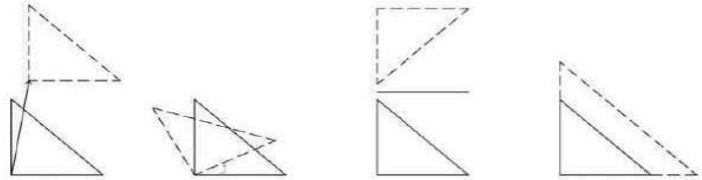
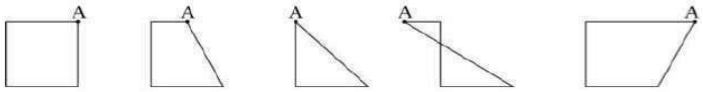
Operation on Shape Grammars		Mitchell grouped operations on shape grammars into four groups: 1. Boolean Operations: addition, subtraction, intersection Euclidean 2. transforms: translation, scaling, rotation, mirror image Making 3. parametric changes to a shape 4. Substitution of one shape for another (Mitchell, 1991)
	Difference in Shapes	The B shape is subtracted from the A shape to create a new A-B shape. (Knight, 1980). It contains lines that are in A and not in B.  *Addition and subtraction of two shapes (Source: Knight, 1980)*
	Boolean Operation	Mathematical operations are applied to a starting shape. "Boolean" operations can be described as mathematics based on adding and subtracting geometric planar shapes like mathematical methods (Aksoy, 2001).
	Intersection of Shapes	The K shape, which results from the intersection of A and B, contains the lines in both A and B. The intersection of A and B, which includes the line parts common to both shapes, is a sub-shape of both A and B (Aksoy, 2001).  *Intersection of shape (Source: Knight, 1980)*

Table 1 (continued). The rule-based design methods

	Euclidean Transforma-tions	- The concept of translation is a transformation in which the shape and position are kept constant but their position changes. - The concept of rotation is the shape of the shape, and the transformation that keeps a single point fixed and move. - The concept of scaling is the transformation in which the shape is changed proportionally. - The concept of mirroring is the transformation that keeps the shape's shape constant and moves it relative to the x and y axes.  Translation Rotation Mirroring Scaling *Euclidean transformations (Source: Knight, 1980)*
	Parametric Changes	The fact that the coordinates of the vectors that make up the shape are variable indicates that the shape is parametric. In assigning values to parameters, exceptional cases occur for that shape (Mitchell, 1986). This change can lead to a complete shift in the original condition.  *Variations as a result of changing the parameter of point A (Source: Knight, 1980)*
	Study on Shape Substitution	It is the process in which the shapes are changed without disturbing the number of conditions that make up the composition and their relationship with each other. (Sener, 1993; Aksoy, 2001).
	Collection of Shapes	The A shape is added to the B shape to produce the A+B shape. The A+B shape includes all the lines in the A and B shapes (Knight, 1980).

3.5 Studies on Shape Grammar

The shape grammar method is used for analytical research. This method sets a shape as the cornerstone. Later, additions are made to this main figure. In additions, differentiations such as merger, separation, growth or shrinkage are observed. In this context, the analyses on some structures located abroad were examined.

3.5.1 Chinese Ice Rays

In 1949, Daniel Sheets Dye compiled a catalogue of Chinese window lattices produced between 1000 and 1900 BC. Stiny analysed them from 1977 with a shape grammar consisting of 5 rules.

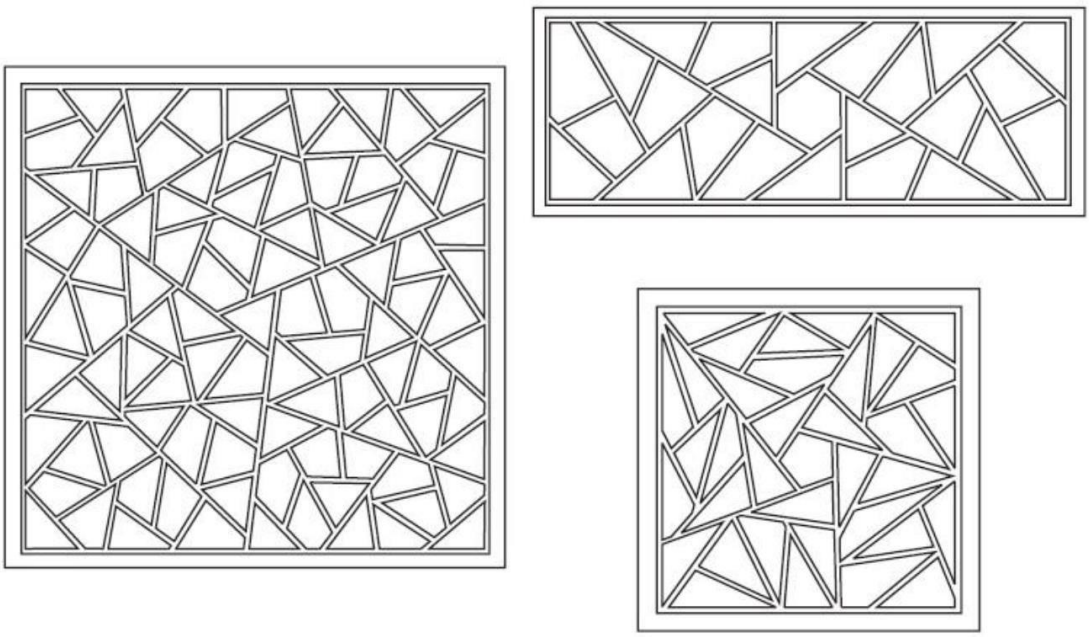


Figure 2. Chinese Ice Rays (Source: Stiny, 1977)

- Rule 1: By passing a line between the side of the triangle taken as the initial shape, it forms a triangle and an irregular quadrilateral.
- Rule 2: Applicable for irregular quadrilaterals. The line drawn between the two sides of a quadrilateral aims to divide the shape into a triangle and a pentagon.

- Rule 3: Applicable for irregular quadrilaterals. The line drawn between the two sides of a quadrilateral aims to divide the shape into a triangle and a pentagon.
- Rule 4: It is a rule applicable to pentagons. Produces a quadrilateral or pentagon from the shape.
- Rule 5: Deleting the dot symbol from the beginning (Stiny, 1977)

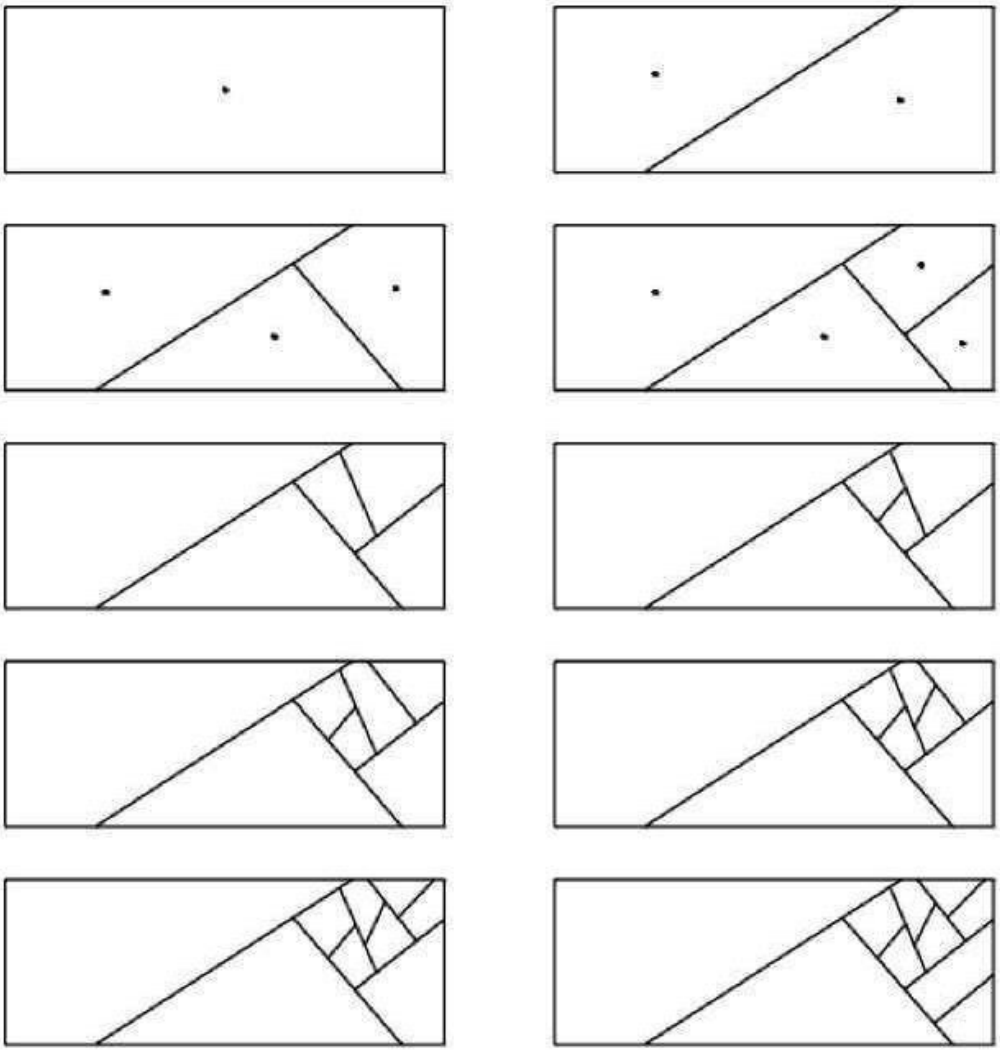


Figure 3. Rules diagrams (Source: Stiny, 1977)

3.5.2 Stirling & Gowan's Leicester Engineering Building

It was studied in 1986 by Wojtowicz and Fawcett. The building consists of 9 geometric components that can come together to produce many alternatives.

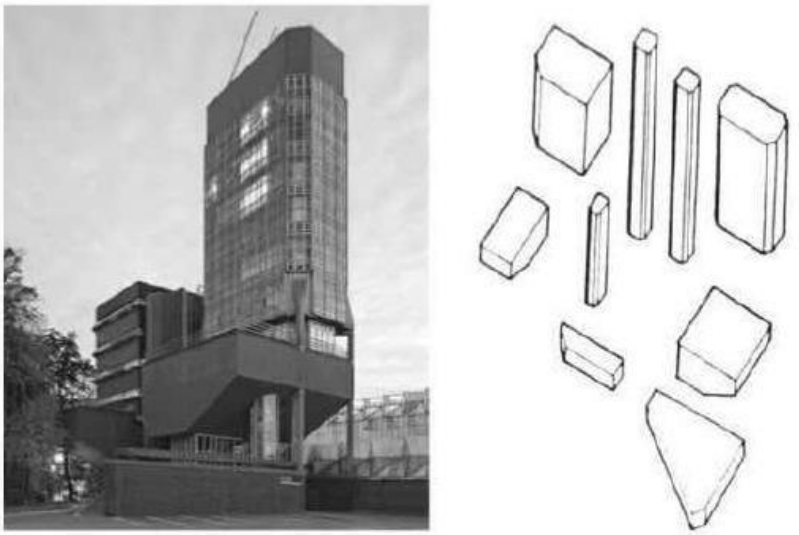


Figure 4. Building and components (Source: Wojtowicz and Fawcett, 1986)

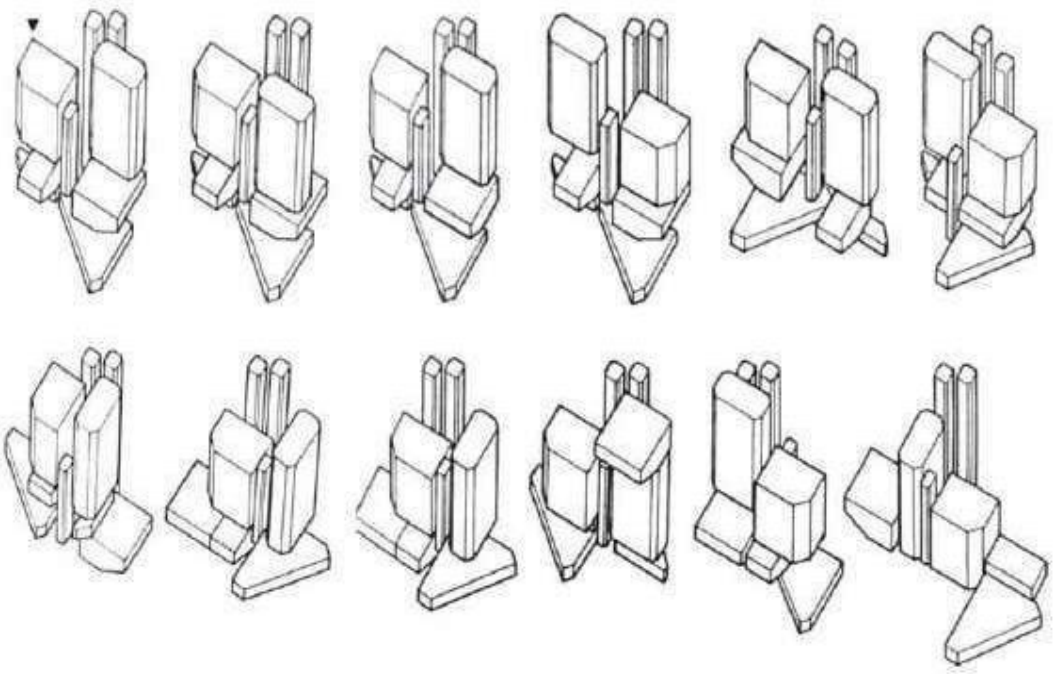
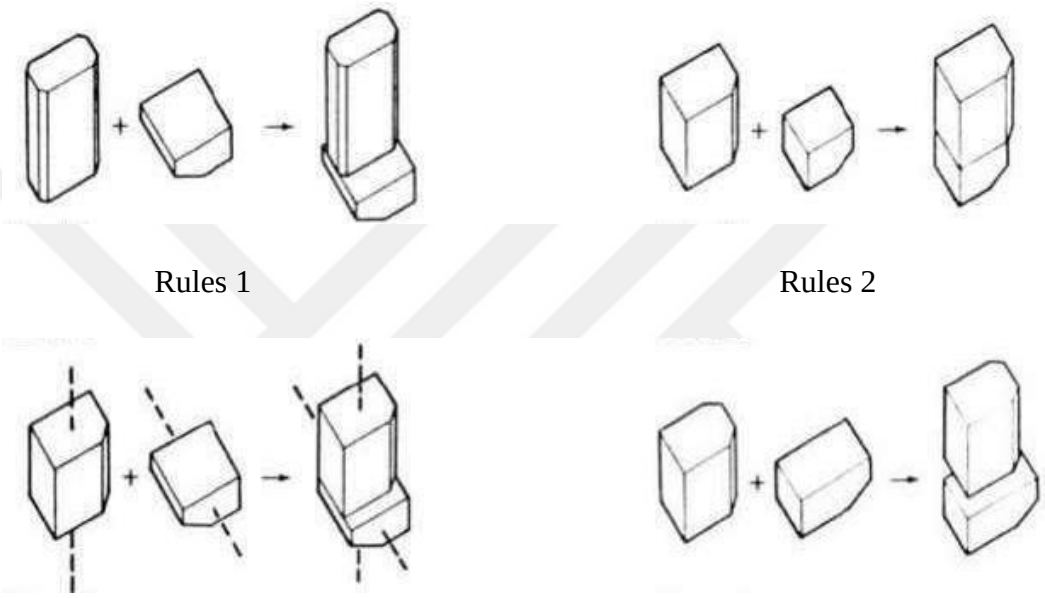


Figure 5. Design alternatives (Source: Wojtowicz and Fawcett, 1986)

However, four rules have been determined for these alternatives to be a good design.

- Rule 1: The blocks with higher heights should be placed above the lower ones.
- Rule 2: Blocks with the same number of surfaces can contact each other.
- Rule 3: Blocks whose axes form right angles to each other can come into contact.
- Rule 4: Blocks with different surface numbers cannot touch.



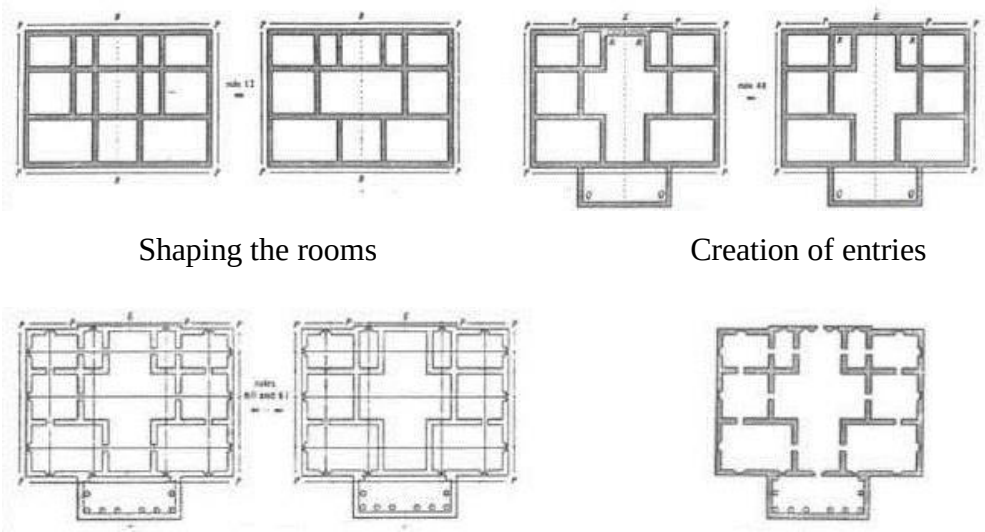
Rules 1 Rules 2

Rules 3 Rules 4

Figure 6. Rules diagrams (Source: Wojtowicz ve Fawcett, 1986)

3.5.3 Villas of Palladio

In 1978, Stiny and Mitchell developed a shape grammar based on ground floor plans to define Palladio's architectural style. This study is the first shape grammar study for residential architecture. The path followed in light of the information obtained from Palladio's book titled "I guattro dell Architectura" has eight stages.



Shaping the rooms | Creation of entries

Opening door and window spaces | Villa Malcontenta

Figure 7. Villa Malcontenta production and rules (Source: Stiny ve Mitchell,1978)

The characteristic features and shapes of the villas are determined, allowing the classification of estates' with similar characteristics. The study can be improved by adding different elements.

Stiny and Mitchell has a production in eight steps. Rules are designed for situations that are likely to happen at each stage. The grammatical patterns of shape created on Palladio's villas explain only a part of Palladio's architectural style. For this reason, a more comprehensive study is required. In this study, two-dimensional shape grammar shows the shapes and characters of the villas (Sass, 2001).

3.5.4 Frank Lloyd Right Country Houses

The study, developed by Koning and Eizenberg in 1981, examined the style rules of Frank Lloyd Wright's country houses. It has been determined that these rules allow reproduction. Rectangular prisms were used as the initial form of the study, carried out on 11 country houses. In blocks of fixed height but variable height and width, the fireplace location plays a key role (like the point in the Chinese Ice Rays). Eighteen

rules in the production process start after the fireplace placement. By applying these rules, 89 different country houses were produced.

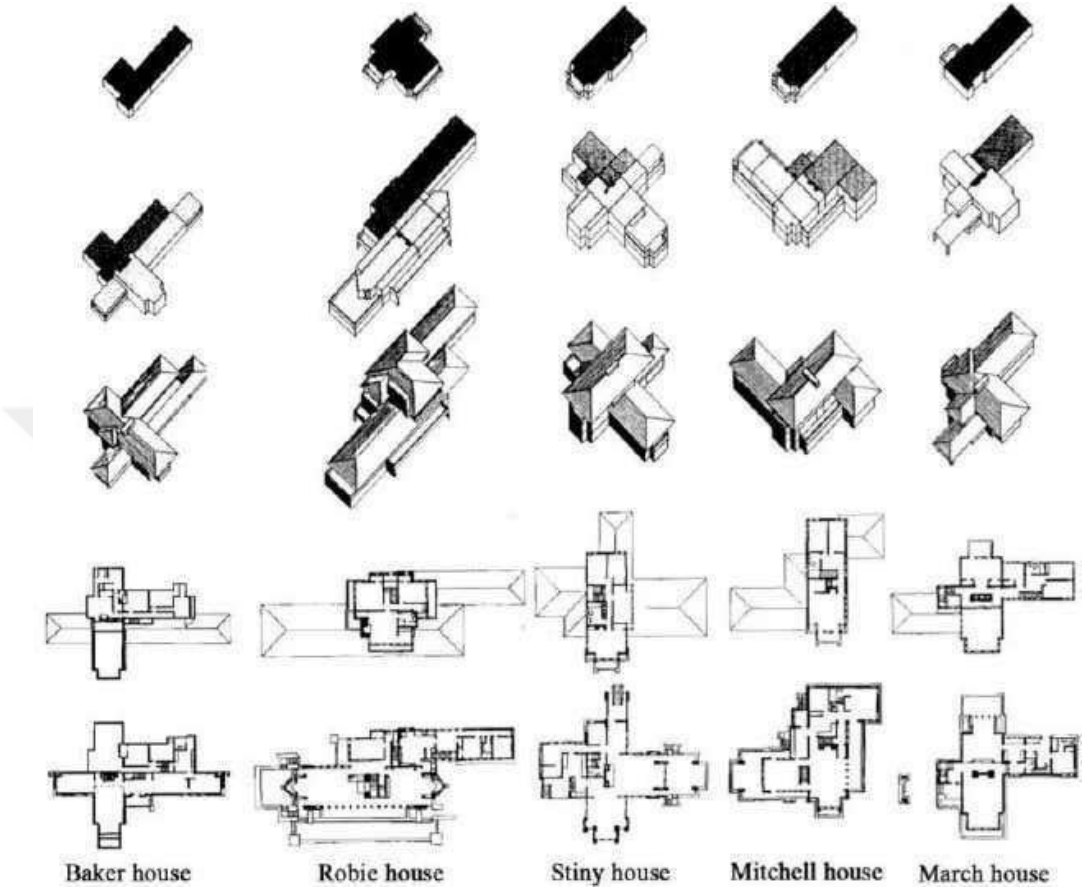


Figure 8. Existing manufactured cottages (Source: Konning and Eizenberg, 1981)

As a result, shape grammars were developed that produced Wright's cottages, unlike what Wright did. In 1994, Knight aimed to show the remarkable change in the effects of a slight change in grammar. For this reason, he studied transforming Wright's early country houses into late Usonian homes (Aksoy, 2001).

3.5.5 Queen Anne Houses

The Queen Anne Houses started in 1880 and spent 30 years in the process of formation and emerged in America as a result of a local architectural movement. In 1987 these houses were analysed by Ulrich Flemming. Flemming determined that countless

designs can be derived from the complex roof shapes of these houses with three rules (March and Steadman, 1971).

