EVALUATION OF WINDOW DESIGN AND DAYLIGHT PERFORMANCE OF MAIN ROOM IN KULA HOUSES

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ABSTRACT

EVALUATION OF WINDOW DESIGN AND DAYLIGHT PERFORMANCE OF MAIN ROOM IN KULA HOUSES

When developing restoration decisions for conservation of historic houses, determination of daylight performance of the spaces is important for new usage proposals. Among the rooms located around sofa in Anatolian historical houses, main room is the most spectacular space. It should have sufficient and homogeneously distributed daylight in restored houses. This study aims to examine daylight performance of main room and preserve original lighting features in restoration and re-functioning decisions. For this purpose, Kaçıklar, Zabunlar, Kestaneciler and Zühtü Bey Houses, were selected as examples for the research. Daylight performance measurements were taken in main rooms in all seasons, in the morning, at noon, in late afternoon using an illuminance meter. As a result of the study, it was determined that illumination was not sufficient for all seasons in unrestored Kaçıklar House, sufficient for all seasons in unrestored Zabunlar House, in restored Kestaneciler House, also sufficient in restored Zühtü Bey House in autumn whereas insufficient in other seasons. In Kaçıklar House, opening the window that was closed, cleaning the paint on top windows, selecting a light-coloured wall finish material will positively affect lighting values. In restored Zühtü Bey House, the window, converted into a built-in cupboard, and the closed top window to be restored to original state and cleaning of improper paint on the top windows on the south wall will affect the lighting level positively. This study is important in terms of determining specific daylight illumination properties of historical houses and underlines the improvement of repair and conservation decisions.

ÖZET

KULA EVLERİNDE BAŞODA PENCERE TASARIMI VE DOĞAL AYDINLATMA PERFORMANSININ DEĞERLENDİRİLMESİ

Tarihi konutların onarım kararlarının geliştirilmesinde mekânların doğal aydınlatma yeterliliğinin belirlenmesi yeni kullanım önerileri için önemlidir. Anadolu'daki tarihi konutlarda sofa etrafında konumlanan odalar arasında başoda, özenle tasarlanmış, çoğunlukla çıkmalı ve üç yönden pencerelerle çevrili en gösterişli mekandır. Yeniden kullanılmak üzere onarılan yapılarda başoda, yeterli ve düzgün dağılımlı aydınlatmaya sahip olmalıdır. Başodalardaki pencereler farklı tip ve boyutlarda ahşap doğrama, parmaklık, kafes ya da kepenklerle birlikte tasarlanmıştır. Bu çalışmanın amacı, tarihi konutlarda başoda doğal aydınlatma performansının incelenerek onarım ve yeniden işlevlendirme kararlarının özgün aydınlatma özelliklerini göz önüne alarak hazırlanmasını sağlamaktır. Bu amaç doğrultusunda inceleme örnekleri olarak Kula'da özgün pencerelere sahip Kaçıklar, Zabunlar, Kestaneciler ve Zühtü Bey Evleri seçilmiştir. Bu konutların başodalarında kış, ilkbahar, yaz ve sonbahar mevsimlerinde sabah, öğle ve öğleden sonra doğal aydınlatma performans ölçümleri aydınlık düzeyi ölçüm cihazı kullanılarak yapılmıştır. Çalışma sonucunda, doğal aydınlatma performans değerlerine göre onarılmamış Kaçıklar Evinde aydınlatma düzeyi dört mevsim için yetersiz, özgün özelliklerini koruyan onarılmamış Zabunlar ve onarılmış Kestaneciler Evinde dört mevsim için yeterli ve onarılmış Zühtü Bey Evinin ise sonbaharda yeterli diğer mevsimlerde yetersiz olduğu tespit edilmiştir. Bu nedenle onarım kararları geliştirilirken Kaçıklar Evinde kapatılmış pencerenin açılması, tepe pencerelerindeki boyaların temizlenmesi ve duvar bitiş malzemesinin açık renkte seçilmesi aydınlatma değerlerini olumlu etkileyecektir. Onarılmış Zühtü Bey Evinde ise gömme dolaba dönüştürülen pencere ve kapatılan tepe penceresinin özgün durumuna getirilerek yeniden pencere işlevi kazandırılması ayrıca mekanın güney duvarındaki tepe pencerelerindeki niteliksiz boyaların temizlenmesi aydınlatma düzeyini olumlu etkileyecektir. Bu çalışma, tarihi konutların özgün doğal aydınlatma özelliklerinin tespit edilerek, onarım ve koruma kararlarının geliştirilmesine dikkat çekmesi açısından önem taşımaktadır.

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CHAPTER 1

INTRODUCTION

Determining the daylight adequacy of spaces is important for new usage suggestions in developing restoration decisions for the protection of traditional houses. The main element that determines the daylight adequacy is the window. Window; the opening that connects the interior and the exterior, made to illuminate and / or ventilate the building, can be defined as an architectural element in the form of a space. Karnak Temple windows in Egypt can be shown as the first window examples that reached today in historical development. The windows that provide daylight to the central nave of the temple are on both sides above the nave and covered with stone cages. It is suggested that glass was first used by the Romans in the window space. It is stated that glass, which was used in cathedrals and important buildings until the 16th century, started to be seen in modest residences after the 16th century (Uluengin, 1982, 10). In the historical Anatolian houses, there are mostly no windows due to the privacy of the ground floors as well as the privacy of the service areas. However, glass is used in vertical rectangular windows with lattices and shutters on the upper floors.

Daylight taken through the windows to the interior is a term that expresses the use of light reflected from the sky to illuminate the interior of the building (Livingston, 2014; Gordon, 2014). The effect of daylight on the interior lighting of the building is related to the orientation of the building. The spaces directed north are the spaces of the building that receive diffused light, easily control the light distribution and do not receive direct sunlight. Spaces located in the south, provide a wide range of light intake throughout the day and year. The spaces on the eastern front get direct sunlight in the morning, while the western front gets direct light in the afternoon. Places should be positioned according to their functions in order to benefit from sunlight correctly and efficiently because each room needs different daylight performance depending on its function (Phillips, 2004). For this reason, the direction of the buildings during the design phase and accordingly their location should be determined by optimizing the daylight.

The design of the openings in buildings directly affects the amount of daylight that passes into the interior volume, the distribution in the volume and the path it takes.

Climate conditions, the phenomenon of privacy and technological advances have had an impact on window size, number and direction. Windows are the main design element in visual and thermal performance evaluations. The window designs of the contemporary buildings and especially work spaces; window dimensions, materials used and optical properties have been examined in various studies (Ochoa et al. 2012; Shen and Tzempelikos, 2013; Fontenelle and Bastos, 2014; Garnier et al. 2015; Acosta et al. 2016). On the other hand, the windows of traditional houses are in certain sizes in line with the opportunities provided by traditional construction techniques and were also designed with specific and local building materials / elements (wooden joinery of window, window railing, lattice, shutter) used in traditional residential architecture.

Although the traditional Anatolian houses show different construction techniques according to the geographical regions, the ground floor outer walls are wooden bonded stone masonry and the upper floor walls are in mudbrick, stone-or- brick-filled timber frame system. The plan features are determined by the placement of the rooms around the *sofa*. These dwellings generally have two or three floors and mostly a garden or a courtyard. The main room (*başoda*) is privileged with its more elaborate design in the traditional houses. This place, where guests are hosted, is highlighted in plan and the front. The main room (*başoda*), designed to provide a visual opening to the exterior, is the largest of the rooms. The main room (*başoda*), which has mostly a projection, is surrounded by rectangular windows in three directions and also there are top windows above these windows in some examples. The correct perception of the colors of ornamental ceiling coverings, paint colors on the walls, cabinet doors, and wood floor coverings, located in the main room (*başoda*), is provided with homogeneously distributed daylight. The light transmittance value of window glass can also affect both the amount and quality of light. The fact that the windows in the main rooms (*başoda*) have different partitions and are designed with different types and sizes of wooden joinery, railings, lattice or shutters affect the entrance of light into the interior. It should have sufficient and homogeneously distributed daylight required by the function in the buildings that are restored for reusage. The color properties of the illuminated surfaces and light used from lamps should be considered together in the selection of artificial lighting elements (Yavuz and Ünver, 2008; Yavuz and Ünver, 2009). The determination of the existing daylight situation in traditional houses is important in guiding the decisions for maintaining the authentic-lighting qualities of the spaces for the new function.

In this study, the daylight performance values of the main room (*başoda*) in the houses in Kula, Manisa, Turkey, which have preserved their original historical texture until today, have been compared in terms of the lighting condition in the unrestored and restored samples and it has been determined whether the results obtained comply with present standard values and how they will be evaluated during the preparation of restoration projects. Based on the evaluations made, suggestions for sufficient and homogeneously distributed daylight required by the function have been developed by preserving the original space features in the restoration projects.

1.1. Literature Survey

The importance of daylight use in terms of energy saving is known and studies on this subject are increasing rapidly with technological developments (IEA, 2000; Baker et al. 2002; Bayram and Kazanasmaz, 2016; Ayoub, 2019; Lee et al. 2020; Tian et al. 2020). In parallel with these studies, also conducted research for the effective usage of daylight in Turkey (Yener, 2002; Güvenkaya and Küçükdoğu, 2009; Yener et al. 2009; Erlalelitepe et al. 2011; Çelik and Ünver, 2016; Kazanasmaz et al. 2017).

In contemporary buildings such as offices, residences and educational buildings, various natural lighting parameters have been addressed, and researches have been conducted on energy efficiency and visual comfort and the perception of the elements in the interior. Lighting conditions to be met as a result of measurements and surveys have been determined. In contemporary buildings such as offices, residences and educational buildings, various natural lighting parameters have been handled and researches have been made on energy efficiency and visual comfort (Reinhart and Selkowitz, 2006; Kruger and Dorigo, 2008; Li and Tsang, 2008; Konis, 2013; Pniewska and Brotas, 2013; Sümengen and Yener, 2015) as well as the perception of the elements in the interior (Ünver and Yener, 2000; Ünver, 2002; Ünver, 2015, Houser et al. 2016; Aydın Yağmur and Şerefhanoğlu Sözen, 2016) so that lighting conditions to be met as a result of measurements and surveys have been determined. In historical buildings, daylight performance has been evaluated in mosques, hans (inns) and residential buildings (Halifeoğlu et al. 2005; Direk and Oğuz, 2005; Çetinkaya and Bakır, 2009; Aykal et al. 2011; Almaiyah and Elkadi, 2012; Nabavi et al. 2013; Sayın, 2014; Xuan et al. 2014; Erdemir and Yener, 2016). In the works carried out within the scope of daylight

performance in historical mosques; natural lighting systems were examined in detail and attention was paid to the importance of protecting these systems in restoration works (Halifeoğlu et al. 2005). In addition, the standard values related to illumination and the measured values in the mosques were compared so that the level of visual comfort was determined (Direk ve Oğuz, 2005). In addition to these studies, the situations that should be considered about the use of artificial lighting elements in the restoration decisions taken during the preservation projects in historical hans were also examined (Çetinkaya and Bakır, 2009). On the other hand, Chartered Institution of Building Services Engineers (CIBSE, 2009); Illuminating Engineering Society of North America (IESNA, 2011); Turkish Standard / European Standard 12464-1 (TS / EN 12464-1, 2011) can be shown as relevant standards.

Studies on daylight performance of historical houses are varied as study of lighting and thermal environments designed based on past experiences (Sakarellou-Tousi and Lau, 2009), comparison of daylight behavior in residential buildings with simulation values (Almaiyah et al. 2010), determining the daylight performance by examining the original and new functions of the re-functioned historical houses under different weather conditions (Aykal et al. 2011), determining the effects of daylight, thermal and visual comfort conditions on bioclimatic properties in traditional houses through field studies and simulation programs (Oikonomou and Bougiatioti, 2011; Oikonomou, 2015), determining design strategies for contemporary buildings by examining the existing historical houses in terms of location, form and shading elements (Nabavi et al. 2013), identifying daylight use in historical dwellings belonging to different cultures and developing suggestions on reuse (Xuan et al. 2014), comparing the daylight performance of buildings in different climatic zones, evaluation of daylight luminance level in terms of old and new functions (Sayın, 2014), evaluation of lighting levels of rural traditional houses in different climatic zones with measurement and simulation programs (Michael et al. 2015), evaluation of warm dry climate traditional houses in terms of daylight performance (Erdemir and Yener, 2016), study of daylight performance of urban and local architecture in indoor and semi-open spaces using measurements and simulations (Michael et al. 2017), and study of daylight usage by using measurements and simulations in designs based on beliefs (Manurung, 2017).

The use of stories is divided into summer and winter in the Karagiannopoulos House (Vysitsa Village), which represents the traditional house of Mount Pelion in Greece and its climate zone is mild in summers and cold in winters. The number and

dimensions of the windows differ according to the use of the stories (Sakarellou-Tousi and Lau, 2009). On the lower stories used in winter, the number of windows and sizes are smaller to keep the interiors warm, as well as the concerns of safety and privacy, whereas the upper floor spaces used in the summer season are multi-windowed to create bright and airy spaces. In addition, moving shutters, colored top windows and roof eaves provide controlled light reception (Sakarellou-Tousi and Lau, 2009).

Suhami House, one of the 17th century traditional houses in Cairo, Eygpt, located in the warm and dry climate region, provided controlled daylight reception with the mashrabiya[1] design on the north facade in the square-shaped Maka'ad place, which is a main room (Almaiyah et al. 2010).

The main room is arranged in the north in the Cahit Sıtkı Tarancı House, which has been re-functioned in the traditional residential texture of Diyarbakır, Turkey, located in the harsh terrestrial climate zone. It has sufficient illumination in its original function, but when the space was re-functioned, the illumination level was evaluated as high for the organic product exhibition (Aykal et al. 2011).

In Florina, Greece located in the continental climate region where winters are long, cold and humid and summers are short, hot and dry, analysis of architectural aspects of forty traditional houses, building typology, form, materials and construction techniques, analysis of bioclimatic properties, thermal behavior of building envelope, thermal and visual comfort conditions were examined through field studies and simulation programs (Oikonomou and Bougiatioti, 2011; Oikonomou, 2015).

ECOTECT software was used in three traditional residences in Guizhou province, China, which is located in the monsoon climate region, which is a little cooler than the tropical climate, where it is hot, humid and sunny in the summer and relatively hot in the winter. Based on the simulation, suggestions such as moving grille and window glass replacement have been submitted to improve daylight status (Xuan et al. 2014).

Turkey's illumination level of selected samples in studies located in different climatic zones, which are in Kemaliye county of Erzincan city, Birgi county of İzmir city and Safronbolu county of Karabük city, were identified. The climate zone is cold in Erzincan (Kemaliye), warm in İzmir (Birgi), temperate and humid in Karabük (Safranbolu). Three re-functioned traditional houses were identified for each settlement. In the study, illumination level measurements were taken at different times for each

[1] It is a single or multi-storey protruding window on the upper floors of Arab houses, made of wooden sticks attached together (Hasol, 1975/2017).

sample, and evaluation was made in terms of the original function and new function of the samples (Sayın, 2014).

Lighting level measurements in rural traditional residences located in different climatic regions such as coastal areas, lowlands and mountainous regions in Cyprus were evaluated with simulation programs and suggestions for improving lighting are presented (Michael et al. 2015).

Some measurements have been taken in different seasons from the *Sahnisi* location on the first floor, which is the main room (*başoda*) of a traditional two-storey residential complex in the city of Nicosia in Cyprus, located in the Mediterranean climate region, which is hot and dry in the summer and mild and rainy in the winter. Daylight performance has been evaluated in terms of function (Michael et al. 2017).

Tongkonan House, which carries traditional residential properties in Indonesia, located in a warm and humid climate zone, is designed according to the ancestral belief of the people of Toraja (Aluk Todolo). Due to this belief, the sun affects the interior and exterior design of the house and caused the houses to be directed to the north. The measurement and simulation results showed that daylight was more diffused in the north than in other directions during the day and year (Manurung, 2017).

In the studies examined, daylight performance evaluations were made by taking measurements from single houses (Sakarellou-Tousi and Lau, 2009; Almaiyah et al. 2010; Aykal et al. 2011; Michael et al. 2017), houses belonging to different ethnic groups (Xuan et al. 2014) and houses in different climate zones (Sayın, 2014; Michael et al. 2015). In the scope of this study, daylight usage of the main room (*başoda*) and the effect of the window design of the main room (*başoda*) on daylight in the selected traditional houses were studied. The current daylight performance values and quantitative trait (daylight measurement values, window glass permeability, reflectance of surface materials) of light are dealt together, and their relationship with window designs was determined. The study drew attention to the correct orientation of the interventions in the restoration and conservation decisions of the main rooms in the historical houses and the preservation of their original lighting features.

1.2. Problem Definition

Historical houses have been abandoned by property owners who have moved to prestigious neighborhoods and residences as a result of the changing lifestyle, and have been subjected to unconscious interventions, mostly to be by more than one family, trade or warehouse. The spatial change caused by the usage has also led to the loss of the original planning and facade features of the buildings, and the interventions have also disrupted the original stylistic features. Incorrect interventions cause the windows forming the facade features to be covered, enlarging their dimensions and consequently loss of balance and aesthetic dimension in their architectural features. The suitability or necessity of these interventions for the re-functioning of the structures can be realized by determining the lighting properties of the traditional houses. There is no such data in the prepared restoration projects in Turkey. This is a deficiency in issues such as interior design and determination of paint colors during the project preparation process. Performance evaluation studies conducted by considering the amount of light in terms of energy saving and visual comfort are amongst the research topics that will also be addressed for traditional houses.

The main approach in the preservation of traditional wooden houses is the development of physical structures that extend the life of the original structure, material, spatial order and architectural elements. In this process, first of all, the unqualified interventions should be cleaned in order to reveal the original features of the building. Elements and materials that are incompatible with the original architecture of the building, which emerged as a result of the usege, are cleaned. After the original elements are revealed, conservation decisions are directed in relation to the cultural, historical, architectural and aesthetic values of the building. In this context, while improving the restoration decisions of the traditional houses to be re-functioned, analyzing the current natural lighting level will direct the decisions regarding the maintenance of the original lighting qualities of the places.

1.3. Aim and Scope of the Study

It can be argued that the natural lighting level of spaces in historical residences depends on the relation of the space with the street and nearby structures, the direction,

number and design of the window, as well as the texture and color of building elements such as ceilings, floors and walls and fixed furniture. The aim of the study is to examine the daylight performance values of the main room (*başoda*) in unrestored and restored traditional houses, to determine the lighting elements by taking into account the original lighting features in the restoration projects, and to prepare the restoration projects by considering this topic. In this context, the current daylight performance values of the main room (*başoda*) in historical houses should be taken into consideration and the relation between window designs should be determined by considering the quantitative characteristics of light. Accordingly, the research has sought some answers to the these questions:

- How does the original daylight performance of the main room (*başoda*) in historical houses vary according to the seasons (winter, spring, summer, autumn) and at different times (09.00-10.00, 12.00-13.00, 15.00-16.00) during the day?
- What is the relationship between the distribution of light to space and the ratio of floor area and wall areas to window area and window glass surface areas in main rooms (*başoda*) in traditional houses?
- How is the daylight performance affected by wooden surface coatings, different paint colors, ceiling and wall decorations used in main rooms in traditional houses? Do the luminous level and luminance value of these opaque material differ according to the seasons? Do the average values of reflectance of the opaque material differ in main rooms located in different directions? If the difference is detected, what are the reasons of this difference?
- Is there any difference in glass permeability values in windows in unrestored and restored traditional houses?

The hypothesis of this study is that there is a relationship between daylight performance in historical residences and the location features of the building, the designs of windows based on the number, size and type of windows. In this study, the daylight performance of the main room in Kula houses, which show their original characteristics from the Ottoman period traditional houses, was studied by associating them with the interior surface materials, window features and the amount and distribution of light. In this direction, Kaçıklar, Zabunlar, Kestaneciler and Zühtü Bey Houses, which have original windows, were selected as examples for the research. Kaçıklar and Zabunlar

Houses are unrestored samples used in housing function, and Kestaneciler and Zühtü Bey Houses are restored samples used for ethnographic exhibition.

In order to determine the daylight performance of the main room in selected houses, room sizes, ceiling and floor coverage materials and colors, window designs and dimensions were examined and luminance level measurements were made in different seasons and hours. The effect of the relationship between the room and window dimensions on lighting was studied, and the measured values in relation to the space and window features were compared with the standard values. As a result of the study, evaluations were made by comparing the original lighting level in the unrestored houses and the lighting level in the restored houses. Based on the evaluations made, suggestions have been developed to provide adequate and uniform illumination based on usage while preserving original space features in restoration projects.

1.4. Method of the Study

Kaçıklar, Zabunlar, Kestaneciler and Zühtü Bey Houses, whose window openings remain original among the traditional Kula houses, have been examined as study examples. The location, the plan features and the facade features of the selected houses, the location and planning features of the main room (*başoda*), as well as the architectural features (stylistic and technical characteristics) of the windows of the main room (*başoda*) were analyzed and their effects on the use of daylight were determined.

The performance evaluation method is based on "*the assessment of the behavior of buildings and building components against daylight. The building is considered an optical system in which light is dispersed. The dimensions of the windows, the shape and structural features of the surfaces affect this distribution. Therefore, in the study area, the impact of each element within the system should be defined. Thus, the successful or unsuccessful effect of each element on the architectural result can be understood and utilizable information can be produced in the field of design."* (Fontoynont, 1999; Erlalelitepe et al. 2011). In this context, the main quantitative parameters affecting the daylight performance are illuminance and its distribution. In addition, reflectance of surface materials used in the interior volume, transmittance of window glass and the window area are other quantitative parameters.

In this study, daylight performance has been determined by considering quantitative parameters (amount and distribution of light), it has been associated with window systems and guiding information has been created in the selection of artificial lighting elements that can be applied while making conservation decisions of traditional houses by comparing the outcome values with standard values. For example, after the parts of the main room, whether they get enough daylight throughout the year, are detected, while preparing conservation projects, it will be possible to decide how much, what number and if the quality of artificial lighting elements can be applied by preserving the original space features according to these determinations. Energy efficiency can be achieved by preventing unnecessary use of lighting elements or by considering control systems. The method of the study is field studies based on in-situ inspection and measurements. These studies are systematically introduced in Chapter 3.

1.5. Structure of the Thesis

The thesis study titled "Evaluation of Window Design and Daylight Performance of Main Room in Kula Houses" consists of six chapters. The first chapter contains literature survey, problem definition, aim and scope of the study, method of the study.

In the second chapter, the layout and architectural features of the main room (*başoda*), the architectural elements that affect the importance and design of the main room, and the stylistic and technical features of the windows in the main room are examined based on the resources and field studies carried out in Kula.

In the third chapter, the method of the study is explained. The tools used for measurement are introduced and the formulas and calculations in the literature are specified for calculation of the window ratios of the main room, determination of measurement points and time, window glass permeability, reflectance of surface materials.

In the fourth section, the historical, geographical and traditional texture features of Kula, the architectural features of the traditional Kula houses and the importance of the main room in the plan are examined.

In the fifth chapter, the location, plan and facade features of the selected Kaçıklar, Zabunlar, Kestaneciler and Zühtü Bey Houses as well as the location, planning features of main room, stylistic and technical features of the windows in the main room of these

houses are introduced. The measurement results related to the daylight performances of the main room in each sample structure are evaluated.

In the sixth chapter, the maximum, minimum and average illumination values of the samples according to the seasons and the reflectance factors of surface materials of the architectural elements (wall, ceiling and floor coverings, woods of cabinet and window) and window glass permeability in the main room are compared in terms of daylight performance. The existing lighting characteristic are compared to the standard values (CIBSE, 2009; IESNA, 2011; TS/EN 12464-1, 2011) and the results obtained are associated with the window design.

In the conclusion chapter, evaluations based on the daylight performances of Kaçıklar and Zabunlar Houses, which are used for accommodation, and Kestaneciler and Zühtü Bey Houses, which are used for ethnographic exhibition, and the developed suggestions are presented.

CHAPTER 2

THE SPACE LAYOUT IN THE TRADITIONAL ANATOLIAN HOUSES AND THE ARCHITECTURAL CHARACTERISTICS OF THE MAIN ROOM

Although the historical Anatolian houses show different construction techniques according to the geographical regions; commonly, the ground floor exterior walls are masonry with timber beams, and the upper floor walls are timber frame system with adobe, stone or brick filled (Figure 2.1). Rooms and *sofa* (*hayat*) determine the plan features. In Anatolian houses, the main floor (actual sitting floor) is the top floor in several-storey houses. Some houses have one more floor between the ground floor and the main floor. This floor is called the mezzanine floor (winter floor) (Eldem, 1968, 12-14). The floor height of the mezzanine floor is lower than the main floor, so the room volume is smaller. Its walls are masonry like on the ground floor.

Figure 2.1. Beyler House in Kula, Manisa.
(Prepared by Author, 02.10.2019)

The main floor is located above mezzanine floor. Places such as *taşlık* (rough stone pavement), storage, barn, cart-house (*arabalık*) and hayloft are located on the ground floor. While the staircase leads to the *sofa* (*hayat*) on the top floor, it provides a transition to the mezzanine floor (winter floor) with a platform. Access to the rooms is provided from the *sofa* (*hayat*), which is a common use and living area. *Sofa* is a transition place and it also has the feature of gathering place where the people come together. Sitting areas such as iwan (an architectural unit with three sides closed and one side opened) (Figure 2.2), *seki* (a raised wooden built-in platform for sitting) (Figure 2.3), *taht* (a raised wooden built-in platform for sitting) and kiosk (a sitting place inside or attached to the *sofa*) in the *sofa* support this function.

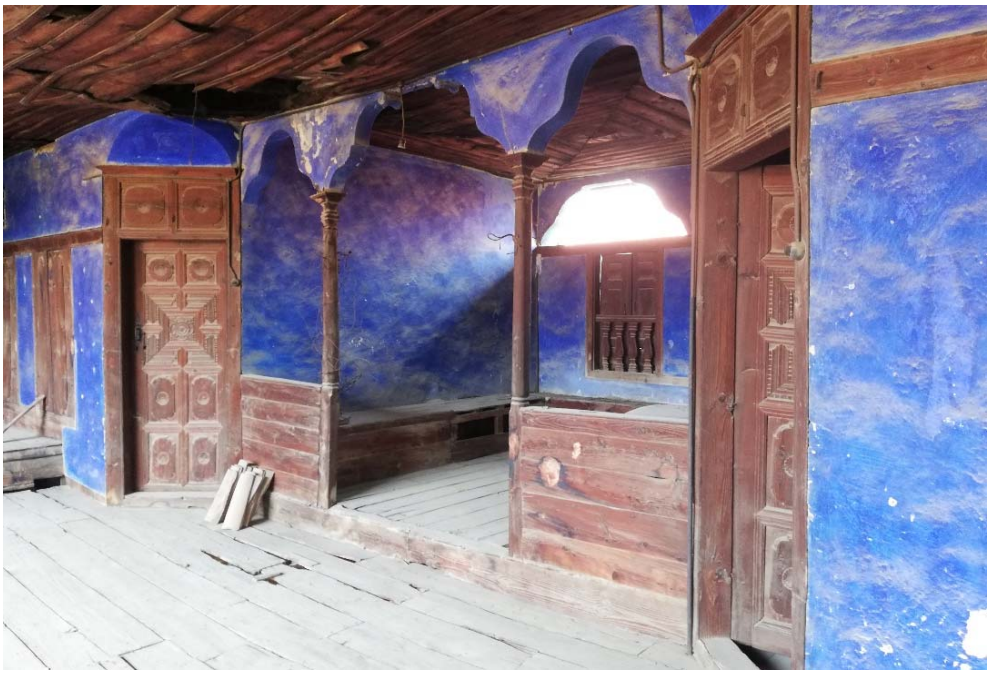

Figure 2.2. Iwan in Urlar House, Kula, Manisa.
(Prepared by Author, 26.07 2018)

The flooring material on the ground floor is usually stone or compressed earth in the storage and barn, besides it is also usually timber covering in the rooms. The floor covering on the mezzanine floor and the main floor is usually timber covering over the timber beam. In the places used for functions such as storage and barn, ceiling covering material is not generally used, beams are open and visible. While the floor covering is

designed plain and simple in places such as room, *sofa* and iwan in historical Anatolian houses, the ceiling covering shows an elaborate and ornamental property.

Figure 2.3. *Seki* in Beyler House, Kula, Manisa
(Prepared by Author, 25.07.2018)

Inverse ceiling[2], flat ceiling[3], caisson ceiling[4] and corbelled ceiling[5] construction techniques were used in timber covering cellings. Depending on the family's economic

[2] Inverse ceiling is the easiest in application and the most modest in decoration. Covering boards are placed side by side onto the wooden beams in inverse ceiling. Since the lower parts of the beams inside the room are not covered, there is a sectioned view on the ceiling (Yıldırım and Hidayetoğlu, 2015, 333; Aras et al. 2015, 415-416).

[3] Flat ceiling is a form of ceiling commonly used in traditional Turkish houses, which are formed by polishing the bottom of the beam or flat boards to form a longitudinal smooth surface (Yıldırım and Hidayetoğlu, 2015, 334; Aras et al. 2015, 416).

[4] In caisson ceiling technique, similar to the technique used in the construction of flat ceilings; wooden planks are placed on wooden beams. This technical term comes from the method whereby bolection moldings are gradually joined to the parts where the ceiling and wall edges meet. In caisson ceilings, the height difference between the moldings and the ceiling floor is at least 15-20 cm. The caisson ceiling is generally applied in the homes of wealthy families or in the main rooms of the house, since high quality workmanship and excess material are required. The caisson ceiling, which is not as common as flat ceilings, has the most ornamentation on the edge moldings and the middle part of the ceiling (Yıldırım and Hidayetoğlu, 2015, 334; Aras et al. 2015, 416-417).

[5] Corbelled Ceiling is usually constructed for square spaces. Geometry of ceiling created by cross beams from a wall to adjacent wall and an octagonal geometry is obtained from these beams on the square plan. This similar octagonal shape consists on another level (Yıldırım and Hidayetoğlu, 2015, 334; Korumaz and Korumaz, 2009).

condition and status, decoration techniques such as lattage ceiling[6] (*çıtakari*), wood jointing[7] (*kündekari*), carved woods[8] (applique), curved woodworking[9] (*eğmeçli ahşap işi*) and painting and picture techniques were applied on the timber covering on the ceilings (Yıldırım and Hidayetoğlu, 2015, 332-341). The ceilings are panel strip[10] (*pasa*) in modest houses. The junction points of the timber covering were formed an ornament by using profiled wooden laths.

In general, in these two or three-storey residences with mostly gardens or courtyards, the ground floor is usually without windows due to privacy and windows of the mezzanine floor are small in terms of being sheltered and easy to warm; on the other hand, the main floor has a vertical rectangular window with lattices and shutters.

The most important element in the concept of housing in Anatolia is the room. The number of rooms, the way they come together and their location allow the type of plan to be determined. Rooms are named according to their place in the plan. While the rooms at the end of the plan are named as the side room (*yan oda*) or corner room (*köşe oda*), the rooms in the middle of the plan are called middle room (*orta oda*) or intermediate (*ara oda*) room (Eldem, 1968, 15). Each room (*göz, hane*) has the feature to accommodate a married couple, and it has the feature to sit, lie down, bath, eat and even cook (Küçükerman, 1978/2007, 69; Bektaş, 1996, 111; Günay, 1998, 46). The mezzanine floor rooms are mostly reserved for sitting in the daytime and handicrafts such as weaving, sewing and embroidery. On the upper floor, there is a room (main room) where the man accepts his guests. This room is either in the selamlık of the houses, which has harem and selamlık, or located in a place that can be reached quickly from the stairs (Günay, 1989, 114). In this order, the main room (*başoda*) has a privileged position in terms of planning and decoration (Eldem, 1968, 15-16; Arel, 1982, 40-54; Bektaş, 1996, 115).

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6 The pattern desired to be obtained in lattage ceiling ornaments is made with wooden pieces such as thin slats and border woods. The parts (pieces with folds as "S" and "C" or laths to form a pattern) that will form the decoration on the flat surface are nailed or glued. The thickness of these slats is 1.5 cm (Yıldırım and Hidayetoğlu, 2015, 335-336).

7 Wood jointing is the combination of geometrical shaped, small sized pieces such as triangle, square, star, pentagon, hexagon to combine with each other to obtain large and decorative surfaces (Söğütlü, 2004; Yıldırım ve Hidayetoğlu, 2015, 336).

8 Carved woods Applique is the use of decoration elements by adhering to the surface or driving. These decoration elements are obtained by cutting around a certain shape with a cutting tool and discharging it. This technique is also called *ajur* (Yıldırım ve Hidayetoğlu, 2015, 337).

9 Curved woodworking is the ornamentation technique in which the ornaments created by assembling twisted thin wooden boards are generally applied in the middle part of the ceiling (Yıldırım ve Hidayetoğlu, 2015, 337).

10 Panel strip is a profiled or flat lath that closes the line between two adjacent elements (wood or metal) in the same plane (Hasol, 1993, 350; Sözen ve Tanyeli, 1986, 187; Ülkü ve Tanyol, 2004, 107-128)

2.1. Main Room (*Başoda*) in Historical Anatolian Houses

The main room in the historical Anatolian houses is the most carefully designed of all. Guests are welcomed in this room. In most examples, it is cantilevered from the mass of the house to form a facade and has become evident in the plan order. According to the positioning feature, it has a design feature that dominates the environment with windows from three sides (Figure 2.4, Figure 2.5).