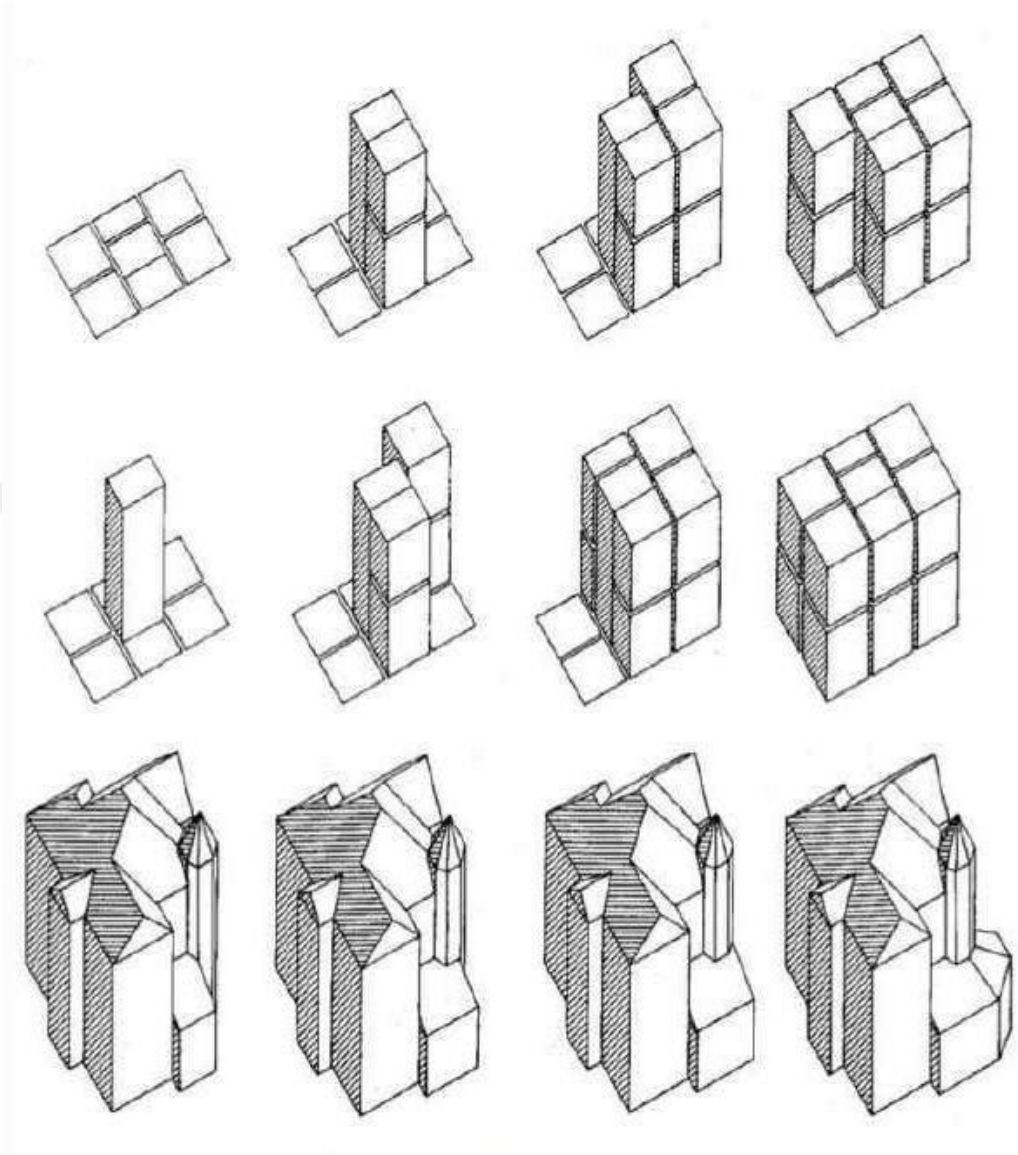


Figure 9. Queen Anne Houses production process (Source: Flemming, 1987)

3.5.6 Malagueira Houses

In 2001, Alvarı Siza's Malagueira Houses were analysed and computerised by Duarte. After specific parameters are entered into the programming language, houses are produced in the same design language as these houses. The reason for the success of the study is that the architect's design language is successful in shape grammar.

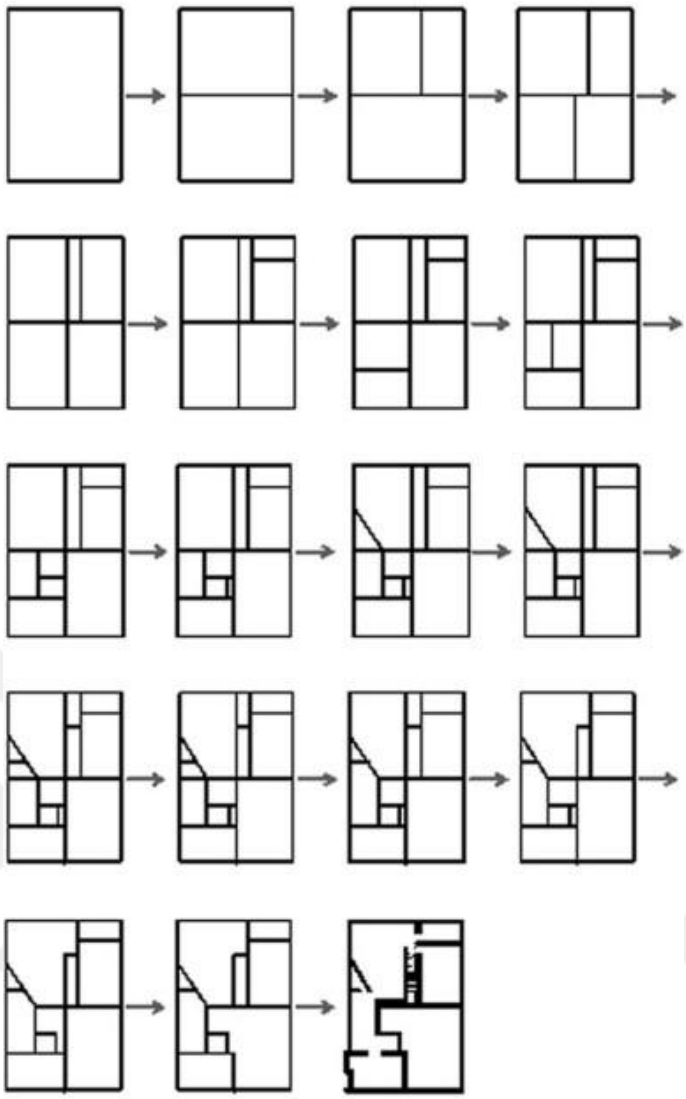


Figure 10. Malagueira Houses (Source: Speller, et al., 2007)

There are between one and five bedrooms. It is a project with 1200 residences and is designed in 8x12 dimensions. Houses have the opportunity to intervene by their owners. As a result of the examination of the houses, it is seen that the same type of buildings are gathered together. Experiments have been made for the structure and these experiments have been derived according to the desired purpose. As a result, it has been seen that the shape grammar is clear in these structures. The reason for this is Siza's designs, which are prone to shape grammar (Duarte, 2001).

3.5.7 Traditional Amasya Yalıboyu Houses

Gülen Çağdaş analysed Turkish houses built in Anatolia and Rumelia over 500 years in 1996. Turkish dwellings, with shape grammars, have spatial relations by the rules. In 1984, she studied the classification of Turkish Houses according to Eldem's plan typologies. As a result, groups were developed over two dimensions.

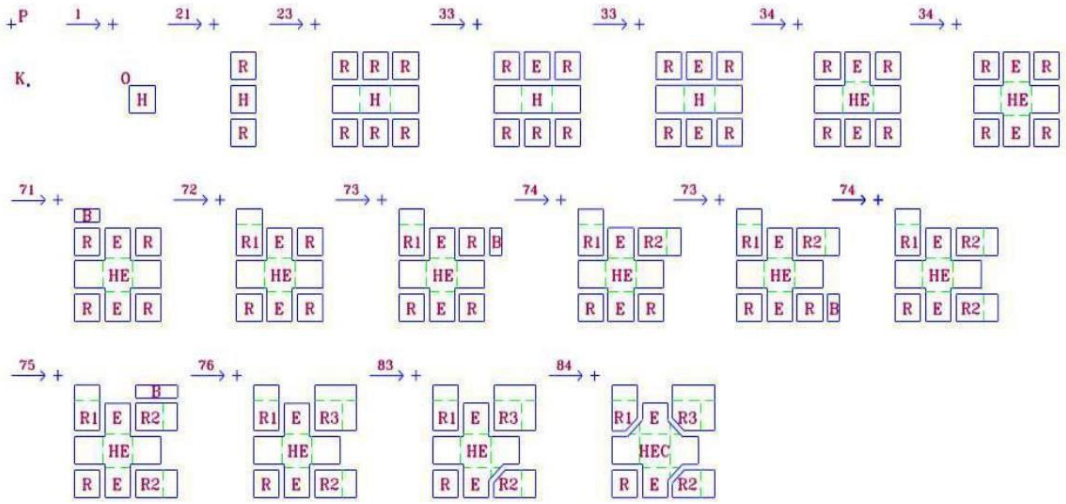


Figure 11. Example of plan production for traditional Turkish house (Source: Çağdaş, 1996)

Gülen Çağdaş analysed the Amasya Yalıboyu houses of the shape grammars he developed in 1996. To obtain new derivations from these analyses, it was studied as a master's thesis by Güzelci in 2012. Twenty houses have been inspected, and an 11-stage rule system has been established. The first eight stages are the rule systems that Çağdaş has derived for Traditional Turkish Houses (Çağdaş, 1996).

- Rule 1: Determination and positioning of sofa type
- Rule 2: Determination and positioning of the number of rooms
- Rule 3: Checking if there is an iwan; if there is, determine their number and location
- Rule 4: Checking whether there is an additional room or service space in the plan type with an outer sofa and, if there is, determine their number and location

- Rule 5: Checking whether there are additional rooms in the plan type with an inner sofa
- Rule 6: Checking whether there is an additional sofa; if there is, determine their number and places
- Rule 7: Control and location of overhangs and balconies
- Rule 8: Checking for chamfered room corners
- Rule 9: Determining the type, number, and position of windows on the facades facing the river
- Rule 10: Checking for a ladder, and if so, determine its type and location
- Rule 11: Determining the way of entering the house

Shape grammars break down unidentified areas of the design process and sets rules. It is then shown that these rules can result in different products even if they have the same language. The whole concept is different from the sum of its parts, which are the rules by which various doers come together. Analysing the factors affecting the designer in the design processes on the analytical plane depends on the determination of these rules systems. Derivations that do not comply with the rule do not make sense or go beyond simple imitations. Examined examples deal partially with shape grammar. In the coming years, it is expected that analysis studies will be carried out in all contexts that affect designs.

CHAPTER 4: SEYFİ ARKAN, ARCHİTECTURE AND ANALYSIS OF HOUSING PROJECTS

The projects selected within the scope of the thesis are architectural structures built by Seyfi Arkan. Seyfi Arkan has produced a wide variety of housing projects. All selected buildings are grouped within the housing typology. The reason for this situation is the comparison of housing structures with the same function with each other.

Analytical studies were carried out for 22 projects designed by Seyfi Arkan. Arkan's designs are divided into private property, apartment, and social housing categories. The selected buildings are grouped into nine private property types, five apartment types, and eight social housing types. Buildings have their characteristics due to their functions. These features are seen as the number of rooms in the building, the number of sofas, floor number difference, room function differences, WC and bathroom numbers, storage areas, and plan design.

The shape grammar method was used to analyze the selected structures. Shape grammars show the progression of designs in structures. Within the scope of the thesis, analytical grammatical analysis of Seyfi Arkan architectural structures has been studied. The geometry of the buildings, their dimensions, and the layout of the space was also analyzed to support the interpretation of shape grammar.

In Seyfi Arkan's buildings, the design geometry of the structures, the dimensions of the building units, and the relationships between the spatial bonds were also examined. Design geometries show the formal forms of plans and building units (room, sofa, WC, etc.). It also shows the functions of the building units. The functions and numbers of structural units form the basis for the formation of shape grammars. The dimensions of the building units aim to support the data obtained as a result of shape grammar. In addition to creating a similarity as a pattern, a proportional similarity was also examined. The relations between the spaces show the communication between the

structures forming the pattern in the shape grammar. It shows the relationship between spatial organizational structure units.

In this section, form grammars of architectural structures are schematized in 4.1. In 4.2, buildings are studied geometrically. In 4.3, a comparative analysis of the data obtained from these analyzes is made. In 4.4, the conclusion drawn from all the received data is explained.

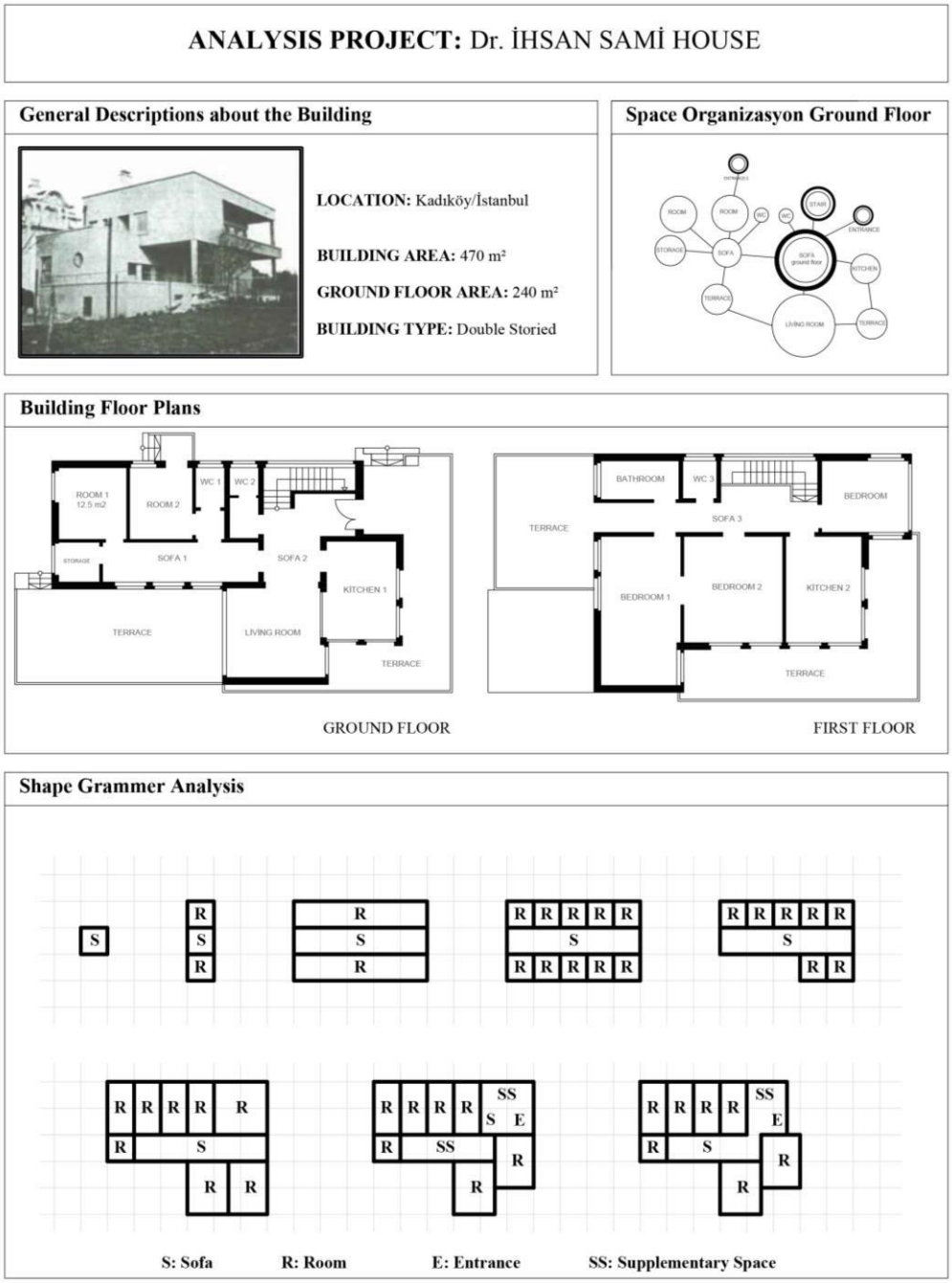
In the explanations at the bottom of each table, there are interpretations of the subjects examined within the scope of the thesis, belonging to the relevant structure. These explanations include the topics researched as standard in the structures. For this reason, the answers to the questions below form the basis for interpretation.

- Is the sofa the basic building unit?
- Have room units been added to the sofa building element?
- Have there been any reductions in the number of rooms while designing the building?
- Has there been an increase in the number of rooms while designing the building?
- Is there a transition to the sofa volume?
- Is there an increase in the volume of the sofa?
- Are there any mergers between the building units?
- Are there divisions between building units?
- Is there a volumetric outward progression in the structure?
- Is there also a volumetric progression inward in the building?
- Is there a pattern of shapes on the horizontal axis?
- Is there a pattern of shapes on the vertical axis?

4.1 Shape Grammar Analysis of Seyfi Arkan Housing Projects

-Dr. Ihsan Sami House Project Analysis

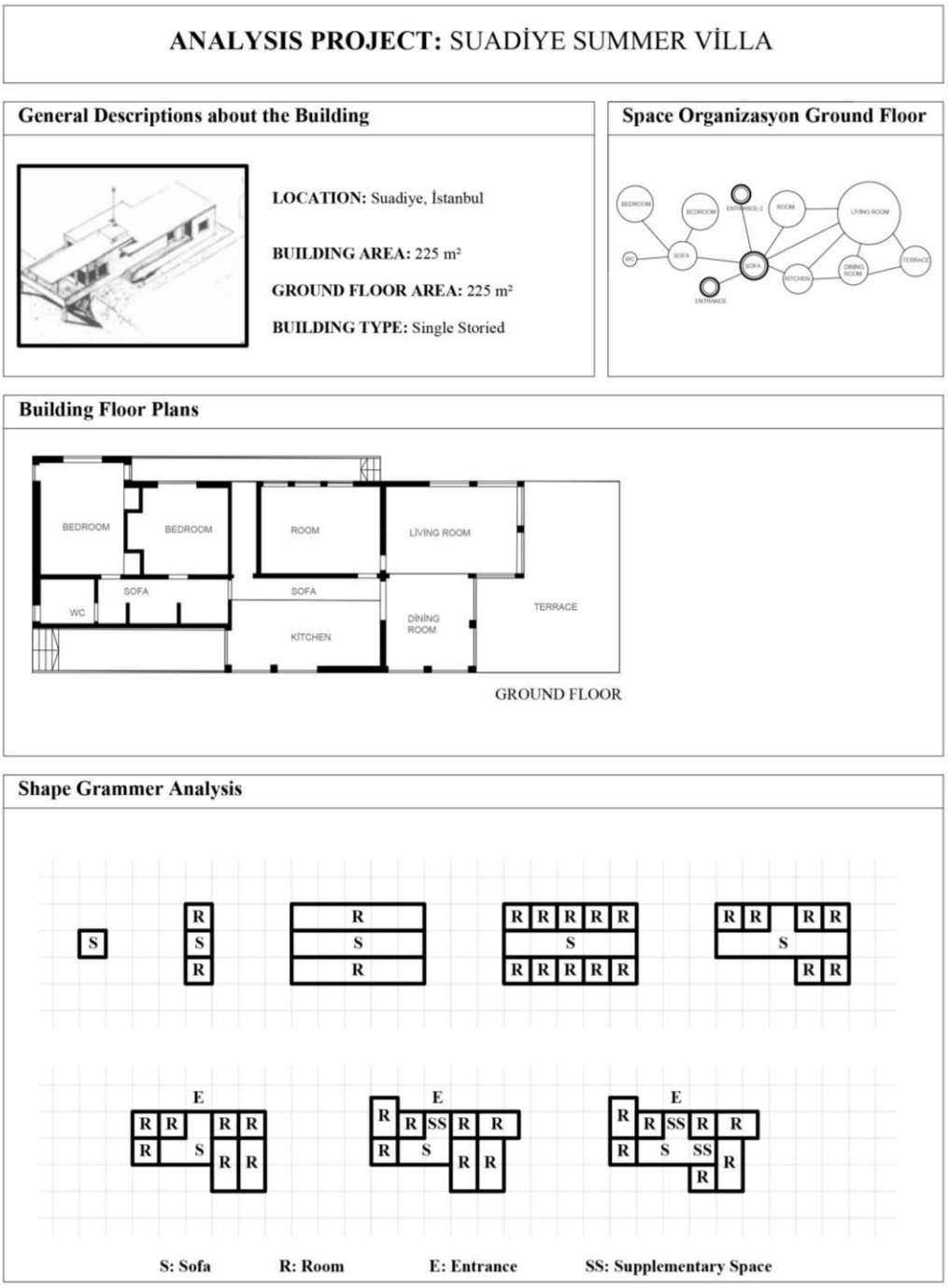
Table 2. Dr Ihsan Sami House Project ground floor typographic analysis



The sofa is the basic building unit. Room units have been added. As a result of the building design, some of the rooms are missing. There is a transition to the volume of the sofa. There are mergers between the building units. There is a decrease in the volume of the sofa. There is also an outward volumetric progression. There is a pattern of shapes on the horizontal axis.

- Suadiye Summer Villa Project Analysis

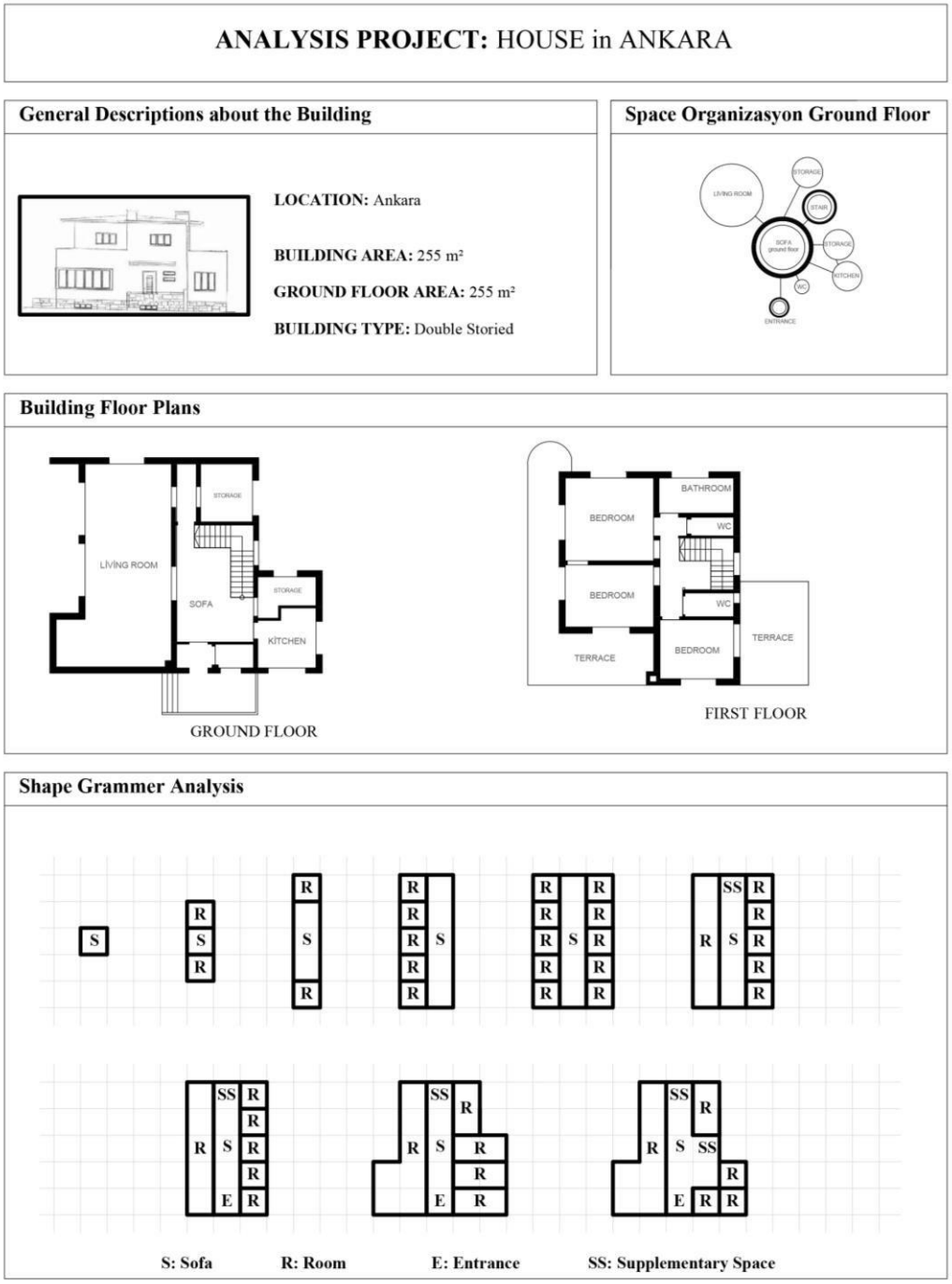
Table 3. Suadiye Summer Villa Project ground floor typographic analysis



The sofa is the basic building unit. Room units have been added. As a result of the building design, some of the rooms are missing. There is a transition to the volume of the sofa. There are mergers between the building units. There is a decrease in the volume of the sofa. There is also an outward volumetric progression. There is a pattern of shapes on the horizontal axis.

- Home in Ankara Project Analysis

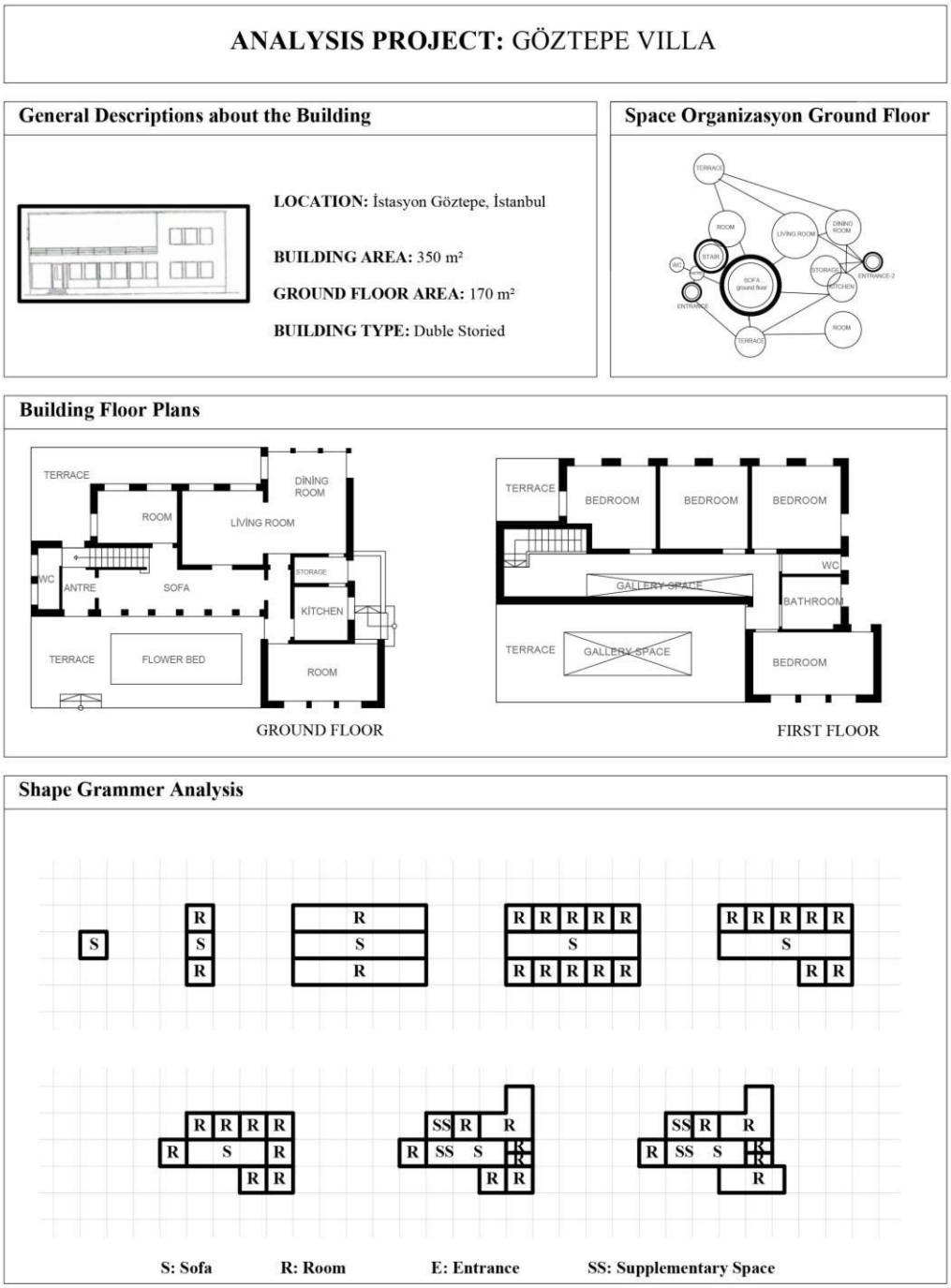
Table 4. Home in Ankara Project ground floor typographic analysis



The sofa is the basic building unit. Room units have been added. As a result of the building design, there is an increase in the number of rooms and convergences between room volumes. There is a transition to the volume of the sofa. There are mergers between the building units. There is an increase in the volume of the sofa. There is also an outward volumetric progression. There is a pattern of shapes on the vertical axis.

- Göztepe Villa Project Analysis

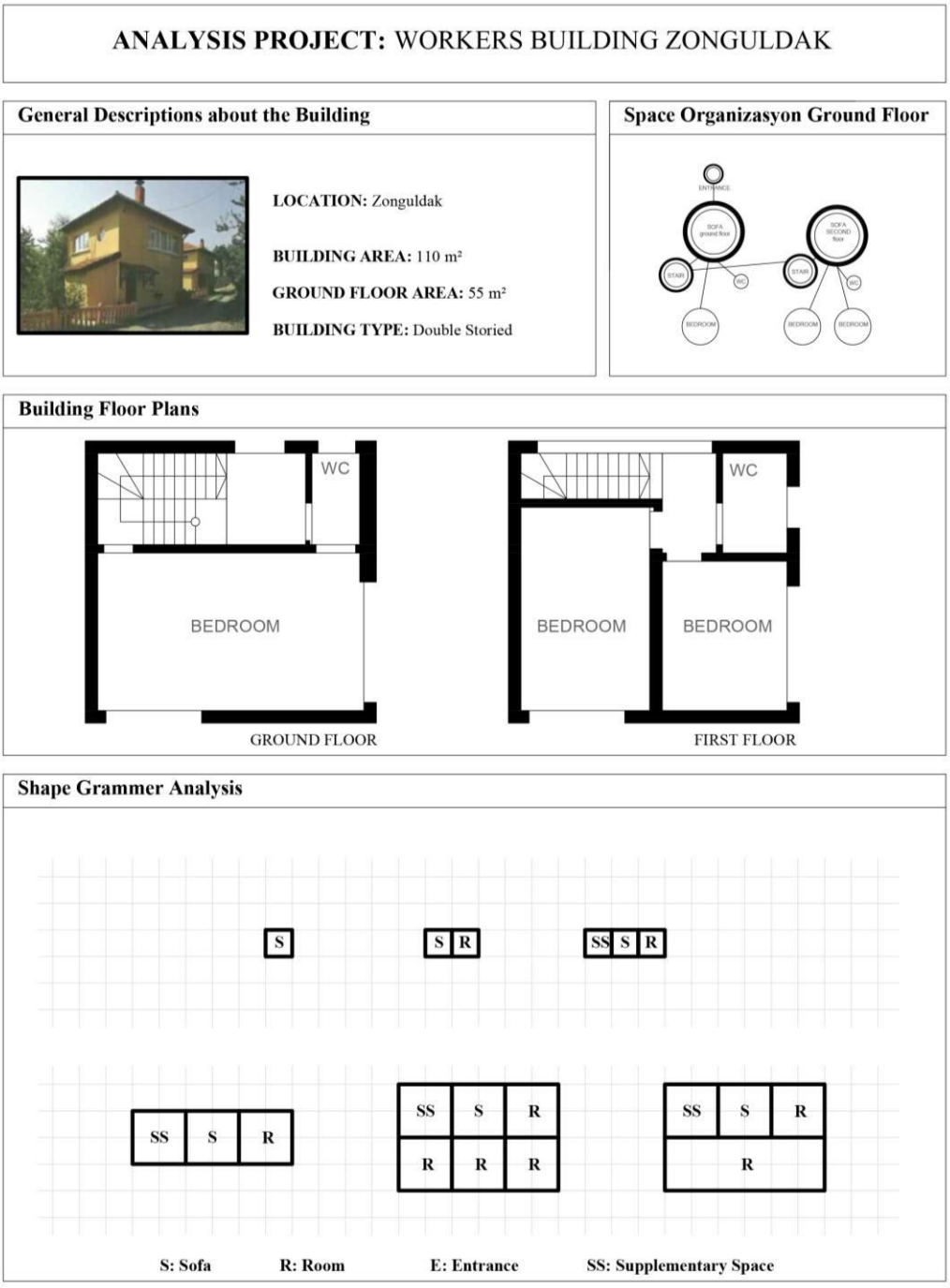
Table 5. Göztepe Villa Project ground floor typographic analysis



The sofa is the basic building unit. Room units have been added. As a result of the building design, some of the rooms are missing. There is a transition to the volume of the sofa. There are mergers between the building units. There is a decrease in the volume of the sofa. There is also an outward volumetric progression. There is a pattern of shapes on the horizontal axis.

- Working on Building Zonguldak Project Analysis

Table 6. Working Building Zonguldak Project ground floor typographic analysis



The sofa is the basic building unit. Room units have been added. There is a transition to the volume of the sofa. There are mergers between the building units. There is a decrease in the volume of the sofa. There is only a one-sided shape pattern on the horizontal axis.

- Kozlu Coal Iş C-D* Type *Home Project Analysis

Table 7. Kozlu Coal Iş C-D Type Home Project ground floor typographic analysis

ANALYSIS PROJECT: KOZLU COAL - İŞ C-D TIP HOUSE

General Descriptions about the Building

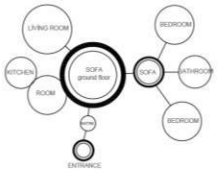
LOCATION: Zonguldak

BUILDING AREA: 110 m²

GROUND FLOOR AREA: 110 m²

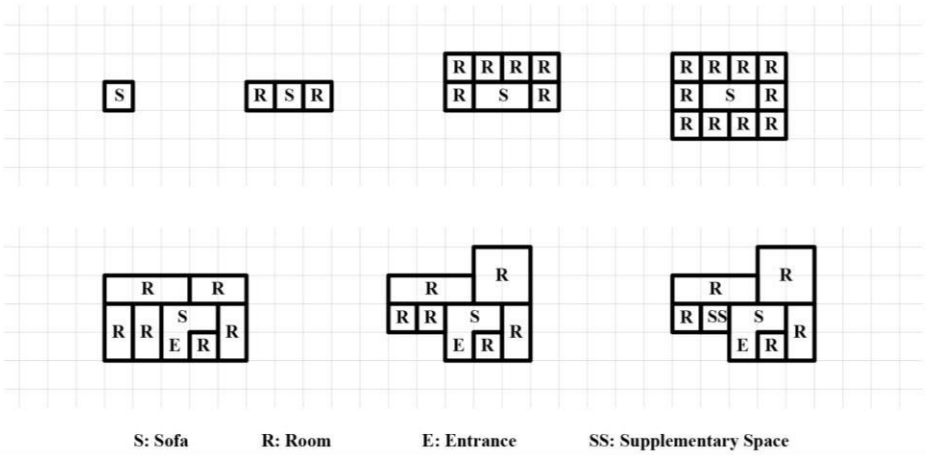
BUILDING TYPE: Single Storied

Space Organizasyon Ground Floor



Building Floor Plans

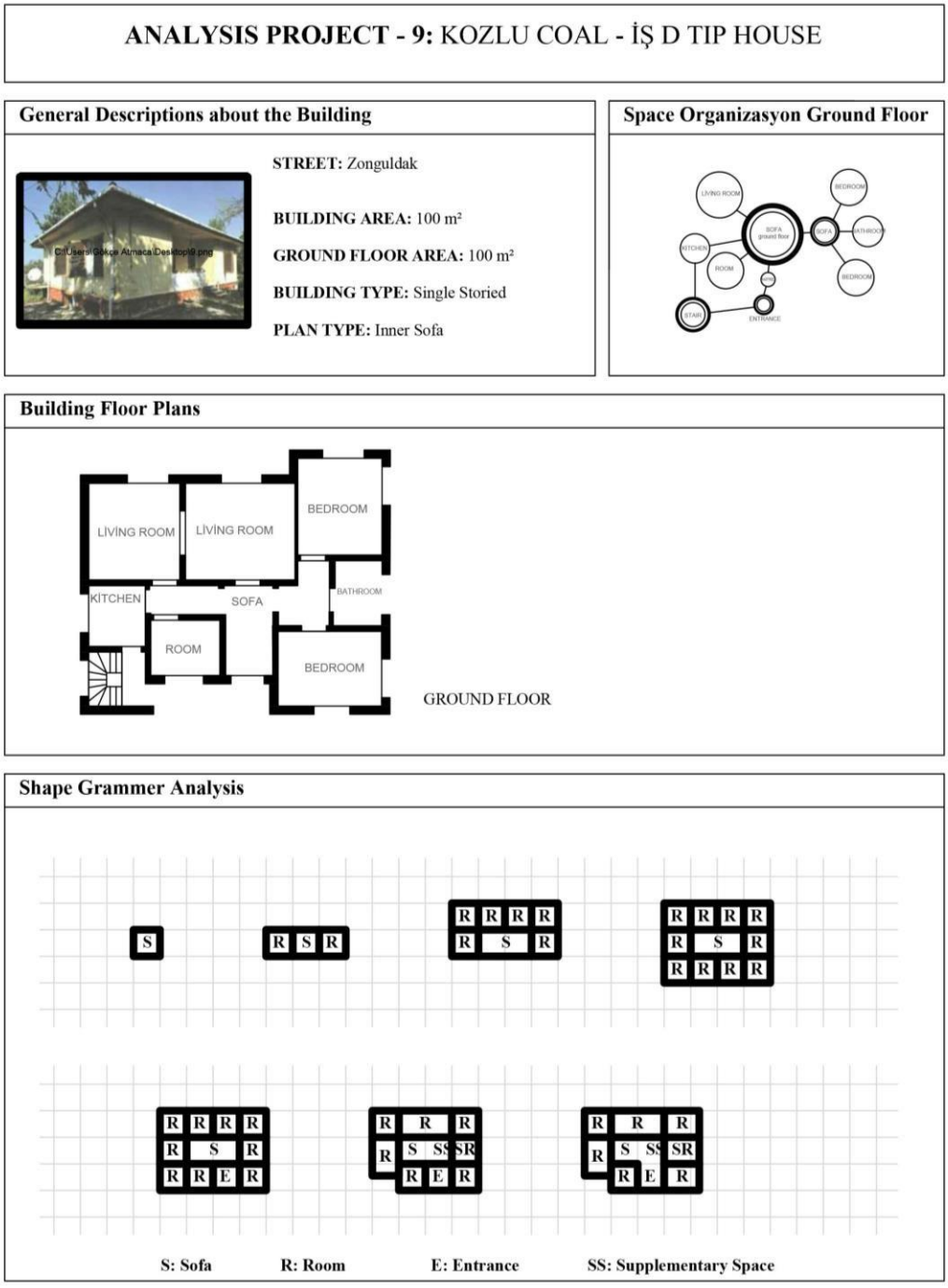
Shape Grammer Analysis



The sofa is the basic building unit. Room units have been added. As a result of the building design, some of the rooms are missing. There is a transition to the volume of the sofa. There are mergers between the building units. There is a decrease in the volume of the sofa. There is also an outward volumetric progression. There is a pattern of shapes on the horizontal axis.

- Kozlu Coal Iş D Type Home Project Analysis

Tablo 8. Kozlu Coal Iş D Type Home Project ground floor typographic analysis



The sofa is the basic building unit. Room units have been added. As a result of the building design, some of the rooms are missing. There is a transition to the volume of the sofa. There are mergers between the building units. There is a decrease in the volume of the sofa. There is also an outward volumetric progression. There is a pattern of shapes on the horizontal axis.

- Kozlu Coal Iş E Type Home Project Analysis

Table 9. Kozlu Coal Iş E Type Home Project ground floor typographic analysis (just single house)

ANALYSIS PROJECT - 10: KOZLU COAL - İŞ E TIP HOUSE

General Descriptions about the Building

STREET: Zonguldak

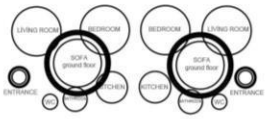
BUILDING AREA: 290 m²

GROUND FLOOR AREA: 290 m²

BUILDING TYPE: Single Storied

PLAN TYPE: Inner Sofa

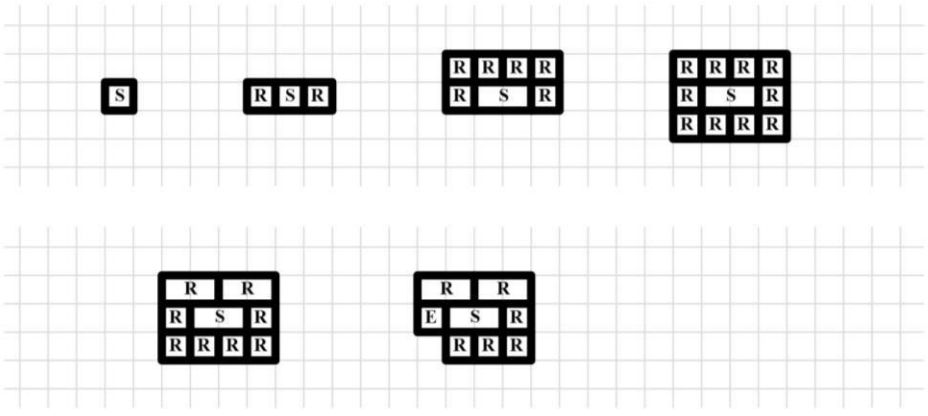
Space Organizasyon Ground Floor



Building Floor Plans

GROUND FLOOR

Shape Grammer Analysis



S: Sofa **R: Room** **E: Entrance** **SS: Supplementary Space**

The sofa is the basic building unit. Room units have been added. As a result of the building design, some of the rooms are missing. There is a transition to the volume of the sofa. There are mergers between the building units. There is a decrease in the volume of the sofa. There is a pattern of shapes on the horizontal axis.

- Cemal Bey Apartment Project Analysis

Table 10. Cemal Bey Apartment Project ground floor typographic analysis (just single house)

ANALYSIS PROJECT: CEMAL BEY APARTMENT

General Descriptions about the Building

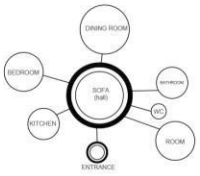
LOCATION: Yenişehir, Ankara

BUILDING AREA: 1020 m²

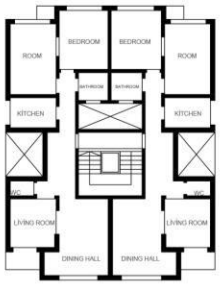
GROUND FLOOR AREA: 255 m²

BUILDING TYPE: Apartment

Space Organizasyon Ground Floor

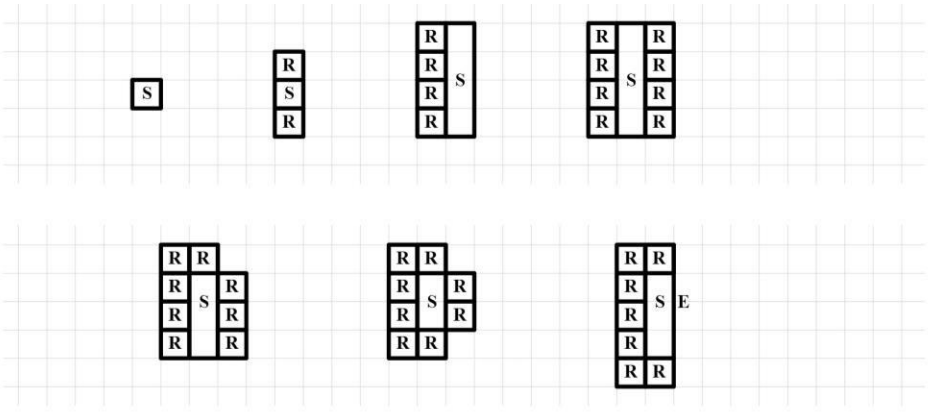


Building Floor Plans



GROUND FLOOR

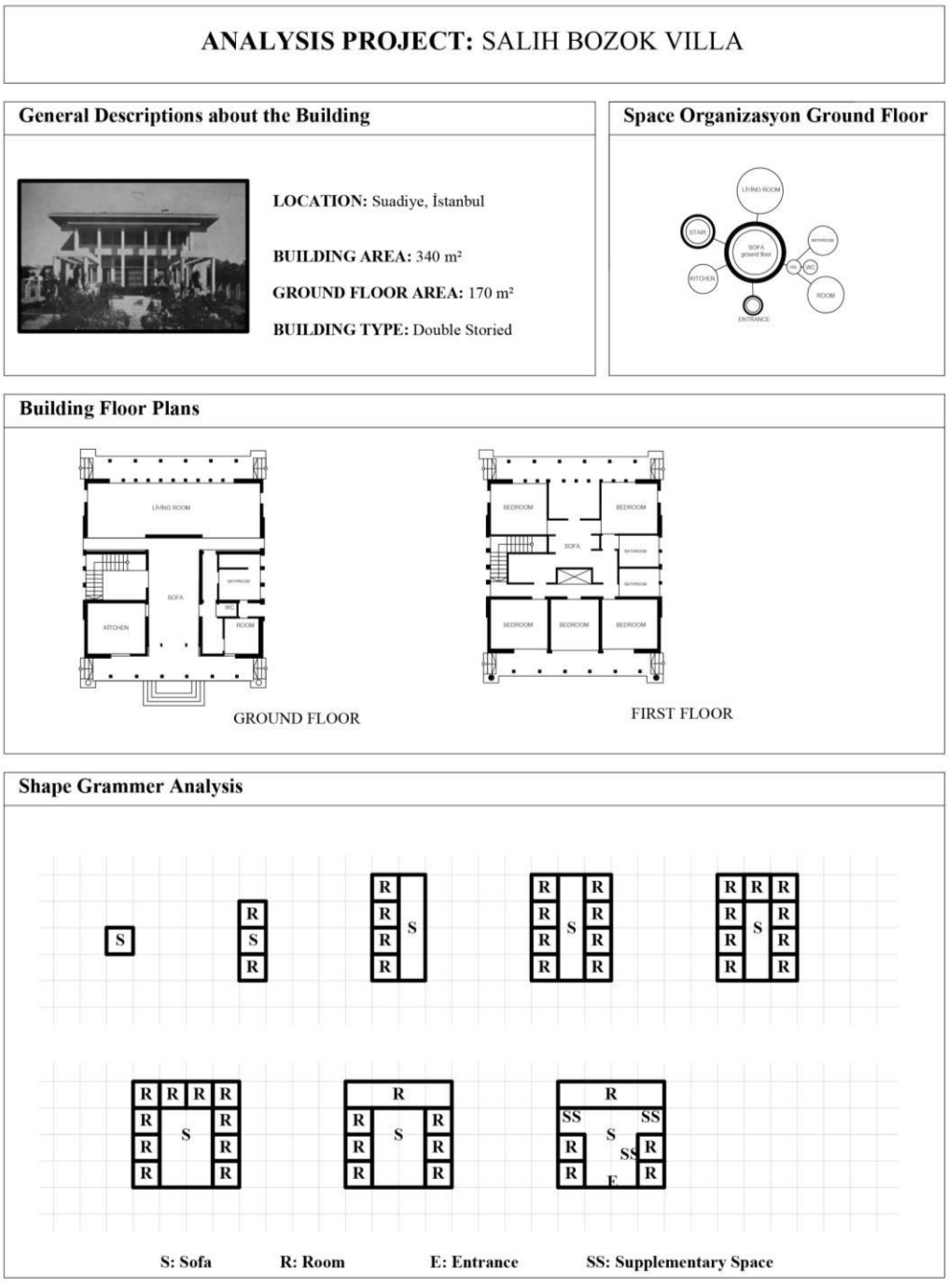
Shape Grammer Analysis



The sofa is the basic building unit. Room units have been added. As a result of the building design, some of the rooms are missing. There is a transition to the volume of the sofa. There are mergers between the building units. There is a decrease in the volume of the sofa. There is also an outward volumetric progression. There is a pattern of shapes on the vertical axis.