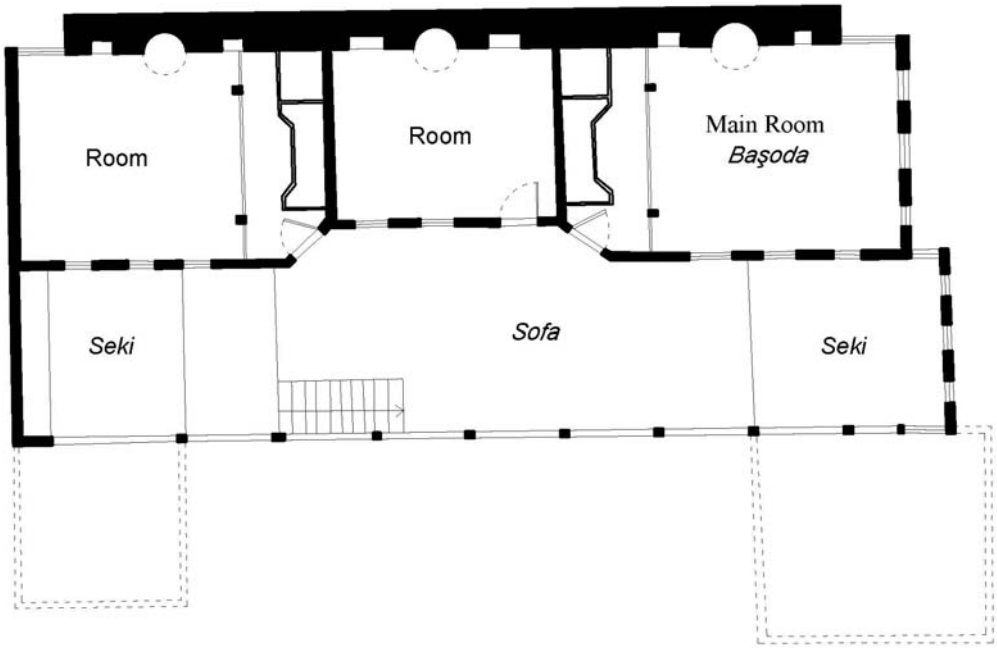


Figure 2.4. The top floor plan of Beyler House in Kula, Manisa.

The main room is not only voluminous but also rich in number of windows and decoration. Generally, it has *seki altı* (*pabuçluk, aşağı seki*), where slippers are taken off, and *seki üstü*, which is separated from the *seki altı* by a step and sometimes by handrail, where there are raised platform for sitting (*sedir*), fireplaces, windows and rugs (Figure 2.6). *Seki altı* is a thin long transition place and one side of the *seki üstü* and the other side of the cupboard with different functions such as a niche for gas lamp (*lambalık*), a niche for flowerpots (*çiçeklik*), a niche for beverage containers (*şerbetlik*), a niche for *fez* (*feslik*), a niche for walking stick (*değneklik*), large cupboard for bedding (*yüklük*), a small space for ablution (*gusülhane*) (Küçükerman, 1978/2007, 171-178; Bektaş, 1996, 106-109).

Figure 2.5 Beyler House in Kula, Manisa.
(Prepared by Author, 02.10.2019)

Figure 2.6. The main room in Beyler House, Kula, Manisa
(Source: Kula Municipality Archive)

In some regions, in addition to this dual order (*seki üstü- seki altı*), the *nimseki*, which is separated from the *seki üstü* by a few steps and handrails, which is reserved for young people to sit and for men to sleep at night, is observed as a third part (Figure 2.7, Figure 2.8) (Arel, 1982, 44-45).

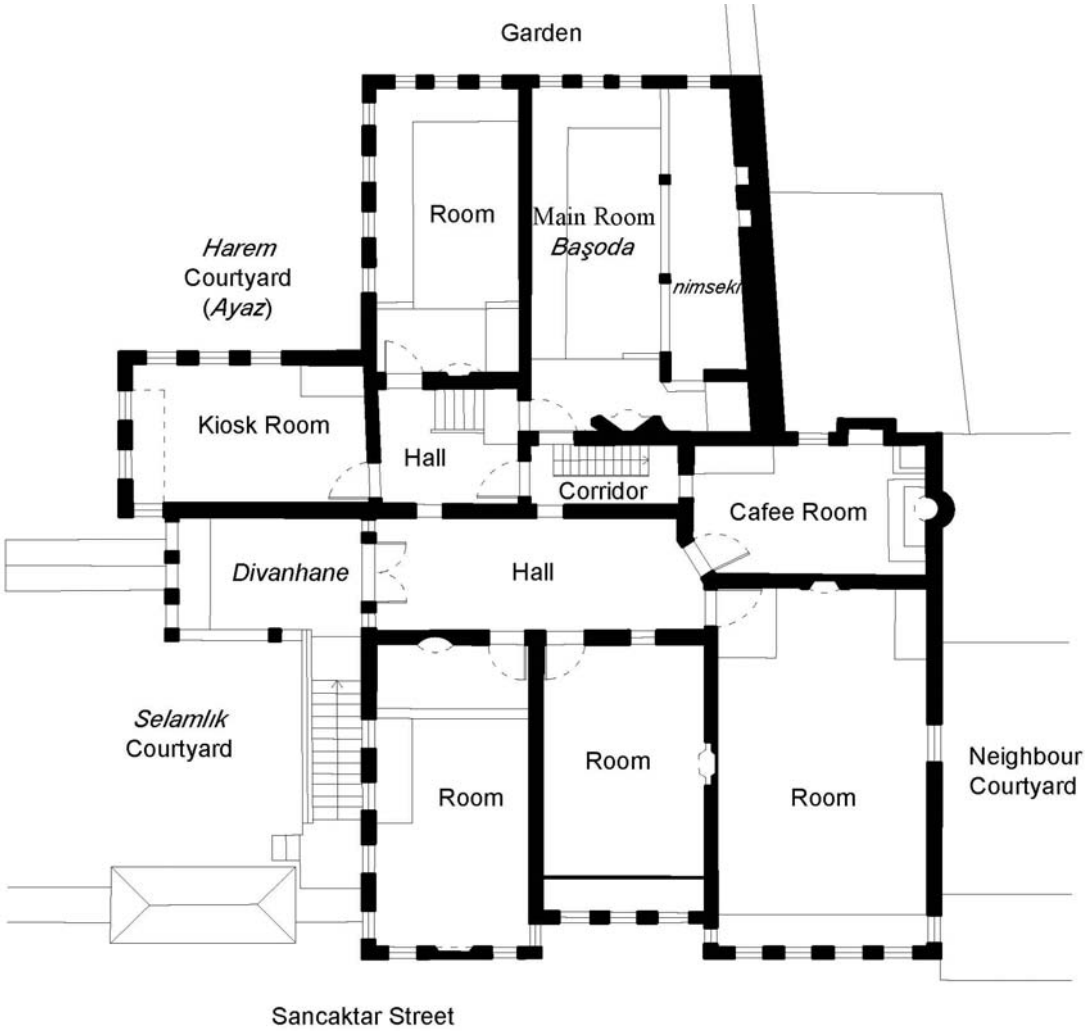


Figure 2.7. The top floor plan of Mühürdarzade House in Divriği, Sivas.
(Source: Erdem, 2014)

The separation created by the level difference between the *seki üstü* and *seki altı* floor has been reflected on the ceiling as well. The ceilings are made with different decorative features according to the importance of the room in the house, the skill of the master, the wishes and economic power of the host. Generally, care and craftsmanship are more in the main room, while smaller rooms are more modest. The ceiling in the *seki*

üstü is usually decorated with a centered motif. This motif may be designed in a circle or a polygon shape. On the walls of the main room, at a height of 200-220 cm above the ground, the *sergen*[11] is surrounded. There are vertical rectangular windows below the *sergen*, while the top windows are located above the *sergen*. In wealthy houses, the wall sections above the *sergen* are sometimes decorated with wall paintings (Figure 2.9) (Bektaş, 1996, 110-112).

Figure 2.8. The main room in Mühürdarzade House, Divriği, Sivas.
(Source: Erdem, 2014)

*Sedir*s are located on two or three sides of the room. These fixed elements are usually placed under the vertical rectangular windows. For this reason, it is located in the best illuminated part of the room. It is designed in a layout that does not close the window with its overall dimensions 70-80 cm deep and 30-40 cm high (Kuban, 1995, 114-117).

[11] *Sergen* (*raf*) : shelf; compartment or place where objects are displayed to show people (Eren et al. 1992, 1283)

Figure 2.9. Wall painting in Külkömürler House, Kula, Manisa.
(Prepared by Author, 25.07.2018)

The small space for ablution (*gusülhane, yunmalık*), large cupboard for bedding (*yüklük*), open shelves and closed sections are located in the cupboard. Cupboard in the main rooms are more ornate than the other rooms. Depending on the family's economic situation, there are simple or rich examples of workmanship. In addition, open shelves (*gözler*) in the cupboards are used as sections where valuable objects (chinaware, plate, cup, flowerpot etc.) are exhibited. Usually the door and the cupboard come together to form a combination of compositions (Figure 2.10).

The fireplace is located only in the main room in two or three-room houses and may be found in other rooms in larger houses. The fireplace in other rooms may not have as much ornamentation as the main room. The most common type of fireplaces placed on the wall, which is usually without windows, is the semicircular niche. It has a wooden or plastered conical hood (*yasmak*) (Figure 2.11) (Kuban, 1995, 127-130).

Figure 2.10. The small space for ablution (*gusülhane*) and large cupboard for bedding (*yüklük*) in main room, Urlar House, Kula, Manisa (Prepared by Author, 26.07.2018)

Figure 2.11. The fireplace and wooden hood in main room, Beyler House, Kula Manisa (Prepared by Author, 14.12.2018)

2.2. Window Design of the Main Room in Historical Anatolian Houses

The positioning of the main room so as to provide a visual opening to the outer environment has increased the number of windows that provide its relationship with the outer space. The windows are usually located on three facades of the main room, as well as making the street appear in depth at the side of the projection. Vertical rectangular windows are generally double or triple ordered in the horizontal (Figure 2.12 a).

Vertical rectangular windows, which are located in an order that will dominate the street and will not interrupt the view of the person sitting and standing, have different partitions besides being designed with different types and sizes of wooden joinery of window, window railings, lattices or shutters. Despite the vertical rectangular windows accessed by the human hand, top windows provide illumination at a height that human hands cannot reach, and in some cases enrich the space with colored glasses. Top windows are elaborate, ornamented and colorful (Figure 2.12 b). Thus, it is ensured that the ceiling covering of the main room is perceived with enriched lighting (Küçükerman, 1978/2007, 131). The construction technique of windows of different types and sizes is similar. While wood is used in vertical rectangular windows; plaster was preferred in top windows (*kafa, rezven*). The partitions are wooden in vertical rectangular windows and are plaster in the top windows. The joinery of the vertical rectangular windows and top windows are wooden.

The parapet height, which is 42-50 cm depending on the *sedir* height in 17th and 18th century houses in Anatolia, is 60-70 cm depending on the furniture height in the 19th and 20th centuries (Uluengin, 2000; Yüksek, 2005).

The vertical rectangular window can be found inside, in the middle and outside of the wall. In thick masonry walls, it is usually located close to the outer surface and creates a niche inside. In thin timber frame walls, it is aimed to make a complete turn of the sashes and not take up space inside the room by being on the inner surface of the wall. According to the opening and movement of the window, three groups can be determined as perpendicular sliding sash (*giyotin*) (Figure 2.13), vertical hinged sashes (*yan dönel*) (Figure 2.14) and combination sash (*karma kanat*) (Figure 2.15) which has a second small sash in the vertical hinged sash (Küçükerman, 1978/2007,123-126).

(a) (b)

Figure 2.12. The vertical rectangular window in Mimar Kri House, Kula, Manisa (Prepared by Author, 25.07.2018) (a); the original top window in main room, Beyler House, Kula, Manisa (Prepared by Author, 27.07.2019) (b)

Figure 2.13. The perpendicular sliding sash (*giyotin*) in main room, Kestaneciler House, Kula, Manisa (Prepared by Author, 15.10.2018)

Figure 2.14. The vertical hinged sashes (*yan dönel*) in main room, Kaçıklar House, Kula, Manisa (Prepared by Author, 15.10.2018)

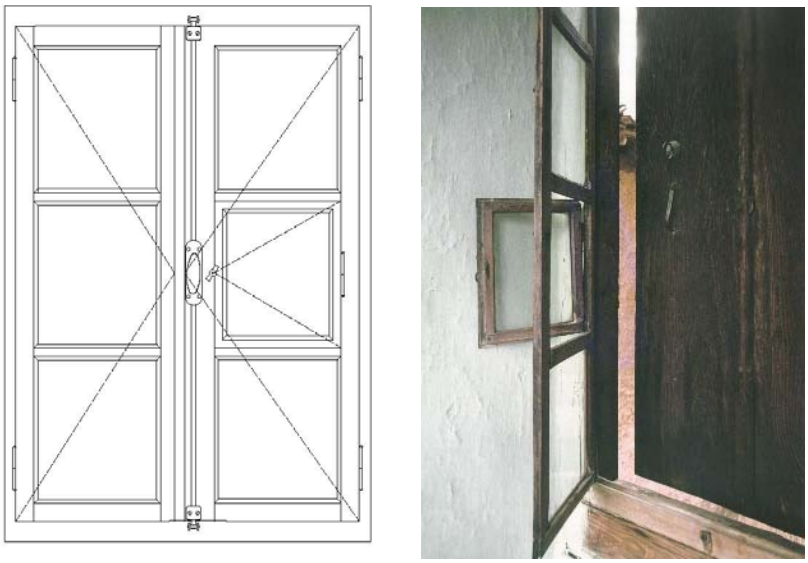


Figure 2.15. The combination sash (*karma kanat*) which has a second small sash in the vertically hinged casement (Source: Küçükerman, 1978/2007,123-126)

Joinery of window are usually placed on a wooden frame designed by the wall thickness or on the window jambs that function as sub-frame. The joints of the wooden jambs with the wall are covered with wooden moldings inside and outside. The joint of

the vertical hinged sashes with the wooden joinery of window is tongue[12]-groove[13] (*lamba-zıvana*) joint. In groove joint, there is a slot (the groove) cut all along the length in wooden joinery of window. In the window sash, a ridge (the tongue), which is suitable for groove, enters into the groove and closes. Grooved joint provides protection against weather conditions (Figure 2.16). The joining of the window sashes can also be tongue-groove; however, perpendicular sliding sash (*giyotin*) is combined in the form of finger joint (*kurtağzı*) (Yüksek, 2005, 17-26).

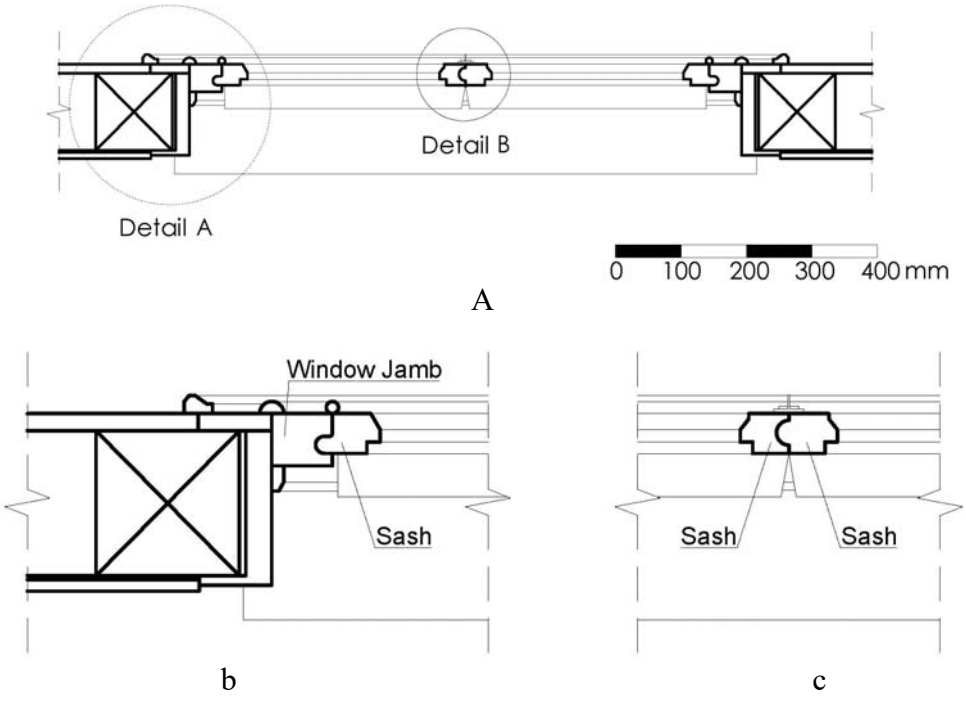


Figure 2.16. Window plan (a), tongued-grooved joint detail A (b), detail B (c) (Source: Yüksek, 2005, 22)

In historical Anatolian houses, complementary elements designed with the window are window railings (*parmaklık*) (Figure 2.17), lattices (*kafes*) (Figure 2.18 a) and shutters (*kepenk*) (Figure 2.18 b). These elements are designed for safety and protecting the interior from natural conditions. Latch (*mandal*), espagnolette (*ispanyolet*) and butterfly (*kelebek*) system were used as window lock system.

[12] Tongue: It is a narrow and long protrusion of the door and window sashes that are made to fit into the frame or sash, tenon, tongue - groove (lamba-zıvana) joint (Hasol, 1975/2017, 297)

[13] Groove: It is a narrow and long hollow of the door and window sashes that are made to fit into the frame or sash (Hasol, 1975/2017, 517)

a b

Figure 2.17. Half window railing in Urlar House, Kula, Manisa (Prepared by Author, 26.07.2018) (a); complete window railing in Zeynep Onbaşı House, Kula, Manisa (Prepared by Author, 25.07.2018) (b)

a b

Figure 2.18. Lattices in Beyler House, Kula, Manisa (Prepared by Author, 14.12.2018) (a); shutter in Beyler House, Kula, Manisa (Prepared by Author, 14.10.2018) (b)

The natural lighting of the main room in historical residences can vary with the size and the depth of the room, the color and the texture of the interior surfaces, the number, the size and the location of the windows. In the examples selected within the scope of the study, the natural lighting properties of the main room have been examined and the importance of the original natural lighting properties of traditional houses has been shown.

CHAPTER 3

THE METHOD OF THE STUDY

In this study, the daylight performance values of the main rooms in traditional houses were studied, illumination status is compared in the unrestored and restored samples, it was determined whether the results obtained comply with present standard values, and if not, how they will be evaluated during the preparation of restoration projects. The study samples were determined by researches in the study area between 15-25 October 2018 in Kula traditional housing texture. In this context, Kaçıklar, Zabunlar, Kestaneciler and Zühtü Bey Houses, which have main rooms that have been preserved in terms of window designs, were selected. Kaçıklar and Zabunlar Houses whose function is accommodation, are unrestored, Kestaneciler and Zühtü Bey Houses whose function is ethnographic exhibition reflecting the original use, are restored. The main room is located in the northwest of Kaçıklar House and Kestaneciler House, and in the northeast of Zabunlar House and Zühtü Bey House. Field studies for researches and measurements were carried out between October 15, 2018 and October 15, 2019.

In the field studies, the location of the houses, the plan and facade features, the construction technique, the location of the main room, the space and material features, and the architectural elements were examined. In traditional houses, the windows are different from their stylistic and technical features and complementary elements such as shutters and window railing. In order to examine these features, detailed drawings of the plan, the section and elevation of the main room windows in the samples were prepared.

In order to determine the current status of the quantitative characteristics of daylight in the main rooms of the traditional houses, it was planned to measure the luminance level and distribution. In order to determine the illumination performance values of the main rooms, window ratios, measurement points and times to measure were determined. Window directions, properties and measurement values were evaluated together.

3.1. Calculation of Window Rates in the Main Room

Natural light source; since the latitude and longitude of the house varies according to the structure of the atmosphere and time, the illumination performance also varies according to the same factors. In order to detect this difference, measurements were made in different seasons (winter, spring, summer, autumn) and different time intervals (morning, noon, afternoon) and the values were compared. In addition, as a result of the measurements made in different houses in the same area, it is seen that the location of the house and the location of the main room in this location affect the illumination performance together with the environmental conditions. Parameters such as the relationship of the houses with the surrounding buildings and the street affect the absorption of light into the interior space.

The most basic geometric definition evaluated in daylight analysis is the size of the window depending on the proportions of the interior volume in the main room. This parameter (window ratio), which is specified as the ratio of the window area to the inner volume floor area, is generally recommended to be between 5-30% (Fontoynont and Berruto, 1997; Erlalelitepe et al. 2011). This ratio can give an idea of the annual lighting value of the interior space and it can be calculated from the volume plan and section drawings. Depending on the glass and wooden joinery of window properties used in the window space, the quantity of daylight entering the volume decreases to a certain extent. The glass surface area in the window systems should also be calculated according to the thickness of the wooden joinery of window and partitions applied in the traditional houses. This situation is expressed by the transparency rate. The transparency rate decreases between 10% and 40% depending on the size of the glass area, the type of joinery of window (wood, iron, plastic, etc.), the thickness and number of panes within the window opening (Ünver, 2000, 110-115; Sayın, 2014, 30). Within the scope of the study, window ratios for the main rooms were calculated based on the formulas (1), (2) (Foytonont and Berruto, 1997; Foytonont, 1999), (3) and (4) (BS 8206, 1992; DIN 5034-4, 1994; Boubekri, 2004).

$$\text{Window Area} - \text{Ratio of Floor Area (\%)} = \frac{\text{Window Area}}{\text{Floor Area}}$$

(1) (WFR)

$$\text{Window Glass Area} - \text{Ratio of Floor Area (\%)} = \frac{\text{Window Glass Area}}{\text{Floor Area}}$$

(2) (WGFR)

$$\text{Window Area} - \text{Ratio of Wall Area (\%)} = \frac{\text{Window Area}}{\text{Wall Area}}$$

(3) (WWR)

$$\text{Window Glass Area/Ratio of Wall Area (\%)} = \frac{\text{Window Glass Area}}{\text{Wall Area}}$$

(4) (WGWR)

3.2. Determination of Measurement Points and Time

The number of measuring points were determined based on the room index (K) formula (5). Luminous level measurements were taken using the "Chartered Institution of Building Services Engineers (CIBSE, 1996)" measurement method and on the horizontal working plane, which is considered to be 80 cm above the floor level (*seki üstü-seki altı*). The points are located at least 50 cm away from the wall and shading surfaces (CIBSE, 1994; CIBSE, 1996; Reinhart vd., 2006, 1-25).

$$\text{Room Index (K)} = \frac{L_x W}{H\,(L + W)}$$

(5)

L: Depth of internal volume
W: Width of internal volume
H: Height of internal volume

K < 1 =>4 points, 1 ≤ K < 2 => 9 points, 2 ≤ K < 3 => 16 points, 3 ≤ K <…=> 25 points (The room index (K) is a coefficient determined by the dimensions of the room. For example, at least four measurement points should be determined when a value smaller than one exists according to the formula (5).)

Measurements were taken to determine daylight performance from the determined points. In addition, the points were determined to take daylight measurements outside of the windows and in the immediate surroundings of house and all points were marked on the plan drawings: The 'O' symbol symbolized the measurements taken 80 cm above the floor level outside the window, while the 'S' symbol symbolized the measurements taken 80 cm above the street level. It symbolized to as Kaçıklar House (1), Zabunlar House (2), Kestaneciler House (3) and Zühtü Bey House (4). For example, the points called as 1.O, 1.S, 1.A, etc. in Kaçıklar House were named as 2.O, 2.S, 2.A in Zabunlar House.

Measuring points and materials that compose the surfaces in the interior volume are given in Table 3.1. The points were considered as wall finish materials (W), wooden mullion of window (T1), cupboard door timbers (T2), floor coverings (F) and ceiling coverings (C) and the reflection factors of the determinated surfaces were found. The measurements were repeated on the determinated dates (Table 3.2).

Table 3.1. Materials forming the inner volume surfaces and reflection factor measurement points.

	Kaçıklar House	**Zabunlar House**	**Kestaneciler House**	**Zühtü Bey House**
				
				
Wall finish material	1.W	2.W	3.W	4.W
Wooden mullion of window	1.T1	2.T1	3.T1	4.T1
Cupboard door timber	1.T2	2.T2	3.T2	4.T2
Floor covering	1.F	2.F	3.F	4.F
Ceiling covering	1.C	2.C	3.C	4.C

Measurements were made in summer (June), autumn (October), winter (December) and spring (April) seasons, with reference to the equinox and solstice dates in order to detect seasonal daylight variations throughout the year. Measurements were taken at three different times in the morning (9:00-10:00), at the noon (12:00-13:00) and in the afternoon (15:00-16:00) to determine the distribution of daylight throughout the day. Measurement days, months, years and hours are given in Table 3.2 for the chosen Kaçıklar, Zabunlar, Kestaneciler and Zühtü Bey Houses.

Table 3.2. Kaçıklar, Zabunlar, Kestaneciler and Zühtü Bey Houses measurement times.

	Kaçıklar House	**Zabunlar House**	**Kestaneciler House**	**Zühtü Bey House**
Winter	December 15, 2018 Saturday 9.00-12.00-15.00	December 16, 2018 Sunday 9.00-12.00-15.00	December 16, 2018 Sunday 9.30-12.30-15.30	December 15, 2018 Saturday 9.30-12.30-15.30
Spring	April 2, 2019 Tuesday 9.00-12.00-15.00	April 3, 2019 Wednesday 9.00-12.00-15.00	April 3, 2019 Wednesday 9.30-12.30-15.30	April 2, 2019 Tuesday 9.30-12.30-15.30
Summer	June 26, 2019 Wednesday 9.00-12.00-15.00	June 27, 2019 Thursday 9.00-12.00-15.00	June 27, 2019 Thursday 9.30-12.30-15.30	June 26, 2019 Wednesday 9.30-12.30-15.30
Autumn	October 2, 2019 Wednesday 9.00-12.00-15.00	October 3, 2019 Thursday 9.00-12.00-15.00	October 3, 2019 Thursday 9.30-12.30-15.30	October 2, 2019 Wednesday 9.30-12.30-15.30

3.3.Measurements and Calculations

An important factor for daylight to pass into the interior in the desired amount is the type of glass. Accordingly, the permeability of the glass affects the daylight factor. During the measurements, the permeability of the glass under a diffuse light source, such as an overcast sky, must be evaluated. For this reason, the luminance level ($L_{int.}$), which is measured from an object standing behind the glass perpendicular to the glass surface, and luminance level ($L_{ext.}$), which is measured from the same point in the same direction without glass, were taken from one point of the main room windows. The points where these leves were taken were determined on the window glass and measured by a luminance meter (Figure 3.1 a).

The reflectivity of materials contributes to creating a homogeneous and brighter environment within the space. In the main room, reflection factor of the wall finish materials, wooden mullion of windows, cupboard door timbers, floor coverings and ceiling covering surfaces were calculated. The luminance level (L) of the opaque material was measured by the luminance meter (Figure 3.1 a) and the luminous level (E) was measured by the illuminance meter (Figure 3.1 b). The illuminance meter was used to determine the daylight level at the determined points, located outside the main rooms and in the main rooms (Formula 5) (Figure 3.1 b).

a b

Figure 3.1. Luminance meter (a), Illuminance meter (b).

3.3.1. Window Glass Permeability

For this reason, the luminance level ($L_{int.}$), which measured an object standing behind the glass perpendicular to the glass surface, and luminance level ($L_{ext.}$), which is measured from the same point in the same direction without glass, were measured from points determined by the luminance meter. Formula (6) was used to calculate the regular transmittance at the glass usage area (Fontoynont, 1999, 119-127).

$$t_{nn} = \frac{L_{int.}}{L_{ext.}} \quad (6)$$

t_{nn}: Regular transmittance

$L_{int.}$: Luminance value (cd / m^2) measured in a direction perpendicular to the glass surface of an object standing behind the glass

$L_{ext.}$: The luminance value (cd / m2) measured same object in the same direction from the same point when the it is not between glass (cd/m^2)

3.3.2.Reflectance of Surface Materials

The luminance level (L) of the opaque material was measured by the luminance meter and the luminous level (E) was measured by the illuminance meter from determined points. The reflectance of opaque material were calculated using the formula (7) at the place of use and at diffuse light (Tregenza and Loe, 1998; Jakubiec, 2016).

$$L = \frac{E.p}{\pi} \quad (7)$$

L: Luminance level (cd/m^2) of opaque material
E: Luminous level (lux)
p: Reflectance of opaque material
π: 3.14

3.4. Comparison of Measurement and Calculation Results

Values taken from the measurement points (Formula 5) determined for the main rooms of Kaçıklar, Zabunlar, Kestaneciler and Zühtü Bey Houses were transferred with different graphics according to the seasons (Table 3.2). Also, in the comparative study, the maximum, minimum and average values of the four houses according to the seasons and the parameters affecting these values are presented in the table. The reflection factors of interior surfaces (the wall finish materials, wooden mullion of windows, cupboard door timbers, floor coverings and ceiling coverings surface) and glass permeability were compared and a table was created.

In the literature, the natural lighting performance of traditional houses, the architectural features and daylight parameters of the main rooms are compared to the values in historical Kula houses and they are indicated in a table.

The available lighting features of Kestaneciler and Zühtü Bey Houses, which are used for ethnographic exhibition purposes, and Kaçıklar and Zabunlar Houses used for accommodation, were determined and compared with the standard values and the results were associated with the window design.

CHAPTER 4

THE HISTORICAL, GEOGRAPHICAL AND TRADITIONAL TEXTURE PROPERTIES OF KULA

Kula, which is located on the "King Road" in Western Anatolia, in the city of Manisa is now on the İzmir-Ankara highway and between the cities of İzmir and Uşak. Its location on a volcanic land and its appearance as if it had just come out of fire are remarkable. Because of this feature, Strabon (1987/2000, XIII. 4, 171), Vitruvius (İ.Ö. I. yy.), Byzantine Stephanos (6–7 yy.) and Eusthatios (12 yy.) defines Kula as Katakeumene (Burned Country) in their works (As of Jan 12, 2020, Kula Municipality website). Information about the Turkish Period in Kula is obtained from Evliya Çelebi's *Seyahatname* (The Book of Travels) (Evliya Çelebi 1895/2011; Bozer, 1988, 3). Evliya Çelebi (1895/2011, 57) also visited Kula while visiting Western Anatolia in 1671 and indicated that Kula had mufti (*müftü*), sirdar (*serdar*) and *kethüdayer* in this period and it takes 8 hours from Uşak to Kula. In addition he defined Kula as "a large place with gardens and vineyards".

Figure 4.1. The satellite image of Kula County
(Source: Google Earth, 07.10.2019)

Today, Kula is a historical, geographically and culturally rich settlement with its traditional houses, volcanic land, thermal springs, fairy chimneys, handicrafts and local dishes.

4.1. The History of Kula

It is understood that there was a settlement in Kula in ancient and Byzantine period due to the presence of reused materials such as dressed marble and epitaphs which were used in the principalities or Ottoman period buildings preserved to date (Arıkan, 2006, 33-59).

Kula constantly changed hands between Turks and Byzantines. Mehmet Bey, the son of Yakup Bey I, took over the Germiyan Principality and repossessed Kula and Angir (Simav), which the Catalans received from the Turks. Germiyan ruler Süleyman Şah left Kütahya, Tavsanlı, Emed, Simav and Gediz under Ottoman rule as a dowery to Yıldırım Bayezit. After Yıldırım Bayezit had taken the throne, when the Germiyan ruler Yakup Çelebi started to repossess the places given to the Ottomans, he (Yıldırım Bayezit) included the Germiyan Principality in the Ottoman lands (Arıkan, 2006, 33-59).

Following the First World War, after the Mondros Armistice Agreement (October 30, 1918), the Greek forces sent troops to İzmir on May 15, 1919, and the troop under the command of General Nider occupied the county of Kula on June 28, 1920.

On the 30th August in 1922, with the victory of Great Offensive, Commander in Field Battle, the second cavalry union, which was under the command of the Corps Commander Fahrettin Altay, saved Kula from occupation on the 4th September 1922 (Elmacı, 2006, 481-491).

4.2. The Geographical Properties

Kula is located on the plateau formed by Gediz River, at an average height of 600-700 meters above the sea level. The area of Kula county is 960 km^2 (Sütgibi, 2006, 167-176). The border of Kula, which is attached to Manisa province, is surrounded by Gediz and Eşme on the east, by Gördes and Salihli on the west, by Simav, Demirci and Selendi on the north, by Alaşehir on the south (Figure 4.2).

Figure 4.2. The location of Kula.
(Source: Google Earth, 07.10.2019)

Kula county center, 140 km away from İzmir, is in a volcanic land surrounded by low hills. The plateau in which Kula is located consists of metamorphic schists, limestone and gneisses. The hills in the county are basalt and agglomerate[14]. The flat parts of the county and the plain to the south of the houses consist of streams and flood deposits covered with soil. Marble and lime quarries are also located in the region (Sütgibi, 2006, 167-176).

In various national and international settings, The Geological Heritage Conservation Association (*JEMİRKO*) promotes Kula, which shines out with its rich geological diversity, historical, cultural, mythological, folkloric and biological values. The rocks named Kulait in the region, the first human footprints, volcano cones, maars[15] and lava flows are important geosite types (Washington, 1893; 1894; 1900; Phillipson, 1913; Erinç, 1970; Ozansoy, 1972; Tekkaya, 1976; Kazancı, 2006). Besides, Kula has natural resources such as geothermal and mineral water due to its geographical location.