- Salih Bozok Villa Project Analysis

Table 11. Salih Bozok Villa Project ground floor typographic analysis



The sofa is the basic building unit. Room units have been added. As a result of the building design, some of the rooms are missing. There is a transition to the volume of the sofa. There are mergers between the building units. There is a decrease in the volume of the sofa. There is a pattern of shapes on the vertical axis.

- Adana Cheap Houses Neighborhood Type -A Project Analysis

Table 12. Adana Cheap Houses Neighborhood Type -A Project ground floor typographic analysis (just single house)

ANALYSIS PROJECT: ADANA CHEAP HOUSES NEIGHBORHOOD TIP-A

General Descriptions about the Building

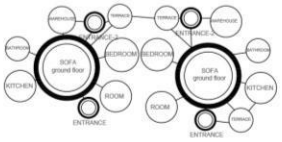
LOCATION: Adana

BUILDING AREA: 120 m²

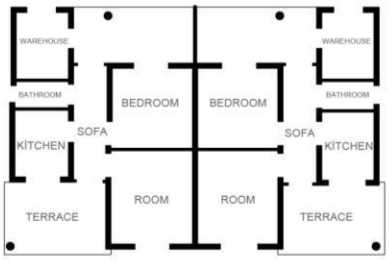
GROUND FLOOR AREA: 120 m²

BUILDING TYPE: Single Storied

Space Organizasyon Ground Floor

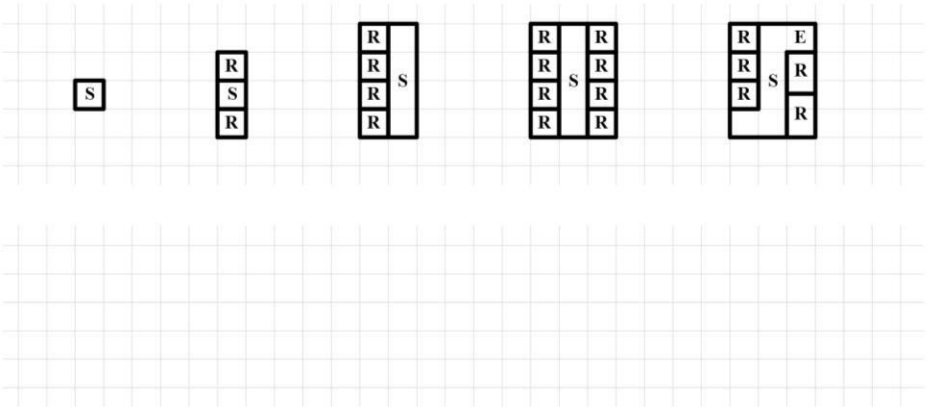


Building Floor Plans



GROUND FLOOR

Shape Grammer Analysis



S: Sofa **R: Room** **E: Entrance** **SS: Supplementary Space**

The sofa is the basic building unit. Room units have been added. As a result of the building design, some of the rooms are missing. There are mergers between the building units. There is a pattern of shapes on the vertical axis.

- ***Adana Cheap Houses Neighborhood Type -B Project Analysis***

Table 13. Adana Cheap Houses Neighborhood Type -B Project ground floor typographic analysis (just single house)

ANALYSIS PROJECT: ADANA CHEAP HOUSES NEIGHBORHOOD TIP-B

General Descriptions about the Building

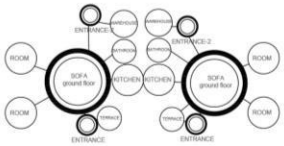
LOCATION: Adana

BUILDING AREA: 140 m²

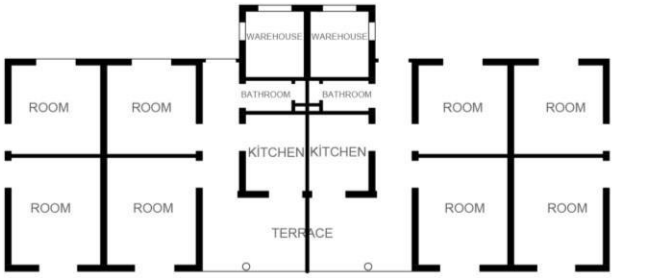
GROUND FLOOR AREA: 140 m²

BUILDING TYPE: Single Storied

Space Organizasyon Ground Floor

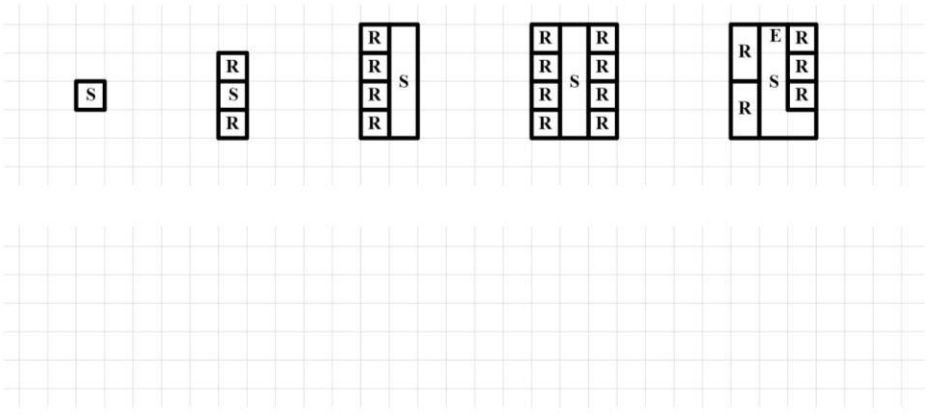


Building Floor Plans



GROUND FLOOR

Shape Grammer Analysis



S: Sofa **R: Room** **E: Entrance** **SS: Supplementary Space**

The sofa is the basic building unit. Room units have been added. As a result of the building design, some of the rooms are missing. There are mergers between the building units. There is a pattern of shapes on the vertical axis.

- Adana Cheap Houses Neighborhood Type -C Project Analysis

Table 14. Adana Cheap Houses Neighborhood Type -C Project ground floor typographic analysis (just single house)

ANALYSIS PROJECT: ADANA CHEAP HOUSES NEIGHBORHOOD TIP-C

General Descriptions about the Building

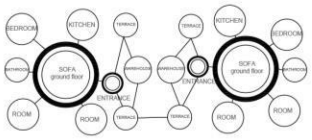
LOCATION: Adana

BUILDING AREA: 160 m²

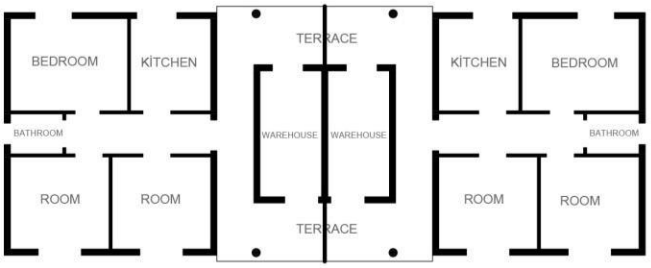
GROUND FLOOR AREA: 160 m²

BUILDING TYPE: Single Storied

Space Organizasyon Ground Floor

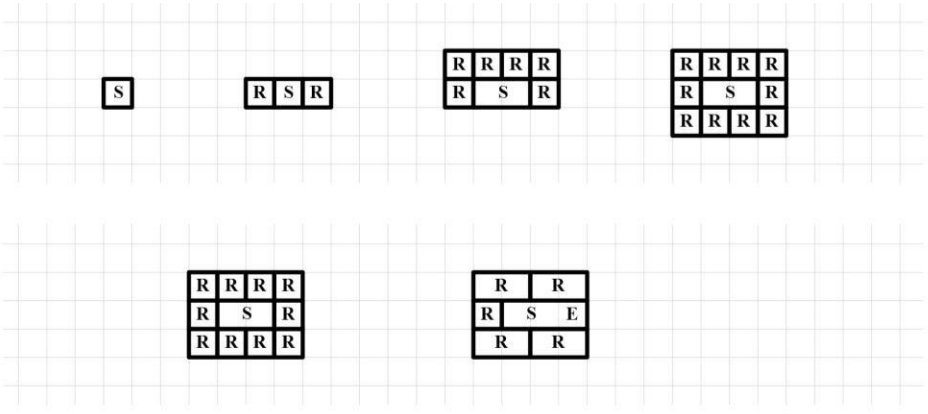


Building Floor Plans



GROUND FLOOR

Shape Grammer Analysis



S: Sofa **R: Room** **E: Entrance** **SS: Supplementary Space**

The sofa is the basic building unit. Room units have been added. As a result of the building design, some of the rooms are missing. There are mergers between the building units. There is a pattern of shapes on the horizontal axis.

- Turkish Commerce Bank Job Houses Project Analysis

Table 15. Turkish Commerce Bank Job Houses Project ground floor typographic analysis (terrace removed)

ANALYSIS PROJECT: TURKISH COMMERCE BANK JOB HOUSES

General Descriptions about the Building

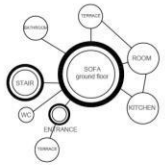
LOCATION: Şişli, İStanbul

BUILDING AREA: 140 m²

GROUND FLOOR AREA: 140 m²

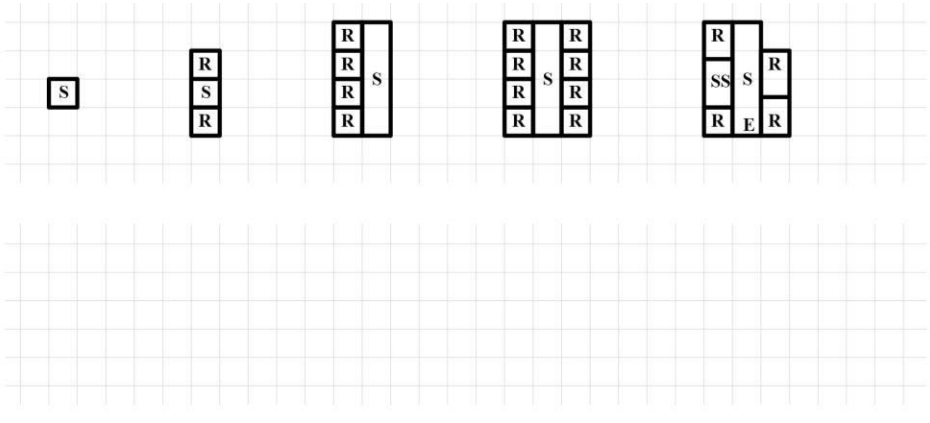
BUILDING TYPE: Double Storied

Space Organizasyon Ground Floor



Building Floor Plans

Shape Grammer Analysis

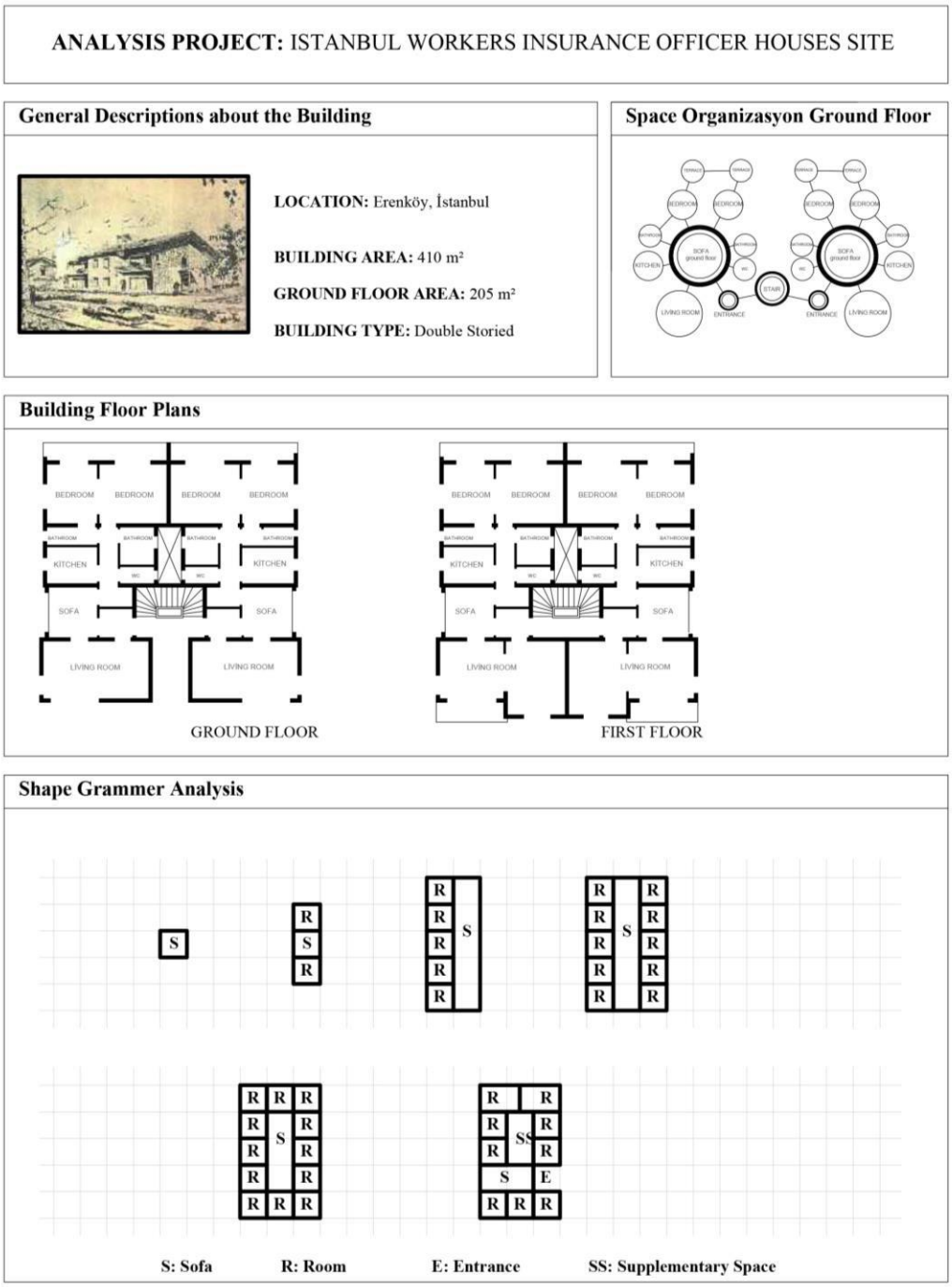


S: Sofa **R: Room** **E: Entrance** **SS: Supplementary Space**

The sofa is the basic building unit. Room units have been added. As a result of the building design, some of the rooms are missing. There are mergers between the building units. There is also an inward volumetric progression. There is a pattern of shapes on the vertical axis.

- Istanbul Workers Insurance Officer Houses Site Project Analysis

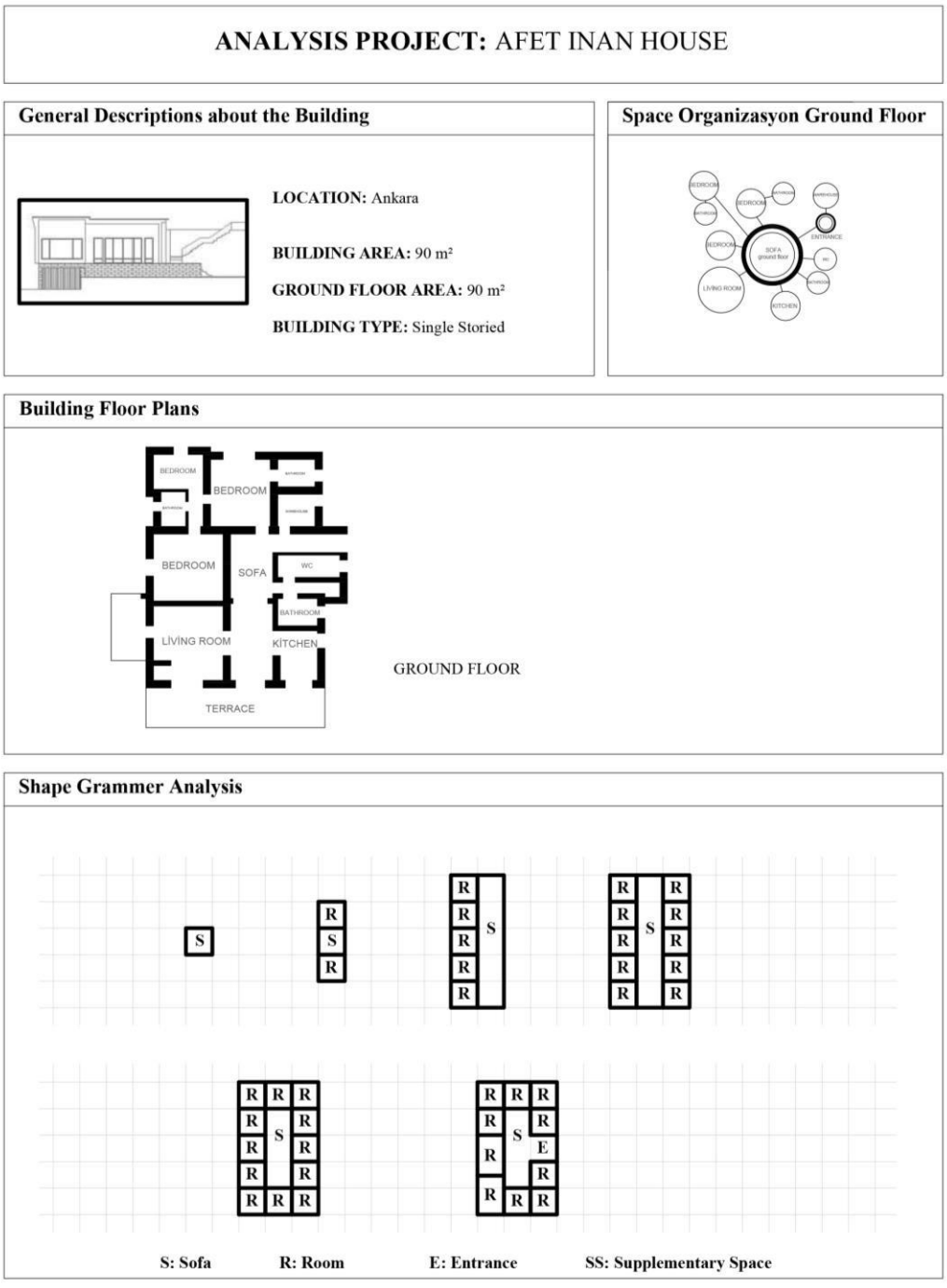
Table 16. Istanbul Workers Insurance Officer Houses Site Project ground floor typographic analysis (just single house)



The sofa is the basic building unit. Added room units. As a result of the building design, some rooms are missing. There are mergers between the building units. The sofa is divided into Supplementary space. There is a pattern of shapes on the vertical axis.

- Afet Inan House Project Analysis

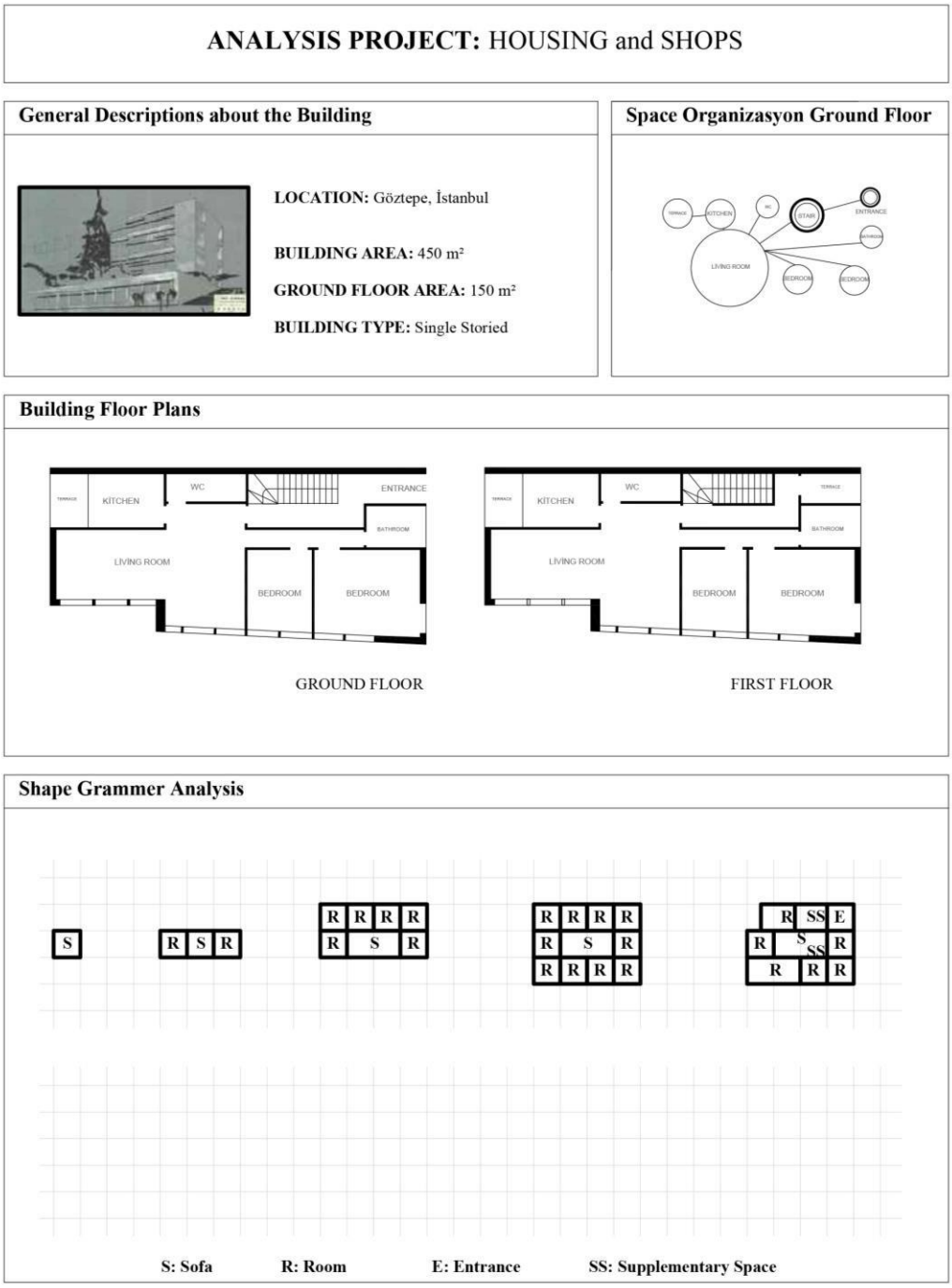
Table 17. Afet Inan House Project ground floor typographic analysis



The sofa is the basic building unit. Room units have been added. As a result of the building design, some of the rooms are missing. There is a transition to the volume of the sofa. There are mergers between the building units. There is a decrease in the volume of the sofa. There is also an outward volumetric progression. There is a pattern of shapes on the horizontal axis.