Located between 37.50º-39.30º latitudes and 27.30º-29.90º longitudes, Kula is located in the first degree earthquake zone (Figure 4.3) (AFAD, 2018).

[14] Agglomerate is the structural element that consists of combining a binder and a mixture of grains (Hasol, 1975/2017, 19).
[15] Maar is the shallow crater that is formed by a volcanic eruption with little lava (Doğanay, 2017).

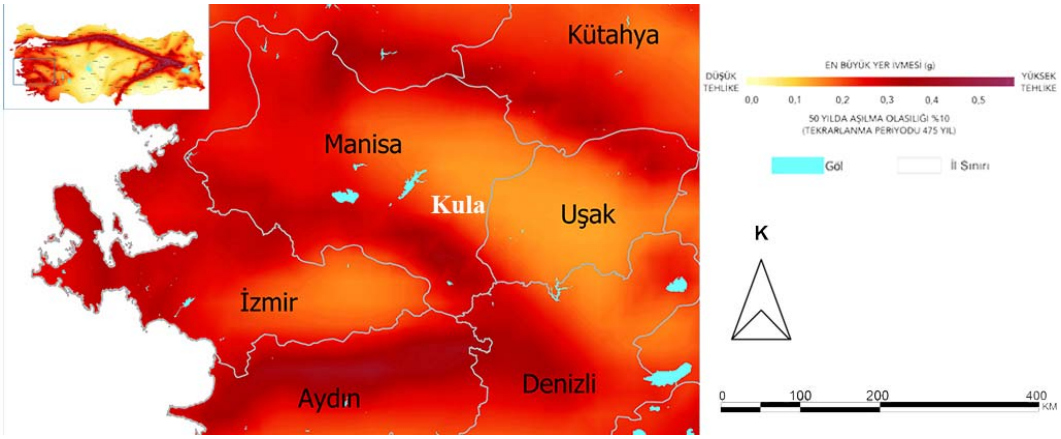


Figure 4.3. Turkey earthquake risk map.
(Source: AFAD, 2018)

The climate seen in the county of Kula is between the Mediterranean climate and the Terrestrial climate. The county is in the Central-Western Anatolian climate zone. Although the climate is generally rainy and mild in the county, sometimes it is observed to be cold and dry, so the climate is variable. Snow, dry cold, frost continues throughout the winter season. According to 4-year observation data received from the Kula meteorological station, the average temperature is 14.3 ºC. Kula county also shows changes in vegetation due to the transition between the Mediterranean climate and Terrestrial climate. The fact that the mountain masses cut off the sea effect there leads to the coexistence of the plant species of the Mediterranean climate and the plant species of the Terrestrial climate (As of Jan 12, 2020, Kula Municipality website).

4.3. Traditional Texture Properties in Kula County

The old settlement texture, which is located to the north of the Izmir-Ankara highway, extends from the foothills of the Black Divlit Mountain to the main road in the south. The Uşak side is called Hisar Gate (*Hisar Kapısı*) and the Alaşehir side is called Demirci Gate (*Demirci Kapısı*); however, they are named this way to indicate the entrance to the county although these gates are not actually found. The new settlements are on the south and west of the main road.

Yeni Hamam Street (Yunus Emre Street) is the main axis of the county and stretches in the southeast - northwest direction by taking the entrance from İzmir - Ankara highway. The street is connected to the secondary roads in the traditional texture in the

east from inside of the industrial zone, the administrative center and the bazaar. Selendi Street (Şehit Ahmet Akdeniz Street), which provides the relationship between the villages and the county, is located in the west. Kışla Street (İstiklal Street /Fatih Sultan Mehmet Street) and its extension are other transportation axes, they reach the old settlement from the Hisarkapı Area besides they extend from the traditional texture to the bazaar and merge with Yeni Hamam Street. It is claimed that Kışla Street is the old caravan road of the settlement (Fersan, 1980, 32). Ankara Street and Alaşehir Street are newly developing roads. The main entrance-exit to the county is provided from four streets as Yeni Hamam Street (Yunus Emre Street), Selendi Street (Şehit Ahmet Akdeniz Street), Ankara Street and Alaşehir Street.

Nine neighborhoods in Kula are mentioned in the dividend books (*temettüat defterleri*) of 1260-1261 H (1844-1845 AD). There are Cami- i Atik, Cami-i Cedid, Bey, Taş, Seyyid Ali, Uşakki, Mehamid, Kızılkaya and Hacı Abdurrahman Neighborhoods (Arıkan, 2006, 33-59). Today, Akgün, Zaferiye, Cami-i Cedit, Kızılkaya, Seyit Ali Bey Neighborhoods are located within the Urban Conservation Area in Kula, which consists of sixty neighborhoods. There are thirty-three mosques, twenty of which are historical, and three churches in Kula, where Karaman Greeks lived in the past. There is 12 Kurnalı Çarşı Turkish Bath in Kula bazaar. There is Zafer Primary School with neo-classical facade design located in Zaferiye Neighborhood within the Urban Conservation Area (Figure 4.4). The Old Fountain (*Eski Çeşme*), which located 16 steps below the street level adjacent to the Old Mosque (*Eski Camii*) in Kula, still maintains its authenticity.

Figure 4.4. Zafer Primary School.
(Source: Kula Municipolity Archive)

Urban Conservation Area borders have been determined with the decision dated from 1978 and numbered A-1266 of the Supreme Council of Immovable Antiquities and Monuments of the Ministry of Culture and Tourism. It consists of organic roads determined by the topography with trade center and islands determined by these roads. Urban Conservation Area, consisting of Akgün, Zaferiye, Cami-i Cedit, Kızılkaya and Seyit Ali Bey Neighborhoods is 149169 m^2 (about 15 ha) (Akın vd., 1994, 34-35).

In order to ensure that historical buildings are transferred to future generations and to guide conservation and restoration works in Kula, the Conservation Plan has been approved with the decision of İzmir 2nd Numbered Conservation Council of Immovable Cultural and Natural Assets dated 02.02.1994 and numbered 3792. Today, this Conservation Plan is in force.

4.4. Architectural Features of Traditional Kula Houses

Traditional Kula Houses are commonly planned with a courtyard. The courtyard walls are high (at least three meters) so that passers-bys do not see the courtyard due to privacy. Generally, an entrance, which opens to the courtyard from the road with a double-wing wooden door (Kaçıklar House and Kestaneciler Evi House), is designed. Otherwise, in some observed examples (Hacı Recepler House), it is passed from the door to the *taşlık* (under the *sofa*) and from there to the courtyard. In another example (Zabunlar House), there are two entrance gates that open both to the courtyard and to the *taşlık*.

The houses are generally two-storey and the outhouses are single-storey. On the ground floor there is a pantry, a barn, storage, kitchen and a toilet (*hela*). Sometimes there is also a room for elderly person and/or a service room. Some houses (Beyler House) have a mezzanine floor between the ground floor and the main floor. The mezzanine floor, which is more flattened and unadorned than the main floor, is generally used in winter months. One facade of the main floor opens towards the courtyard, while another facade opens towards the street. The houses are divided into two main groups, which are exterior and interior *sofa*, in terms of their plan features. In the original houses, the exterior *sofa* was later closed with windows (Bozer, 1987, 40-42). On the main floor, there are usually rooms in the north, and the *sofa* (*hayat*) in the south. The iwan[16], which opens to the *sofa*

[16] Iwan (eyvan, *ayvan*) is a rectangular planned volume surrounded by walls on three sides with high floor level, its one facade facing the courtyard is open (Hasol, 1975/2017, 165)

as circulation and living space, is usually positioned to see the door. There may also be a *seki*[17], kiosk and/or kiosk room[18] on the *sofa*.

Traditional houses within the Urban Conservation Area of Kula usually extend over the road by projection over the high courtyard wall. Depending on the location of the house, triangular (saw teeth) projection or stepped projected are arranged towards the street in order to obtain spaces with the desired geometry. Thus, different perspectives are created in alleyway with various forms of facade movements, wide eaves and hipped roofs. In addition, in the Urban Conservation Area of Kula, there are houses that do not have any projection and there are also examples inside the courtyard or garden.

In the houses with entirely street fronts, direct entrance is taken from the street to the house, while in the houses with courtyard there is an entrance from the street to the courtyard. Considering these features, traditional houses can be divided into two groups: courtyard house type (*avlulu ev tipi*) and street house type facade (*sokak cepheli ev tipi*) (Akın, 1994, 55). The balconies were started to be seen after the second half of the 19th century (Bozer, 1987, 52).

In the Urban Conservation Area of Kula, there are densely timber- framed houses with one wall (usually sidewall) in masonry technique and there are also houses built entirely of masonry. The construction system is generally timber-frame system on stone ground floor wall. The floor covering material in ground floors and courtyards is generally slate stones, which are dark colored schist[19] type. There is a use of black stones[20] (*Kara taş*) and *köfeke* stones[21] as a feature of the region in Kula, which has a volcanic land. Black stone is black, hard and heavy. *Köfeke* stone is soft, light and easily carved.

The main material is generally black stone in the courtyard, ground floor and the masonry wall of the upper floor; however, it can also be seen in brick and slate with alternate bond technique (Figure 4.5). The other walls are *köfeke* stone, adobe and/or brick infill between timber frames. The alternate walls are not plastered, there are usually used lime plaster with tow on the other walls, and in some examples, mud with straw (Bozer, 1987, 51). Within the ground floor walls and the masonry rubble stone walls of the upper

[17] *Seki* is a flat and high stone or wooden place to sit. (Hasol, 1975/2017, 410).
[18] Kiosk room is a room facing east to be cool in summer. (Hasol, 1975/2017, 282).
[19] Schist is the common name for siliceous and aluminous sedimentary rocks that can be easily separated into leaves.
[20] Basalt, which is extrusive rock type, is dense and high strength.
[21] Volcanic tuff, which is extrusive rock type, is porous and low strength.

floor, timber beams are usually placed every 1.50-2.00 meters. Lathing (*bağdadi*) technique is used less frequently; nevertheless, it is generally observed on projection.

Figure 4.5. The masonry wall of Mumcular House in Kula, Manisa.
(Prepared by Author, 27.06.2019)

In ground floor rooms and upper stories, floor covering and ceiling covering material is timber. In addition, the upper floor covering is located on the timber beams. Beams under the *sofa* are usually uncoated. Timber is also used in ceiling coverings, hoods and cupboards that require fine craftsmanship (Figure 4.6).

Figure 4.6. The ceiling in the main room of Arıklar House in Kula, Manisa.
(Prepared by Author, 26.07.2018)

a b

Figure 4.7. The slate stone (Prepared by Author, 26.06.2019) (a), the compacted soil (Prepared by Author, 27.06.2019) (b)

The floor covering material in courtyard is slate stones or compacted soil (Figure 4.7). Iron is used in the clamps, nails, hinges, door badges and knockers, door and cupboard handles (Figure 4.8).

a b

Figure 4.8. Door lattice (*kapı kafesi*) of Kazaklar House in Kula, Manisa (Prepared by Author, 02.10.2019) (a); the door knocker of Kazaklar House in Kula, Manisa (Prepared by Author, 02.10.2019) (b).

The materials used in decorations are hand-drawnings made with paint on wood, gypsum and plaster (Figure 4.9). Wood as decoration material is seen on ceilings, room doors, cupboard doors, eyes on the cupboard, fireplace hoods, door newells, column capitals and eave cornices. There is gypsum in top window, fireplace hoods and fireplace.

a b

Figure 4.9. The wall painting of Külkömür House in Kula, Manisa (Prepared by Author, 25.07.2018) (a); the ceiling decoration of Beyler Evi in Kula, Manisa (Prepared by Author, 14.12.2018) (b).

Three types of eaves are observed in traditional houses, these are under the eaves uncoated and exposed beams (Figure 4.10); under the eave flat and inward sloping wood veneer (Figure 4.11); the wood-lath concave eave (Figure 4.12). The width of the eaves is between 50 and 150 cm. There are two types of roofs as gable roof and hipped roof. Roofs are covered with pantile (*alaturka kiremit*).

Figure 4.10. Under the eaves uncoated and exposed beams in Urlar House, Kula, Manisa (Prepared by Author, 26.07.2018)

Figure 4.11. Under the eave flat and inward sloping wood veneer in Beyler House, Kula, Manisa (Prepared by Author, 02.10.2019)

Figure 4.12. The wood-lath concave eave in Kula, Manisa.
(Prepared by Author, 25.07.2018)

CHAPTER 5

DESCRIPTION OF STUDIED THE TRADITIONAL HOUSES

The traditional settlement texture of Kula was examined on site and Kaçıklar, Zabunlar, Kestaneciler and Zühtü Bey Houses, which have the main rooms that retain their original features in terms of window designs, were determined. Selected samples are located in the north of Kula Conservation Area and are registered buildings. In the residences with courtyards located on the street, the main room faces the road and the *sofa* (*hayat*). In the selection of these buildings, which have housing function in their original state, the direction of the main room, the restoration status, the direction of the facade, stylistic and technical features of windows, top windows and complementary elements were taken into account. In the study, the daylight performance values of the main rooms in two buildings, which are functioned for ethnographic display (Kestaneciler and Zühtü Bey Houses) with two unrestored buildings in the housing function (Kaçıklar ve Zabunlar Houses), were measured. The windows of Kaçıklar and Zabunlar Houses have vertical hinged sashes; however, the windows of Kestaneciler and Zühtü Bey Houses have perpendicular sliding sash. Thus, the effect of this change on the illumination performance was determined while the mullions dimensions and proportions were different. The main room of the restored Zühtü Bey House with the unrestored Kaçıklar House, have top windows on the upper elevations of the vertical rectangular windows; nevertheless, the main room of the unrestored Zabunlar House and the restored Kestaneciler House do not have any topwindow. In addition, they are different examples in terms of their stylistic features, although the main room of Kaçıklar and Zühtü Bey Houses have top windows.From the selected houses, the half- railing is used in Kaçıklar and Kestaneciler Houses while half and full railings are used in Zabunlar and Zühtü Bey Houses. There are shutters in all four selected houses.

5.1. Kaçıklar House

The house, which is located in the urban site in Kula county of Manisa city, was first registered with the decision of the Supreme Council of Immovable Antiquities and Monuments dated 10.11.1979 and numbered 1986. The house, whose registration is appropriate to continue with the decision of İzmir 2nd Numbered Conservation Council of Immovable Cultural and Natural Assets dated 09.04.1993 and numbered 3248. According to the land registration in 1956, it is understood that the owner was Şerif Kaç, Ş. Rüstem's son (Figure A.1) and it belonged to Kaçıklar family thus the house is known as Kaçıklar House. It can be argued that the house (block 13, lot 10) located next to the old prison lot (block 13, lot 9), which is not available today in Kula, is an 18th century building considering the plan, facade and decoration features (Bozer, 1987, 68-70). The fact that the top windows are arched and elephane-eyed sash bar indicates the features of the 18th century Ottoman house (Uluengin, 2000).

a b

Figure 5.1. View from the south of Kaçıklar House on the west side (Prepared by Author, 15.10.2018) (a), View from the north (Prepared by Author, 15.10.2018) (b)

5.1.1.Location

Kaçıklar House is located in Akgün Neighborhood within Kula Conservation Area. The neighborhood, located at the foot of the Black Divlit Mountain, which is konown as '*Karataş*' in the northwest of the county, is known as the section where the Greeks lived. Thanks to both the distance to new settlement area and the center, and that the residents do not have the financial facilities necessary for renovation, the neighborhood has preserved its traditional features. Two churches and the old Greek primary school, which are located within the boundaries of this neighborhood consisting of five lots, form certain historical buildings of this neighborhood. It is known to be a mansion on the lot in the north east of Kaçıklar House, which does not exist today and is known as a prison (Fersan, 1980, 59). The street silhouette formed by the roofs that touch each other with the house in the west of Kaçıklar House is privileged amongst traditional streets in Kula (Figure 5.1 a, Figure 5.1 b).

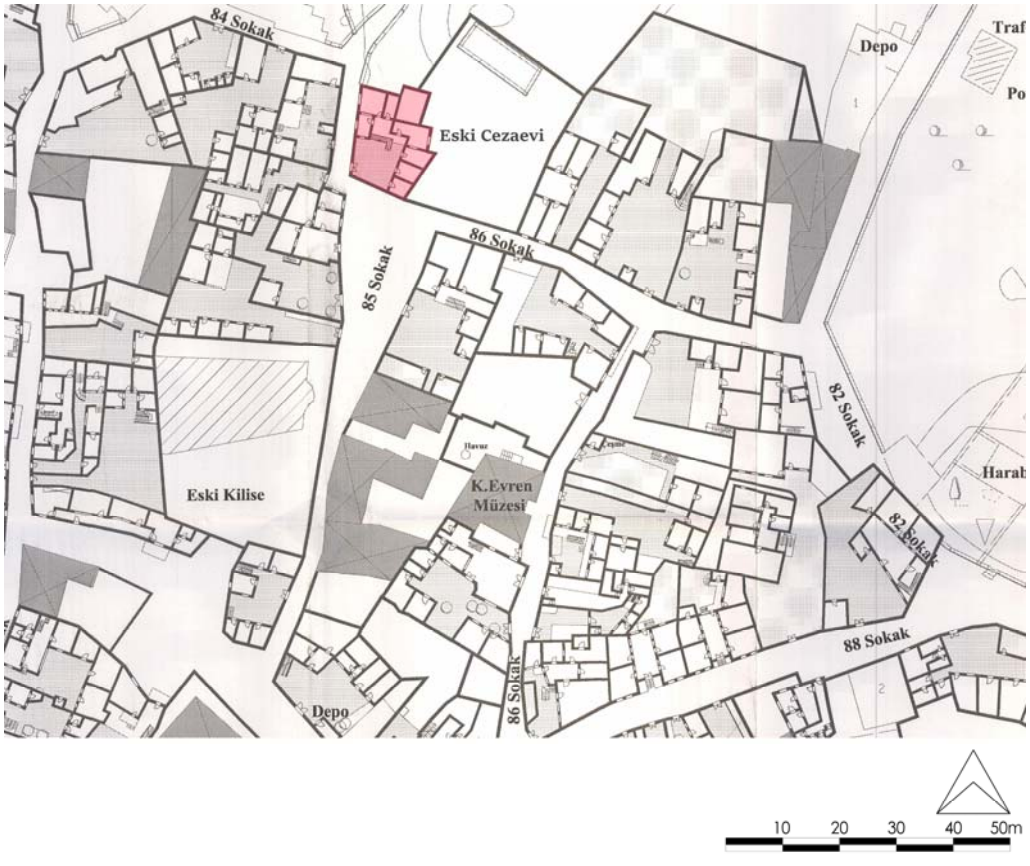


Figure 5.2. The site plan of Kaçıklar House.
(Source: Saf, 2004)

The building is located on the 86th Street, on the block 13 and the lot 10. The entrance to the building is provided from the courtyard from the street on the south in the corner lot (230.333 m^2) where it is located. The boundaries of the lot are determined with the streets in the south and west of Kaçıklar House in the south west of the block (Figure 5.2).

5.1.2.Plan Features

The two-storey building is located to the north of the lot, and the single-storey outbuilding to the east. Today, outbuilding spaces consist of a toilet, a bathroom, a kitchen and a daily room (Figure 5.3).

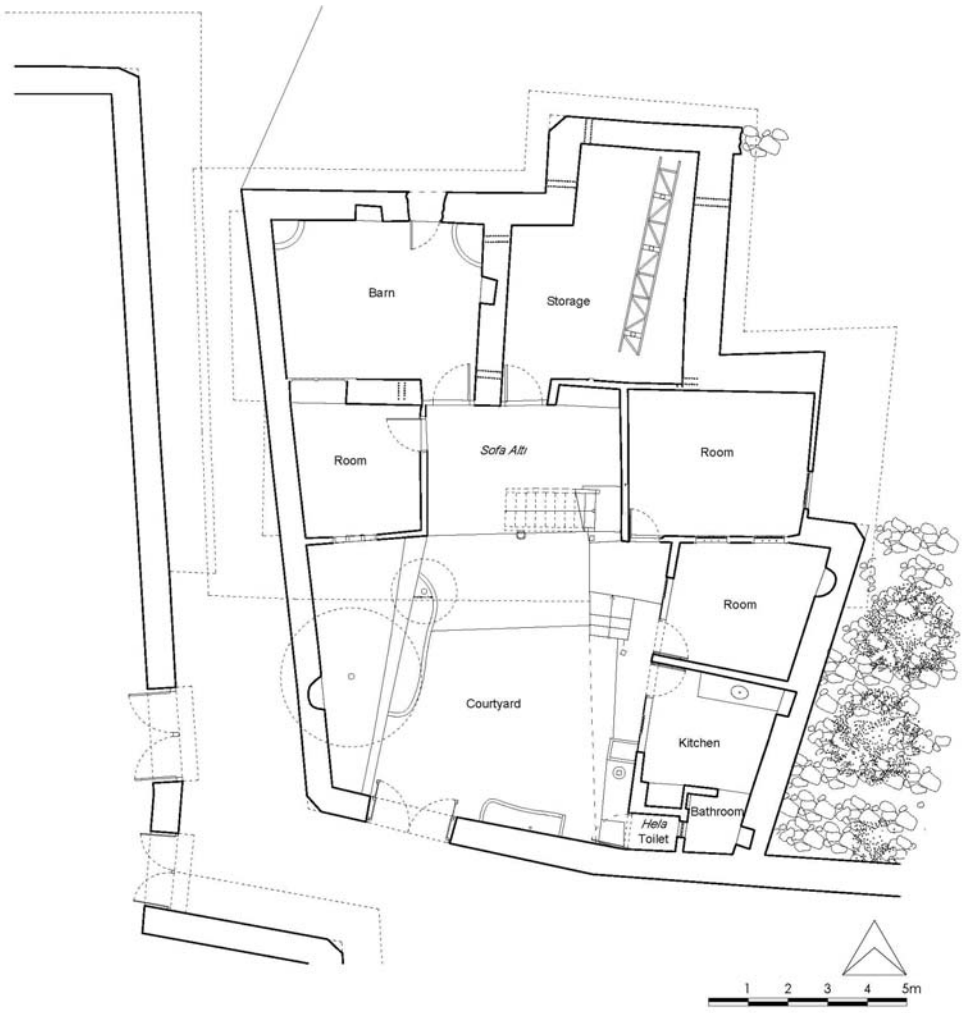


Figure 5.3. The plan of the ground floor of Kaçıklar House.
(Source: Kenar et al. 2019)

There is one room in the east and west on the ground floor of the building; in addition, a barn in the west and a storage in the east are arranged to position further north between these rooms. There is a cellar underneath the room in the east and this room is entered through a platform accessed by a four-step staircase. For this reason, the ground level of the room is 1.03 m higher than the ground level of the courtyard (Figure 5.3). It is reached from the platform in front of the room, the staircase with two steps and then to the outer *sofa* (*hayat*) upstairs with a 10-step wooden stairs (Figure 5.4).

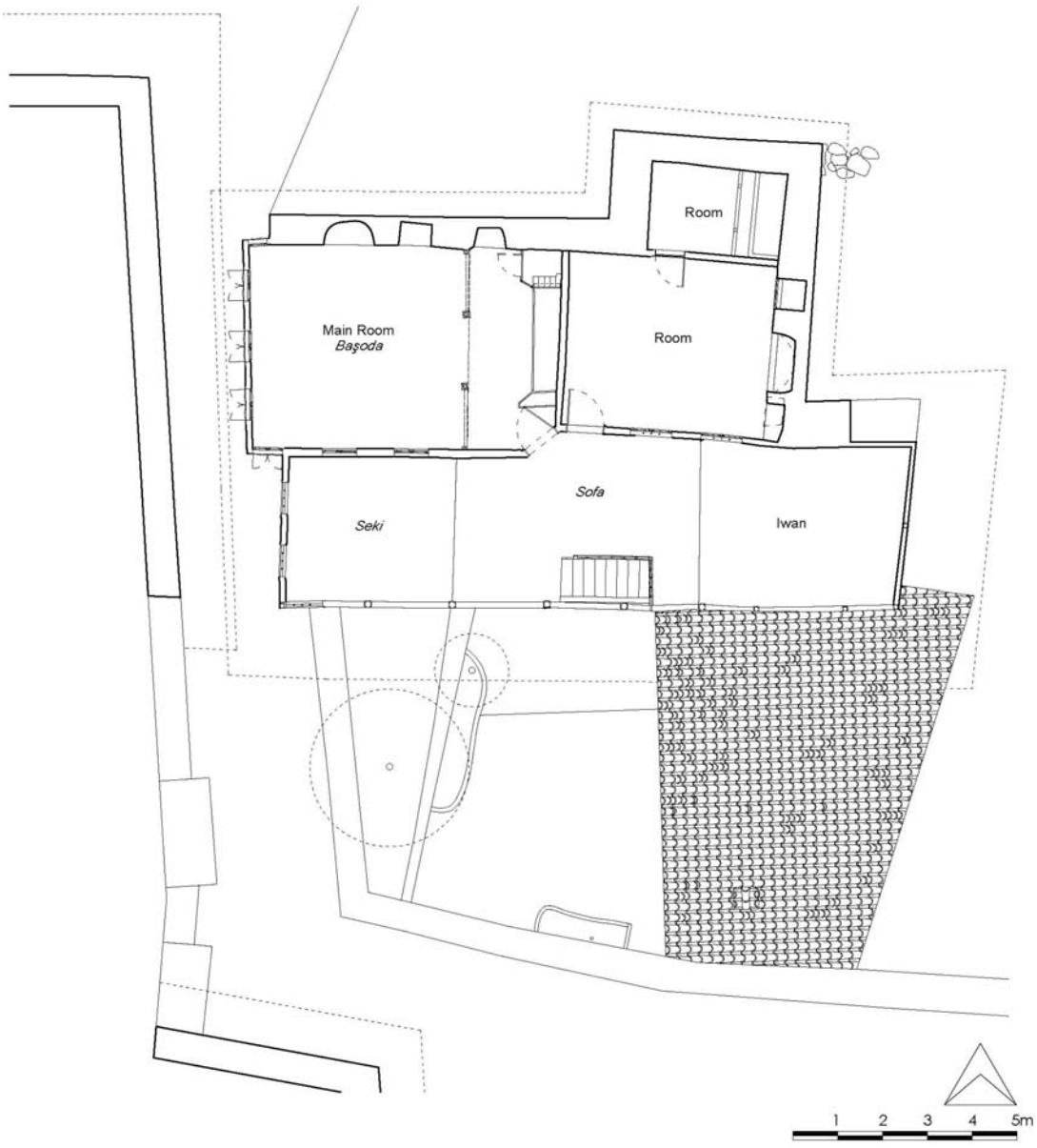


Figure 5.4. The plan of the first floor of Kaçıklar House.
(Source: Kenar et al. 2019)

Figure 5.5. The courtyard in Kaçıklar House.
(Prepared by Author, 02.04.2019)

The outer *sofa* extends in the east-west direction. The south facing the courtyard is open and the roof is held in this direction with nine timber pillars (*öz*) (Figure 5.5). *Sofa* is located in the east of the *seki* and the west of the iwan (Figure 5.4). The floor of the *seki* and iwan is 35-40 cm high from the *sofa* floor. Two rooms, which are main room (*başoda*) on the north-west of the *sofa* and a room on the north-east, are planned. The *seki* and the main room (*başoda*) form projection on the street. There are two vertical rectangular windows in the west of the projection section and one vertical rectangular window in the south. An entry to another room in the north is arranged from the room in the north east and there are two top windows in the north of this room. The main room has a corner chamfered entrance and provides a decorative integrity (composition) with the entrance of the other room. Two vertical rectangular windows on the south walls of the rooms look to the *sofa* with the top windows arranged at the upper elevation (Figure 5.6). In the main room there are three vertical rectangular windows on the west one with the top windows. The top window is, also, designed on the southern window from the vertical rectangular windows in the south and north projection section.

Figure 5.6. The iwan, *sofa* and *seki* in Kaçıklar House.
(Prepared by Author, 15.10.2018)

Figure 5.7. The ceiling of the *sofa* in Kaçıklar House.
(Prepared by Author, 15.10.2018)

Floor covering material is timber in the rooms downstairs and slate stone in barn and the storage. The ceiling of the room in the east is flat and the ceiling of the room in the west is rhombus-shaped timber. There is no covering on the timber beam elements in the barn and the storage. The floor covering in the upstairs are timber veneer over timber beams. Apart from the rooms located in the northeast, the *sofa* and the main room have a decorated ceiling. The central part of the ceiling in the *sofa* has a circle-shaped ceiling rose in a square frame. Radial wooden laths, which are opened from the wrought iron flower motif in the center of the circle, protrude from the surface and form an ornament. The composition is enriched as the wooden laths are lighter than the timber covering at the bottom (Figure 5.7).

5.1.3. Facade Features

As is common in traditional Kula houses, the connection to the street on the ground floor is limited. The courtyard wall is between +3.90 and +4.10 m height and the only connection to the street is the courtyard door. The courtyard wall is bevelled edge at the west and south junction and it facilitates the passage of vehicles to the street.

An entrance to the courtyard from the south is provided. The windows of the ground floor spaces generally face to the courtyard. In upstairs, the outer *sofa* and the windows opening to the *sofa* are related to the courtyard. The eave width of the *sofa* on the courtyard facade (south) is 1.65 meters and provides shade.

There is no opening on the ground floor to the western front. On the first floor, the main room's (*başoda*) projection has three vertical rectangular windows and upper windows. There are traces of hand-drawn on the concave plastered surface on the projection struts. There are two vertical rectangular windows on the projection of the *seki*. There are two rows of timber beams on the ground floor. The garden wall advances at the level of the projection (Figure 5.8).

There are four rows of timber beams within the masonry wall at certain heights on the north side, which is determined by the brick-lined rubble masonry. The left side of the facade come to the forefront and the right corner is chamfered. In this section, two top windows are designed on the first floor. On the right facade, the main room on the first floor has a vertical rectangular window which is closed with the top window. A vertical rectangular

window and a hand-drawn decorated pano are seen on the projection of the main room to the right of the north facade. The eaves width is 55 cm on this facade (Figure 5.9).

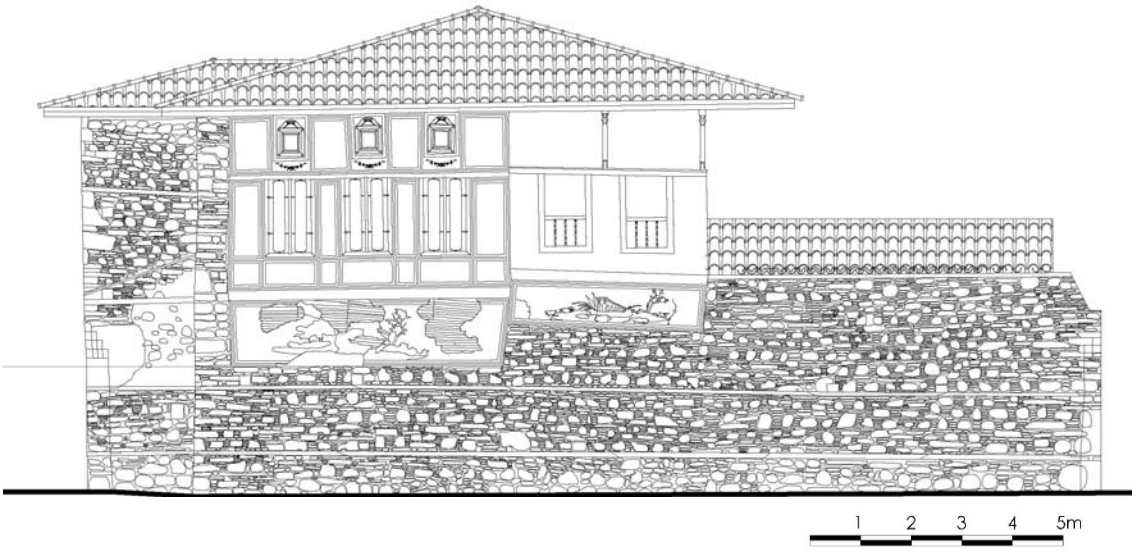


Figure 5.8. The west side of Kaçıklar House.
(Source: Kenar et al. 2019)

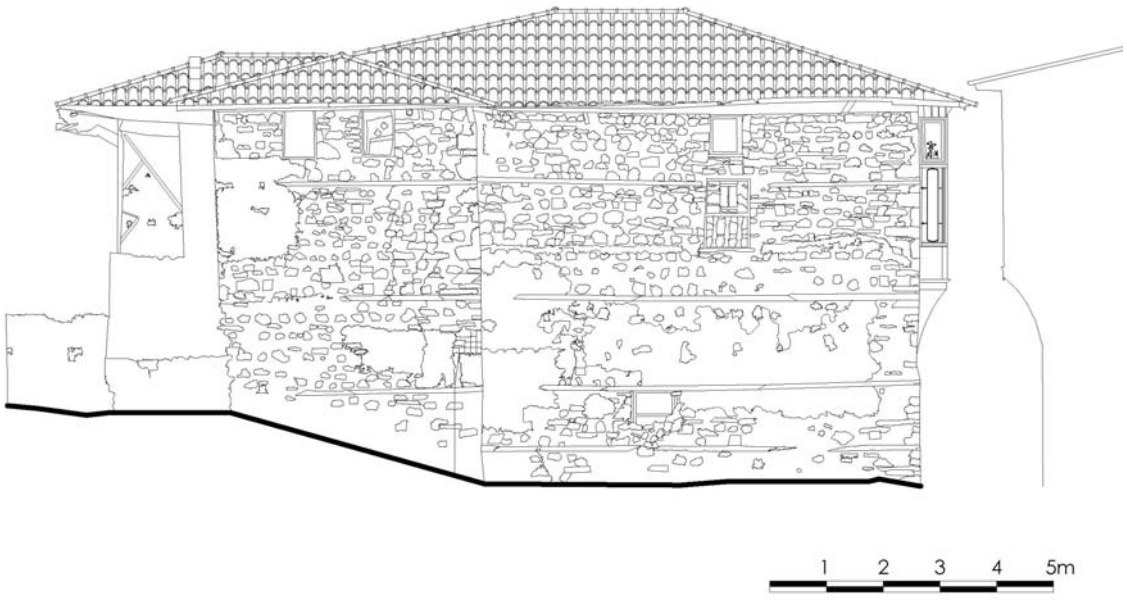


Figure 5.9. The north side of Kaçıklar House.
(Source: Kenar et al. 2019)

5.1.4. Main Room Location and Planning Features

The main room on the first floor of the house, located in the northwest of the *sofa* (*hayat*), measures 6.90 m x 4.50 m (31.05 m^2); it consists of *seki üstü* section (4.85 m x 4.50 m) and *seki altı* (*pabuçluk*) section (2.05 m x 4.50 m). *Seki üstü* is 15 cm high from *seki altı*. Between the two sections, a three-arched system (*direklik*) is formed with concave and convex profiles that sit on four timber pillars. There are wooden railings on the side sections, the middle section is left open for circulation. The room has a large cupboard for bedding (*yüklük*), a cupboard, a small space for ablution (*gusühane*), a shelf and a fireplace. The large cupboard for bedding (*yüklük*) and the small space for ablution (*gusühane*) are located the *seki altı* in the east of the room, while the fireplace is located in the *seki üstü* on the north wall. There is a narrow closet above the small space for ablution (*gusühane*), which is arranged on the left of the cupboard (Figure 5.10). There is a vertical rectangular window in the north, which is understood to be closed on the east of the fireplace, and a vertical rectangular window in the projection part on the west. Three vertical rectangular windows on the south and west walls are designed with top windows located at the upper elevation.