- Housing and Shops Project Analysis

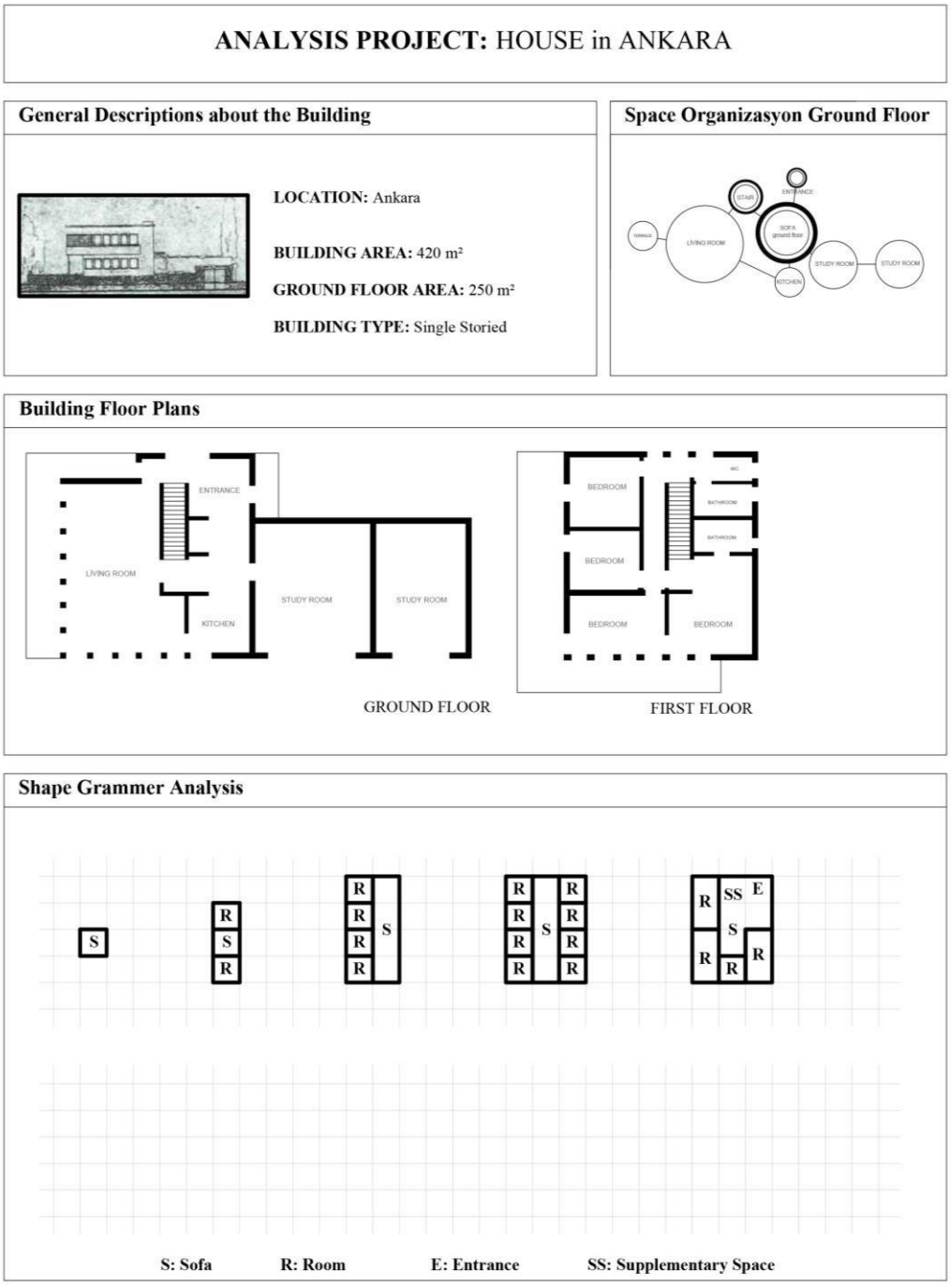
Table 18. Housing and Shops Project ground floor typographic analysis



The sofa is the basic building unit. Added room units. As a result of the building design, some rooms are missing. There are mergers between the building units. The sofa is divided into Supplementary spaces. There is a pattern of shapes on the horizontal axis.

- House in Ankara Project Analysis

Table 19. House in Ankara Project ground floor typographic analysis



The sofa is the basic building unit. Room units have been added. As a result of the building design, some of the rooms are missing. There is a transition to the volume of the sofa. There are mergers between the building units. There is a decrease in the volume of the sofa. There is also an outward volumetric progression. There is a pattern of shapes on the vertical axis.

- Ayhan Apartment Project Analysis

Table 20. Ayhan Apartment Project ground floor typographic analysis (just single house)

ANALYSIS PROJECT: AYHAN APARTMENT

General Descriptions about the Building

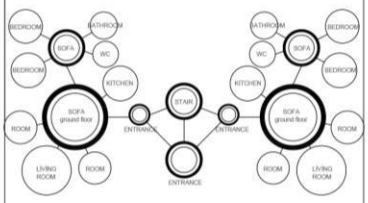
LOCATION: Taksim, Istanbul

BUILDING AREA: 700 m²

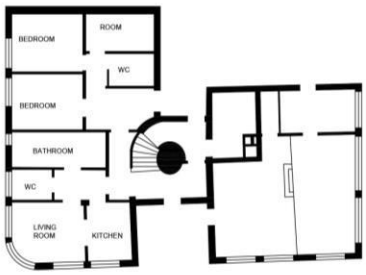
GROUND FLOOR AREA: 180 m²

BUILDING TYPE: Apartment

Space Organizasyon Ground Floor



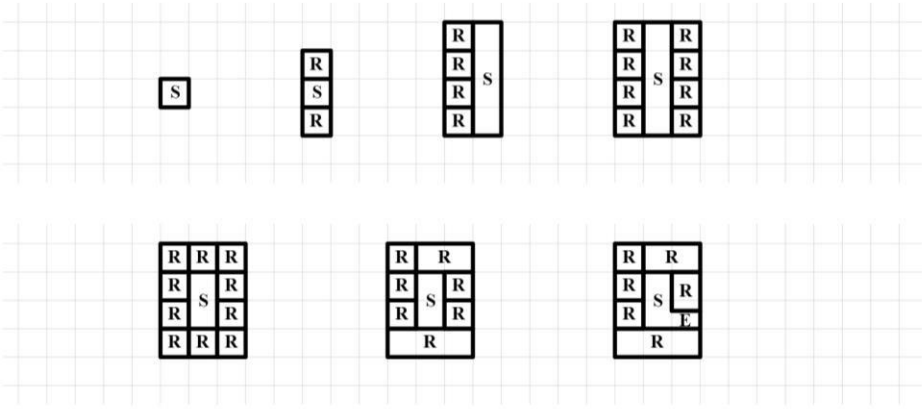
Building Floor Plans



GROUND FLOOR

FIRST FLOOR

Shape Grammer Analysis

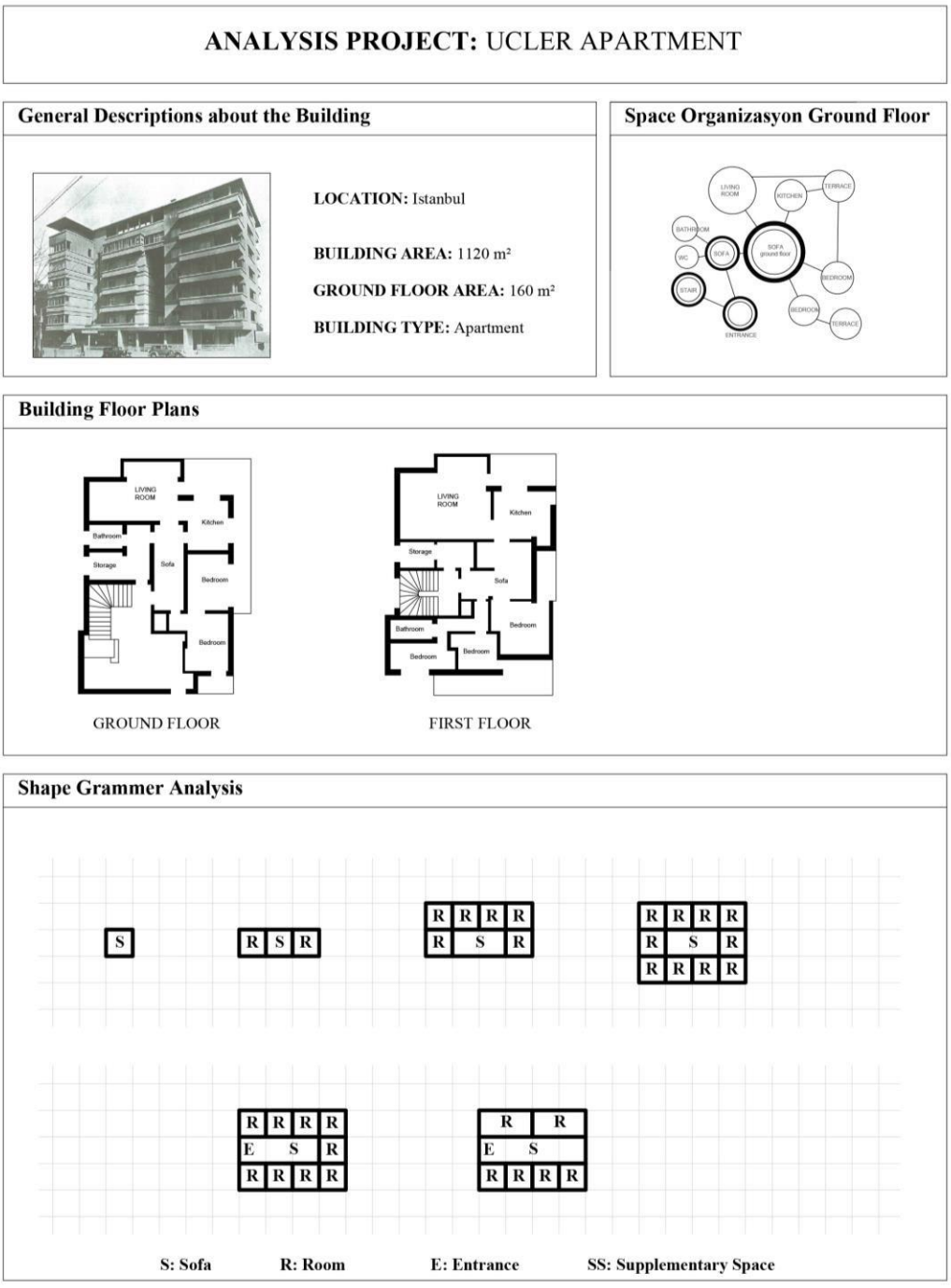


S: Sofa **R: Room** **E: Entrance** **SS: Supplementary Space**

The sofa is the basic building unit. Room units have been added. As a result of the building design, some of the rooms are missing. There is a transition to the volume of the sofa. There are mergers between the building units. There is a decrease in the volume of the sofa. There is a pattern of shapes on the vertical axis.

- Üçler Apartment Project Analysis

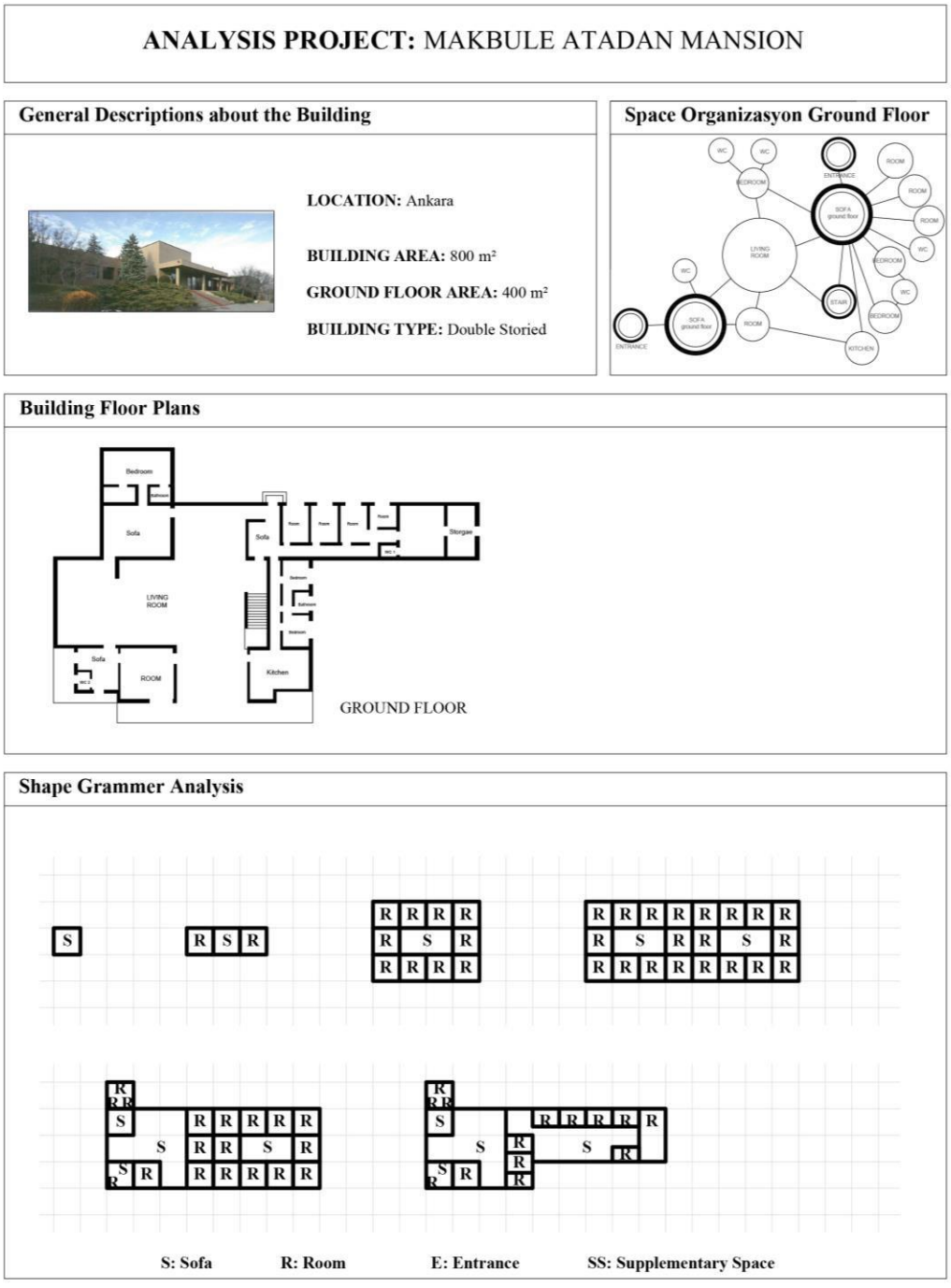
Table 21. Üçler Apartment Project typographic analysis



The sofa is the basic building unit. Room units have been added. As a result of the building design, some of the rooms are missing. There is a transition to the volume of the sofa. There are mergers between the building units. There is a decrease in the volume of the sofa. There is also an outward volumetric progression. There is a pattern of shapes on the horizontal axis.

- Makbule Atadan Mansion Project Analysis

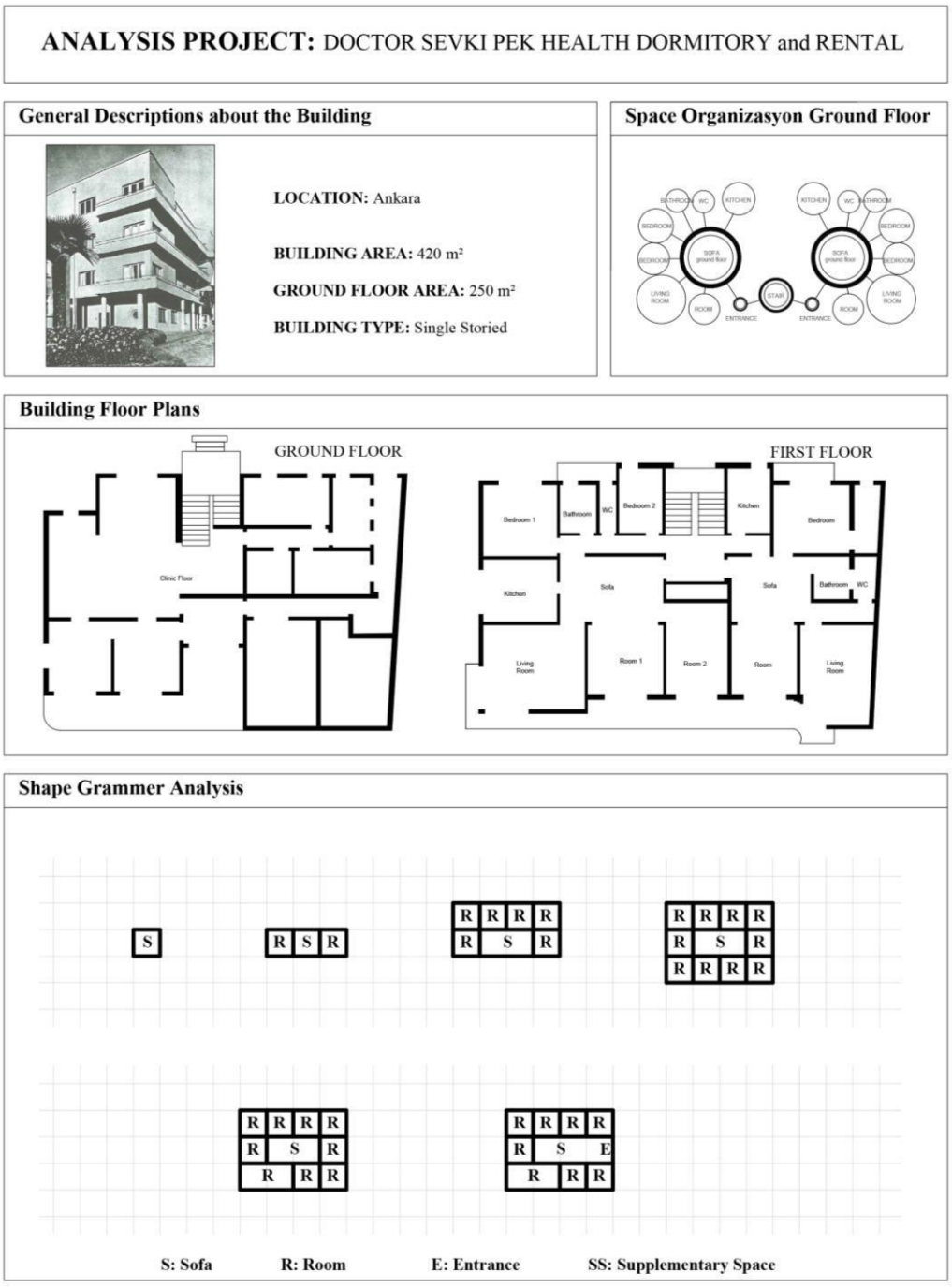
Table 22. Makbule Atadan Mansion Project ground floor typographic analysis



The sofa is the basic building unit. Room units have been added. As a result of the building design, some of the rooms are missing. There is a transition to the volume of the sofa. There are mergers between the building units. There is a decrease in the volume of the sofa. There is also an outward volumetric progression. There is a pattern of shapes on the horizontal axis. A combination of two shapes is seen.

- Doctor Şevki Pek Health Dormitory and Rental Project Analysis

Table 23. Doctor Şevki Pek Health Dormitory and Rental Project typographic analysis



The sofa is the basic building unit. Room units have been added. As a result of the building design, some of the rooms are missing. There is a transition to the volume of the sofa. There are mergers between the building units. There is a decrease in the volume of the sofa. There is also an outward volumetric progression. There is a pattern of shapes on the horizontal axis.

Shape grammar, rule diagrams of main floor plans in buildings and shape organisations in the tables above are explained. Shape grammars describe the grammatical structure of Seyfi Arkan architectural structures. This grammatical structure includes plan elements such as a sofa, kitchen, room, toilet, bathroom, and storage. The sofa provides horizontal circulation in the buildings. For this reason, the sofa is the first shape of grammar, and the other building units are positioned around the sofa.

4.2 Geometrical Analysis of Seyfi Arkan Housing Projects

In section 4.1 of the thesis, there are tables of shape grammars in which the spatial setup of Seyfi Arkan architectural structures and the connection between spaces are analysed. Section 4.2 of the thesis includes an analysis of the geometries and numerical values of the areas.

One sample was selected from each building category. Visualisations and tables of other structures are included in Appendix 1.

The data obtained from this section's numerical and visual analyses formed a basis for section 4.3 of the thesis. The data from the comments made here are compared between the same building groups in the tables.

-Dr. Ihsan Sami House Project Analysis (property house type)

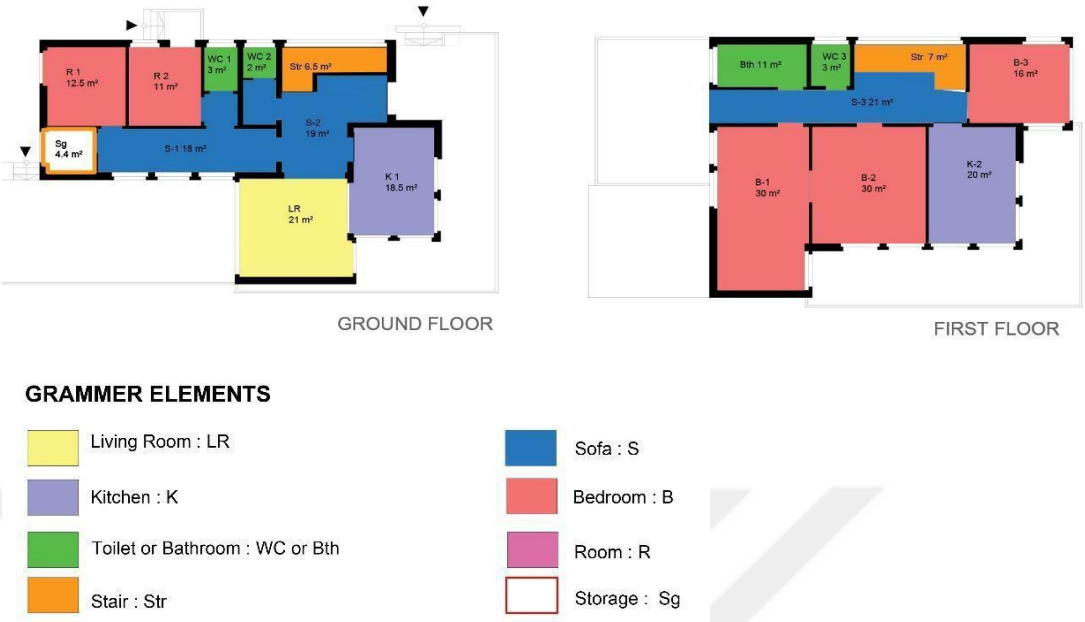


Figure 12. Dr Ihsan Sami House space geometry analysis with colour

Table 24. Dr Ihsan Sami House space geometry square meter analysis

	Ground Floor	First Floor
Living Room	21	-
Kitchen 1	18,5	-
Kitchen 2	-	20
WC 1	3	-
WC 2	2	-
WC 3	-	3
Bathroom	-	11
Stair Space 1 (Vertical circulation)	6,5	-
Stair Space 2 (Vertical circulation)	-	7
Sofa 1 (Horizontal circulation)	18	-
Sofa 2 (Horizontal circulation)	19	-
Sofa 3 (Horizontal circulation)	-	21
Room 1	12,5	-
Room 2	11	-
Bedroom 1	-	30
Bedroom 2	-	30
Bedroom 3	-	16
Storage	4,4	-

- Kozlu Coal Iş E Type Home Project Analysis (social housing type)