Figure 5.10. The small space for ablution (*gusühane*) and the large cupboard for bedding (*yüklük*) in the main room (Prepared by Author, 15.10.2018)

The timber floor covering used longitudinally in the east-west direction in both parts provides greater perception of the room. In *seki üstü*, the square core of the caisson with lattage adorned ceiling was arranged 45 cm inwards from the surface, allowing the place to be raised in volume. Timber covering was used as a decorative element on the ceiling (Figure 5.11). The height of the ceiling (shoe) in the *seki altı* is 3.11 m and in the *seki üstü* is 3.41 m.

Figure 5.11. The ceiling of the main room
(Prepared by Author, 15.10.2018)

5.1.5. Architectural Features of the Windows in the Main Room

There are top windows at the upper level of rectangular windows on the south and west facing-walls of the main room (Figure 5.12). The windows are arranged in groups of two in the vertical direction and groups of three along the horizontal direction. There is a window in the projection part on the wall facing north and there are not top windows. The architectural features of vertical rectangular windows and top windows are examined in terms of stylistic and technical features.

Figure 5.12. The window layout of the main room.
(Prepared by Author, 15.10.2018)

5.1.5.1. Stylistic and Technical Features of Vertical Rectangular Windows

a) Stylistic Features: Rectangular windows are 40 cm high from the flooring of the *seki üstü*. The ratio of rectangular windows, which are 80 x 122 cm in size, is 2/3. The sections in the window are three groups in vertical and two groups in horizontal. The upper fixed section (80 x 37) of the windows was separated by a horizontal mullion from the vertical hinged sashes (80 x 85). Opened sashes are divided into a thin mullion and form two groups horizontally and vertically. The upper fixed part is in the form of single in horizontal and two groups in vertical. Opened sashes have espagnolette (*ispanyolet*) lock system (Figure 5.12, Figure 5.13, Figure 5.16 e).

b) Technical Features: The rectangular window is located on the inner surface of the timber carcass wall. The frame-sash relationship is with tongue-groove. The sash-sash relationship is also with tongue-groove and the union points are closed with lathes (Figure 5.16 d, Figure 5.16 g).

a b

Figure 5.13. The closed window sashes of the main room (Prepared by Author, 15.10.2018) (a), the opened window sashes of the main room (Prepared by Author, 15.10.2018) (b)

c) Complementary Elements: There are shutters in the windows which look to the street; however, there are no shutters in the two windows which look into the *sofa*. Today, the windows have 50 cm height rails, but in unique situations, rails can be in the whole window and this can be understood from the traces of the joinery (Figure 5.13 b, Figure 5.14).

a b

Figure 5.14. The main room windows from Sofa (Prepared by Author, 15.10.2018) (a), the shutters of the windows (Prepared by Author, 15.10.2018) (b)

5.1.5.2. Stylistic and Technical Features of Top Windows

a) Stylistic Features: Arched top windows are located 45 cm above rectangular windows. The top windows are 44 cm wide and 66 cm high consisting of internal (*içlik*) and external (*dışlık*) parts. The internal part is rectangular-shapely arranged intertwined and the corners of the sash bar are decorated (Figure 5.15 a; Figure 5.16 b). External parts are with elephane-eyed sash bar (Figure 5.15 b; Figure 5.16 c). These windows are generally made of colorful glasses and designed in a decorative order; however, they are nonfunctional since they are closed with paint.

b) Technical Features: The top windows consist of internal (*içlik*) and external (*dışlık*) parts. In upper windows the frames are timber; the sash bar and sections are plastered (Figure 5.16 a).

a b

Figure 5.15. The internal part (*içlik*) of the top window (Prepared by Author, 15.10.2018) (a), the external part (*dışlık*) of the top window (Prepared by Author, 15.10.2018) (b)

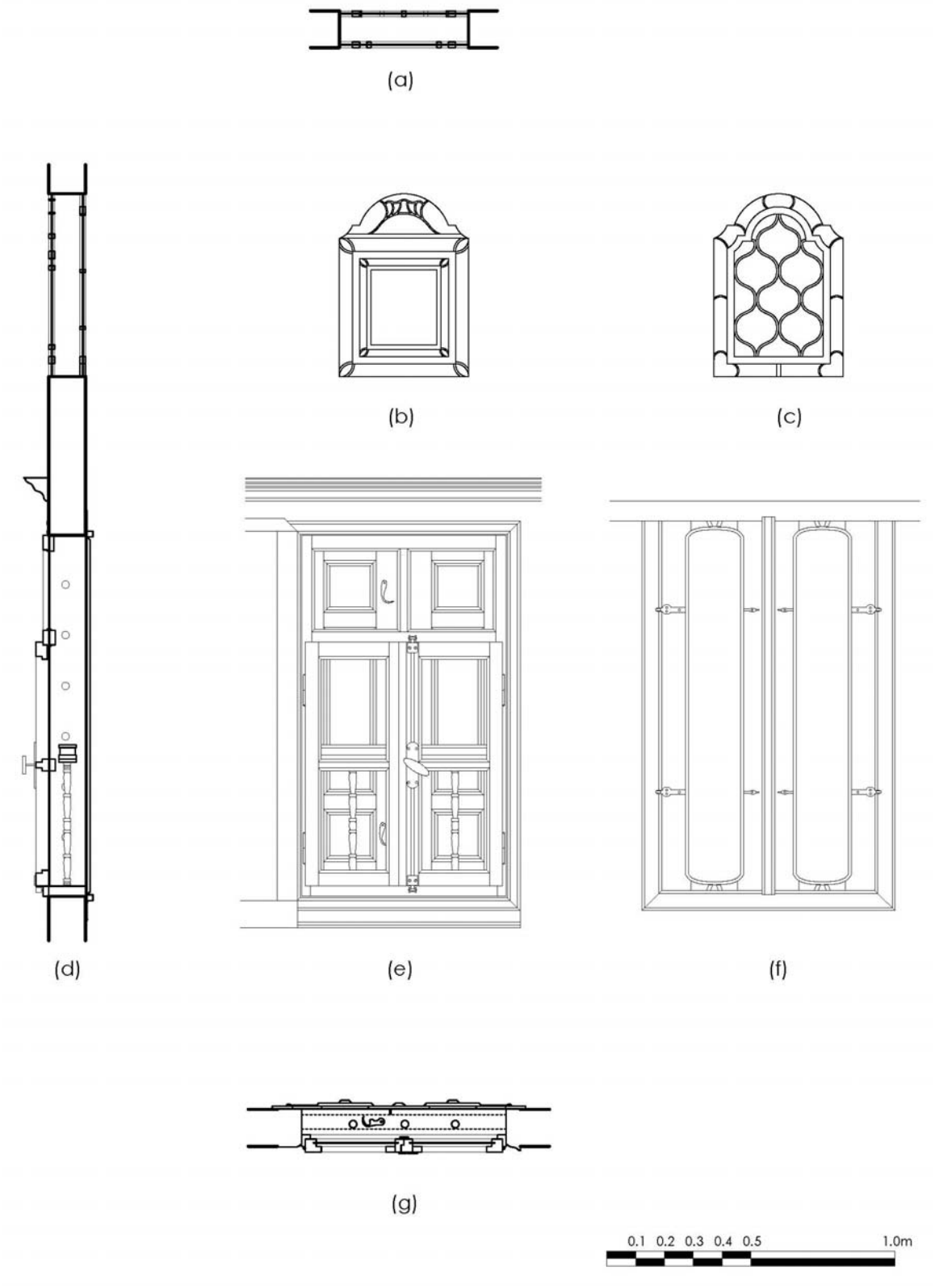


Figure 5.16. Top window plan (a), Top window internal part (içlik) view (b), Top window external part (dışlık) view (c), Rectangular and top window section (d), Rectangular window view (e), Rectangular window shutter view (f), Rectangular window plan (g).

5.1.6. Determination of the Measurement Points and Time of the Main Room (*Başoda*)

Measurement points were determined according to room idex formula. When the room index (K) is calculated (Formula 5), there has to be at least 4 measurement points in the main room. However, since it consists of two sections as *seki üstü* and *seki altı*, a total of 15 (5x3) points were determined by increasing the number of points to get more precise results. These points are located at a distance of 50 cm from the window in *seki üstü* and from cupboard in *seki altı* (Figure 5.17).

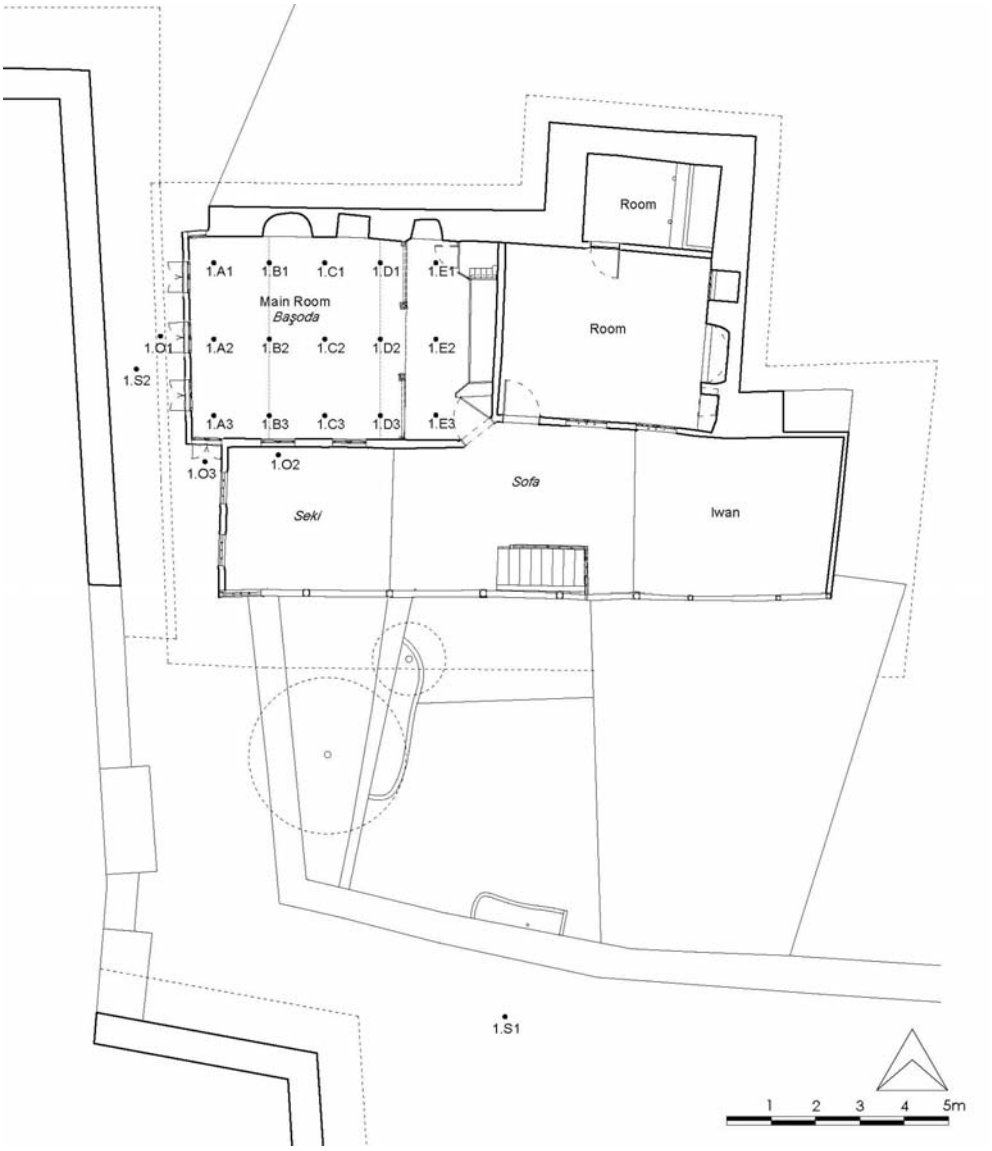


Figure 5.17. Measurement points for illuminance in the main room of Kaçıklar House.

The outdoor illuminance measurements were taken at the junction of the eaves in the west of the main room (1.O1) and 80 cm above the floor of the main room in the south (1.O2). On the street, the measurements were taken from the point where three roads meet in the south of the lot (1.S1) and the point where the roofs meet in the west (1.S2). These points have been determined in order to determine the level of illumination without shading elements (eaves) and in case of shading elements. Those measured values are used to calculate the daylight factor in the further process. So, indoor illuminance would be evaluated according to the outdoor conditions as well.

5.1.7.Daylight Performance of the Main Room

The main room of Kaçıklar House had a west front which has projection at the street. This front's ratio of the window area to the floor area (Formula 1) is 9.44%, and the ratio of the window glass area to the floor area (Formula 2) is 4.51%. As it can be understood from the proportions, window factions and intensity of the sash bars cause the values to be almost half. The ratio of the window glass area to the inner area is expected to be 5%- 30% (Foytonont and Berruto, 1997; Foytonont, 1999); however, expectation cannot be met because of the mullions. The same situation is valid for ratio of window-window glass area to the wall area. The ratio of the window to the wall area (Formula 3) was measured as 21.84%, and the ratio of the window glass area to the wall area (Formula 4) was measured as 10.44%.

To identify the materials forming the surfaces in the main room, luminance measurements were taken from the determined points (Table 3.1) by the luminance meter and on the determined dates (Table 3.2). The average of the reflectance was calculated using the formula (7) and are specified in Table 5.1. The percentages of surface material reflectance (p value) change between 47.1% and 95.8%. The light color of the ceiling causes p value to be higher (95.1%), the dark color of the floor covering provides reflectance to be lower (47.1%) (Figure 5.18 a, Figure 5.18 b).

To calculate the transmittance of window glazing, the values obtained when the window was open and closed measuring the luminance values at the same point on Saturday, December 15, 2018. Table 5.2 shows the calculated transmittance values as 85.93% using the formula (6). The glass transmittance value is at an acceptable level within the framework of standard values.

a b

Figure 5.18. The surface reflectance at the measurement points in the main room of Kaçıklar House on the west wall (15.10.2018) (a), on the east wall (15.10.2018) (b).

Table 5.1. Calculation of the measured values and reflectance of materials.

	L (cd/m^2)				E (lux)				p (%)
	Dec 15, 2018	April 2, 2019	June 26, 2019	Oct 2, 2019	Dec 15, 2018	April 2, 2019	June 26, 2019	Oct 2, 2019	Average
1.W	6.9	10.2	9.2	13.9	39.9	49.9	47.0	67.4	61.8
1.T1	7.9	12.8	25.7	17.1	35.2	44.7	91.5	55.2	88.0
1.T2	6.2	7.8	6.3	7.2	26.9	45.7	27.1	33.7	64.7
1.F	12.8	7.3	7.1	7.0	68.9	75.0	72.0	12.2	47.1
1.C	9.5	30.6	42.9	28.7	48.7	100.3	120.5	96.5	95.8

Table 5.2. Transmittance of glass Saturday, December 15, 2018.

	$L_{int.}$ (cd/m^2)	$L_{ext.}$ (cd/m^2)	t (%)
1.G	60.56	70.48	%85.9

The daily and hourly values of the exterior illuminance of the reference points determined in the spaces on Saturday, December 15, 2018 are given in Table 5.3 and the interior illuminance are given in Figure 5.19. The measurements taken from the street

(1.S1 and 1.S2) are between 382.8 lux and 7623 lux. The exterior measurements (1.O1, 1.O2 and 1.O3) taken from the main room measurement points level are between 174.5 lux and 456.9 lux. The measurements taken from the interior range from 3.2 to 95.4 lux. This value is between 3.8 - 48.5 lux at 9.00, 7.0 - 95.4 lux at midday and 3.2 - 39.9 lux at 15.00. As a result of the measurements taken at 9.00 in the morning, 12.00 at the noon and 15.00 in the afternoon, illuminance of all points are below 100 lux.

Table 5.3. Measured exterior illuminance (lux) Saturday, December 15, 2018.

Time / Point	9.00	12.00	15.00
1.O1	130.9	182.2	125.5
1.O2	247.3	456.9	259.9
1.O3	174.5	392.6	189.7
1.S1	5012	7623	5914
1.S2	522.8	759.3	382.8

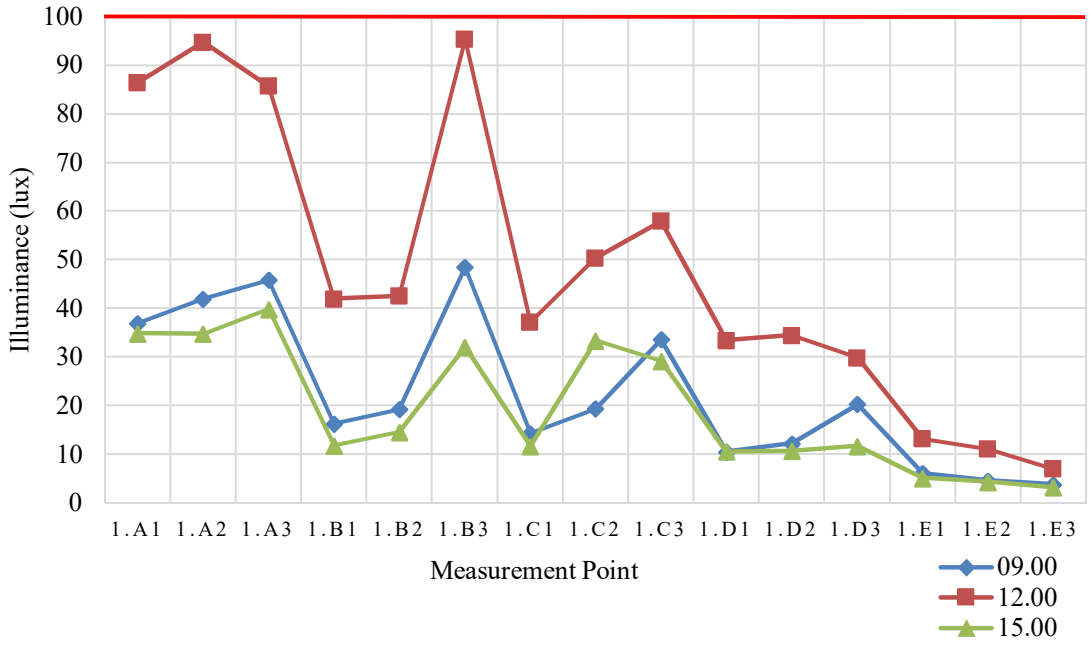


Figure 5.19. Measured interior illuminance (lux) (December 15, 2018).

The daily and hourly values of the exterior illuminance of the reference points determined in the spaces on Tuesday, April 2, 2019 are given in Table 5.4 and the interior

illuminance are given in Figure 5.20. The measurements taken from the street (1.S1 and 1.S2) are between 858 lux and 9858 lux. The exterior measurements (1.O1, 1.O2 and 1.O3) taken from the main room measurement points level are between 332.2 lux and 756.0 lux. The measurements taken from the interior range from 8.7 to 270.6 lux. This value is between 8.7-270.6 lux at 9.00, 10.3-202.5 lux at midday and 8.9-159.5 lux at 15.00. As a result of the measurements taken at 9.00 in the morning, the illuminance of the 20% of the points are between 100-300 lux and the 80% under 100 lux. The 30% of the measurement points taken at 12:00 at noon are between 100-300 lux and the 70% under 100 lux. The 30% of the measurement points taken at 15.00 in the afternoon are between 100-300 lux and the 70% under 100 lux.

Table 5.4. Measured exterior illuminance (lux) Tuesday, April 2, 2019.

Time / Point	9.00	12.00	15.00
1.O1	671.9	473.4	332.2
1.O2	658.5	713.3	756.0
1.O3	346.0	628	824.5
1.S1	7523	9858	7547
1.S2	858	1043	973

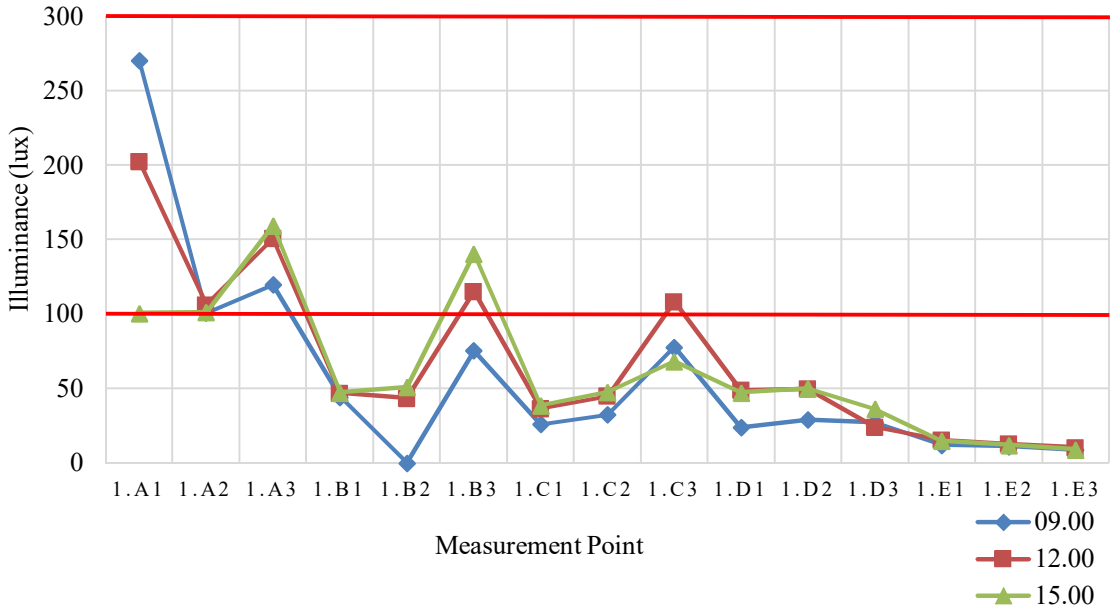


Figure 5.20. Measured interior illuminance (lux) (April 2, 2019).

The daily and hourly values of the exterior illuminance of the reference points determined in the spaces on Wednesday, June 26, 2019 are given in Table 5.5 and the interior illuminance are given in Figure 5.21. The measurements taken from the street (1.S1 and 1.S2) are between 908.6 lux and 9734 lux. The exterior measurements (1.O1, 1.O2 and 1.O3) taken from the main room measurement points level are between 321.3 lux and 1192 lux. The measurements taken from the interior range from 10.7 to 297.5 lux. This value is between 17.0-297.5 lux at 9.00, 11.7-212.8 lux at midday and 10.7-164.7 lux at 15.00. As a result of the measurements taken at 9.00 in the morning, 12.00 at the noon and 15.00 in the afternoon, the illuminance of the 20% of the points are between 100-300 lux and the 80% under 100 lux.

Table 5.5. Measured exterior illuminance (lux) Wednesday, June 26, 2019.

Time / Point	9.00	12.00	15.00
1.O1	898.6	412.7	321.3
1.O2	415.3	624.4	644.7
1.O3	545.3	1192	474.2
1.S1	5422	9734	9208
1.S2	1858	1412	908.6

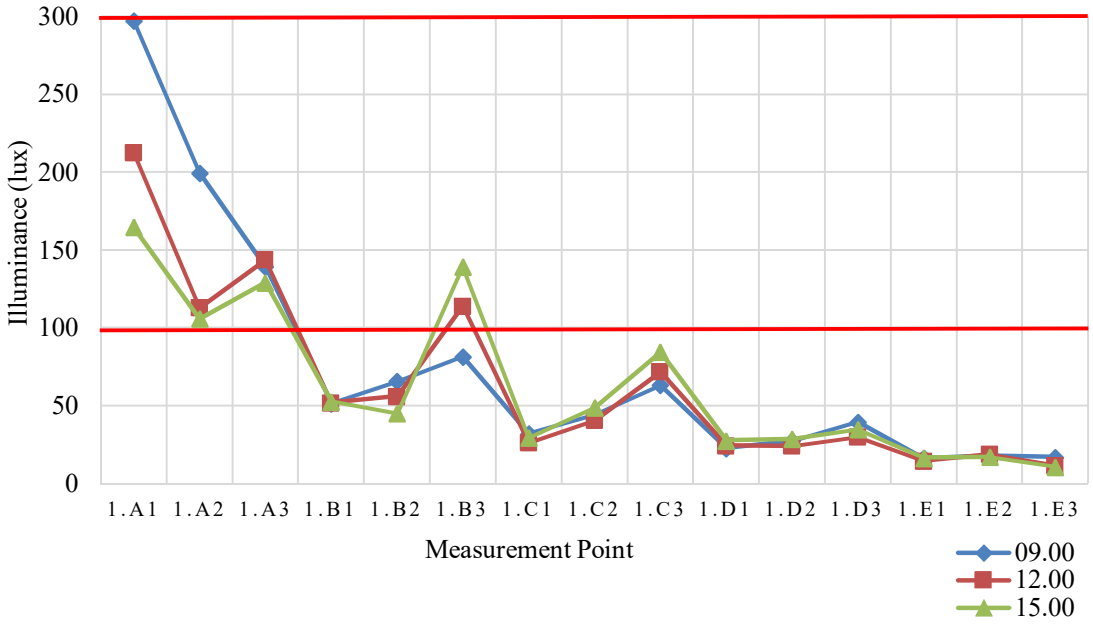


Figure 5.21. Measured interior illuminance (lux) (June 26, 2019).

The daily and hourly values of the exterior illuminance of the reference points determined in the spaces on Wednesday, October 2, 2019 are given in Table 5.6 and the interior illuminance are given in Figure 5.22. The measurements taken from the street (1.S1 and 1.S2) are between 608.5 lux and 9117 lux. The exterior measurements (1.O1, 1.O2 and 1.O3) taken from the main room measurement points level are between 288.0 lux and 1066 lux. The measurements taken from the interior range from 9.8 to 295.3 lux. This value is between 9.8-295.3 lux at 9.00, 13.4-232.7 lux at midday and 11.7-132.3 lux at 15.00. As a result of the measurements taken at 9.00 in the morning, the illuminance of the 10% of the points are between 100-300 lux and the 90% under 100 lux. The 30% of the measurement points taken at 12:00 at noon are between 100-300 lux and the 70% under 100 lux. The 30% of the measurement points taken at 15.00 in the afternoon are between 100-300 lux and the 70% under 100 lux.

Table 5.6. Measured exterior illuminance (lux) Wednesday, October 2, 2019.

Time / Point	9.00	12.00	15.00
1.O1	355.2	298.3	288.0
1.O2	690.1	1066	890.0
1.O3	438.0	781.9	1377
1.S1	7762	9117	5078
1.S2	608.5	1642	910

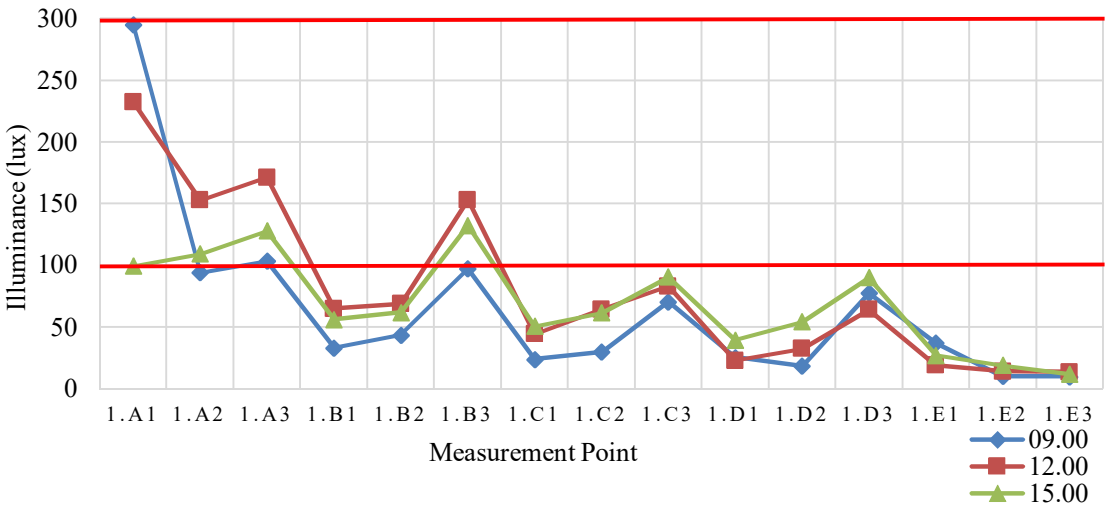


Figure 5.22. Measured interior illuminance (lux) (October 2, 2019).

5.1.8.Daylight Performance Evaluation in the Main Room

The lowest value of the main room illuminance for four seasons is 3.2 lux at 15.00 in December and the highest value is 297.5 lux at 9.00 in June (Figure 5.23). The average of the measurements taken is 29.9 lux in winter, 63.6 lux in spring, 66.8 lux in summer and 71.1 lux in autumn (Figure 5.23). This value is below 300 lux which is the standard value and it is understood that the illuminance of the main room is insufficient.

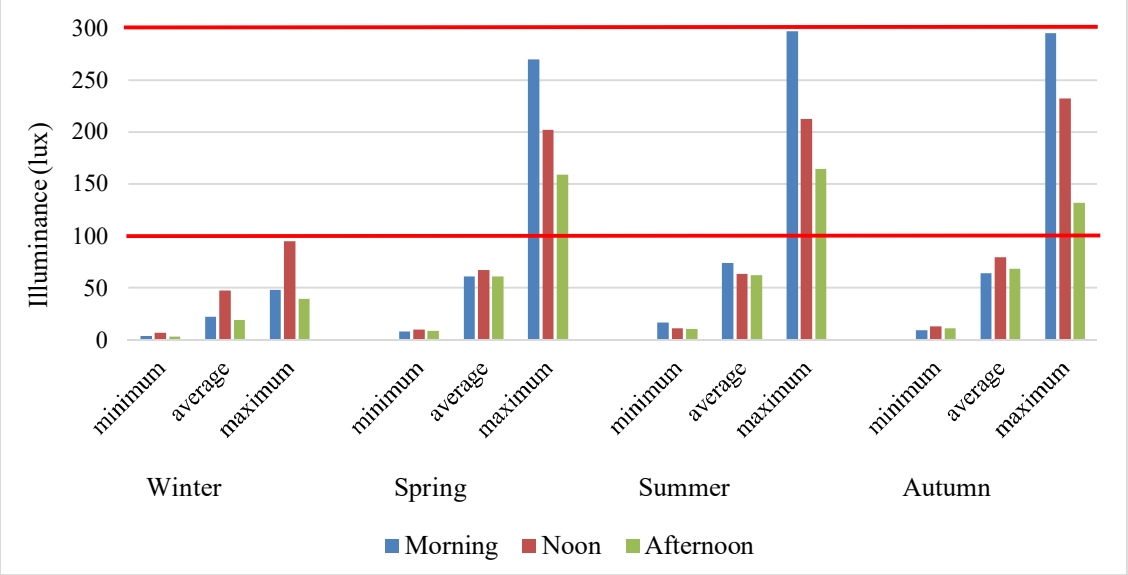


Figure 5.23. Illuminance (lux) of main room in Kaçıklar House.

The reason is that the daylight levels are below the standards (300 lux), because the roofs are adjacent to the house located in the west and the street in this direction is narrow (1.O1-1.O3), it receives light from a semi-open space (*sofa*) in the south (1.O2), there is a window closed in the north, it has lost its permeability by painting the top windows and the ratio of the window glass area to floor area (WGFR: 4.51% < 5-30%) is not sufficient; besides, the wall finishing material is dark.

This value was observed between 5012-9858 lux since there were no shadows in the measurements taken from the street (1.S1) in the south of the building. The reason for the insufficiency of the measurements taken from the west of the building (1.S2) is that the street is narrow and the direct sun cannot be obtained due to the overlap of the roof with the building in the west.

5.2. Zabunlar House

The house, which is located in the urban site in Kula county of Manisa city, was registered with the decision of İzmir 2nd Numbered Conservation Council of Immovable Cultural and Natural Assets dated 09.04.1993 and numbered 3248. It was determined as the 2nd group with the decision of İzmir 2nd Numbered Conservation Council of Immovable Cultural and Natural Assets dated 19.04.2006 and numbered 2037. The building belonging to the Zabuns (block 43, lot 2) in Kula is used as a house by Akile Zabun, the wife of Mehmet Zabun. According to the land registration in 1958, it is understood that the owner was Mehmet Zabun, Mehmet's son (Figure A.2, Figure A.3) and the house is known as Zabunlar House. The building has been preserved to date, as it is used, periodically maintained and repaired. Kenan Evren Museum and Kestaneciler House, which are restored and open to visitors, are located in the close vicinity of the house; therefore, it is one of the places frequented by tourists and the products of Kula (walnuts, almonds, *tarhana*, etc.) are sold in its courtyard. The family that feeds pigeons, provides shows to tourists by flying birds at certain times.

Figure 5.24. Zabunlar House.
(Prepared by Author, 15.10.2018)

5.2.1.Location

Zabunlar House (Figure 5.24) is in the north of the restored Kenan Evren Museum and Kestaneciler House in the Akgün Neighborhood and in the southeast of Kaçıklar House.

Figure 5.25. The site plan of Zabunlar House House.
(Source: Saf, 2004)

The building is located on the 86th Street, on the block 43 and the lot 3. The lot boundaries have been determined with the streets in the north and the east of Zabunlar House located in the northeast of the block. The entrance to the building is provided through two doors. The entrance to the building is provided through two gates in the corner lot where it is located, one opening to the courtyard through the street in the north and another entrance opening to the *taşlık* via the street in the east (Figure 5.25).

5.2.2.Plan Features

The two-storey building is located in the north and the east of the lot, the single-storey outbuilding (*müştemilat*) is in the south, and the bird house is in the west. Today, outbuilding spaces consist of a kitchen, a bathroom and a toilet (Figure 5.26).

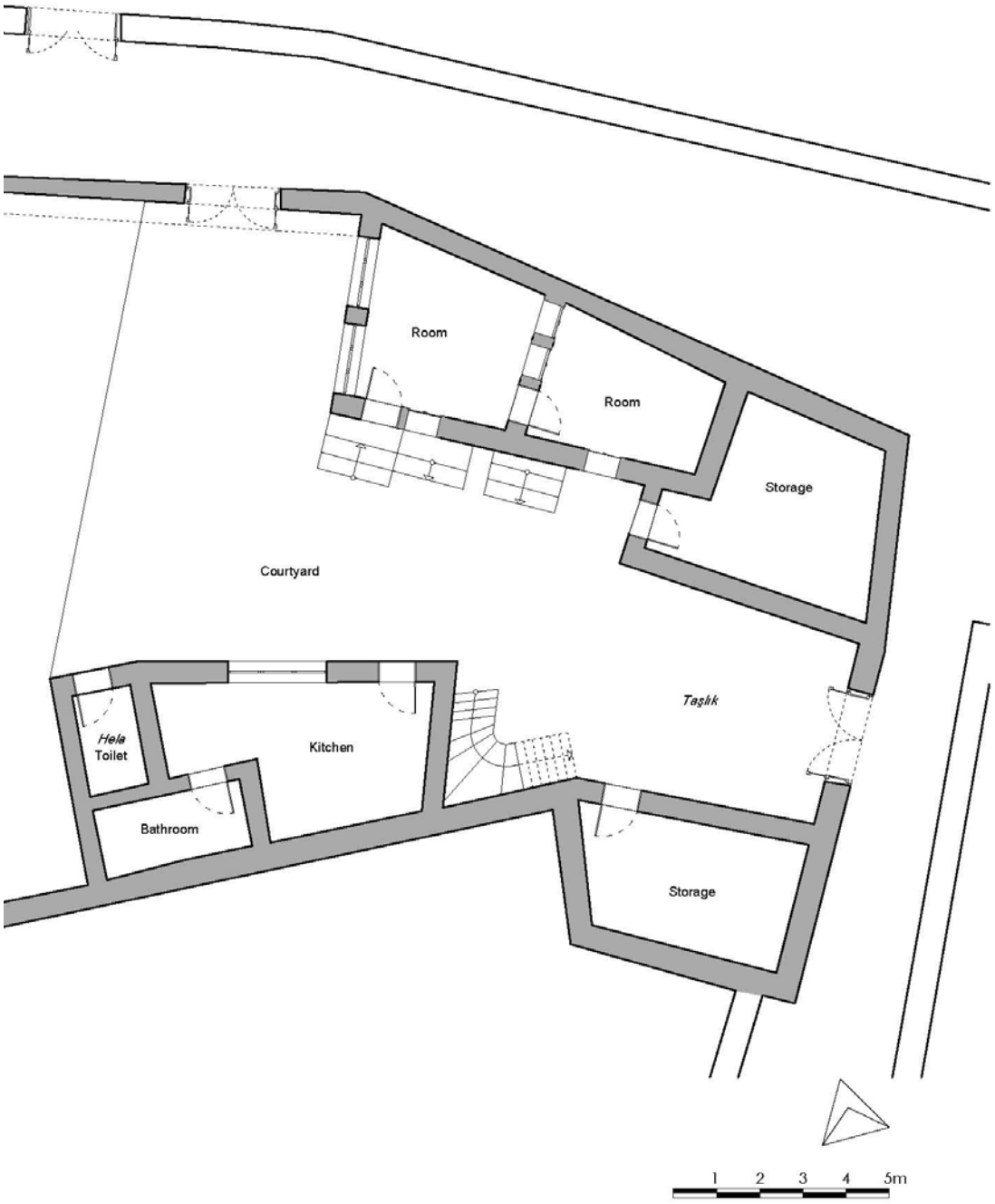


Figure 5.26. The plan of the ground floor of Zabunlar House.

On the ground floor of the building, there are storages on the north and south of the east gate. There is a room to the east of the north gate, accessed by three steps from the south, and another room to the east of which takes its entrance from this room. There are two cellars with two steps designed under these rooms. The fifteen-step wooden L-shaped stairs to the east of the kitchen reaches the *sofa* (*hayat*) on the top floor (Figure 5.26).

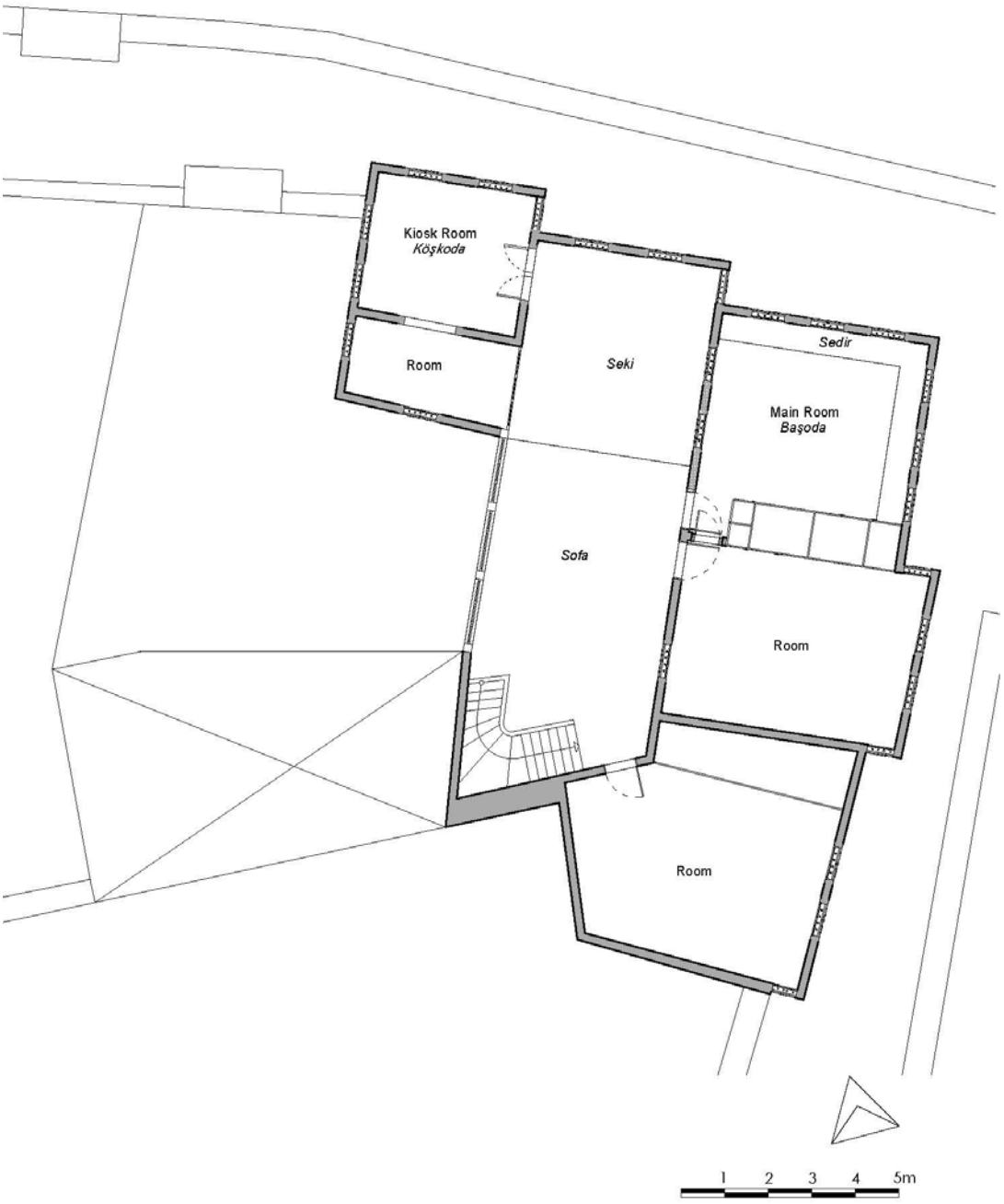


Figure 5.27. The plan of the first floor of Zabunlar House.

The *sofa* that was subsequently closed, extends in the north-south direction. The roof is carried by 4 timber pillars (*öz*) in the closed western part of the *sofa*. There is a room in the southeast and the east of the *sofa* and the main room (*başoda*) is located in the north-east of the *sofa.* In the north, there is a *seki*, which has a projection, 26 cm higher than the *sofa*. The kiosk room (*köşk oda*) has been arranged in the west of the *seki*. The main room, which cantilevers to both streets in the corner, forms triangular (saw teeth) projection (*testere çıkma*) with a *seki* and kiosk room in north and with another room in the east (Figure 5.27, Figure 5.28).

Figure 5.28. The courtyard in Zabunlar House.
(Prepared by Author, 16.12.2018)

The rooms in the southeast and the east have one in the south and two vertical rectangular windows in the east. The room in the east also has a vertical rectangular window opening to the *sofa*. The main room has two vertical rectangular windows opening to the *sofa*, three opening to the east and the north. Two vertical rectangular windows in the north and one in the east of the projection section of the *seki* and kiosk room were designed (Figure 5.27).

Figure 5.29. The *sofa* (*hayat*) in Zabunlar House.
(Prepared by Author, 15.10.2018)

The floor covering material is timber in the rooms downstairs and slate stone in the courtyard and storages. The ceiling covering material of the rooms is timber. Timber beams are uncoated in storage spaces. In the storage, timber beam is observed among the rough stone masonry and it is understood from the plaster remainders that the wall used to be covered with straw and mud plaster (Figure 5.30). The floor and ceiling covering in the *sofa* upstairs and rooms are timber veneer over timber beams (Figure 5.29).

Figure 5.30. The south storage wall.
(Prepared by Author, 16.12.2018)

5.2.3.Facade Features

The only connection to the street on the ground floor of Zabunlar House is the entrance doors to the north and to the east. The openings of all the spaces on this floor are located on the courtyard side.

There is no other opening on the ground floor except the entrance door arranged on the east side. On the first floor, the projection of the main room is further behind the projection of the room in the middle. There are vertical rectangular windows that are three in the main room, and two in the center and in the left rooms (Figure 5.31 a).

There is a courtyard wall on the north side and a courtyard entry on this wall and there is no opening on the ground floor of the building on the left side. The kiosk room, the *seki* and main room on the first floor form the triangular (saw teeth) projection. There are vertical rectangular windows that are three in the main room, and two in the *seki* and in the kiosk room (Figure 5.31 b).

a b

Figure 5.31. The eastern facade of Zabunlar House (Prepared by Author, 15.10.2018) (a), the northern facade (Prepared by Author, 15.10.2018) (b)

5.2.4.Main Room Location and Planning Features

The main room on the first floor of the house, located in the northeast of the *sofa* (hayat), measures 10 m x 4.80 m (24.48 m^2). There is a door to the south of the west wall and two vertical rectangular windows opening to the *seki* to the north. A large cupboard for bedding (*yüklük*) is arranged on the south wall of the room (Figure 5.32). The large cupboard for bedding (*yüklük*) serves both the main room and the adjacent room. There is a door to the adjacent room to the west of the large cupboard for bedding (*yüklük*). On the west wall, there are two vertical rectangular windows. The raised platform for sitting (*sedir*) is positioned in the north and the east of the room should be 30-40 cm high from the floor, while it is 50 cm high and the *sedir* cushion covers a part of the windows. The timber floor and the ceiling covering are used longitudinally in the north-south direction.

Figure 5.32. The large cupboard for bedding (*yüklük*) in the main room.
(Prepared by Author, 15.10.2018)

5.2.5.Architectural Features of the Windows in the Main Room

There are three rectangular windows on the north and east wall and two rectangular windows opening to the *seki* on the western wall. Rails in the east of the north wall and in the north of the east wall are in the half of the window and others are on the whole of it (Figure 5.33).

Figure 5.33. The window layout of the main room.
(Prepared by Author, 15.10.2018)

a) Stylistic Features: The rectangular windows are 52 cm high from the floor. The ratio of rectangular windows, which are 80 x 119 cm in size, is 2/3. The sections in the window are three groups in vertical and two group in horizontal. The window has four flaps as upper (83 x 39 cm), lower (80 x 73 cm) and double vertical hinged sashes. These two sections are separated from each other with a horizontal mullion (80 x 7 cm). The double vertical hinged sashes section form a single line in vertical, two lines in horizontal. The double vertical hinged sash in the lower part is double series in horizontal and vertical. Both of the upper and lower flaps have butterfly lock systems (Figure 5.34 a, Figure 5.34 b; Figure 5.35 b; Figure 5.35 e).

b) Technical Features: The rectangular window is located on the inner surface of the timber carcass wall. The frame-sash relationship is with tongue-groove. The sash-sash relationship is straight joint.The joints formed between the window frame and the wall are covered with moldings from the inside (Figure 5.35 c, Figure 5.35 f).

c) Complementary Elements: There is a 45-cm-high rail in the windows in the north on the east wall and in the east on the north wall. In the other windows, the rails are in the whole window and timber sections separate the surface into 5 in horizontal, into 9 in vertical line (Figure 5.34 b, Figure 5.35 b). All windows have shutters (Figure 5.35).

a b

Figure 5.34. The rectangular windows with half rail (Prepared by Author, 02.10.2019) (a), the rectangular windows with full railings in the main room (Prepared by Author, 02.10.2019) (b)

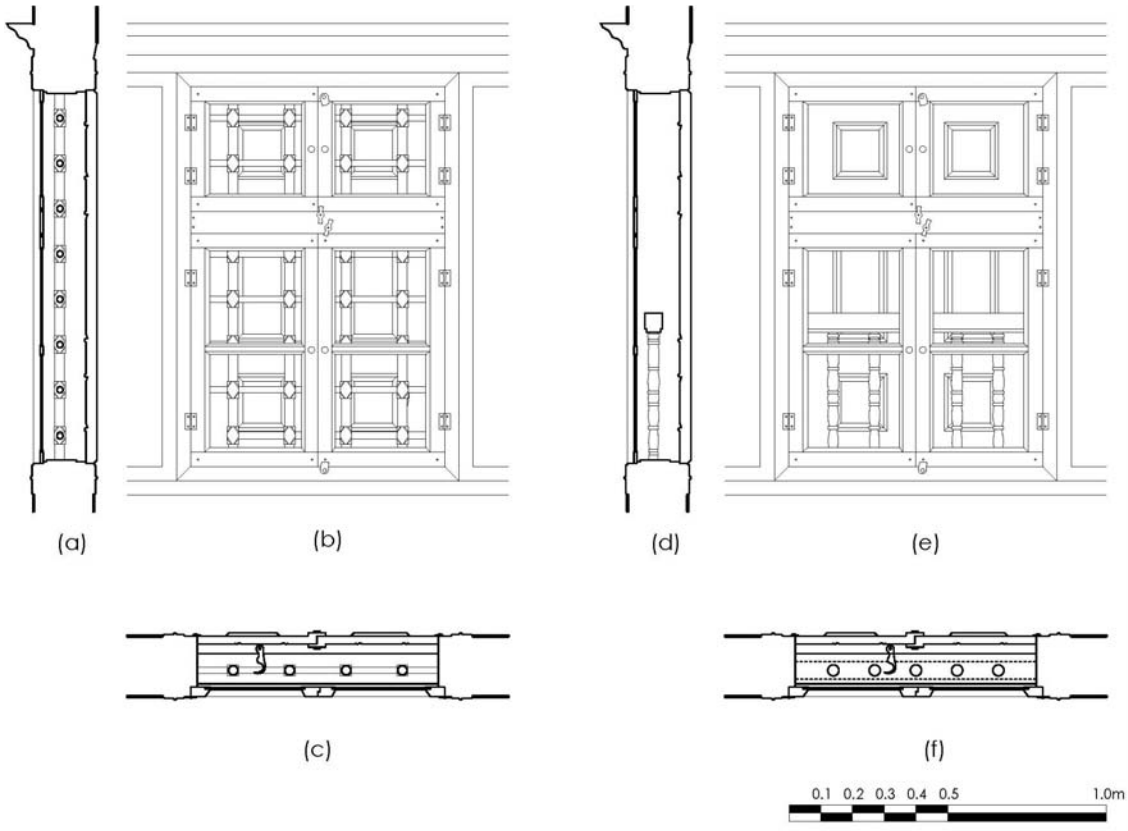


Figure 5.35. Rectangular window section with full rain (a), view (b), plan (c), Rectangular window section of half-rain (d), View (e), Plan (f)

5.2.6. Determination of the Measurement Points and Time of the Main Room (*Başoda*)

Measurement points were determined according to room idex formula. When the room index (K) is calculated (Formula 5), there has to be at least 4 measurement points in the main room. However, in order to get more precise results, 9 (3x3) points were determined by increasing the number of points. These points are located at a distance of 50 cm from the window and the cupboard (Figure 5.36).

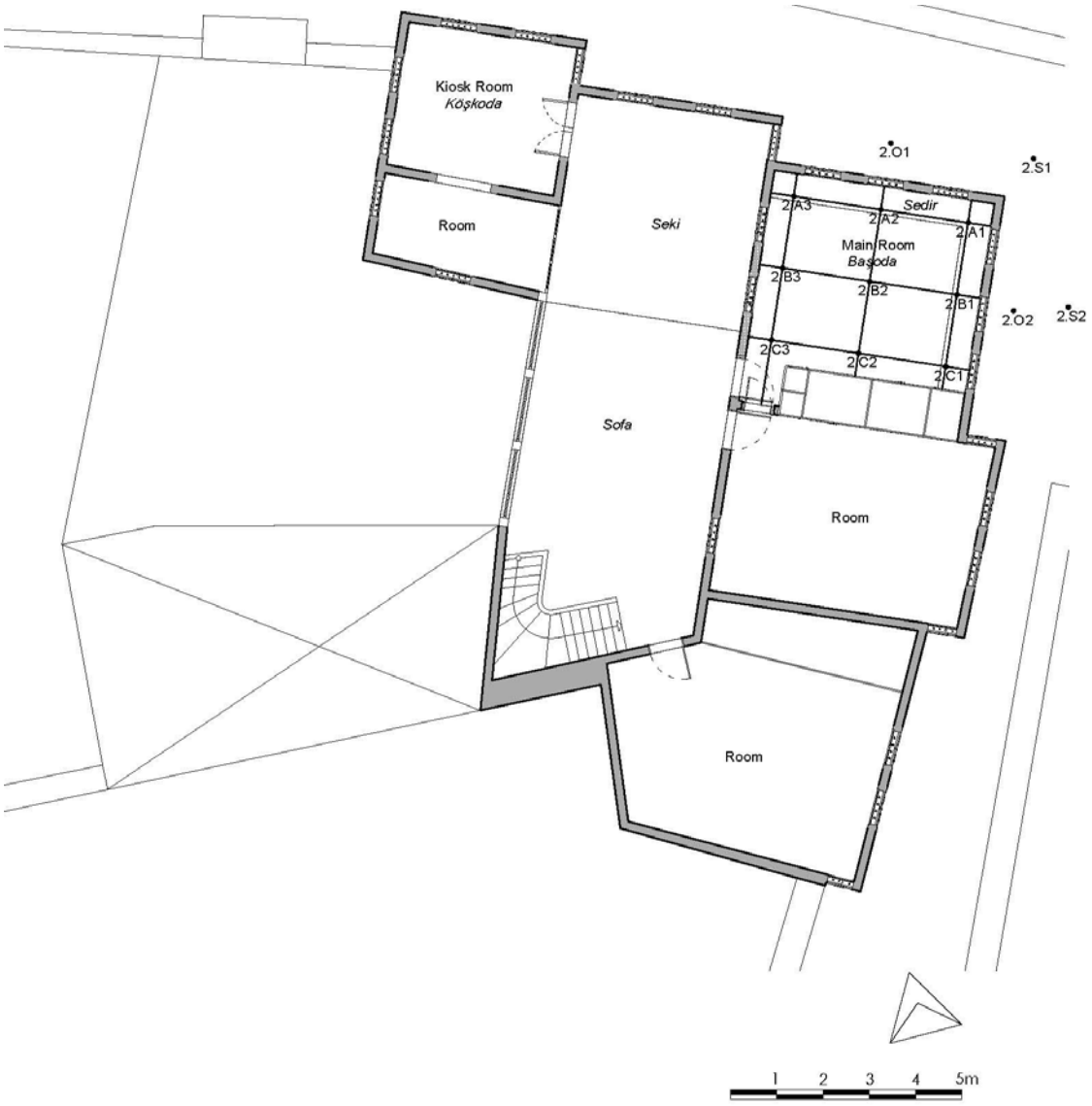


Figure 5.36. Measurement points for illuminance in the main room of Zabunlar House

The outdoor illuminance measurements was taken 80 cm above the main room floor in the north (2.O1) and the east (2.O2) of the main room. On the street, the measurements were taken from the streets in the north (2.S1) and the east (2.S2) of the lot. These points were decided to determine the level of illumination in the north and the east.

5.2.7. Daylight Performance of the Main Room

The window dimension ratio of the north facede of the main room which looks the street to the floor area (Formula 1) is 11.68%, the ratio of the window glass area to the floor area (Formula 2) is 6.08%. The proportion of the window glass area to the inner area is expected to be 5%-30% (Foytonont and Berruto, 1997; Foytonont, 1999). In this regard, Zabunlar House is among these values. The ratio of the same front area to the wall area (Formula 3) was measured as 21.28% and the ratio of the window glass area to the wall area (Formula 4) was measured as 10.44%. In this case, the high number of mullions and partitions makes almost a half difference between the window and glass ratios.

To identify the materials forming the surfaces in the main room, luminance measurements were taken from the determined points (Table 3.1) by the luminance meter and on the determined dates (Table 3.2). The average of the reflectance was calculated using the formula (7) and is specified in Table 5.7. The percentages of surface material reflectance (p value) change between 30.1% and 73.2%. The light color of the wooden mullion of window causes p value to be higher (73.2%), the dark color of the ceiling covering provides reflectance to be lower (30.1%) (Figure 5.37 a, Figure 5.37 b).

Table 5.7. Calculation of the measured values and reflectance of materials.

	L (cd/m^2)				E (lux)				p (%)
	Dec 16, 2018	April 3, 2019	June 27, 2019	Oct 3, 2019	Dec 16, 2018	April 3, 2019	June 27, 2019	Oct 3, 2019	Average
2.W	15.3	30.7	17.5	21.1	129.3	225.5	136.5	111.5	44.1
2.T1	31.5	26.8	17.1	19.76	130.5	116.2	88.0	73.3	73.2
2.T2	45.3	116.0	69.1	51.9	342.4	717.4	427.2	372.1	47.7
2.F	18.9	26.0	31.9	25.7	155.2	218.5	246.4	243.6	39.1
2.C	12.2	41.0	22.1	23.2	112.9	447.8	307.7	132.2	30.1

a b

Figure 5.37. The surface reflectance at the measurement points in the main room of Zabunlar House on the north wall (Prepared by Author, 15.10.2018) (a), on the south wall (Prepared by Author, 15.10.2018) (b)

To calculate the transmittance of window glazing, the values obtained when the window was open and closed measuring the luminance values at the same point on Sunday, December 16, 2018. Table 5.8 shows the calculated transmittance values as 79.6% using the formula (6). The glass transmittance value is at an acceptable level within the framework of standard values.

Table 5.8. Transmittance of glass
Sunday, December 16, 2018.

	$L_{int.}$ (cd/m^2)	$L_{ext.}$ (cd/m^2)	t (%)
2.G	330.0	414.6	79.6

The daily and hourly values of the exterior illuminance of the reference points determined in the spaces on Sunday, December 16, 2018 are given in Table 5.9 and the interior illuminance are given in Figure 5.38. The measurements taken from the street (2.S1 and 2.S2) are between 1227 lux and 7231 lux. The exterior measurements (2.O1 and 2.O2) taken from the main room measurement points level are between 3389 lux and

5672 lux. The measurements taken from the interior range from 3.4 to 637.0 lux. This value is between 3.4 - 147.0 lux at 9.00, 19.8 - 637.0 lux at midday and 14.4 - 548.4 lux at 15.00. As a result of the measurements taken at 09.00 in the morning, the 300 lux value given in the standards does not exist at any point. The 22% of the measurement points are between 100-300 lux and the 78% under 100 lux. The 56% of the measurement points taken at 12.00 at noon are above 300 lux, the 11% between 100-300 lux and the 33% under 100 lux. The 67% of the measurement points taken at 15.00 in the afternoon are above 300 lux and the 33% under 100 lux.

Table 5.9. Measured exterior illuminance (lux)
Sunday, December 16, 2018.

Time / Point	9.30	12.30	15.30
2.O1	3763	4517	3389
2.O2	5672	5650	4851
2.S1	1227	1283	5982
2.S2	6271	7231	5425

Figure 5.38. Measured interior illuminance (lux)
(December 16, 2018).

The daily and hourly values of the exterior illuminance of the reference points determined in the spaces on Wednesday, April 3, 2019 are given in Table 5.10 and the interior illuminance are given in Figure 5.39. The measurements taken from the street (2.S1 and 2.S2) are between 1432 lux and 8763 lux. The exterior measurements (2.O1 and 2.O2) taken from the main room measurement points level are between 2819 lux and 7864 lux. The measurements taken from the interior range from 53.8 to 1494 lux. This value is between 81.5-1494 lux at 9.00, 57.5-1226 lux at midday and 53.8-399.9 lux at 15.00. As a result of the measurements taken at 09.00 in the morning, the illuminance of the 56% of the points are above 300 lux, the 33% between 100-300 lux and the 11% are below 100 lux. 56% of the measurement points taken at 12.00 at noon are above 300 lux, the 22% between 100-300 lux and the 22% of under 100 lux. The 56% of the measurement points taken at 15.00 in the afternoon are above 300 lux, the 33% between 100-300 lux and the 11% under 100 lux.

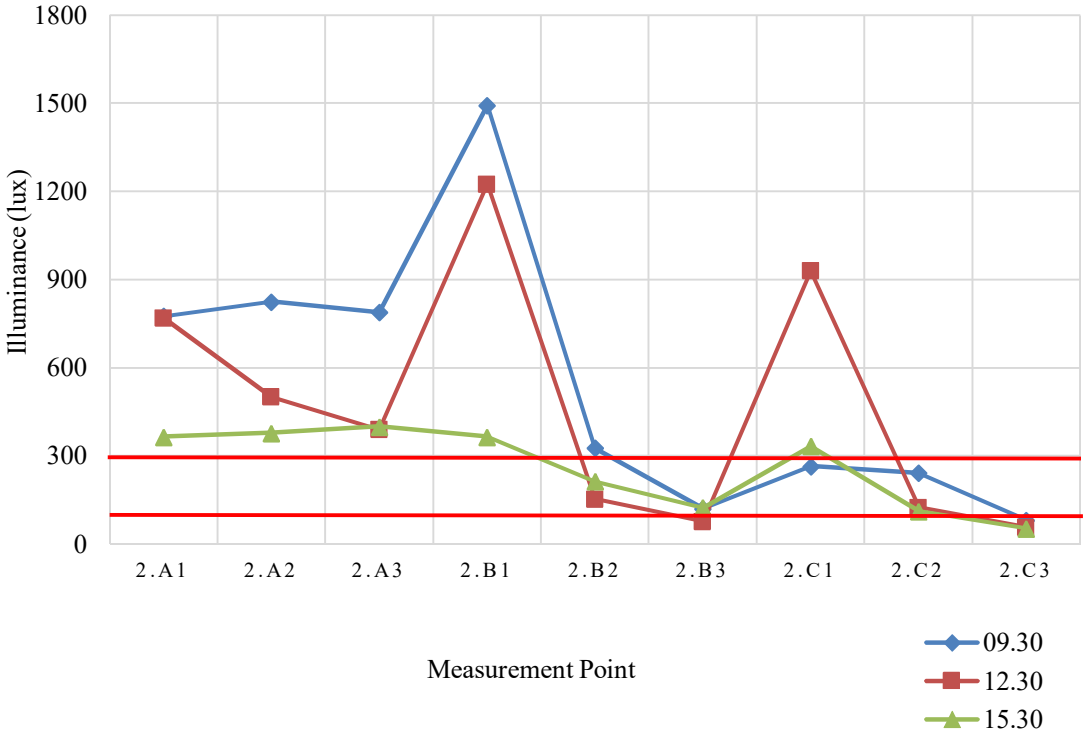


Figure 5.39. Measured interior illuminance (lux)
(April 3, 2019)

Table 5.10. Measured exterior illuminance (lux)
Wednesday, April 3, 2019

Time / Point	9.30	12.30	15.30
2.O1	2946	3472	2901
2.O2	4016	7864	2819
2.S1	4037	8755	6340
2.S2	1432	8763	4974

The daily and hourly values of the exterior illuminance of the reference points determined in the spaces on Thursday, June 27, 2019 are given in Table 5.11 and the interior illuminance are given in Figure 5.40. The measurements taken from the street (2.S1 and 2.S2) are between 908 lux and 9339 lux. The exterior measurements (2.O1 and 2.O2) taken from the main room measurement points level are between 765 lux and 7691 lux. The measurements taken from the interior range from 45.7 to 1460 lux. This value is between 52.8-1460 lux at 9.00, 31.2-694.4 lux at midday and 45.7-623.4 lux at 15.00. As a result of the measurements taken at 09.00 in the morning, the illuminance of the 67% of the points are above 300 lux, the 11% between 100-300 lux and the 22% are below 100 lux. The 56% of the measurement points taken at 12.00 at noon are above 300 lux, the 22% between 100-300 lux and the 22% under 100 lux. The 56% of the measurement points taken at 15.00 in the afternoon are above 300 lux, the 33% between 100-300 lux and the 11% under 100 lux.

Table 5.11. Measured exterior illuminance (lux) Thursday, June 27, 2019.

Time / Point	9.30	12.30	15.30
2.O1	6870	5254	6570
2.O2	7477	765	7691
2.S1	6301	975	908
2.S2	6797	9339	7673

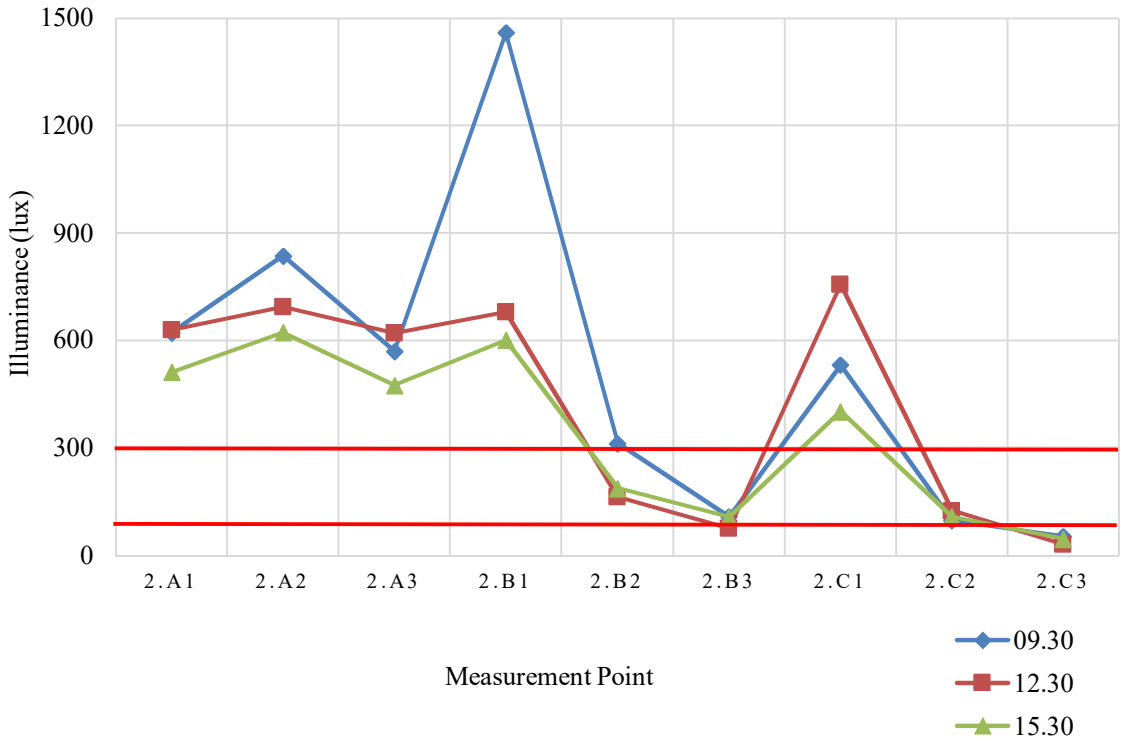


Figure 5.40. Measured interior illuminance (lux) (June 27, 2019).