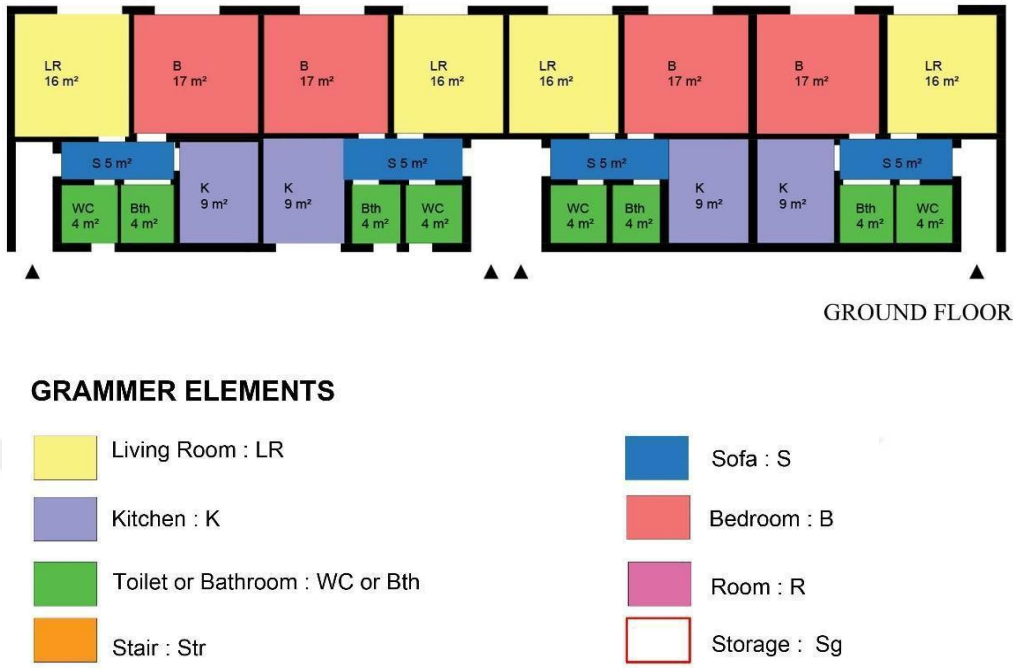


Figure 13. Kozlu Coal Iş E Type Home Project space geometry analysis with colour

Table 25. Kozlu Coal Iş E Type Home Project space geometry square meter analysis

	Ground Floor	First Floor
Living Room	16	
Kitchen	9	
Bathroom	4	
Sofa (Horizontal circulation)	5	
WC	4	
Bedroom	17	

- Cemal Bey Apartment Project Analysis (apartment type)

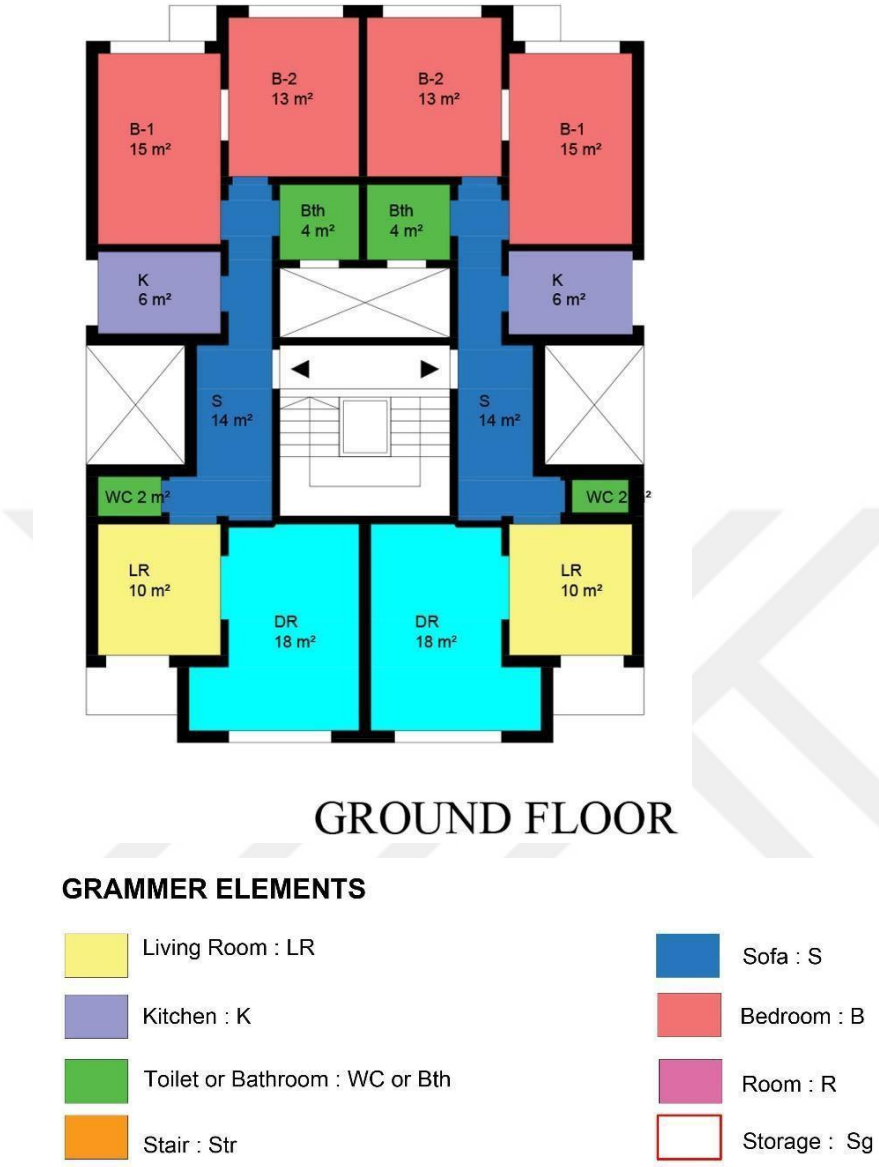


Figure 14. Cemal Bey Apartment Project space geometry analysis with colour

Table 26. Cemal Bey Apartment Project space geometry square meter analysis

	Ground Floor	First Floor
Living Room	10	
Dining Room	18	
WC	2	
Bathroom	4	
Sofa (Horizontal circulation)	14	
Kitchen	6	
Bedroom 1	15	
Bedroom 2	13	

4.3 Comparative Analysis of Structures

As a result of the examination of the buildings, it has been seen that the spatial organisation generally has similar contents. In the villa-type building category, it has been observed that the buildings are generally 2-storey. There are at least three bedrooms in the buildings. Because the buildings are private property, there are various numbers of WC and bathroom volumes. In some buildings, there are rooms reserved for different functions. Some buildings have storage. There are different sizes of living rooms in other buildings. However, the Housing and Shops structure has a seating area on both floors. Only one building has a separately defined dining room. It has been observed that there is a topological and geometric analogy between the structures, albeit a little, in the villa-type structure examined.

Table 27. Analysis of private property house type structures unit number

Number of	floors	bedrooms	WC	bathrooms	kitchen	room	storage	living room	dining room
1. Dr İhsan Sami House	2	3	3	1	2	2	1	1	
2. Suadiye Summer Villa	1	3		1	1			1	1
3. Home in Ankara	2	3	3	1	1		2	1	
4. Göztepe Villa	2	4	2	1	1	2	1	1	
5. Salih Bozok Villa	2	5	1	3	1	1		1	
6. Afet Inan House	1	3	1	3	1			1	
7. Housing and Shops	2	4	2	2	2			2	
8. House in Ankara	2	4	1	2	1	2		1	
9. Makbule Atadan Mansion	1	4	1	4	1	6	1	1	

Table 28. Analysis of apartment type structures unit number

Number of…		bedrooms	bathroom	WC	living room	dining room	storage	kitchen	room
1. Cemal Bey Apartment		2	1	1	1	1		1	
2. Istanbul Workers Insurance Officer Houses		2	2	1	1			1	
3. Ayhan Apartment	F1	3	1	1	1			1	
	F2	2	1		1			1	
4. Üçler Apartment	G	2	1		1		1	1	
	UF	3	1		1		1	1	
5. Doctor Şevki Pek Health Dormitory And Rental	F1	2	1	1	1			1	2
	F2	1	1	1	1			1	1
G: Ground Floor UF: Upper Floor F1: Flat 1 F2: Flat 2									

It has been observed that different designs are made in apartment-type buildings. In some buildings, there is a differentiation between the ground floor and the upper floors. In some buildings, various designs were made in different flats on the same floor. It has been observed that there are rooms with the same functions in separate apartments on other floors or in various apartments on the same floor; only the number and size of them differ.

Although there are differences in the apartment-type buildings examined, it has been observed that they are topological and geometrical, albeit a little.

Table 29. Analysis of social housing type structures unit number

Number of…	floors	bedrooms	bathroom	WC	living room	kitchen	room	storage
1. Working Building Zonguldak	2	3	2					
2. Kozlu Coal Iş C-D Type Home	1	2	1		1	1		
3. Kozlu Coal Iş D Type Home	1	2	1		2	1	1	
4. Kozlu Coal Iş E Type Home	1	1	1	1	1	1		
5. Adana Cheap Houses Neighborhood Type -A	1	1	1		1	1		1
6. Adana Cheap Houses Neighborhood Type -B	1	1	1		1	1		1
7. Adana Cheap Houses Neighborhood Type -C	1	2	1		1	1		1
8. Turkish Commerce Bank Job Houses	2	3	2	1	1	1		

Social housing building types are structures designed for employees. For this reason, it was seen that the designs were kept simple. It has been designed as a bedroom, bathroom, kitchen and living room. They are single-storey and repeating structures. However, it has been seen that the Working Building Zonguldak structure has two floors. It has been designed to have a maximum of 3 bedrooms and at least one bedroom. Among the building studied, there are only two bathrooms in two buildings. There is no living room in one building, and there are two living rooms in one building. All three buildings designed in Adana have storage. Only one building does not have

a kitchen. It has been observed that there is a topological and geometric analogy in the social housing type structures examined, in the structures built for the same purpose. In addition, the empty cells in Tables 26, 27 and 28 remained empty because they were not found in the forms to which they were attached.

Table 30. Average area (m2) analysis according to different building types

	Structure name	Kitchen	Sofa	Living room	WC	Bathroom	Bedroom
private property house-type structures	1. Dr İhsan Sami House	18	18	21	2	11	16
	2.Suadiye Summer Villa	22	12	24	-	5	17
	3.Home in Ankara	8	18	44	2	6	10
	4.Göztepe Villa	6	20	28	2	5	11
	5.Salih Bozok Villa	16	38	50	2	6	13
	6. Afet Inan House	15	70	42,5	11	7	20
	7. Housing and Shops	10	22	37	5	6	13
	8.House in Ankara	6	8	29	3	3	8
	9.Makbule Atadan Mansion	14	8	130	1	2	5
apartment type structures	1. Cemal Bey Apartment	6	14	28	2	4	13
	2. Istanbul Workers Insurance Officer Houses	9	25	28	3	4	13
	3. Ayhan Apartment	9 7	11 9	30 18	2 -	6 4	10 9
	4.Üçler Apartment	13 18	25 34	29 41	- -	5 5	13 9
	5. Doctor Şevki Pek Health Dormitory and Rental	24 15	47 38	45 36	4 5	9 8	28 38

Table 30 (continued). Average area (m2) analysis according to different building types

social housing-type structures	1.Working Building Zonguldak	-	4	-	3	-	11
	2.Kozlu Coal Iş C-D Type Home	6	13	24	-	4	10
	3.Kozlu Coal Iş D Type Home	5	13	26	-	4	10
	4.Kozlu Coal Iş E Type Home	9	5	16	4	4	17
	5.Adana Cheap Houses Neighborhood Type -A	5	6	11	-	5	9
	6.Adana Cheap Houses Neighborhood Type -B	5	5	10	-	2	9
	7.Adana Cheap Houses Neighborhood Type -C	10	8	12	-	3	12
	8.Turkish Commerce Bank Job Houses	9	6	13	1	8	7

Building groups are listed in Tables 26, 27 and 28, and each building is numbered in its group. The building examined within the scope of the thesis were coded using the numbers above for comparison in Table 29.

Structures are analysed in square meters. The buildings are categorised according to three different building types. As a result of these analyses, it has been determined that there is no one-to-one integrity in terms of square meters between the buildings, but the values obtained are close to each other. Each structure remained in specific proportions. However, there are also structures with different dimensions. But there are also structures of various sizes. For this reason, it has been determined that there

is no complete integrity between the structures and that there is generally closeness to each other.

In the tables in Appendix 2, each building type is analysed separately. In these analyses, each structure was proportioned one by one. At these rates, each space belonging to a building is proportioned with other areas of the same building. Whether or not there is a similar ratio in buildings in the same category is examined in three tables.

The naming of the buildings in each category has progressed as much as the number of buildings examined as Structure 1, Structure 2, and Structure 3. These data are grouped in 3 separate tables in Appendix 2.

The case of a specific ratio within the scope of the balance between rooms in private house-type buildings has been examined. As a result of the examinations, it was seen that there was no available ratio, and close values were obtained among the obtained ratios. However, although different effects were observed in the percentage of toilet and bathroom spaces, it was observed that there were changes in relative values.

4.4 Result:

Within the scope of the ratio between rooms in social housing-type buildings, the case of a specific percentage has been examined. As a result of the examinations, it was seen that there were similar ratios between the building units. Although there are different results in the proportioning of the spaces, it has been seen that these results are close values.

The topological and geometric analogy case among Seyfi Arkan residential buildings has been analysed. In this context, Seyfi Arkan structures are divided into three sub-

categories. Both the building geometry and the building typologies of these structures were examined.

As a result of the examination of the selected structures, the case of a typological similarity was first investigated. Although it is seen that there is a similarity in general, it has been seen that there is not precisely a topological and geometric analogy. It has been seen that each building has its design.

In addition, within the scope of the analysis of the structures, the situation of geometric similarity was investigated. For this reason, structures were analysed in shape and square meters. Each building has its design. However, as a result of these analyses, it has been seen that there are generally close ratios for square meters of building units.

As a result of the analysis of the buildings, it is seen that there is usually a sofa in the middle, and other building units are lined up around it. At the same time, it has been seen that there are room volumes with different uses and functions in the same building types designs, in line with the existing conditions and determined parameters. Although a general unity was achieved in the content of the building, it was seen that there was not a complete unity of style.

CHAPTER 4: CONCLUSION

The scope of the study consists of buildings designed by architect Seyfi Arkan. These architectural works were from around Turkey, without a specific location. This study analysed housing types such as apartments, social housing, and villa buildings.

The study examines the historical texture of Seyfi Arkan structures. The study focuses on planning and spatial organisation. For this reason, the facades and urban textures of the buildings were not examined. Within the scope of the study, the building plans were analysed using the shape grammar method. The study examines the elements of Arkan structures and the spatial organisation of the elements among themselves. As a result of his education, Arkan applied not traditional building design but building designs with a modernist morphology. Arkan has adopted a style that does not try to show itself but only applies modernism to its structures. In addition, he did not just gravitate towards the modernist movement. He adopted creative approaches in space design. While Arkan used these approaches in his buildings, traces of the modernist movement can also be seen.

This study was conducted to see whether there is a similar structural harmony in the same building types in Seyfi Arkan structures. For this purpose, it has been tried to obtain a result by pouring the common language between the buildings into numerical and visual data. The shape grammar method was preferred for visual data. To obtain numerical data, independent space areas were calculated in the plans, and the ratios of these areas were calculated and tabulated. As a result of the numerical value obtained in these tables, the case of having a common language in Seyfi Arkan structures has been examined. As a result of these visualisations and analyses, positive or negative answers were sought within the scope of stylistic unity in Seyfi Arkan residential architectural structures.

As a result of all the research and analysis carried out in Seyfi Arkan residential type architectural structures, different inferences have been gained according to the housing types in examinations of the structures as space organisations. It has been observed that there is no significant similarity in private house-type structures. This is because the main factors affecting the building design are the parameters determined by the user group in line with their needs and wishes. It has been observed that arrangements are made in line with the requirements and dimensions of apartment-type buildings. In social housing-type buildings, it has been observed that there is a functional and repetitive building design in general. At the same time, because of the shape grammatical analysis, it is seen that there are building sections around the sofas that provide horizontal circulation.

According to the data obtained as a result of the ratio of numerical values, it is seen that the mathematical proportions of wet areas such as the WC and bathroom to other rooms of the building are generally similar compared to other buildings.

As a result of the analysis of all these data, it is seen that there is no significant similarity in the residential buildings of Seyfi Arkan. Still, the values obtained are generally close to each other. It has been seen that the reason for this is personal wishes, needs, the function of the building, and the max design area that the building will have. However, the most significant similarity in these building types was in the social housing building types.

With this study, it has been seen that the common language in the works of architect Seyfi Arkan, one of the pioneers of the modern architectural movement, is the buildings designed with simplicity in line with the needs. It is aimed that the analyses made on architectural projects that could not be fully reached due to insufficient storage and protection in the period will form a basis for future studies. This research aimed to create a foundation for a new approach to studying Seyfi Arkan architecture. As mentioned in the background, there have been valuable research efforts to introduce

Arkan’s architecture in earlier works of researchers. The contribution of this study lies in the quantitative analytical approach to Seyfi Arkan’s architectural production.

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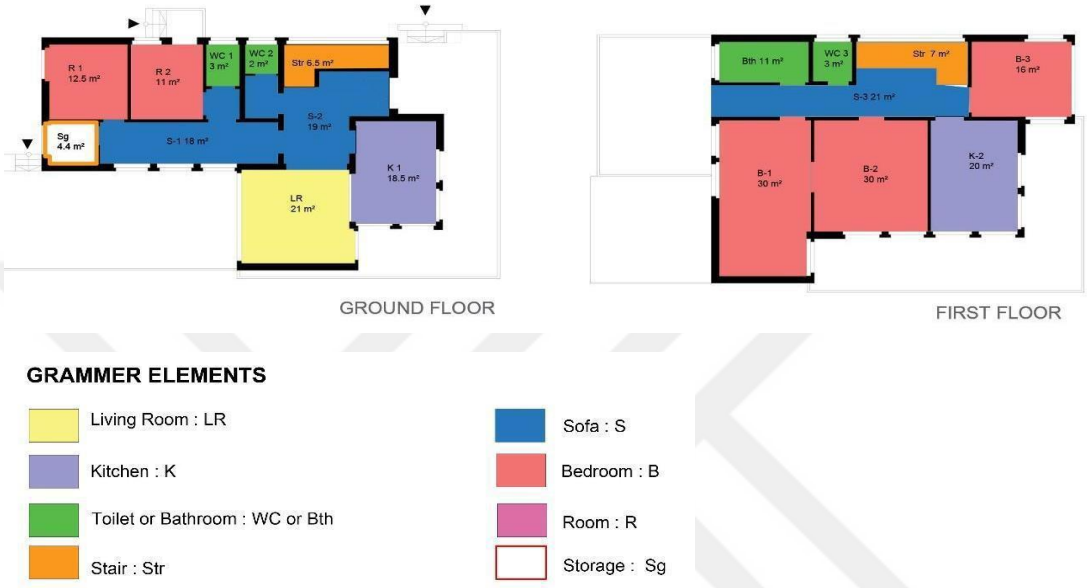
APPENDICES

Appendix 1. space geometry analysis with colour and square meter analysis

-Dr Ihsan Sami House Project Analysis



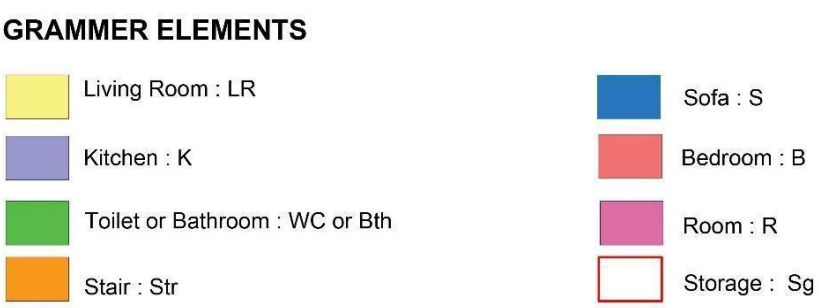
Dr Ihsan Sami House space geometry analysis with colour

	Ground Floor	First Floor
Living Room	21	-
Kitchen 1	18,5	-
Kitchen 2	-	20
WC 1	3	-
WC 2	2	-
WC 3	-	3
Bathroom	-	11
Stair Space 1 (Vertical circulation)	6,5	-
Stair Space 2 (Vertical circulation)	-	7
Sofa 1 (Horizontal circulation)	18	-
Sofa 2 (Horizontal circulation)	19	-
Sofa 3 (Horizontal circulation)	-	21
Room 1	12,5	-
Room 2	11	-
Bedroom 1	-	30
Bedroom 2	-	30
Bedroom 3	-	16
Storage	4,4	-

Dr Ihsan Sami House space geometry square meter analysis

- Suadiye Summer Villa Project Analysis

GROUND FLOOR

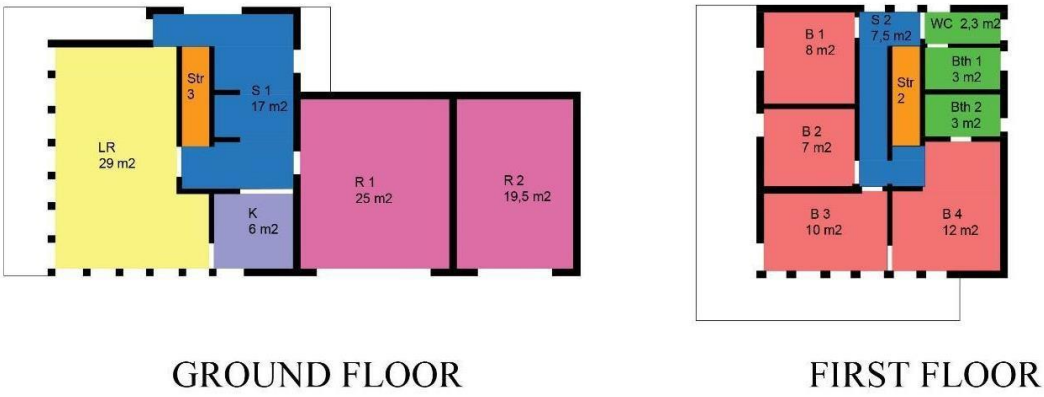


Suadiye Summer Villa project space geometry analysis with color

Suadiye Summer Villa project space geometry square meter analysis

	Ground Floor	First Floor
Living Room	24,2	
Kitchen	22	
WC	5	
Dining Room	18	
Sofa 1 (Horizontal circulation)	12,6	
Sofa 2 (Horizontal circulation)	12	
Bedroom 1	21,5	
Bedroom 2	17	
Bedroom 3	22	

- Home in Ankara Project Analysis



Home in Ankara space geometry analysis with colour

Home in Ankara space geometry square meter analysis

	Ground Floor	First Floor
Living Room	44	-
Kitchen	8	-
WC 1	2	-
WC 2	-	2
WC 3	-	3
Bathroom	-	6
Storage 1	7	-
Storage 2	4,5	-
Stair Space 1 (Vertical circulation)	6	-
Stair Space 2 (Vertical circulation)	-	4
Sofa 1 (Horizontal circulation)	18	-
Sofa 2 (Horizontal circulation)	-	8
Bedroom 1	-	17
Bedroom 2	-	13
Bedroom 3	-	10

- Göztepe Villa Project Analysis

Göztepe Villa space geometry analysis with color

Göztepe Villa Project space geometry square meter analysis

	Ground Floor	First Floor
Living Room	28	-
Kitchen	6	-
WC 1	3	-
WC 2	-	2
Bathroom	-	5
Storage	3	-
Stair Space 1 (Vertical circulation)	4	-
Stair Space 2 (Vertical circulation)	-	4
Sofa 1 (Horizontal circulation)	20	-
Sofa 2 (Horizontal circulation)	-	20
Room 1	8	-
Room 2	12	-
Bedroom 1	-	11
Bedroom 2	-	12
Bedroom 3	-	12
Bedroom 4	-	12