The daily and hourly values of the exterior illuminance of the reference points determined in the spaces on Thursday, October 3, 2019 are given in Table 5.12 and the interior illuminance are given in Figure 5.41. The measurements taken from the street (2.S1 and 2.S2) are between 1120 lux and 5682 lux. The exterior measurements (2.O1 and 2.O2) taken from the main room measurement points level are between 836 lux and 4858 lux. The measurements taken from the interior range from 35.8 to 1640 lux. This value is between 53.3-1640 lux at 9.00, 52.0-793.2 lux at midday and 35.8-241.1 lux at 15.00. As a result of the measurements taken at 09.00 in the morning, the illuminance of the 78% of the points are above 300 lux, the 11% between 100-300 lux and the 11% are below 100 lux. The 56% of the measurement points taken at 12.00 at noon are above 300 lux, the 22% between 100-300 lux and the 22% under 100 lux. In the measurements taken at 3.00 in the afternoon, the 300 lux value given in the standards does not exist at any point. The 56% of the measurement points taken at 15.00 in the afternoon are between 100-300 lux and the 44% under 100 lux.

Table 5.12. Measured exterior illuminance (lux)
Thursday, October 3, 2019

Time / Point	9.30	12.30	15.30
2.O1	4351	2996	2511
2.O2	4858	836	3700
2.S1	5581	4523	3622
2.S2	1120	5682	3346

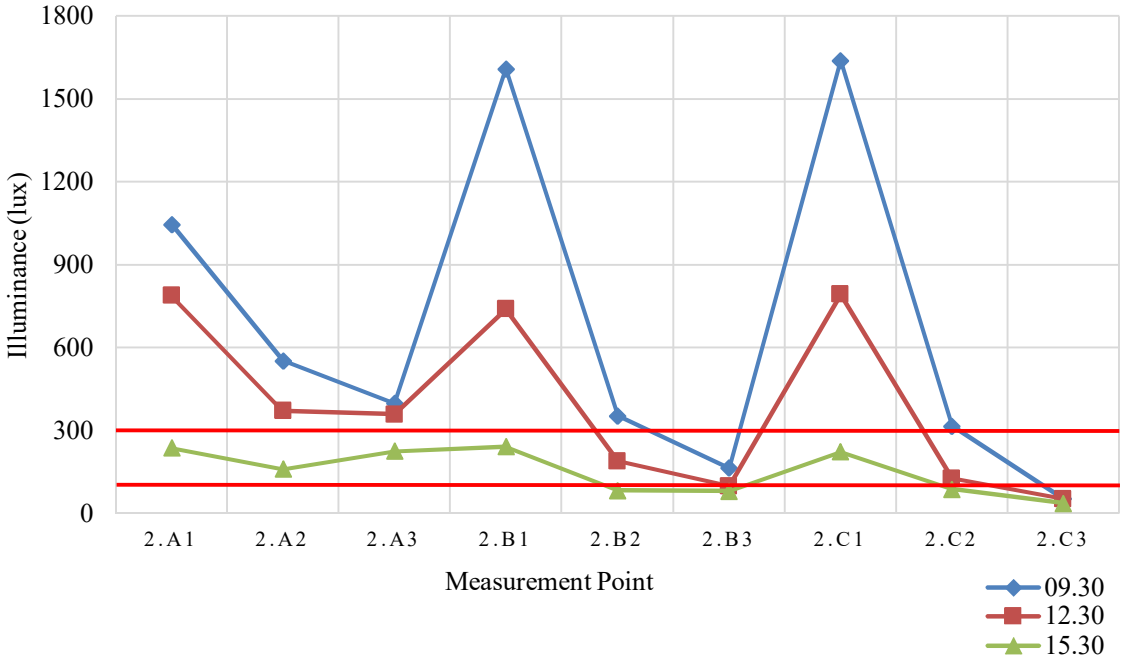


Figure 5.41. Measured interior illuminance (lux) (October 3, 2019)

5.2.8.Daylight Performance Evaluation in the Main Room

The lowest value of the main room illuminance for the four seasons is 3.4 lux (Figure 5.38) at 9.00 in December and the highest value is 1640 lux at 9.00 in October (Figure 5.41). The average of the measurements taken is 225.5 lux in winter, 426.0 lux in spring, 423.4 lux in summer and 408.5 lux in autumn (Figure 5.42). This value is below the standard value (300 lux) in winter but above in spring, summer and autumn. In winter,

the measurement values at noon are higher than in the morning and afternoon under overcast sky conditions. The main reason for this situation is that the sun is taken more at noon. The low daylight intake was observed in the morning due to the fog. In the other seasons (spring, summer, autumn) the measurements in the morning are higher than at noon and in the afternoon. The main reasons are that the main rooms are located in the northeast, the morning sun rises from the east and fog is not observed in the mentioned seasons.

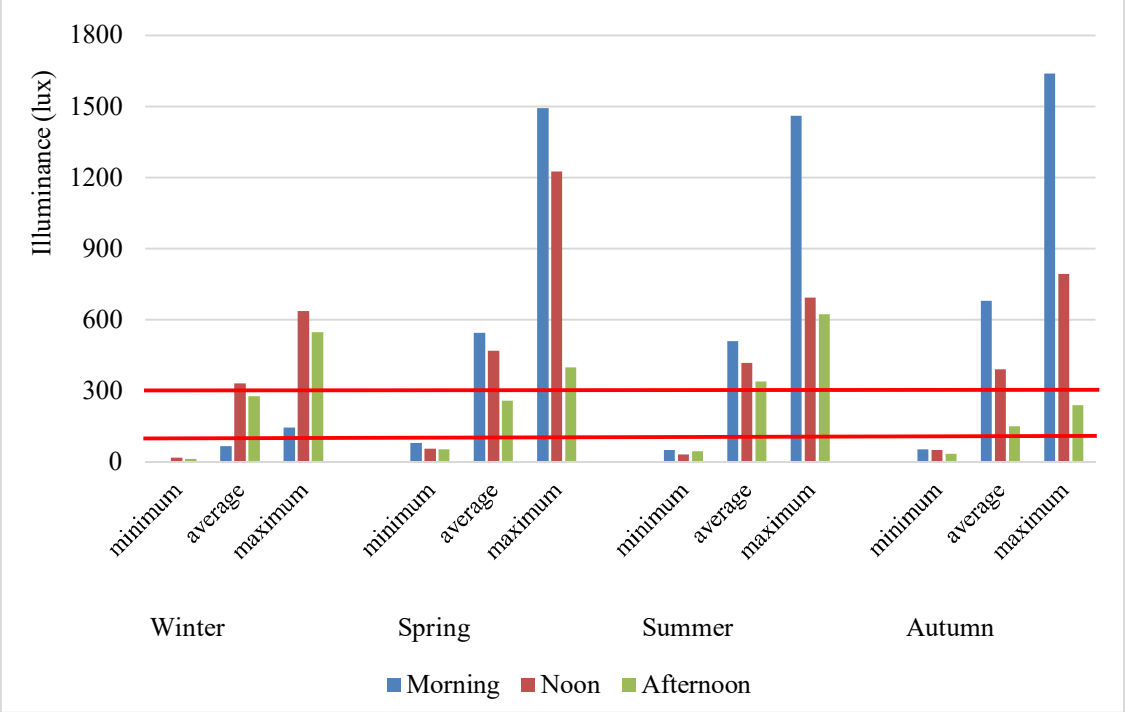


Figure 5.42. Illuminance (lux) of the main room in Zabunlar House.

Considering the measurements taken under the eaves (2.O1-2.O2), the width of the streets in the north and east, the distance between the mutual houses and the lathing concave covering of the eaves, and the ratio of the window glass area to the floor area (WGFR: 5% < 6.08% < 30%) between the standard values ensure the level of illumination in the main room. The inadequacy of the measurements taken from the west of the room (2.B3 ve 2.C3) in terms of illumination level results from the fact that the *sofa* is closed. Also, the dark color of the wall finishing material of the room causes the reflection factor to be low, thus affecting the daylight performance negatively.

5.3. Kestaneciler House

The house, which is located in the urban site in Kula county of Manisa city, was registered with the decision of İzmir 2nd Numbered Conservation Council of Immovable Cultural and Natural Assets dated 09.04.1993 and numbered 3248 and It was expropriated by the Ministry of Culture and Tourism in 1987. The building, the restoration of which was completed in 1992, was handed over to the Municipality of Kula on the condition that it became a “Museum House” in 1997 by the Ministry of Culture and Tourism. Today, Kestaneciler House, which is used as a "Museum House", displays the characteristic features of Kula Houses (Figure 5.43 a, Figure 5.43 b). According to the land registration of the Canbazlar House (block 15, lot 7) located in the south of the building, it is understood that in 1926, the owner of Kestaneciler House (block 15, lot 8) was Kiryako, Pilgrim Çırak’s son (Figure A.4). After the exchange, the building, which passed in to Kestaneciler family, is known as Kestaneciler House.

a b

Figure 5.43. The view from the south of Kestaneciler House (Prepared by Author, 15.10.2018) (a), the view from the north (Prepared by Author, 15.10.2018) (b)

5.2.9.Location

Kestaneciler House is located in the Akgün Neighborhood within the Kula Conservation Area and opposite (to the west) is Kenan Evren House, which is used as the Ethnography Museum. The building, which is also known as the Turkish House today, is among the symbolic buildings in Kula.

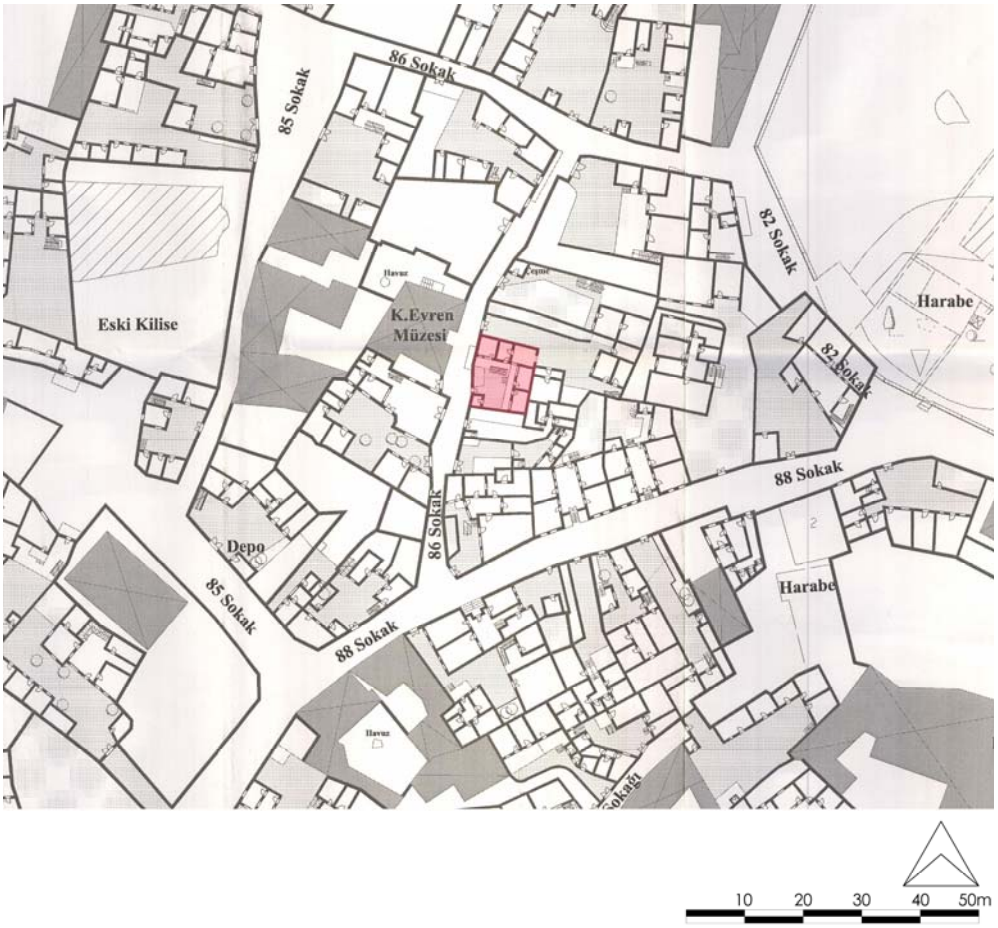


Figure 5.44. The site plan of Kestaneciler House.
(Source: Saf, 2004)

The building is located on the 86th Street, on the block 15 and the lot 8th. The lot boundary of Kestaneciler House, located in the west of the block, is determined by the street to the west and adjacent lots in three directions. The entrance to the building is provided by the door opening to the courtyard through the street where it is located. There are courtyards of adjacent lots on both sides (Figure 5.44).

5.2.10. Plan Features

The two-storey building is located in the north and east of the lot and has an 'L' plan. The toilet is in the southwest. There are three spaces in the north and two in the east of the L plan.

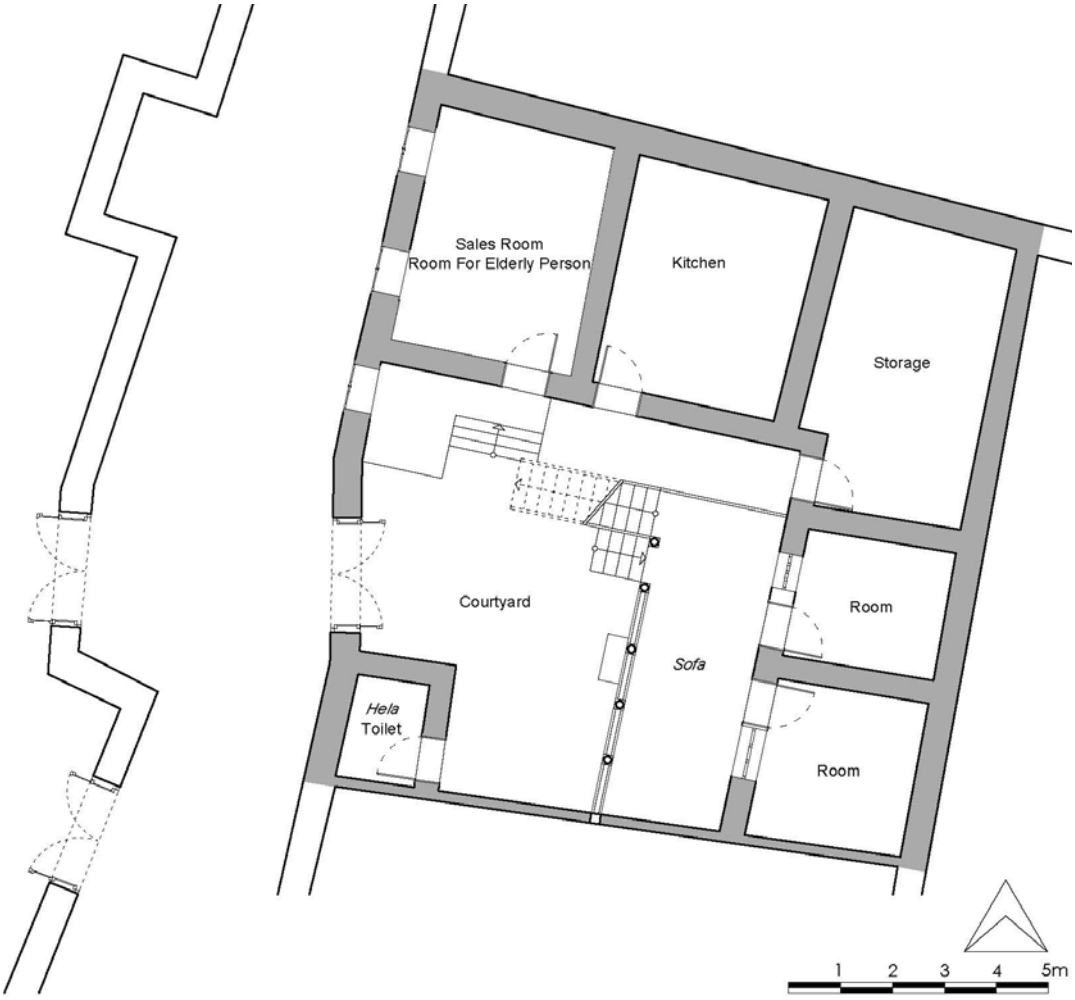


Figure 5.45. The plan of the ground floor of Kestaneciler House.

There is the kitchen in the middle from the places in the north, the sales room in the west today, the storage in the east. The *sofa* of the ground floor in front of the two rooms in the east is reached by a five-step staircase. The cellar is located under this section and is descended by a two-step staircase. The cellar is located under this section and is reached by a two-step staircase. An entry is arranged with four-step staircase for the place

which is used as a sales unit, the interior is carefully designed and is used as room for elderly person (*yaşlı odası*) in its original state (Figure 5.49 a).The outer *sofa* (*hayat*) is reached on the upper floor with twelve-step wooden stairs to the north of the five-step staircase leading to the *sofa* downstairs (Figure 5.45).

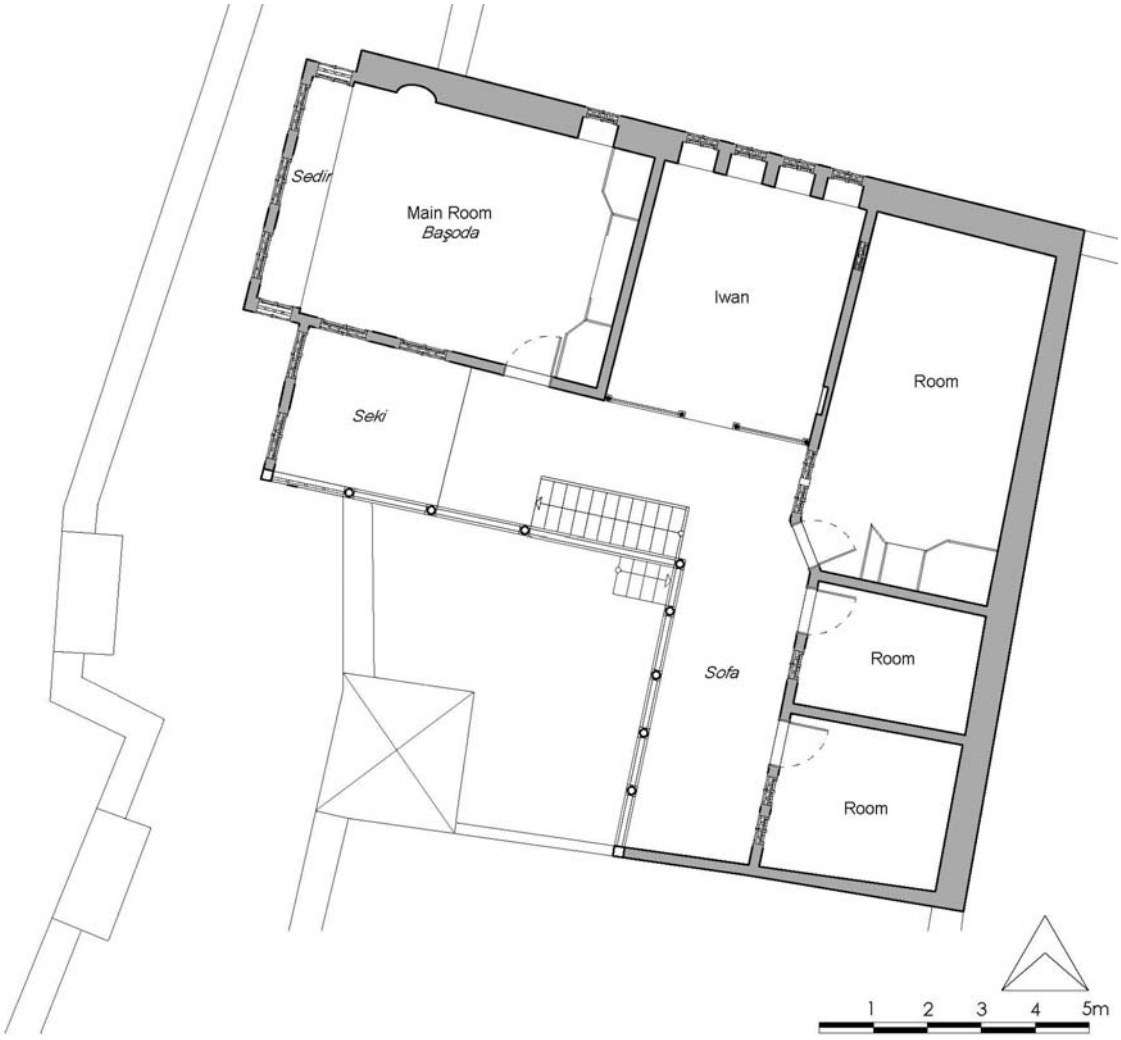


Figure 5.46. The plan of the first floor of Kestaneciler House

The outer *sofa* extends north and east direction in the form of L (Figure 5.46). The roof is carried by five timber pillars (*öz*) on the north wing of the *sofa* facing the courtyard and six on the east wing (Figure 5.47). In the north wing of the *sofa*, a main room in the west and a room in the east and an iwan between the two places are arranged. The iwan floor is 40 cm higher than the *sofa*. A *seki*, which is 38 cm high from the *sofa* floor, has been designed in the west of the north wing of the *sofa* (Figure 5.46, Figure 5.48 a).

Figure 5.47. The courtyard in Kestaneciler House
(Source: As of Jan 12, 2020, Kula Municipality website)

The main room, located in the north of the *seki*, forms the triangular (saw teeth) projection with the *seki*. The seki faces the street through two vertical rectangular windows. Two vertical rectangular windows open to the *seki* on the south wall of the main room and a window opens on the projection to the street. There are three vertical rectangular windows on the west wall and two on the north wall, one on the projection and the other on the east. Iwan opens to the *sofa* with a three-arched system (*direklik*) formed with concave and convex profiles that sit on four timber pillars (Figure 5.48 b). There are wooden railings on the side sections, the middle section is left open for circulation. There are top windows on four vertical rectangular windows in the north of the iwan. There is a top window designed on a vertical rectangular window and a built-in cupboard (*gömme dolap, delik*) on the wall between the iwan and its northeast room. The two vertical rectangular windows of the room in the northeast face the *sofa* with its top windows. Its door, which is a corner chamfered, opens to the *sofa* (Figure 5.46). One in

the room on the east wing of the *sofa*, two vertical rectangular windows in the southeast room, and the top windows designed at the upper elevation face the *sofa*.

a b

Figure 5.48. The *seki* in Kestaneciler House (Prepared by Author, 15.12.2018) (a), the iwan (Prepared by Author, 15.12.2018) (b).

The floor covering material downstairs is timber in the *sofa*, rooms and sales room (room for elderly person). The sales room has a decorated ceiling. The perimeter of the ceiling is surrounded by five laths and the square planned middle section is decorated in lattage technique (Figure 5.49). The ceiling covering material in the *sofa* and rooms upstairs is flat. The ceiling covering upstairs in the *sofa* and rooms are timber veneer over timber beams. The ceiling is designed with four-section star motifs in *seki* (Figure 5.50 a), with diamond pattern in the north wing of the *sofa* (Figure 5.50 b), with two rhombic sections in the northeast corner (Figure 5.51 a), with nested square and flat wooden slatted section in the east. The ceiling of the iwan is decorated with lattage technique (Figure 5.51 b). Its middle part has a square shaped corners in a square frame (Figure 5.51 b).

a b

Figure 5.49. The exterior of the room for elderly person (*yaşlı odası*) (Prepared by Author, 15.12.2018) (a), the interior (Prepared by Author, 15.12.2018) (b).

a b

Figure 5.50. The ceiling of the *seki* on the main floor (Prepared by Author, 15.12.2018) (a), the diamond-patterned ceiling of *sofa* in Kestaneciler House

a b

Figure 5.51. Two rhombic sections in the northeast corner of *sofa* ceiling (Prepared by Author, 15.12.2018) (a), the ceiling of iwan (Prepared by Author, 15.12.2018) (b)

5.3.3.Facade Features

On the ground floor on the west entrance facade of Kestaneciler House, there is a courtyard door on the right side and three vertical rectangular windows below the projection on the left side. On the triangular (saw teeth) projection on the top floor, three vertical rectangular windows of the main room on the left and two of the *seki* on the right are arranged (Figure 5.43 a).

5.3.4.Main Room Location and Planning Features

The main room on the first floor of the house, located in the northwest of the *sofa* (hayat), measures 5.90 m x 4.25 m (25.08 m^2). There is a door to the east of the south wall, a vertical rectangular window to the west of the south wall in the projection section, two vertical rectangular windows opening to the *seki* and three on the western wall. There is a vertical rectangular window in the north in the projection part (to the west) and in the east of the room; besides, the fire place is located between them. A small space for

ablution (*gusülhane*) was arranged in the large cupboard for bedding (*yüklük*) on the east wall of the room (Figure 5.52). The raised platform for sitting (*sedir*) positioned in the west of the room should be 30-40 cm high from the floor, while it is 60 cm high and the *sedir* cushion covers a part of the windows.

Figure 5.52. The large cupboard for bedding (*yüklük*) in the main room.
(Prepared by Author, 15.10.2018)

The timber floor covering used longitudinally in the east-west direction provides greater perception of the room. The square core of the caisson with lattage adorned ceiling was arranged 36 cm inward from the surface, allowing the place to be raised in volume. Timber covering was used as a decorative element on the ceiling (Figure 5.53).

Figure 5.53. The ceiling of the main room.
(Prepared by Author, 02.04.2019)

5.3.5.Architectural Features of the Windows in the Main Room

There are three rectangular windows on the south and west walls of the main room, and two rectangular windows on the north wall (Figure 5.54).

Figure 5.54. The window layout of the main room.
(Prepared by Author, 15.10.2018)

a) Stylistic Features: The rectangular windows are 60 cm high from the floor. The ratio of rectangular windows, which are 98.5 x 168.0 cm in size, is 3/5. The sections in the window are four groups in vertical and two groups in horizontal. In the perpendicular sliding sash, the upper fixed part (98.5 x 81 cm) is positioned behind the lower movable part (98.5 x 81.5 cm). The upper fixed part and the lower moving part form double series in vertical and horizontal (Figure 5.55 a, Figure 5.56 b).

b) Technical Features: The rectangular window is located on the inner surface of the timber carcass wall. The frame partition is at the same height as the upper fixed part of the perpendicular sliding sash and is joined by grooved on the sides of the frame (Figure 5.56 a, Figure 5.56 d).

c) Complementary Elements: All of the windows have 47 cm high wooden rails and shutters (Figure 5.55 b, Figure 5.56 c).

a b

Figure 5.55. The rectangular window in the main room (Prepared by Author, 15.10.2018) (a), the shutter of the windows (Prepared by Author, 15.10.2018) (b)

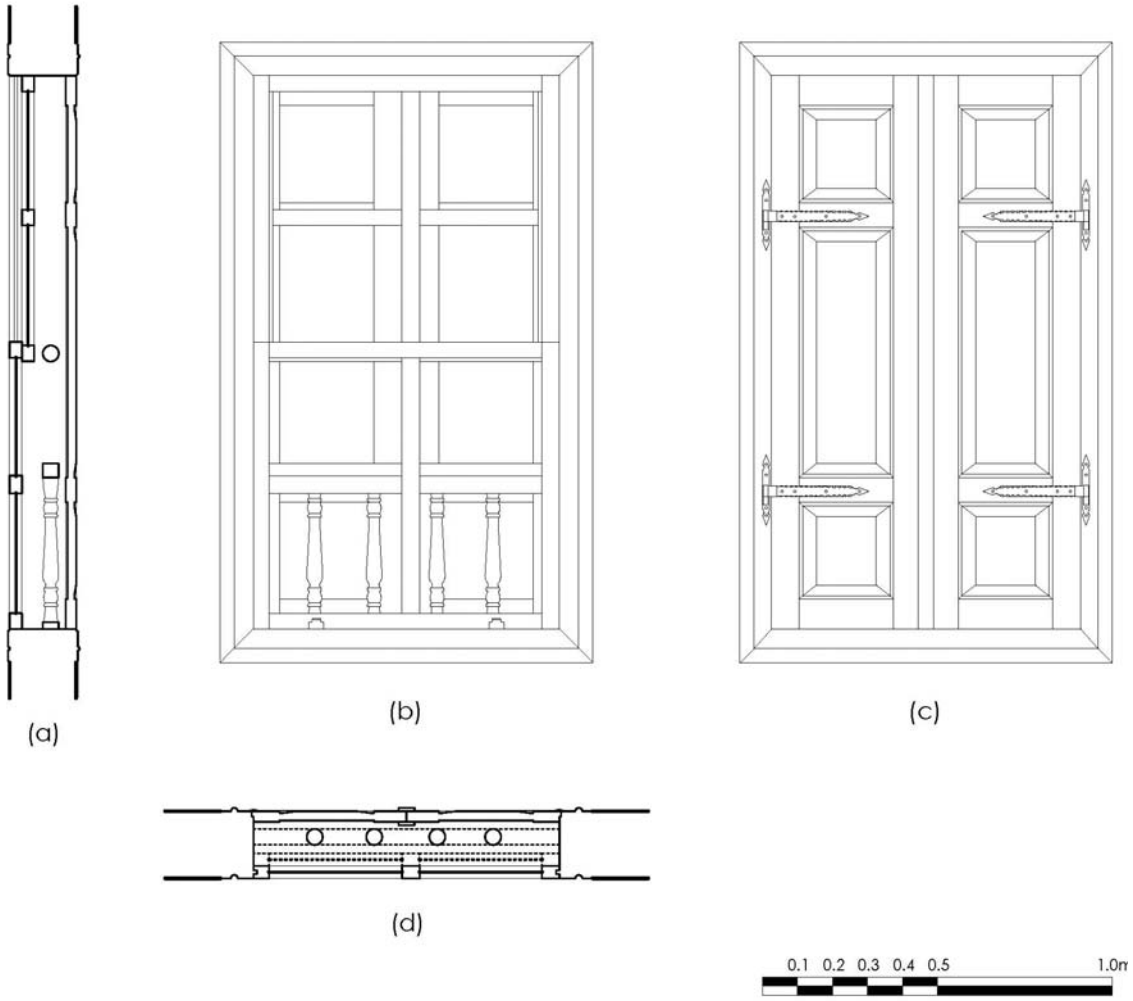


Figure 5.56. The rectangular window section (a), elevation (b), shutter elevation (c), plan (d)

5.3.6. Determination of the Measurement Points and Time of the Main Room (*Başoda*)

Measurement points were determined according to room idex formula. When the room index (K) is calculated (Formula 5), there has to be at least 4 measurement points in the main room. However, in order to get more precise results, 15 (3x5) points were determined by increasing the number of points. These points are located at a distance of 50 cm from the window and cupboard (Figure 5.57).

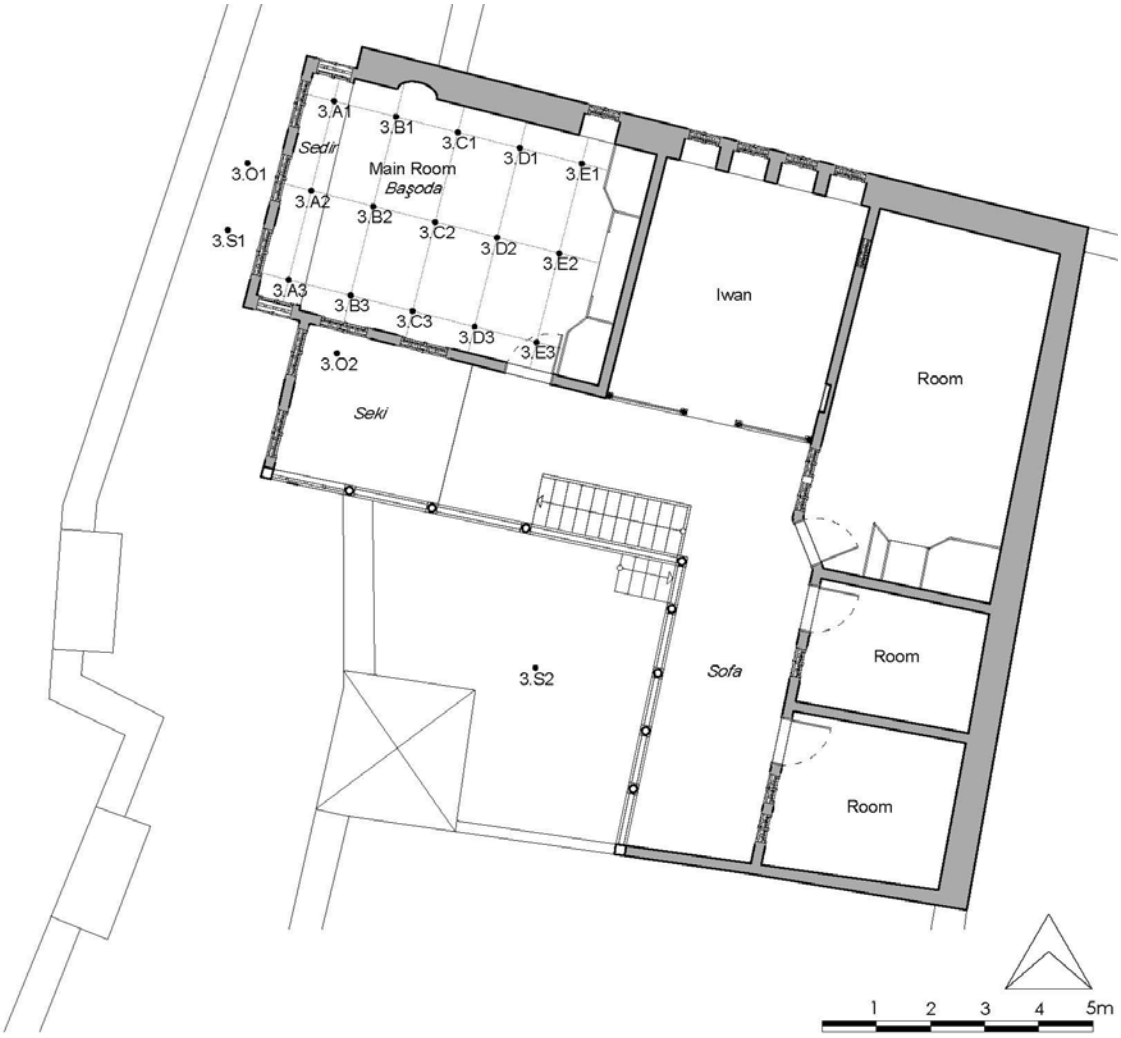


Figure 5.57. Measurement points for illuminance in the main room of Kestaneciler House

The outdoor illuminance measurements were taken 80 cm above the main room floor in the west (3.O1) and the south (2.O2) of the main room. The measurements were taken from the streets in the west (2.S1) of the lot and from the courtyard (2.S2). These points are determined to determine the level of illumination in the west and the courtyard.

5.3.7.Daylight Performance of the Main Room

The window dimension ratio of the western facede of the main room which looks into the street to the floor area (Formula 1) is 19. The 78%, the ratio of the window glass area to floor area (Formula 2) is 11.44%. The proportion of the window glass area to the inner area is expected to be 5%- 30% (Foytonont and Berruto, 1997; Foytonont, 1999).

In this regard, Kestaneciler House is among these values. The ratio of the same front area to the wall area (Formula 3) was measured as 39.4% and the ratio of window glass area to the wall area (Formula 4) was measured as 22.81%. In this case, the high number of mullions and partitions make almost a half difference between the window and glass ratios.

To identify the materials forming the surfaces in the main room, luminance measurements were taken from the determined points (Table 3.1) by the luminance meter and on the determined dates (Table 3.2). The average of the reflectance was calculated using the formula (7) and is specified in Table 5.13. The percentages of surface material reflectance (p value) change between 24.9% and 93.3%. The white color of the wall causes p value to be higher (93.3%), the dark color of the wooden mullion of the window provides reflectance to be lower (30.1%) (Figure 5.58).

a b

Figure 5.58. The surface reflectance at the measurement points in the main room of Kestaneciler House on the south wall (Prepared by Author, 15.10.2018) (a), on the west wall (Prepared by Author, 15.10.2018) (b)

Table 5.13. Calculation of the measured values and reflectance of materials.

	L (cd/m^2)				E (lux)				p (%)
	Dec 16, 2018	April 3, 2019	June 27, 2019	Oct 03, 2019	Dec 16, 2018	April 3, 2019	June 27, 2019	Oct 3, 2019	Average
3.W	40.1	80.7	83.4	80.9	130.4	269.7	295.9	263.1	93.3
3.T1	9.6	17.0	23.1	34.2	164.3	304.9	284.0	303.2	24.9
3.T2	24.5	65.1	96.1	30.6	249.2	307.7	423.7	346.3	51.2
3.F	10.4	9.0	53.3	20.1	187.9	143.0	386.5	368.0	26.9
3.C	40.1	39.8	75.0	35.8	130.4	288.5	368.4	278.9	56.2

To calculate the transmittance of window glazing, the values obtained when the window was open and closed measuring the luminance values at the same point on Sunday, December 16, 2018. Table 5.14 shows the calculated transmittance value as 86.6% using the formula (6). The glass transmittance value is at an acceptable level within the framework of standard values.

Table 5.14. Transmittance of glass
Sunday, December 16, 2018

	$L_{int.}$ (cd/m^2)	$L_{ext.}$ (cd/m^2)	t (%)
3.G	197.2	227.7	86.6

The daily and hourly values of the exterior illuminance of the reference points determined in the spaces on Sunday, December 16, 2018 are given in Table 5.15 and the interior illuminance are given in Figure 5.59. The measurements taken from the street and the courtyard (3.S1 and 3.S2) are between 397.8 lux and 8282 lux. The exterior measurements (2.O1 and 2.O2) taken from the main room measurement points level are between 61.5 lux and 5603 lux. The measurements taken from the interior range from 6.4 to 1739 lux. This value is between 6.4 - 132.6 lux at 9.30, 81.9 – 1739 lux at midday and 46.7 - 1191 lux at 15.30. As a result of the measurements taken at 09.30 in the morning, the 300 lux value given in the standards does not exist at any point. The 11% of the the measurement points are between 100-300 lux and the 87% under 100 lux. The 67% of the measurement points taken at 12.30 at noon are above 300 lux, the 27% between 100-300

lux and the 6% under 100 lux. The 47% of the measurement points taken at 15.30 in the afternoon are above 300 lux, the 33% between 100-300 lux and the 20% under 100 lux.

Table 5.15. Measured exterior illuminance (lux)
Sunday, December 16, 2018

Time / Point	9.30	12.30	15.30
3.O1	349.5	5603	3780
3.O2	61.5	756.1	584.5
3.S1	397.8	3415	1635
3.S2	1175	8282	3377

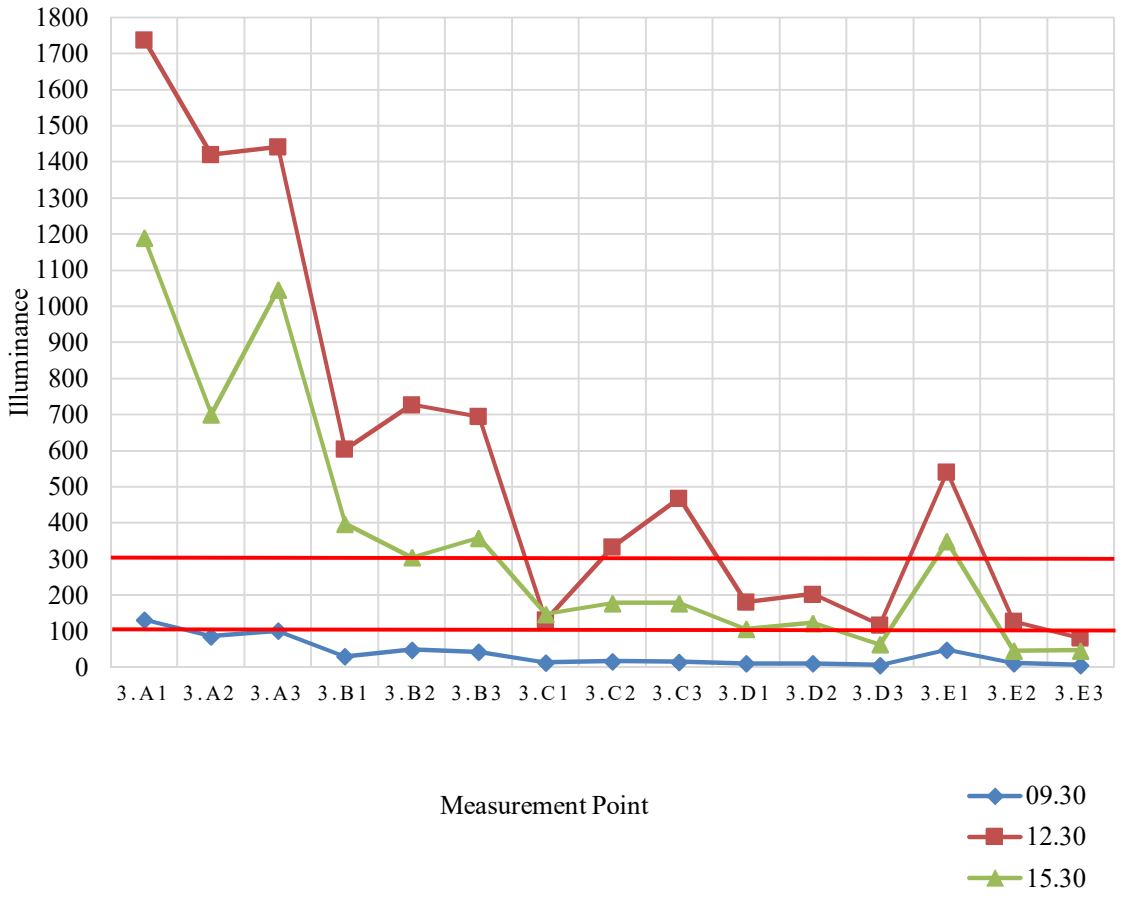


Figure 5.59. Measured interior illuminance (lux) (December 16, 2018)

The daily and hourly values of the exterior illuminance of the reference points determined in the spaces on Wednesday, April 3, 2019 are given in Table 5.16 and the interior illuminance are given in Figure 5.60. The measurements taken from the street and the courtyard (3.S1 and 3.S2) are between 1859 lux and 8671 lux. The exterior measurements (3.O1 and 3.O2) taken from the main room measurement points level are between 778.3 lux and 7614 lux. The measurements taken from the interior range from 53.5 to 2083 lux. This value is between 53.5-603.2 lux at 9.30, 56.5-753.0 lux at midday and 82.3-2083 lux at 15.30. As a result of the measurements taken at 09.30 in the morning, the illuminance of the 46% of the points are above 300 lux, the 27% between 100-300 lux and the 27% are below 100 lux. The 40% of the measurement points taken at 12.30 at noon are above 300 lux, the 47% between 100-300 lux and the 13% of under 100 lux. The 60% of the measurement points taken at 15.30 in the afternoon are above 300 lux, the 27% between 100-300 lux and the 13% under 100 lux.

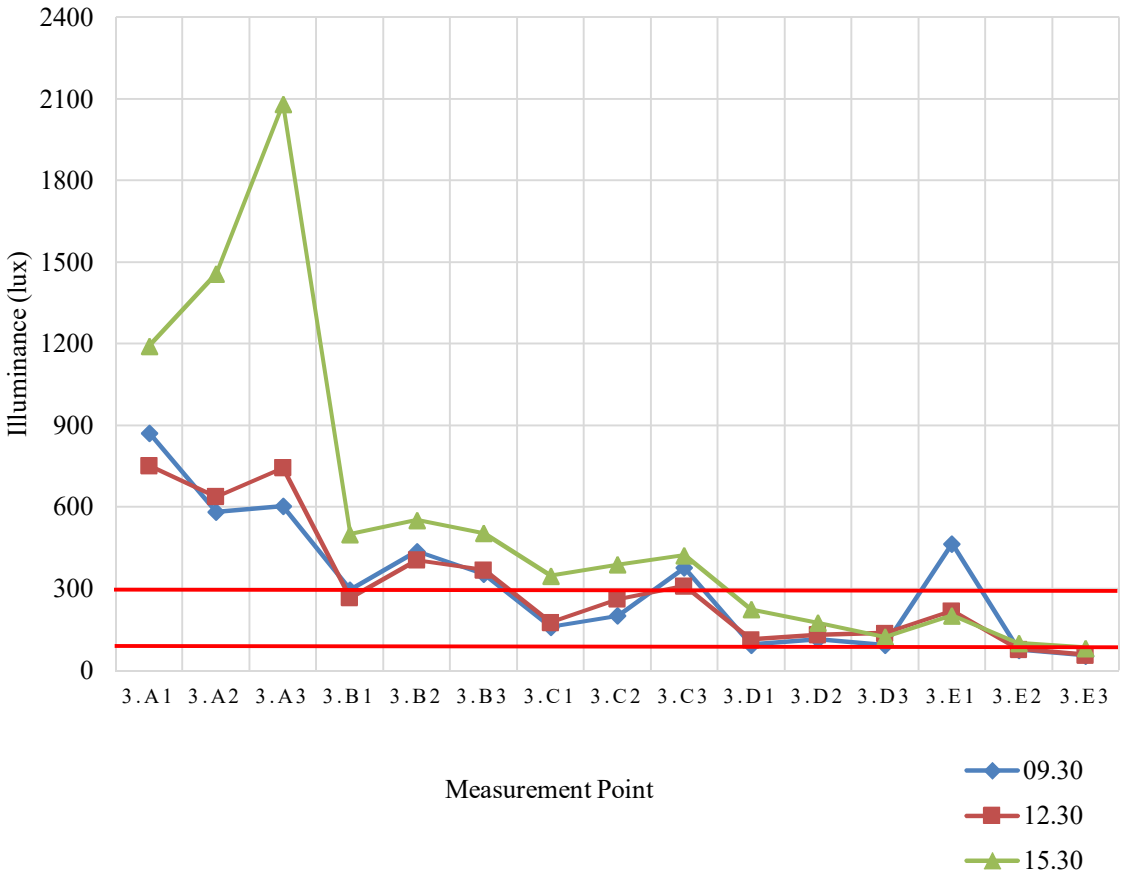


Figure 5.60. Measured interior illuminance (lux) (April 3, 2019)

Table 5.16. Measured exterior illuminance (lux)
Wednesday, April 3, 2019

Time / Point	9.30	12.30	15.30
3.O1	1859	2711	7614
3.O2	778.3	827	783
3.S1	1859	2711	7614
3.S2	4603	8671	7741

The daily and hourly values of the exterior illuminance of the reference points determined in the spaces on Thursday, June 27, 2019 are given in Table 5.17 and the interior illuminance are given in Figure 5.61. The measurements taken from the street and the courtyard (3.S1 and 3.S2) are between 2778 lux and 9921 lux. The exterior measurements (3.O1 and 3.O2) taken from the main room measurement points level are between 443 lux and 8332 lux. The measurements taken from the interior range from 67.4 to 3866 lux. This value is between 67.4-896 lux at 9.30, 72.4-1003 lux at midday and 94.2-3866 lux at 15.30. As a result of the measurements taken at 09.30 in the morning, the illuminance of the 47% of the points are above 300 lux, the 33% between 100-300 lux and the 20% are below 100 lux. The 53% of the measurement points taken at 12.30 at noon are above 300 lux, the 40% between 100-300 lux and the 7% of under 100 lux. The 66% of the measurement points taken at 15.30 in the afternoon are above 300 lux, the 27% between 100-300 lux and the 7% under 100 lux.

Table 5.17. Measured exterior illuminance (lux)
Thursday, June 27, 2019

Time / Point	9.30	12.30	15.30
3.O1	2154	3708	8332
3.O2	509.2	752.1	443
3.S1	2778	4365	5827
3.S2	4188	9921	7873

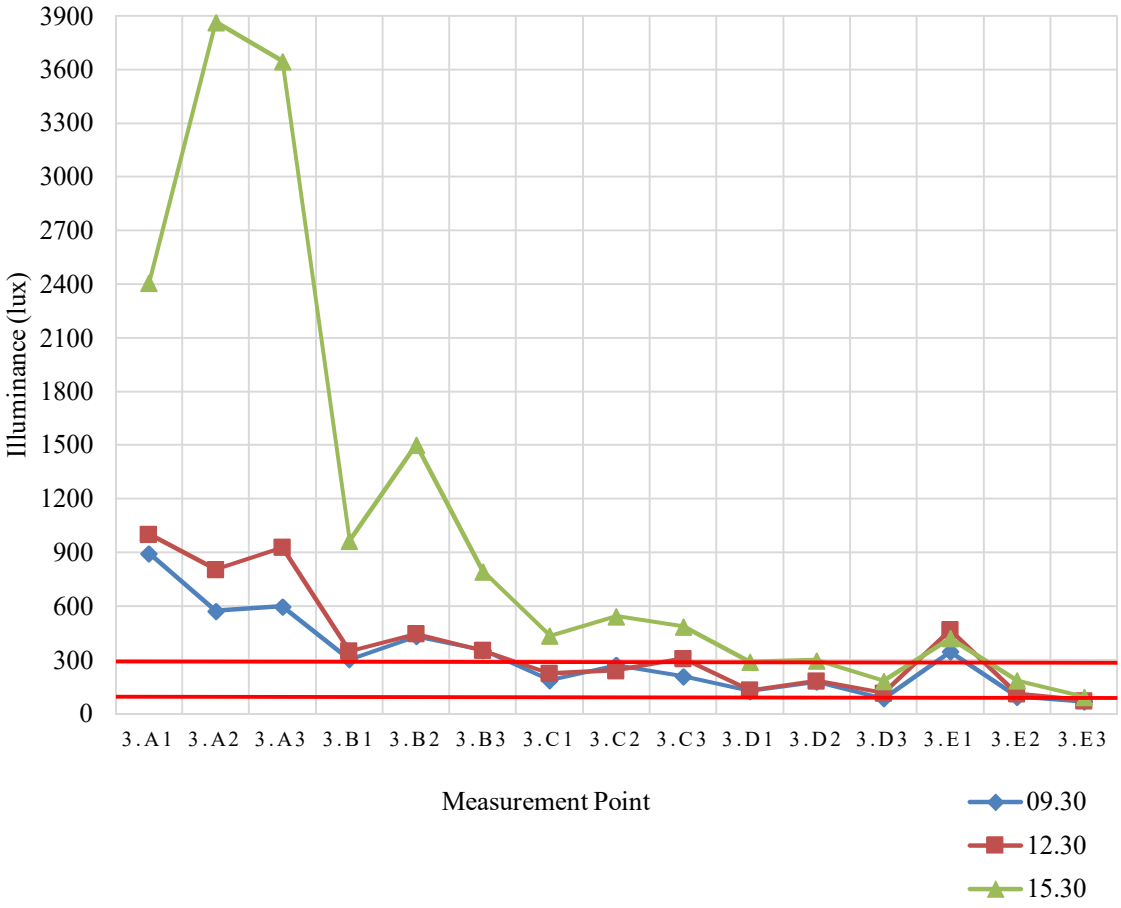


Figure 5.61. Measured interior illuminance (lux) (June 27, 2019)

The daily and hourly values of the exterior illuminance of the reference points determined in the spaces on Thursday, October 3, 2019 are given in Table 5.18 and the interior illuminance are given in Figure 5.62. The measurements taken from the street and the courtyard (3.S1 and 3.S2) are between 2126 lux and 7568 lux. The exterior measurements (3.O1 and 3.O2) taken from the main room measurement points level are between 1202 lux and 7862 lux. The measurements taken from the interior range from 43.6 to 1040 lux. This value is between 43.6-675.6 lux at 9.30, 72.9-1040 lux at midday and 82.9-846.7 lux at 15.30. As a result of the measurements taken at 09.30 in the morning, the illuminance of the 33% of the points are above 300 lux, the 40% between 100-300 lux and the 27% are below 100 lux. The 47% of the measurement points taken at 12.30 at noon are above 300 lux, the 40% between 100-300 lux and the 13% of under 100 lux. The 47% of the measurement points taken at 15.30 in the afternoon are above 300 lux, the 47% between 100-300 lux and the 6% under 100 lux.

Table 5.18. Measured exterior illuminance (lux)
Thursday, October 3, 2019

Point \ Time	9.30	12.30	15.30
3.O1	1910	3564	7862
3.O2	1387	1550	1202
3.S1	2126	7568	3492
3.S2	3497	5116	5239

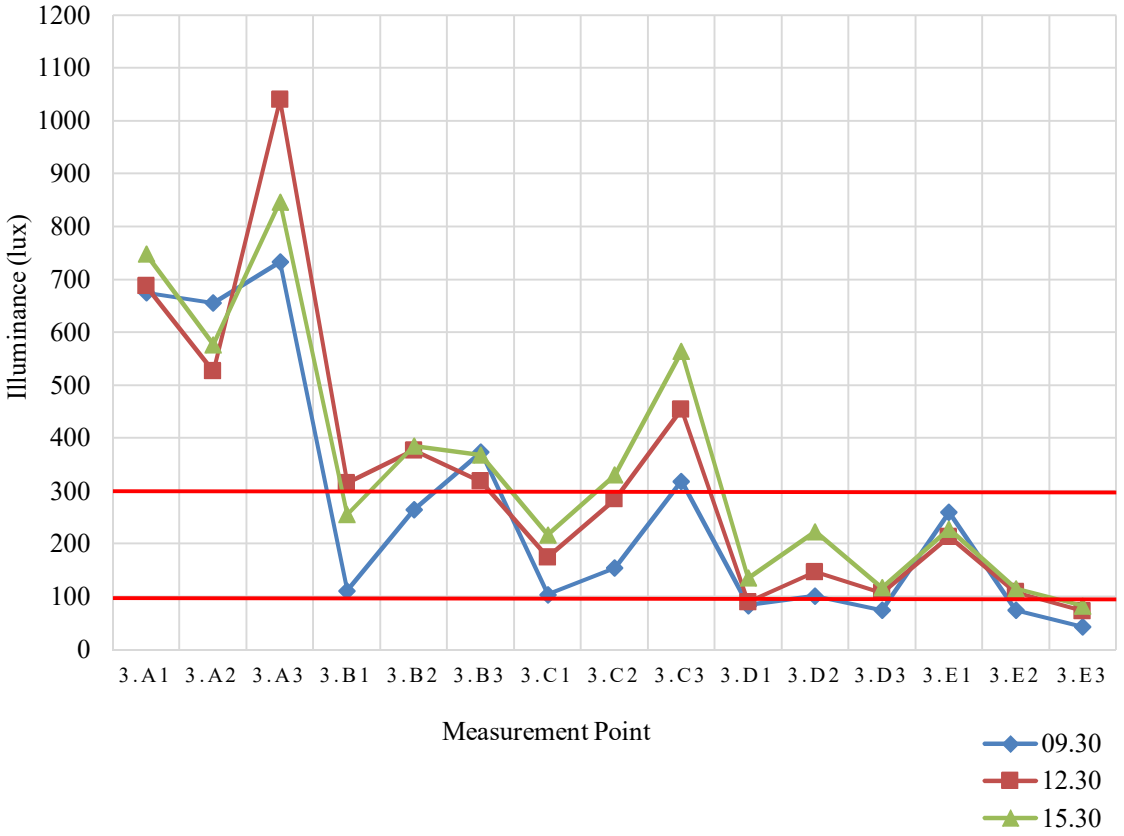


Figure 5.62. Measured interior illuminance (lux) (October 3, 2019).

5.3.8.Daylight Performance Evaluation in the Main Room

The lowest value of the main room illuminance for the four seasons is 6.4 lux (Figure 5.59) at 9.30 in December and the highest value is 3866 lux at 15.30 in June (Figure 5.61). The average of the measurements taken is 325.5 lux in winter, 395.5 lux in

spring, 591.1 lux in summer and 314.4 lux in autumn (Figure 5.63). This value is above the standard value (300 lux) lux for the four seasons. Looking at the measurements taken at noon, the average illuminance in winter is above the other seasons. The fringe type (The fringed wood flat and inward-curved veneer) has made it easier to take the daylight from the diffused daylight in winter compared to other seasons. The average of the values taken in the afternoon for the four seasons is higher than the average of the values taken in the morning. The reason for this is that the main room is located in the northwest and the sun is in the west direction in the afternoon.

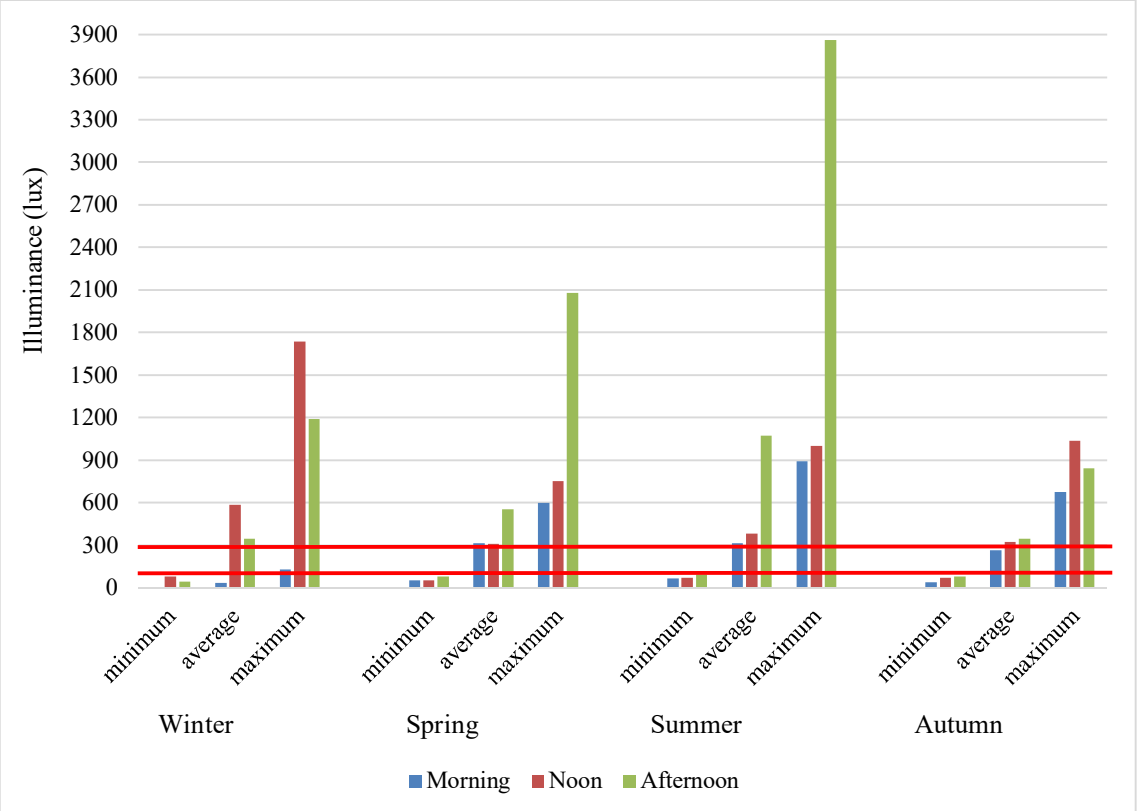


Figure 5.63. Illuminance (lux) of main room in Kestaneciler House.

Considering the measurements taken under the eaves (3.O1), the width of the street in the west and the distance between the mutual houses, being in the original state (open) of the *sofa*, and the ratio of the window glass area to the floor area (WGFR: 5% <11.44% <30%) between the standard values and the high reflection factor of the wall finishing material (3.W) in white color (p: 93.3) are the reasons why the daylight is sufficient.

5.4. Zühtü Bey House

The house, which is located in the urban site in Kula county of Manisa, was first registered with the decision of the Supreme Council of Immovable Antiquities and Monuments dated 10.11.1979 and numbered 1986 (Figure 5.64). The building is deemed to be suitable for the continuation of its registration with the decision of İzmir 2nd Numbered Conservation Council of Immovable Cultural and Natural Assets, dated 09.04.1993 and numbered 3248 and it was determined as the 2nd group with the decision of İzmir 2nd Numbered Conservation Council of Immovable Cultural and Natural Assets dated 19.04.2006 and numbered 2037. In the Council's decision dated 12.02.2016 and numbered 6252, the restoration application was found appropriate and it was given occupancy permit. According to the land registration of the Architect Kri House (block 41, lot 8) located in the north of the building, the building known as Zühtü Bey House (block 41, lot 9) is known as Ağabeyzadeler House (Figure A.5). Today, the building belonging to Tülay Horasan is operated as a cafeteria by Şükran Horasan with the name of Zühtü Bey House / Courtyard Cafe.

Figure 5.64. Zühtü Bey House.
(Prepared by Author, 15.10.2018)

5.4.1. Location

Zühtü Bey House is located in the oldest Turkish neighborhood of Cami-i Atik Neighborhood, which is situated within the boundaries of Akgün Neighborhood, in Kula Conservation Area. Old Mosque (*Eski Camii*), the oldest mosque in the county, is in this neighborhood. Formerly named as Cami-i Atik Neighborhood it has largely preserved the traditional features of civil architecture; however, there are new buildings in the parts opening to the center in the east as it is close to the bazaar (Fersan, 1980, 59).

Figure 5.65. The site plan of Zühtü Bey House.
(Source: Saf, 2004)

The building is located on the 87th Street, on block 41 and lot 9. The entrance to the building is provided by the door opening to the *taşlık* through the street from the corner lot where it is located. The lot boundaries of Zühtü Bey House located in the south east of the block are determined by the Architect Kri House in the north and the streets in the south and east (Figure 5.65).

5.4.2. Plan Features

The two-storey building is located in the southeast of the lot. The outbuilding where there can be found the toilet and the kitchen is in the northwest of the building and the storage is in the south west of the lot (Figure 5.66).

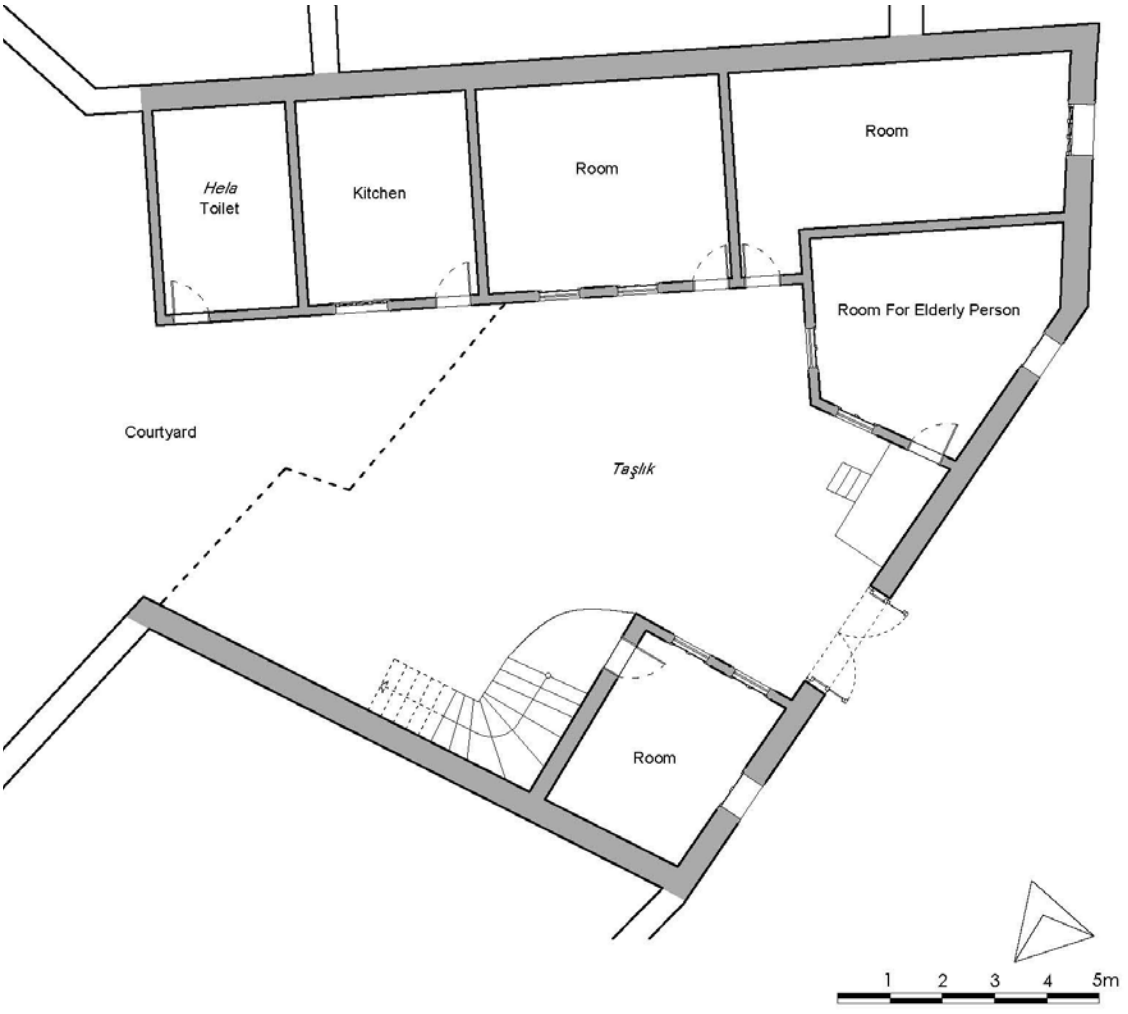


Figure 5.66. The plan of the ground floor of Zühtü Bey House

A service room is designed in the south of the entrance door and three rooms in the north (Figure 5.66, Figure 5.67 a). The room, which is located in the northeast and to which it is accessed by a four-step staircase from the west, is the room for elderly person (*yaşlı odası*). The *sofa* (*hayat*) on the upper floor is reached by a three-step stone and a four-step wooden L-shaped stairs to the west of the service room in the south (Figure 5.66, Figure 5.67 b).

a b

Figure 5.67. The courtyard of Zühtü Bey House (Prepared by Author, 02.04.2018) (a), the stairs (b) (Prepared by Author, 02.04.2018).