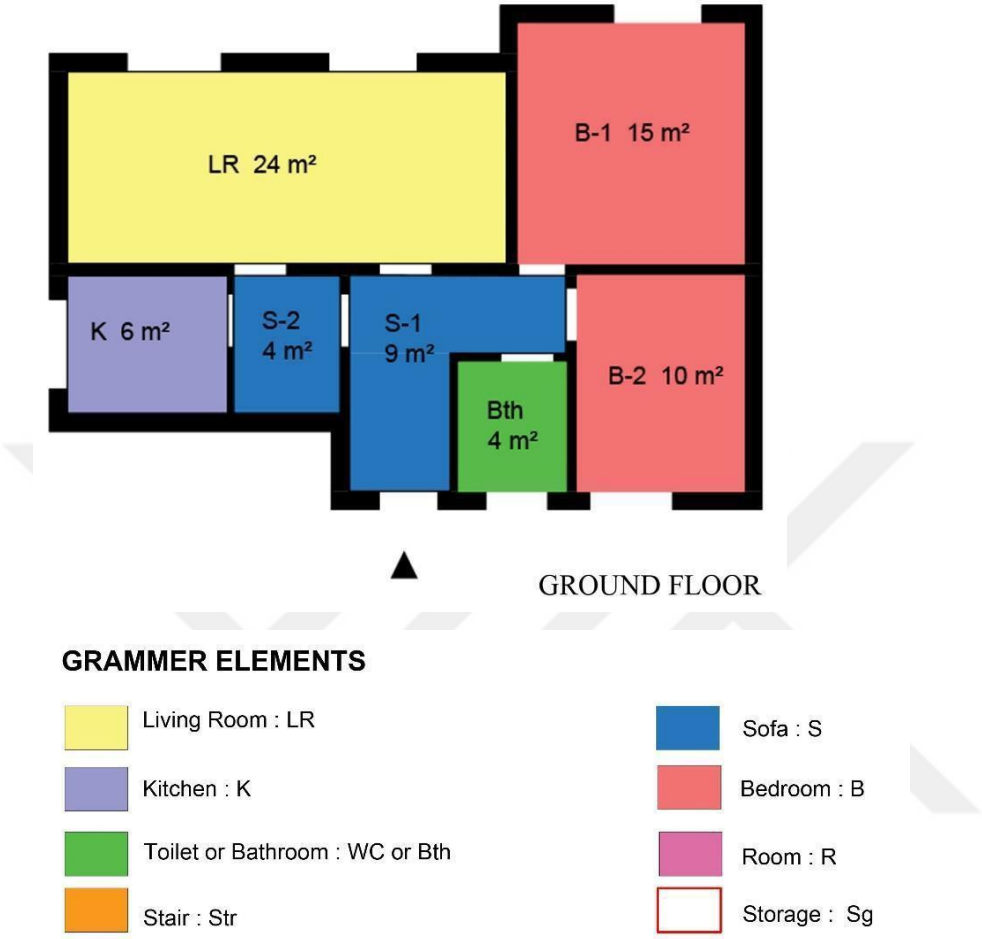
- Working on Building Zonguldak Project Analysis

Working Building in Zonguldak space geometry analysis with color

Working Building Zonguldak space geometry square meter analysis

	Ground Floor	First Floor
WC 1	2,5	-
WC 2	-	4
Stair Space 1 (Vertical circulation)	7	-
Stair Space 2 (Vertical circulation)	-	4
Sofa 1 (Horizontal circulation)	4	-
Sofa 2 (Horizontal circulation)	-	4
Bedroom 1	24	-
Bedroom 2	-	15
Bedroom 3	-	11

- Kozlu Coal Iş C-D* Type *Home Project Analysis

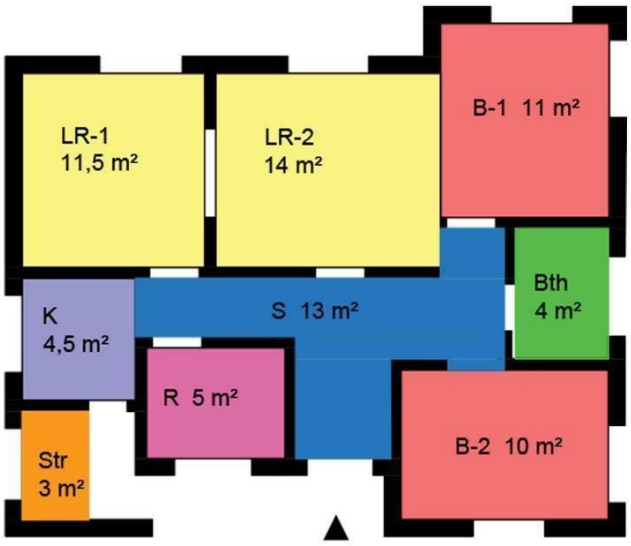


Kozlu Coal Iş C-D Type Home Project space geometry analysis with colour

Kozlu Coal Iş C-D Type Home Project space geometry square meter analysis

	Ground Floor	First Floor
Living Room	24	
Kitchen	6	
Bathroom	4	
Sofa 1 (Horizontal circulation)	9	
Sofa 2 (Horizontal circulation)	4	
Bedroom 1	15	
Bedroom 2	10	

- Kozlu Coal Iş D Type Home Project Analysis



GROUND FLOOR

GRAMMER ELEMENTS

Living Room : LR

Kitchen : K

Toilet or Bathroom : WC or Bth

Stair : Str

Sofa : S

Bedroom : B

Room : R

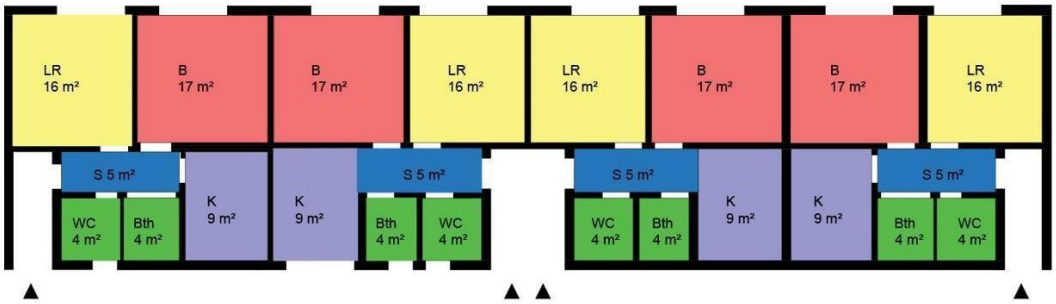
Storage : Sg

Kozlu Coal Iş D Type Home Project space geometry analysis with colour

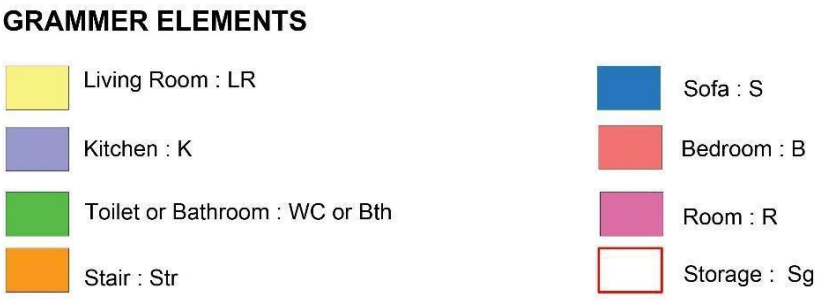
Kozlu Coal Iş D Type Home Project space geometry square meter analysis

	Ground Floor	First Floor
Living Room 1	11,5	
Living Room 2	14	
Kitchen	4,5	
Bathroom	4	
Sofa (Horizontal circulation)	13	
Stair Space (Horizontal circulation)	3	
Bedroom 1	11	
Bedroom 2	10	
Room	5	

- Kozlu Coal Iş E Type Home Project Analysis



GROUND FLOOR

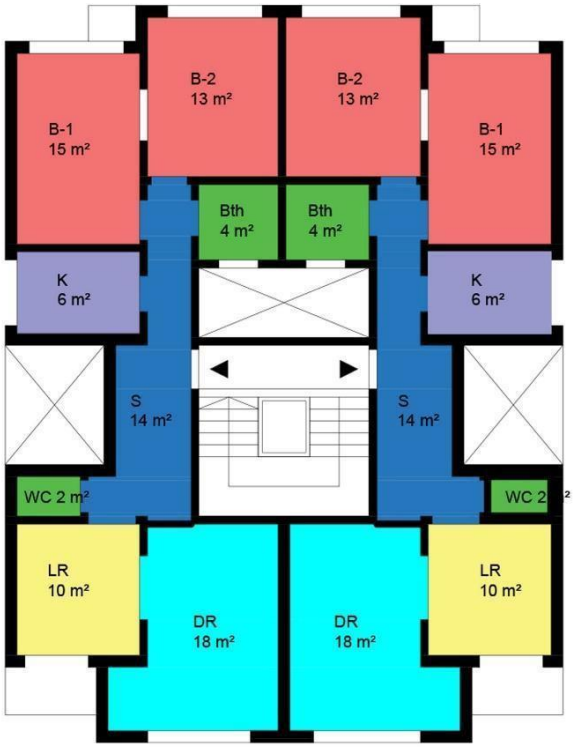


Kozlu Coal Iş E Type Home Project space geometry analysis with colour

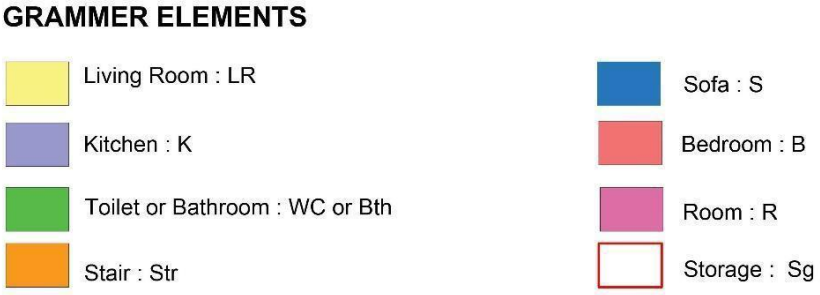
Kozlu Coal Iş E Type Home Project space geometry square meter analysis

	Ground Floor	First Floor
Living Room	16	
Kitchen	9	
Bathroom	4	
Sofa (Horizontal circulation)	5	
WC	4	
Bedroom	17	

- Cemal Bey Apartment Project Analysis



GROUND FLOOR

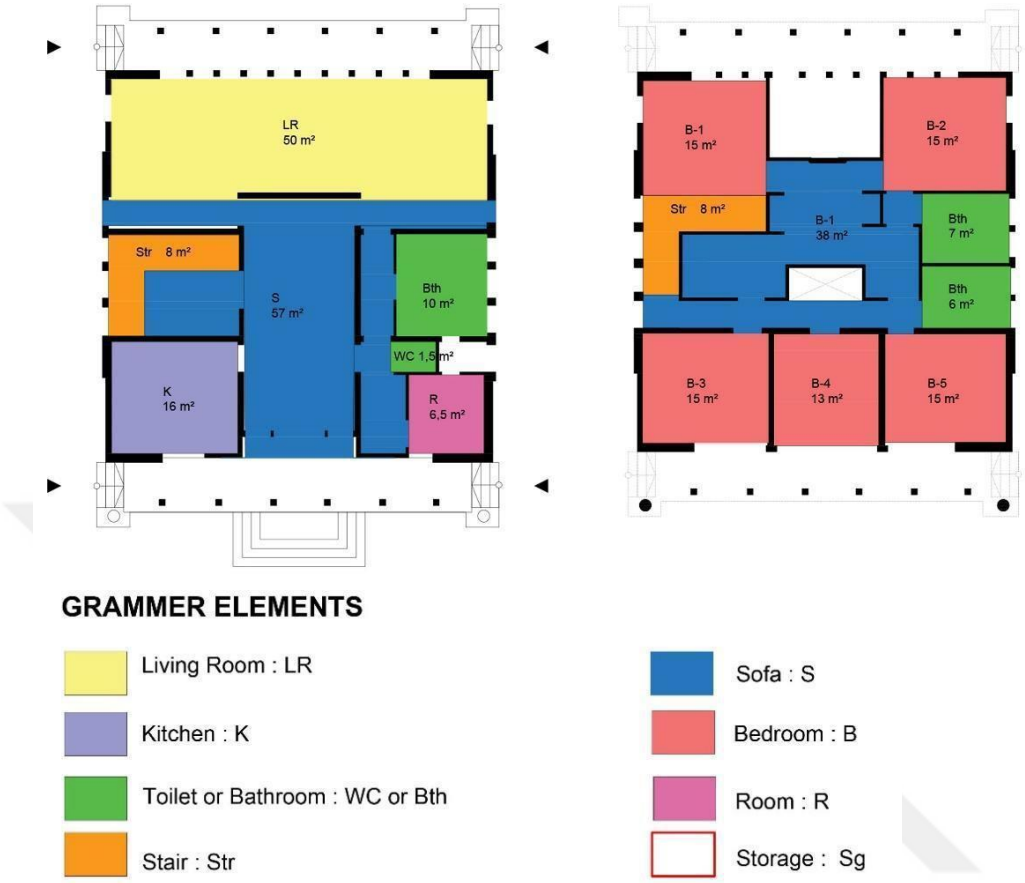


Cemal Bey Apartment Project space geometry analysis with colour

Cemal Bey Apartment Project space geometry square meter analysis

	Ground Floor	First Floor
Living Room	10	
Dining Room	18	
WC	2	
Bathroom	4	
Sofa (Horizontal circulation)	14	
Kitchen	6	
Bedroom 1	15	
Bedroom 2	13	

- Salih Bozok Villa Project Analysis

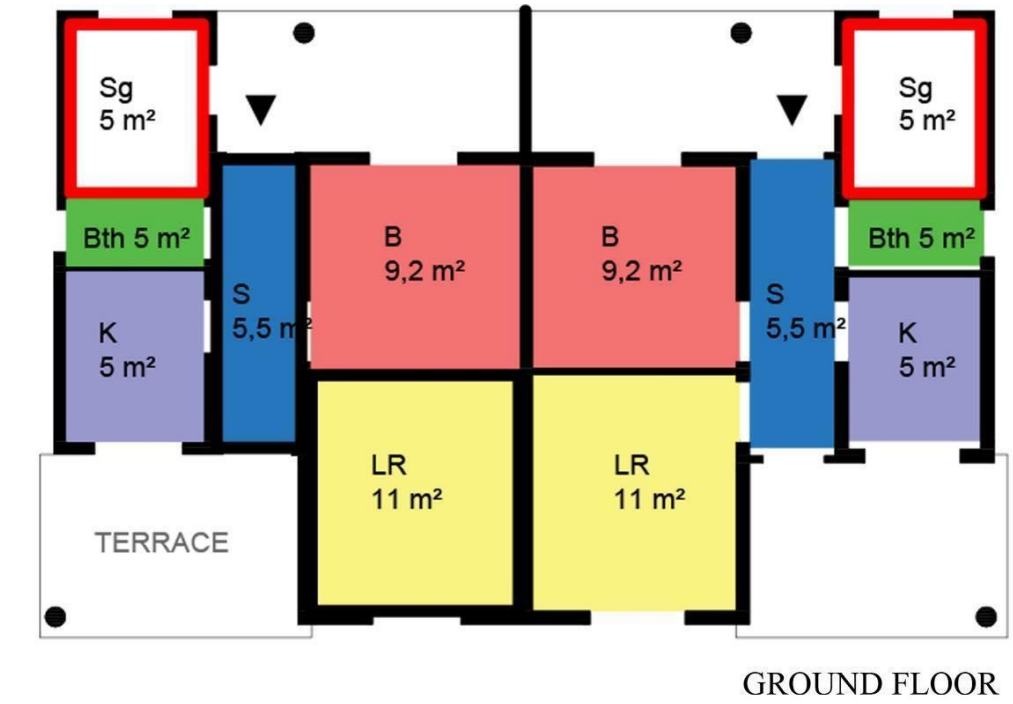


Salih Bozok Villa project space geometry analysis with colour

Salih Bozok Villa project space geometry square meter analysis

	Ground Floor	**First Floor**
Living Room	50	-
Room	6,5	-
WC	1,5	-
Bathroom 1	10	-
Bathroom 2	-	7
Bathroom 3	-	6
Sofa 1 (Horizontal circulation)	57	-
Sofa 2 (Horizontal circulation)	-	38
Stair Space 1 (Vertical circulation)	8	-
Stair Space 2 (Vertical circulation)	-	8
Kitchen	16	-
Bedroom 1	-	15
Bedroom 2	-	15
Bedroom 3	-	15
Bedroom 4	-	13
Bedroom 5	-	15

- Adana Cheap Houses Neighborhood Type -A Project Analysis

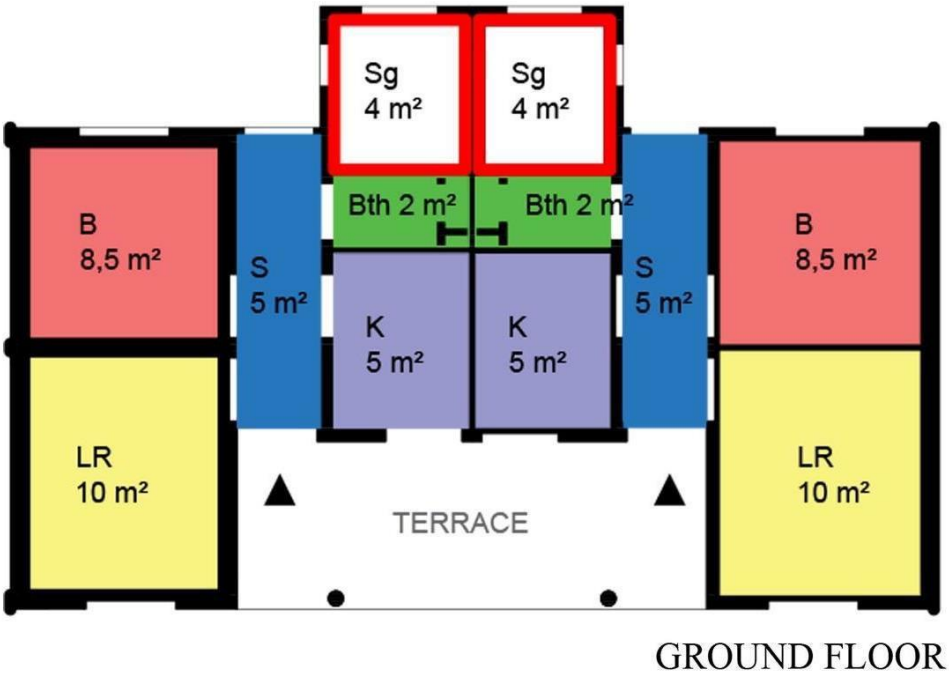


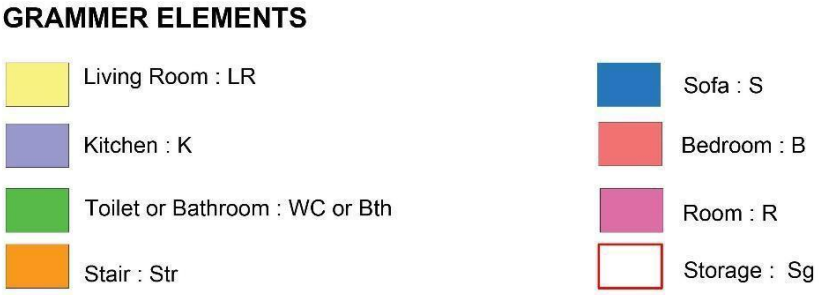
Adana Cheap Houses Neighborhood Type -A Project space geometry analysis with colour

Adana Cheap Houses Neighborhood Type -A Project space geometry square meter analysis

	Ground Floor	First Floor
Living Room	11	
Storage	5	
Bathroom	3	
Sofa (Horizontal circulation)	5,5	
Kitchen	5	
Bedroom	9,2	

- ***Adana Cheap Houses Neighborhood Type -B Project Analysis***



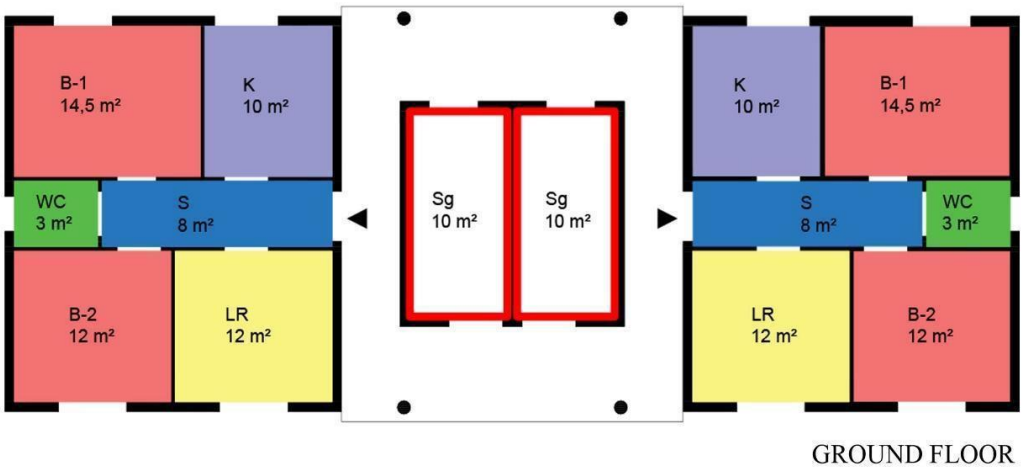


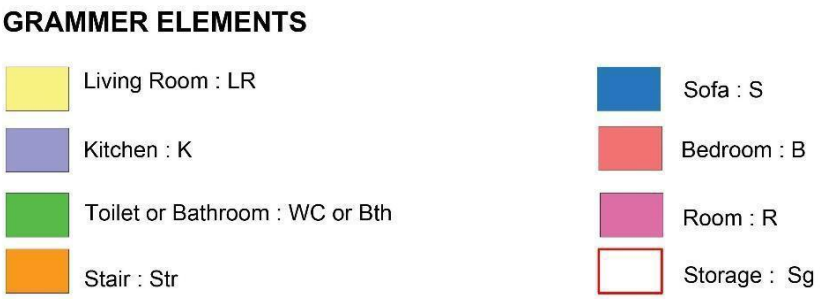
Adana Cheap Houses Neighborhood Type -B Project space geometry analysis with colour

Adana Cheap Houses Neighborhood Type -B Project space geometry square meter analysis

	Ground Floor	First Floor
Living Room	10	
Storage	4	
Bathroom	2	
Sofa (Horizontal circulation)	5	
Kitchen	5	
Bedroom	8,5	

- Adana Cheap Houses Neighborhood Type -C Project Analysis



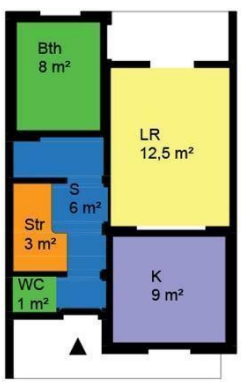


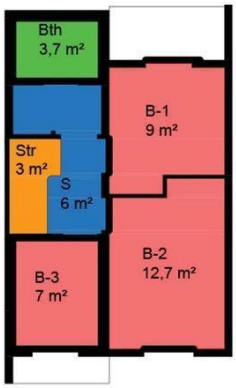
Adana Cheap Houses Neighborhood Type -C Project space geometry analysis with colour

Adana Cheap Houses Neighborhood Type -C Project space geometry square meter analysis

	Ground Floor	First Floor
Living Room	12	
Storage	10	
WC	3	
Sofa (Horizontal circulation)	8	
Kitchen	10	
Bedroom 1	14,5	
Bedroom 2	12	

- Turkish Commerce Bank Job Houses Project Analysis





GROUND FLOOR FIRST FLOOR

GRAMMER ELEMENTS

Living Room : LR

Kitchen : K

Toilet or Bathroom : WC or Bth

Stair : Str

Sofa : S

Bedroom : B

Room : R

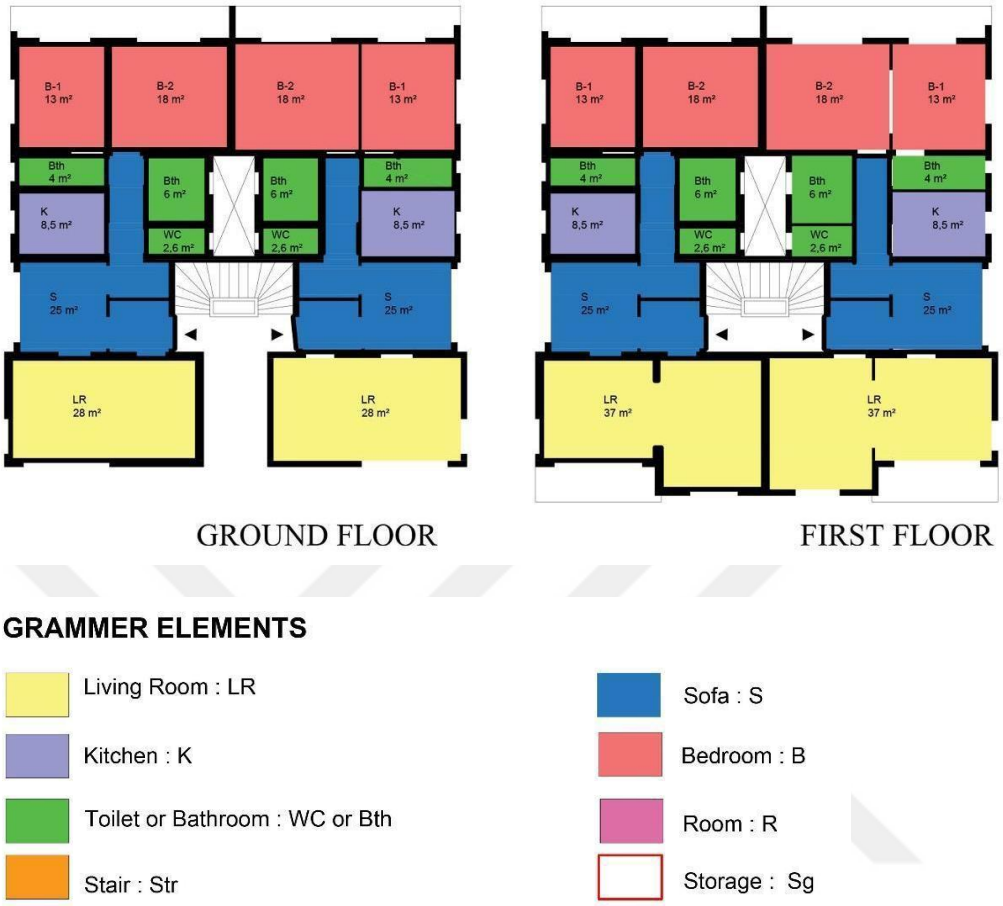
Storage : Sg

Turkish Commerce Bank Job Houses Project space geometry analysis with colour

Turkish Commerce Bank Job Houses Project space geometry square meter analysis

	Ground Floor	First Floor
Living Room	12,5	-
Bathroom 1	8	-
Bathroom 2	-	3,7
WC	1	-
Sofa 1 (Horizontal circulation)	6	-
Sofa 2 (Horizontal circulation)	-	6
Stair Space 1 (Vertical circulation)	3	-
Stair Space 1 (Vertical circulation)	-	3
Kitchen	9	-
Bedroom 1	-	9
Bedroom 2	-	12,7
Bedroom 3	-	7

- Istanbul Workers Insurance Officer Houses Site Project Analysis

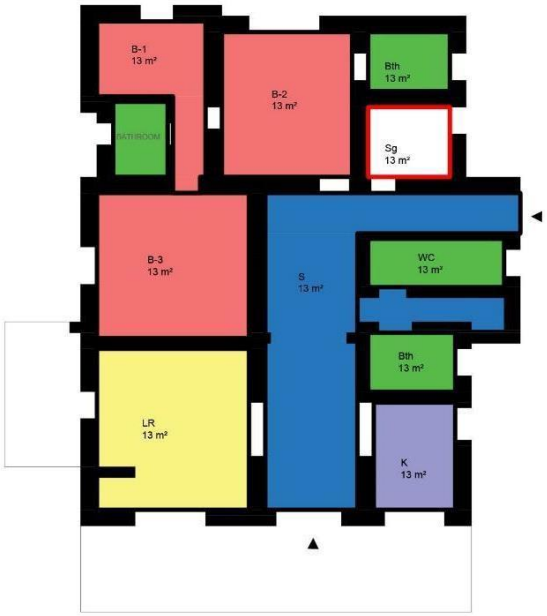


Istanbul Workers Insurance Officer Houses Site Project space geometry analysis with colour

Istanbul Workers Insurance Officer Houses Site Project space geometry square meter analysis

	Ground Floor	First Floor
Living Room	28	37
Bathroom 1	4	4
Bathroom 2	6	6
WC	2,6	2,6
Sofa (Horizontal circulation)	25	25
Kitchen	8,5	8,5
Bedroom 1	13	13
Bedroom 2	18	18

- Afet Inan House Project Analysis



GRAMMER ELEMENTS

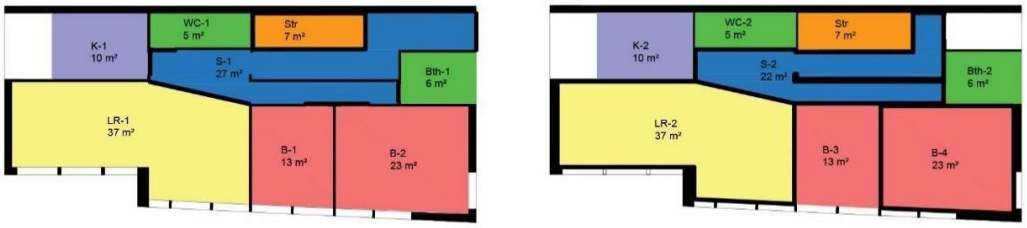
- Living Room : LR
- Kitchen : K
- Toilet or Bathroom : WC or Bth
- Stair : Str
- Sofa : S
- Bedroom : B
- Room : R
- Storage : Sg

Afet Inan House Project space geometry analysis with colour

Afet Inan House Project space geometry square meter analysis

	Ground Floor	First Floor
Living Room	42,5	
Bathroom 1	7	
Bathroom 2	8,3	
Bathroom 3	9	
WC	11	
Sofa (Horizontal circulation)	70	
Kitchen	15	
Bedroom 1	20	
Bedroom 2	32	
Bedroom 3	39	
Storage	10	

- Housing and Shops Project Analysis



GROUND FLOOR FIRST FLOOR

GRAMMER ELEMENTS

Living Room : LR

Kitchen : K

Toilet or Bathroom : WC or Bth

Stair : Str

Sofa : S

Bedroom : B

Room : R

Storage : Sg

Housing and Shops Project space geometry analysis with colour

Housing and Shops Project space geometry square meter analysis

	Ground Floor	First Floor
Living Room 1	37	-
Living Room 2		37
Bathroom 1	6	-
Bathroom 2	-	6
WC 1	5	-
WC 2	-	5
Sofa 1 (Horizontal circulation)	27	-
Sofa 2 (Horizontal circulation)	-	22
Stair Space 1 (Vertical circulation)	7	-
Stair Space 2 (Vertical circulation)	-	7
Kitchen 1	10	-
Kitchen 2		10
Bedroom 1	13	-
Bedroom 2	23	-
Bedroom 3	-	13
Bedroom 4	-	23

- House in Ankara Project Analysis

GROUND FLOOR FIRST FLOOR

GRAMMER ELEMENTS

Living Room : LR

Kitchen : K

Toilet or Bathroom : WC or Bth

Stair : Str

Sofa : S

Bedroom : B

Room : R

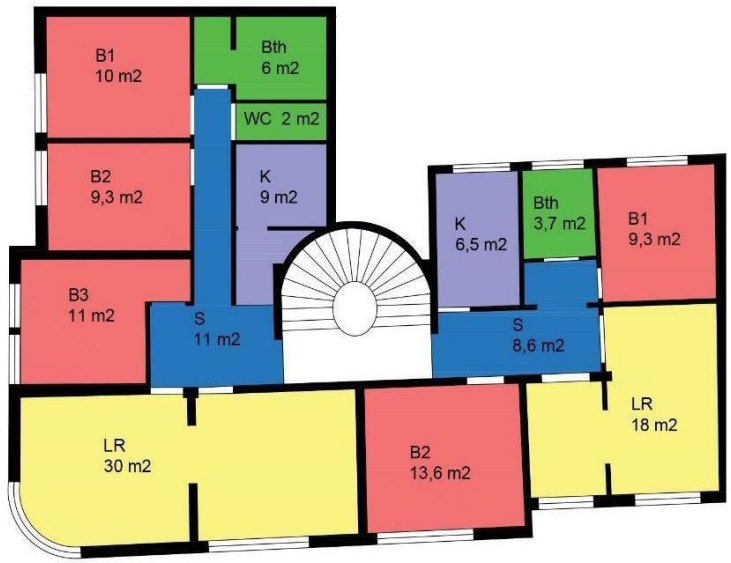
Storage : Sg

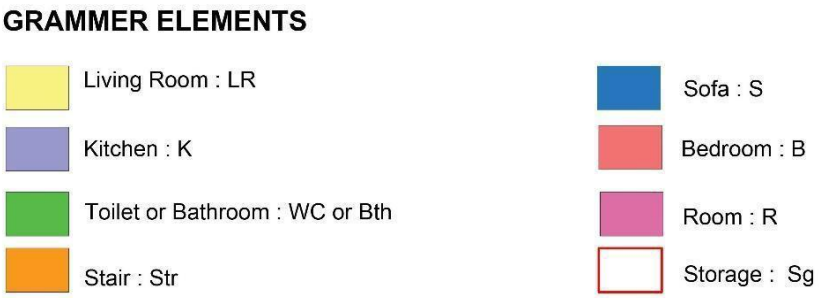
House in Ankara Project space geometry analysis with colour

House in Ankara Project space geometry square meter analysis

	Ground Floor	First Floor
Living Room	29	-
Bathroom 1	-	3
Bathroom 2	-	3
WC	-	2,3
Sofa 1 (Horizontal circulation)	17	-
Sofa 2 (Horizontal circulation)	-	7,5
Stair Space 1 (Vertical circulation)	3	-
Stair Space 2 (Vertical circulation)	-	2
Kitchen	6	-
Room 1	25	-
Room 2	19,5	-
Bedroom 1	-	8
Bedroom 2	-	7
Bedroom 3	-	10
Bedroom 4	-	12

- Ayhan Apartment Project Analysis





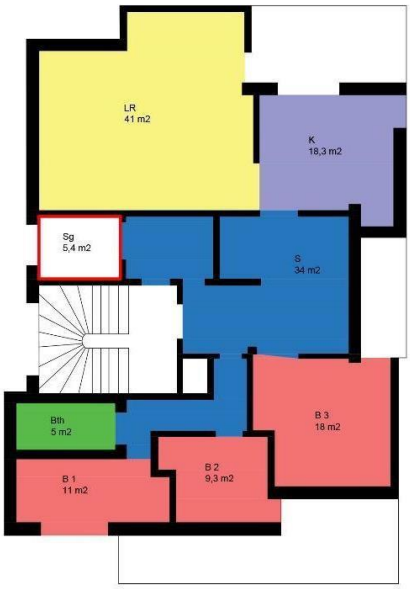
Ayhan Apartment Project space geometry analysis with color

Ayhan Apartment Project space geometry square meter analysis

	Flat 1	**Flat 2**
Living Room	30	18
Bathroom	6	3,7
WC	2	-
Sofa (Horizontal circulation)	11	8,6
Kitchen	9	6,5
Bedroom 1	10	9,3
Bedroom 2	9,3	13,6
Bedroom 3	11	-

- Üçler Apartment Project Analysis

GROUND FLOOR



FIRST FLOOR

GRAMMER ELEMENTS

Living Room : LR

Kitchen : K

Toilet or Bathroom : WC or Bth

Stair : Str

Sofa : S

Bedroom : B

Room : R

Storage : Sg

Üçler Apartment Project space geometry analysis with color

Üçler Apartment Project space geometry square meter analysis

	Ground Floor	**First Floor**
Living Room	28,8	41
Bathroom	4,8	5
Sofa (Horizontal circulation)	25	34
Kitchen	13,3	18,3
Bedroom 1	13,8	11
Bedroom 2	16,5	9,3
Bedroom 3	-	18
Storage	5,6	5,4

- Makbule Atadan Mansion Project Analysis

Makbule Atadan Mansion Project space geometry analysis with color

Makbule Atadan Mansion Project space geometry square meter analysis

	Ground Floor	**First Floor**
Living Room	130	
Bathroom 1	1,2	
Bathroom 2	2	
Bathroom 3	1,2	
WC	1	
Sofa 1 (Horizontal circulation)	36	
Sofa 2 (Horizontal circulation)	8	
Sofa 3 (Horizontal circulation)	18	
Kitchen	14	
Bedroom 1	5	
Bedroom 2	5	
Bedroom 3	16	
Room 1	3	
Rooms 2, 3, 4	5	
Room 5	15	
Storage	7,5	

- Doctor Şevki Pek Health Dormitory and Rental Project Analysis

GRAMMER ELEMENTS

Living Room : LR

Kitchen : K

Toilet or Bathroom : WC or Bth

Stair : Str

Sofa : S

Bedroom : B

Room : R

Storage : Sg

Doctor Şevki Pek Health Dormitory and Rental Project space geometry analysis with color

Doctor Şevki Pek Health Dormitory and Rental Project space geometry square meter analysis

	Flat 1	**Flat 2**
Living Room	45	36
Bathroom	9,3	8
WC	4,3	5
Sofa (Horizontal circulation)	47	38
Kitchen	24,3	15
Bedroom 1	28	38
Bedroom 2	15	-
Room 1	27	24
Room 2	30	-

Appendix 2. Ratio between rooms in private property house type, apartment type and social housing type buildings.

- Ratio between rooms in private property house-type buildings.

Structure 1	Kitchen	Sofa	Living room	WC	Bathroom	Bedroom
Kitchen		1,0	1,2	0,1	0,6	0,9
Sofa	1,0		2,0	0,1	0,6	1,3
Living room	0,9	0,4		0,1	0,5	0,7
WC	7,2	7,2	8,4		4,4	6,4
Bathroom	1,6	1,6	1,9	0,2		1,4
Bedroom	0,8	0,8	0,9	0,1	0,6	

Structure 2	Kitchen	Sofa	Living room	WC	Bathroom	Bedroom
Kitchen		0,5	1,0		0,2	0,8
Sofa	1,8		2,0		0,4	1,4
Living room	0,9	0,5			0,2	0,7
WC						
Bathroom	4,4	2,4	4,8			3,4
Bedroom	1,2	0,7	1,4		0,3	

Structure 3	Kitchen	Sofa	Living room	WC	Bathroom	Bedroom
Kitchen		2,3	5,5	0,3	0,8	1,3
Sofa	0,4		2,5	0,1	0,3	0,6
Living room	0,2	0,4		0,1	0,1	0,2
WC	4,0	9,0	22,0		3,0	5,0
Bathroom	1,3	3,0	7,3	0,3		1,7
Bedroom	0,8	1,8	4,4	0,2	0,6	

Structure 4	Kitchen	Sofa	Living room	WC	Bathroom	Bedroom
Kitchen		3,3	4,7	0,3	0,8	2,0
Sofa	0,3		1,4	0,1	0,3	0,6
Living room	0,2	0,7		0,1	0,2	0,4
WC	3,0	10,0	14,0		2,5	6,0
Bathroom	1,2	4,0	5,6	0,4		2,4
Bedroom	0,5	1,6	2,3	0,2	0,4	

Structure 5	Kitchen	Sofa	Living room	WC	Bathroom	Bedroom
Kitchen		2,4	3,1	0,1	0,4	0,8
Sofa	0,4		1,3	0,1	0,2	0,3
Living room	0,3	0,8		0,1	0,1	0,3
WC	8,0	19,0	25,0		3,0	6,5
Bathroom	2,7	6,3	8,3	0,7		2,2
Bedroom	1,2	3,0	3,8	0,2	0,5	

Structure 6	Kitchen	Sofa	Living room	WC	Bathroom	Bedroom
Kitchen		4,7	2,8	0,7	0,5	1,3
Sofa	0,2		0,6	0,2	0,1	0,3
Living room	0,4	1,7		0,3	0,2	0,5
WC	1,4	6,4	3,8		0,6	1,8
Bathroom	2,1	10,0	6,0	1,6		2,9
Bedroom	0,8	3,5	2,1	0,6	0,4	

Structure 7	Kitchen	Sofa	Living room	WC	Bathroom	Bedroom
Kitchen		2,2	3,7	0,5	0,6	1,3
Sofa	0,5		1,7	0,2	0,3	0,6
Living room	0,3	0,6		0,1	0,2	0,4
WC	2,0	4,4	7,4		1,2	2,6
Bathroom	1,7	3,7	6,2	0,8		2,2
Bedroom	0,8	1,7	2,8	0,4	0,5	

Structure 8	Kitchen	Sofa	Living room	WC	Bathroom	Bedroom
Kitchen		1,3	4,8	0,5	0,5	1,3
Sofa	0,8		3,6	0,4	0,4	1,0
Living room	0,2	0,3		0,1	0,1	0,3
WC	2,0	2,7	9,7		1,0	2,7
Bathroom	2,0	2,7	9,7	1,0		2,7
Bedroom	0,8	1,0	3,6	0,4	0,4	

Structure 9	Kitchen	Sofa	Living room	WC	Bathroom	Bedroom
Kitchen		0,6	9,3	0,1	0,1	0,4
Sofa	1,8		16,3	0,1	0,3	0,6
Living room	0,1	0,1		0,1	0,0	0,0
WC	14,0	8,0	130,0		2,0	5,0
Bathroom	7,0	4,0	65,0	0,1		2,5
Bedroom	2,8	1,6	26,0	0,1	0,4	

- Ratio between rooms in apartment-type buildings.

Structure 1	Kitchen	Sofa	Living room	WC	Bathroom	Bedroom
Kitchen		2,3	4,7	0,3	0,7	2,2
Sofa	0,4		2,0	0,1	0,3	0,9
Living room	0,2	0,5		0,1	0,1	0,5
WC	3,0	7,0	14,0		2,0	6,5
Bathroom	1,5	3,5	7,0	0,5		3,3
Bedroom	0,5	1,1	2,2	0,2	0,3	

Structure 2	Kitchen	Sofa	Living room	WC	Bathroom	Bedroom
Kitchen		2,8	3,1	0,3	0,4	1,4
Sofa	0,4		1,1	0,1	0,2	0,5
Living room	0,3	0,9		0,1	0,1	0,5
WC	3,0	8,3	9,3		1,3	4,3
Bathroom	2,3	6,3	7,0	0,8		3,3
Bedroom	0,7	1,9	2,2	0,2	0,3	

Structure 3-a	Kitchen	Sofa	Living room	WC	Bathroom	Bedroom
Kitchen		1,2	3,3	0,2	0,7	1,1
Sofa	0,8		2,7	0,2	0,5	0,9
Living room	0,3	0,4		0,1	0,2	0,3
WC	4,5	5,5	15,0		3,0	5,0
Bathroom	1,5	1,8	5,0	0,3		1,7
Bedroom	0,9	1,1	3,0	0,2	0,6	

Structure 3-b	Kitchen	Sofa	Living room	WC	Bathroom	Bedroom
Kitchen		1,3	2,6		0,6	1,3
Sofa	0,8		2,0		0,4	1,0
Living room	0,4	0,5			0,2	0,5
WC						
Bathroom	1,8	2,3	4,5			2,3
Bedroom	0,8	1,0	2,0		0,4	

Structure 4-a	Kitchen	Sofa	Living room	WC	Bathroom	Bedroom
Kitchen		1,9	2,2		0,4	1,0
Sofa	0,5		1,2		0,2	0,5
Living room	0,4	0,9			0,2	0,4
WC						
Bathroom	2,6	5,0	5,8			2,6
Bedroom	1,0	1,9	2,2		0,4	

Structure 4-b	Kitchen	Sofa	Living room	WC	Bathroom	Bedroom
Kitchen		1,9	2,3		0,3	0,5
Sofa	0,5		1,2		0,1	0,3
Living room	0,4	0,8			0,1	0,2
WC						
Bathroom	3,6	6,8	8,2			1,8
Bedroom	2,0	3,8	4,6		0,6	

Structure 5-a	Kitchen	Sofa	Living room	WC	Bathroom	Bedroom
Kitchen		2,0	1,9	0,2	0,4	1,2
Sofa	0,5		1,0	0,1	0,2	0,6
Living room	0,5	1,0		0,1	0,2	0,6
WC	6,0	11,8	11,3		2,3	7,0
Bathroom	2,7	5,2	5,0	0,4		3,1
Bedroom	0,9	1,7	1,6	0,1	0,3	

Structure 5-b	Kitchen	Sofa	Living room	WC	Bathroom	Bedroom
Kitchen		2,5	2,4	0,3	0,5	2,5
Sofa	0,4		0,9	0,1	0,2	1,0
Living room	0,4	1,1		0,1	0,2	1,1
WC	3,0	7,6	7,2		1,6	7,6
Bathroom	1,9	4,8	4,5	0,6		4,8
Bedroom	0,4	1,0	0,9	0,1	0,2	

- Ratio between rooms in social housing-type buildings.

Structure 1	Kitchen	Sofa	Living room	WC	Bathroom	Bedroom
Kitchen						
Sofa				0,8		2,8
Living room						
WC		1,3				3,7
Bathroom						
Bedroom		0,4		0,3		

Structure 2	Kitchen	Sofa	Living room	WC	Bathroom	Bedroom
Kitchen		2,2	4,0		0,7	1,7
Sofa	0,5		1,8		0,3	0,8
Living room	0,3	0,5			0,2	0,4
WC						
Bathroom	1,5	3,3	6,0			2,5
Bedroom	0,6	1,3	2,4		0,4	

Structure 3	Kitchen	Sofa	Living room	WC	Bathroom	Bedroom
Kitchen		2,6	5,2		0,8	2,0
Sofa	0,4		2,0		0,3	0,8
Living room	0,2	0,5			0,2	0,4
WC						
Bathroom	1,3	3,3	6,5			2,5
Bedroom	0,5	1,3	2,6		0,4	

Structure 4	Kitchen	Sofa	Living room	WC	Bathroom	Bedroom
Kitchen		0,6	1,8	0,4	0,4	1,9
Sofa	1,8		3,2	0,8	0,8	3,4
Living room	0,6	0,3		0,3	0,3	1,1
WC	2,3	1,3	4,0		1,0	4,3
Bathroom	2,3	1,3	4,0	1,0		4,3
Bedroom	0,5	0,3	0,9	0,2	0,2	

Structure 5	Kitchen	Sofa	Living room	WC	Bathroom	Bedroom
Kitchen		1,2	2,2		1,0	1,8
Sofa	0,8		1,8		0,8	1,5
Living room	0,5	0,5			0,5	0,8
WC						
Bathroom	1,0	1,2	2,2			1,8
Bedroom	0,6	0,7	1,2		0,6	

Structure 6	Kitchen	Sofa	Living room	WC	Bathroom	Bedroom
Kitchen		1,0	2,0		0,4	1,8
Sofa	1,0		2,0		0,4	1,8
Living room	0,5	0,5			0,2	0,9
WC						
Bathroom	2,5	2,5	5,0			4,5
Bedroom	0,6	0,6	1,1		0,2	

Structure 7	Kitchen	Sofa	Living room	WC	Bathroom	Bedroom
Kitchen		0,8	1,2		0,3	1,2
Sofa	1,3		1,5		0,4	1,5
Living room	0,8	0,7			0,3	1,0
WC						
Bathroom	3,3	2,7	4,0			4,0
Bedroom	0,8	0,7	1,0		0,3	

Structure 8	Kitchen	Sofa	Living room	WC	Bathroom	Bedroom
Kitchen		0,7	1,4	0,1	0,9	0,8
Sofa	1,5		2,2	0,2	1,3	1,2
Living room	0,7	0,5		0,1	0,6	0,5
WC	9,0	6,0	13,0		8,0	7,0
Bathroom	1,1	0,8	1,6	0,1		0,9
Bedroom	1,3	0,9	1,9	0,1	1,1	