In the plan of the interior *sofa* (*iç sofa*), there are rooms located in the north and south. The western part of the *sofa* has been closed with glass, but the eastern part has been left open (Figure 5.67 a). In the middle of the *sofa*, an opening has been created on the floor and the daylight has been provided to the ground floor. In the north wing of the *sofa*, there is a main room raised 15 cm from the *sofa* in the east, and there are two adjacent rooms on the *sofa* level in the west. The *seki*, which is 50 cm above the *sofa*, is organized in the south of the main room (Figure 5.69 a). The main room forms stepped projected (*kademeli çıkma*) with the *seki* in the direction of the street. The south wing has a room facing the courtyard in the west and a weaving room (*dokuma odası*) facing the street in the east. The main room with three, the weaving room and *seki* with two vertical

rectangular windows face the street. Two vertical rectangular windows of the main room open to the *seki* in the south of the main room, two vertical rectangular windows open to the *sofa* in the north of the weaving room, three in the northwest room, one in the next room and one in the south-west room. A vertical rectangular window located in the southwest and northwest faces the courtyard (Figure 5.68). The doors of the main room in the north and the other two rooms have rich wood workmanship (Figure 5.69 b).

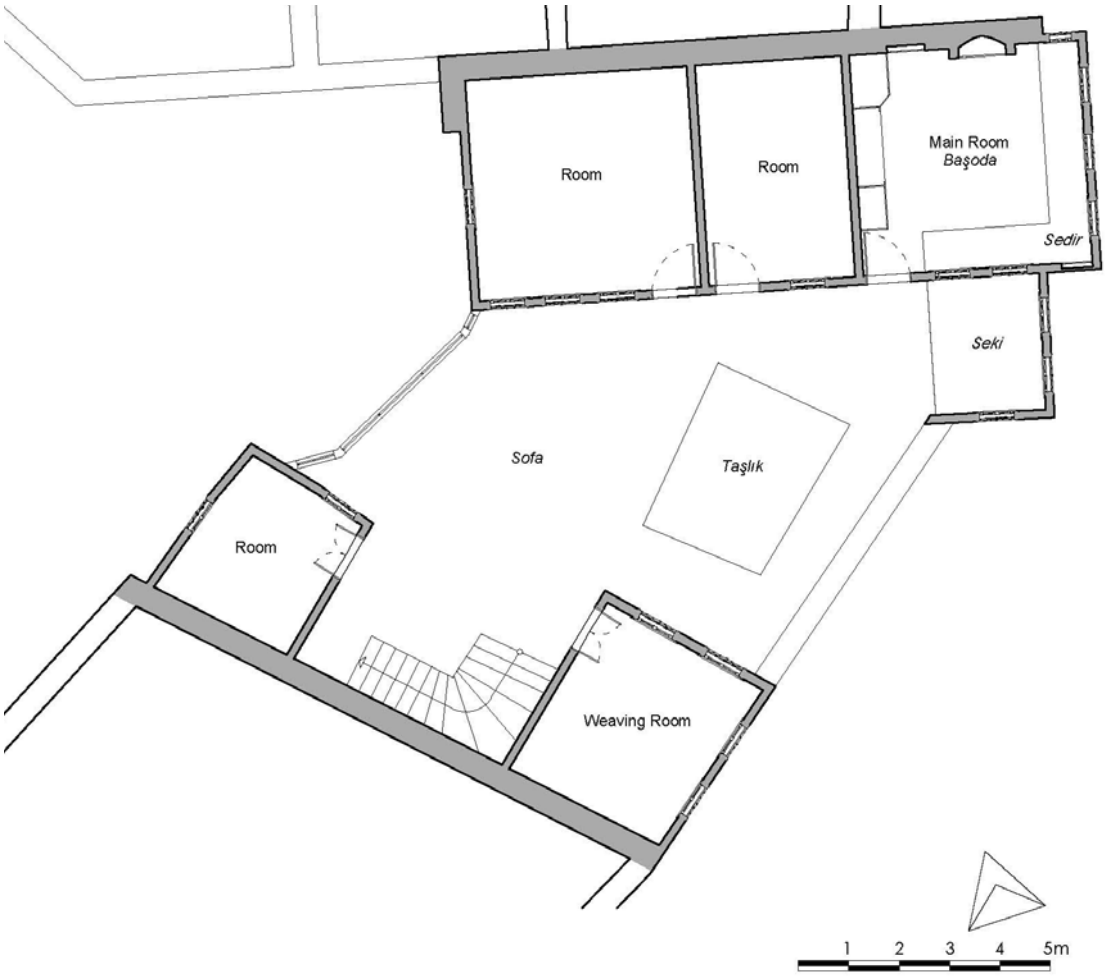


Figure 5.68. The plan of the first floor of Zühtü Bey House.

The floor covering material is timber in the rooms and slate stone in the courtyard. The ceiling covering material of the rooms is timber and the timber beams are uncoated in the *taşlık*. The floor covering upstairs is timber veneer over the timber beams. The ceiling covering in the *sofa*, the weaving room, the room in the southwest and in the north is flat. The ceiling of the room located in the northwest is a diagonal square pattern in

lattage decoration technique, the middle of the square area has an octagonal core and the edges are flat (Figure 5.70).

a b

Figure 5.69. The *sofa* of Zühtü Bey House (Prepared by Author, 27.06.2019) (a), the door of the main room (Prepared by Author, 14.12.2018) (b)

Figure 5.70. The ceiling of the room located in the northwest of the upper floor.(Prepared by Author, 14.12.2018)

5.4.3. Facade Features

On the east entrance facade of Zühtü Bey House, on the ground floor, there is a courtyard door in the middle and a window under the stepped projected on the right. Three vertical rectangular windows of the main room and two *sekis* are arranged on the projection on the top floor. Two top windows are seen on two vertical rectangular windows on the right of the main room. One downstairs and two vertical rectangular windows upstairs are designed on the left of the courtyard door (Figure 5.71, Figure 5.72).

Figure 5.71. The east facade of Zühtü Bey House.
(Prepared by Author, 15.10.2018)

Figure 5.72. The east facade of Zühtü Bey House.
(Prepared by Author, 15.10.2018)

5.4.4. Main Room Location and Planning Features

The main room on the first floor of the house, located in the northeast of the *sofa* (hayat), measures 4.38 m x 4.56 m (19.97 m^2). There is a door to the west of the south wall, two vertical rectangular windows to the east and two top windows on the upper level. The original window is thought to have been converted into a closet in the departing section. In the projection section, the original window is considered to be converted into a built-in cupboard (*gömme dolap, delik*). On the eastern wall facing the street, two top windows are arranged on two of the three vertical rectangular windows. There is no trace of the window on the east wall to the south as a top window. There is a vertical rectangular window on the north wall (to the east) of the projection section of the room, a built-in cupboard in the west and a fire place between them. On the west wall of the room, there is a large cupboard for bedding (*yüklük*) in the middle, a small space for ablution (*gusülhane*) in the right and an arched niche on the left (Figure 5.73). The raised platform for sitting (*sedir*) is positioned in the west of the room should be 30-40 cm high from the floor, while it is 50 cm high and the *sedir* cushion covers a part of the windows.

Figure 5.73. The large cupboard for bedding (*yüklük*) in the main room.
(Prepared by Author, 15.10.2018)

The timber floor covering used longitudinally in the east-west direction provides the room a greater perception. A diagonal square pattern is designed on the ceiling in lattage decoration technique, the middle of the square area has an octagonal core and the edges are flat. The perimeter of the square area is surrounded by ornamented slats and small square ornaments with floral motifs are designed at the corners. In the octagonal core, there are floral motifs at the corners (Figure 5.74).

Figure 5.74. The ceiling of the main room.
(Prepared by Author, 02.04.2019)

5.4.5.Architectural Features of the Windows in the Main Room

There are top windows above two in the north of the three rectangular windows in the east and above two rectangular windows in the south. A rectangular window is designed in the north in the projection part (Figure 5.75).

Figure 5.75. The window layout of the main room.
(Prepared by Author, 15.10.2018)

5.4.5.1. Stylistic and Technical Features of Vertical Rectangular Windows

a) Stylistic Features: Rectangular windows are 50 cm high from the floor. The ratio of rectangular windows, which are 86.0 x 121.5 cm in size, is 2/3. In the window there are four groups in vertical and two groups in horizontal. In the perpendicular sliding sash, the upper fixed part (86.0 x 66.5 cm) is positioned behind the lower movable part (86.0 x 64 cm). The upper fixed part and the lower moving part form double series in vertical and horizontal (Figure 5.76, Figure 5.78 b, Figure 5.78 e).

b) Technical Features: The rectangular window is located on the inner surface of the timber carcass wall. The frame partition is at the same height as the upper fixed part of the perpendicular sliding sash and is joined by grooving on the sides of the frame (Figure 5.78 a, Figure 5.78 c, Figure 5.78 d, Figure 5.78 f). Double glazing is used.

c) Complementary Elements: The eastern windows have 47 cm high wooden rails. The southern windows have rails all over the window, and the wooden rail sections are eight in horizontal and four in vertical. There are shutters attached all the windows (Figure 5.76 b).

a b

Figure 5.76. The rectangular window in the main room (Prepared by Author, 15.10.2018) (a), the shutter and window railing of the windows (Prepared by Author, 15.10.2018) (b).

5.4.5.2. Stylistic and Technical Features of Top Windows

a) Stylistic Features: The top windows are located 22.5 cm above rectangular windows. The top windows are 40.5 cm wide and 42 cm high. The top windows close to the square form are those that are located in the east, and have uncolored glass, those in the south are painted in an unqualified pattern (Figure 5.77 a, Figure 5.77 b).

b) Technical Features: The top windows are on the outer surface of the wall, the frame and joinery of the windows are timber.

a b

Figure 5.77. The top window on the east wall (Prepared by Author, 15.10.2018) (a), the top on the south wall (Prepared by Author, 15.10.2018) (b).

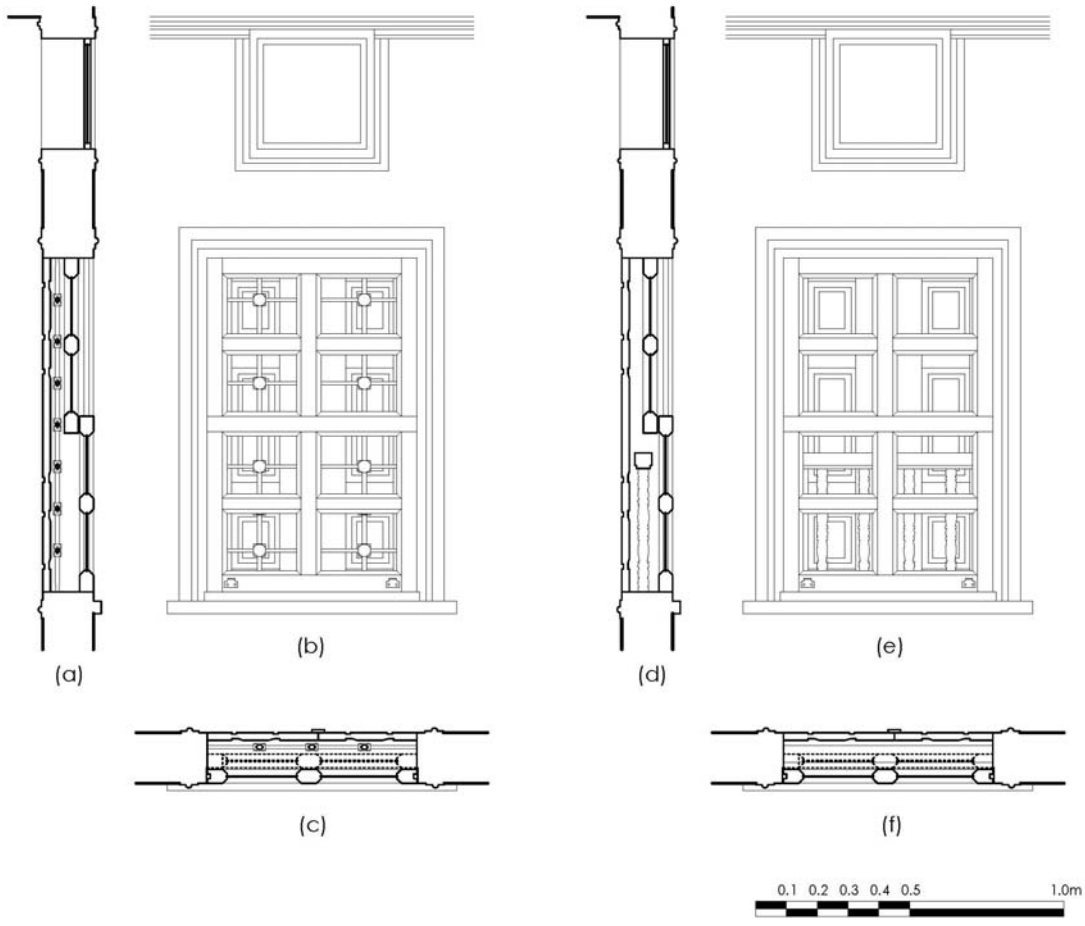


Figure 5.78. The rectangular window section with full rain (a), view (b), plan (c); the rectangular window section of half-rain (d), view (e), plan (f).

5.4.6. Determination of the Measurement Points and Time of the Main Room (*Başoda*)

Measurement points were determined according to room index formula. When the room index (K) is calculated (Formula 5), there has to be at least 4 measurement points in the main room. However, in order to get more precise results, 9 (3x3) points were agreed on by increasing the number of points. These points are located at a distance of 50 cm from the window and the cupboard (Figure 5.79).

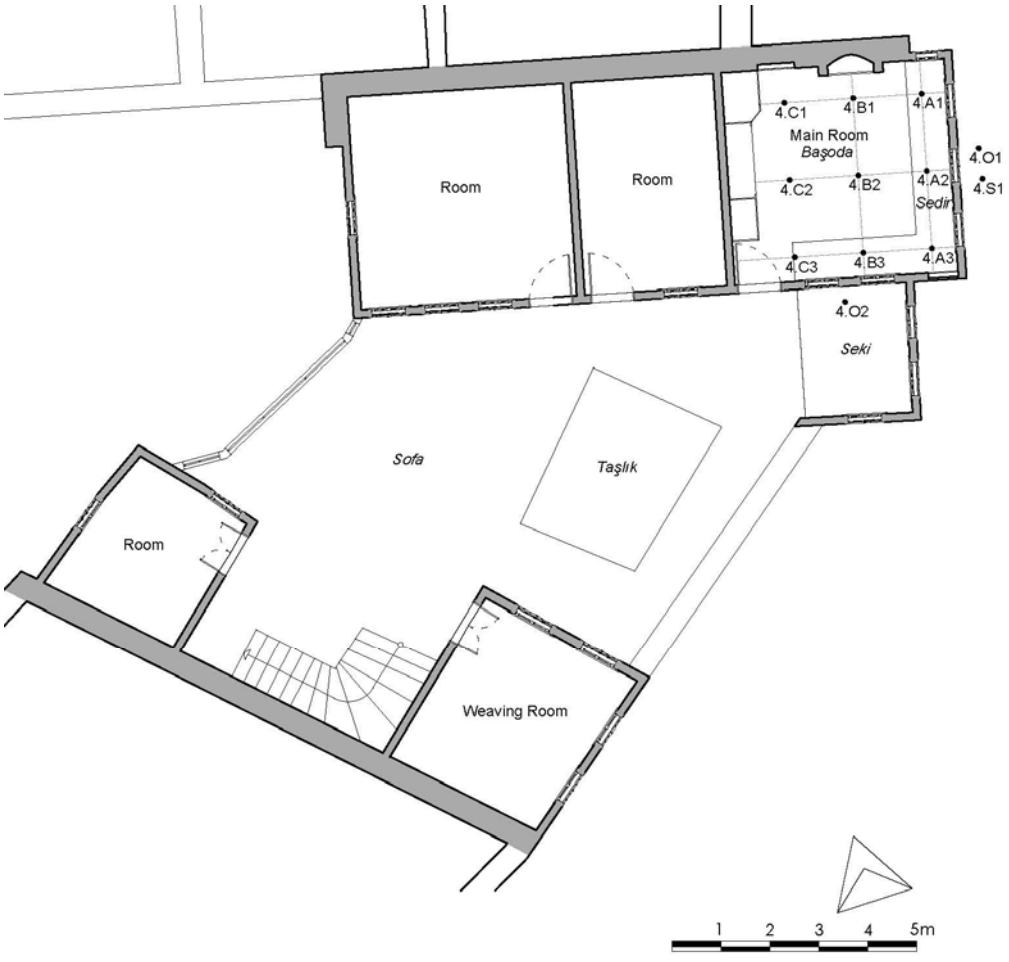


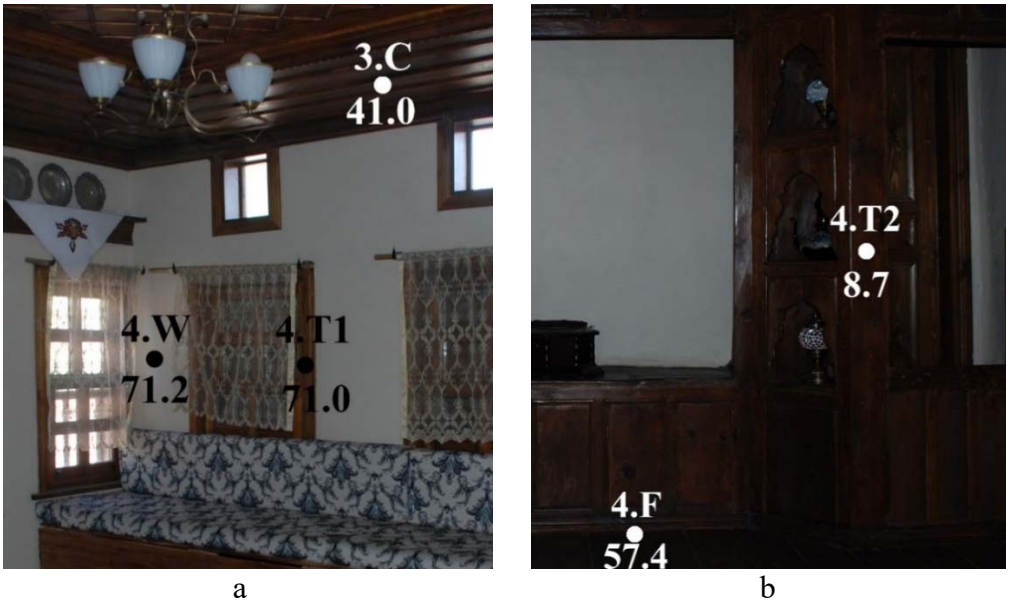
Figure 5.79. Measurement points for illuminance in the main room of Zühtü Bey House

The outdoor illuminance measurements were taken 80 cm above the main room floor in the east (4.O1) and in the south (*seki*) (4.O2) of the main room. On the street, the measurements were taken in the east (4.S1) of the lot.

5.4.7. Dayligt Performance of the Main Room

The window dimension ratio of the east facede of the main room which looks into the street to the floor area (Formula 1) is 17.48%, the ratio of the window glass area to the floor area (Formula 2) is 6.26%. The proportion of the window glass area to the inner area is expected to be 5%- 30% (Foytonont and Berruto, 1997; Foytonont, 1999). In this regard, Zühtü Bey House is among these values. The ratio of the same front area to the wall area (Formula 3) was measured as 31.87% and the ratio of the window glass area to the wall area (Formula 4) was measured as 11.42%. In this case, the high number of mullions and partitions makes almost a half-and-half difference between the window and glass ratios.

To identify the materials forming the surfaces in the main room, luminance measurements were taken from the determined points (Table 3.1) by the luminance meter and on the determined dates (Table 3.2). The average of the reflectance was calculated using the formula (7) and is specified in Table 5.19. The percentages of surface material reflectance (p value) change between 8.7% and 71.2%. The white color of the wall causes p value to be higher (71.2%), the dark color of the wooden large cupboard for bedding provides reflectance to be lower (8.7%) (Figure 5.80).



a b

Figure 5.80. The surface reflectance at the measurement points in the main room of Zühtü Bey on the south wall (Prepared by Author, 15.10.2018) (a), on the west wall (Prepared by Author, 15.10.2018) (b)

Table 5.19. Calculation of the measured values and reflectance of materials.

	L (cd/m^2)				E (lux)				p (%)
	Dec 15, 2018	April 2, 2019	June 26, 2019	Oct 02, 2019	Dec 15, 2018	April 2, 2019	June 26, 2019	Oct 2, 2019	Average
4.W	63.4	72.7	123.0	121.2	220.0	311.6	565.2	582.0	71.2
4.T1	4.1	14.8	26.7	86.0	32.6	89.9	143.0	316.1	71.0
4.T2	4.1	2.3	2.2	1.9	19.1	111.7	113.9	132.7	8.7
4.F	1.3	10.2	85.5	26.3	35.3	108.4	166.5	363.9	57.4
4.C	2.6	49.5	29.3	56.0	36.7	349.2	187.6	480.0	41.0

To calculate the transmittance of window glazing, the values obtained when the window was open and closed measuring the luminance values at the same point on Saturday, December 15, 2018. Table 5.20 shows the calculated transmittance value as 81.3 % using the formula (6). The glass transmittance value is at an acceptable level within the framework of standard values.

Table 5.20. Transmittance of glass
Saturday, December 15, 2018

	$L_{int.}$ (cd/m^2)	$L_{ext.}$ (cd/m^2)	t (%)
4.G	720.4	886.1	81.3

The daily and hourly values of the exterior illuminance of the reference points determined in the spaces on Saturday, December 15, 2018 are given in Table 5.21 and the interior illuminance are given in Figure 5.81. The measurements taken from the street (4.S1) are between 2251 lux and 7663 lux. The exterior measurements (4.O1 and 4.O2) taken from the main room measurement points level are between 19.0 lux and 320.6 lux. The measurements taken from the interior range from 5.5 to 432.4 lux. This value is between 20.4-386.5 lux at 9.30, 15.4-432.4 lux at midday and 5.5-197 lux at 15.30. As a result of the measurements taken at 09.30 in the morning and at 12.30 at noon, the illuminance of the 22% of the points are above 300 lux, the 11% between 100-300 lux and the 67% are below 100 lux. The 300 lux value given in the standards does not exist at any point at 15.30 in the afternoon. The 22% of the measurement points are between 100-300 lux and the 78% under 100 lux.

Table 5.21. Measured exterior illuminance (lux)
Saturday, December 15, 2018

Point \ Time	9.30	12.30	15.30
4.O1	320.6	302.7	263.0
4.O2	66.5	49.4	19.0
4.S1	7663	4720	2251

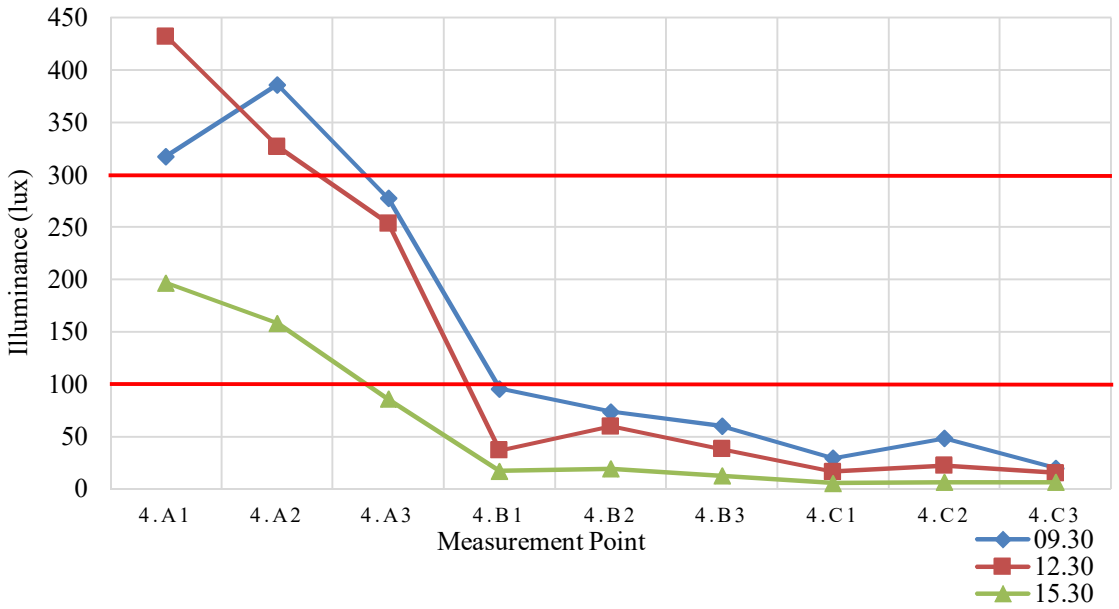


Figure 5.81. Measured interior illuminance (lux) (December 15, 2018)

The daily and hourly values of the exterior illuminance of the reference points determined in the spaces on Tuesday, April 2, 2019 are given in Table 5.22 and the interior illuminance are given in Figure 5.82. The measurements taken from the street (4.S1) are between 6008 lux and 9785 lux. The exterior measurements (4.O1 and 4.O2) taken from the main room measurement points level are between 236.4 lux and 8861 lux. The measurements taken from the interior range from 28.6 to 860.2 lux. This value is between 86.7-860.2 lux at 9.30, 32.1-489.6 lux at midday and 28.6-283.5 lux at 15.30. As a result of the measurements taken at 09.30 in the morning, the illuminance of the 44% of the points are above 300 lux, the 44% between 100-300 lux and the 12% are below 100 lux. The 22% of the measurement points taken at 12.30 at noon are above 300 lux, the 22% between 100-300 lux and the 56% of under 100 lux. The 300 lux value given in

the standards does not exist at any point at 15.30 in the afternoon. The 33% of the measurement points are between 100-300 lux and the 67% under 100 lux.

Table 5.22. Measured exterior illuminance (lux)
Tuesday, April 2, 2019

Point \ Time	9.30	12.30	15.30
4.O1	5793	8861	3894
4.O2	370.8	445.4	236.4
4.S1	6008	9785	7713

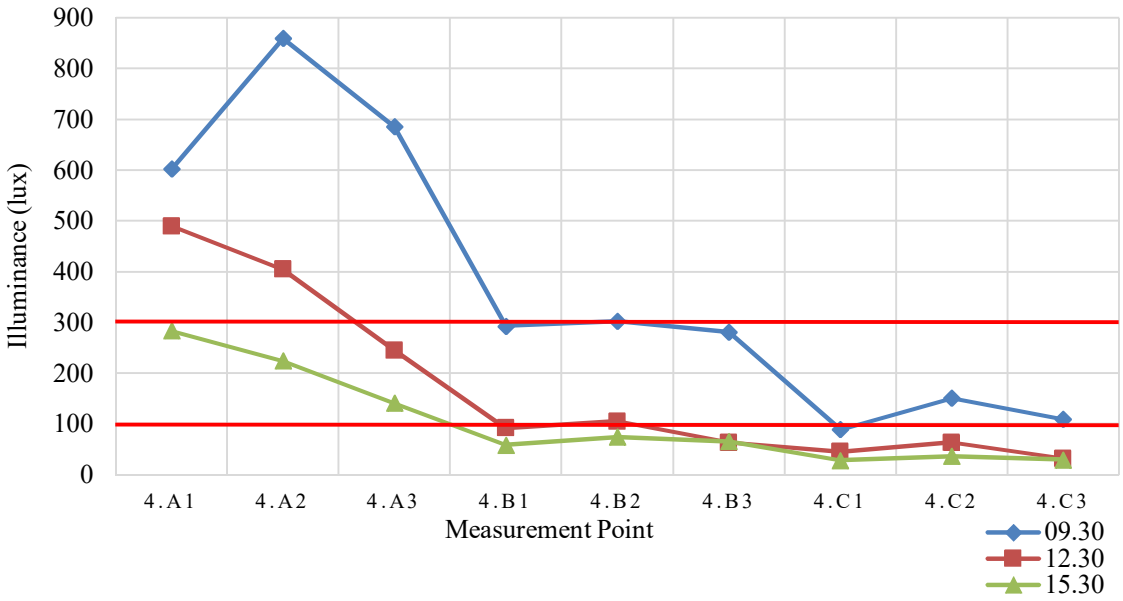


Figure 5.82. Measured interior illuminance (lux) (April 2, 2019)

The daily and hourly values of the exterior illuminance of the reference points determined in the spaces on Wednesday, June 26, 2019 are given in Table 5.23 and the interior illuminance are given in Figure 5.83. The measurements taken from the street (4.S1) are between 7915 lux and 9925 lux. The exterior measurements (4.O1 and 4.O2) taken from the main room measurement points level are between 150.4 lux and 9696 lux. The measurements taken from the interior range from 25.2 to 875 lux. This value is between 37.9-875 lux at 9.30, 25.2-718.9 lux at midday and 34.2-425.8 lux at 15.30. As

a result of the measurements taken at 09.30 in the morning, the illuminance of the 33% of the points are above 300 lux, the 33% between 100-300 lux and the 34% are below 100 lux. The 33% of the measurement points taken at 12.30 at noon are above 300 lux, the 11% between 100-300 lux and the 56% of under 100 lux. The 22% of the measurement points taken at 15.30 in the afternoon are above 300 lux, the 11% between 100-300 lux and the 67% under 100 lux.

Table 5.23. Measured exterior illuminance (lux)
Wednesday, June 26, 2019

Time / Point	9.30	12.30	15.30
4.O1	9696	9094	6061
4.O2	203.9	150.4	212.4
4.S1	8355	9925	7915

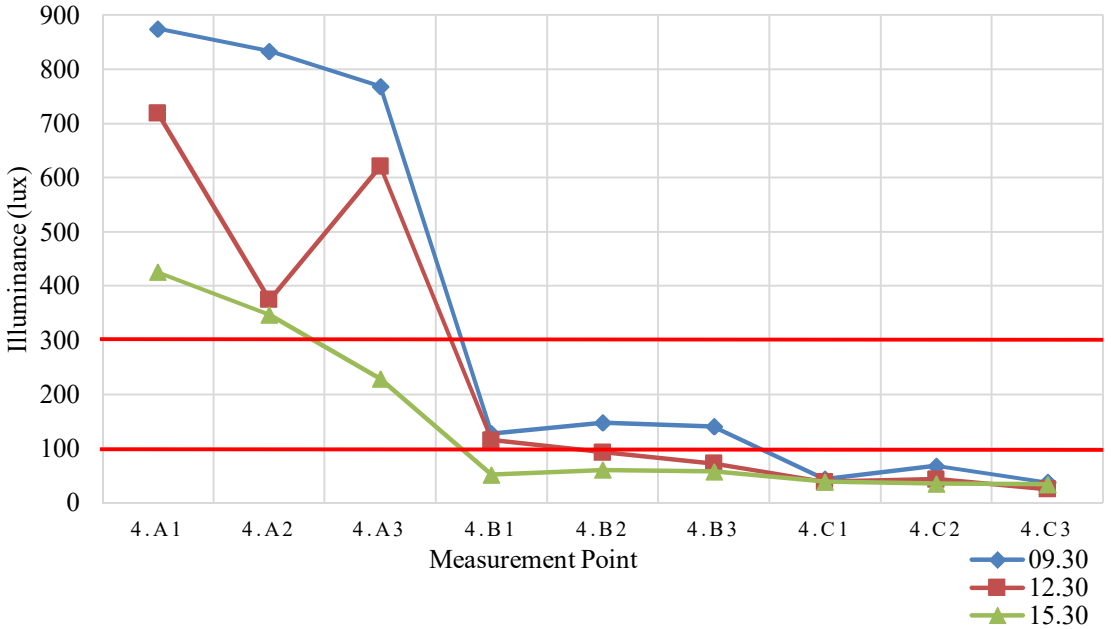


Figure 5.83. Measured interior illuminance (lux) (June 26, 2019)

The daily and hourly values of the exterior illuminance of the reference points determined in the spaces on Wednesday, October 2, 2019 are given in Table 5.24 and the

interior illuminance are given in Figure 5.84. The measurements taken from the street (4.S1) are between 3518 lux and 8151 lux. The exterior measurements (4.O1 and 4.O2) taken from the main room measurement points level are between 129.2 lux and 6178 lux. The measurements taken from the interior range from 24.1 to 936 lux. This value is between 66.5-879 lux at 9.30, 36.8-936 lux at midday and 24.1-282.9 lux at 15.30. As a result of the measurements taken at 09.30 in the morning, the illuminance of the 45% of the points are above 300 lux, the 22% between 100-300 lux and the 33% are below 100 lux. The 33% of the measurement points taken at 12.30 at noon are above 300 lux, the 33 % between 100-300 lux and the 34% of under 100 lux. The 300 lux value given in the standards does not exist at any point at 15.30 in the afternoon. The 33% of the the measurement points are between 100-300 lux and the 67% under 100 lux.

Table 5.24. Measured exterior illuminance (lux)
Wednesday, October 2, 2019

Time / Point	9.30	12.30	15.30
4.O1	5495	6178	4273
4.O2	180.9	129.2	136.6
4.S1	3518	8151	4749

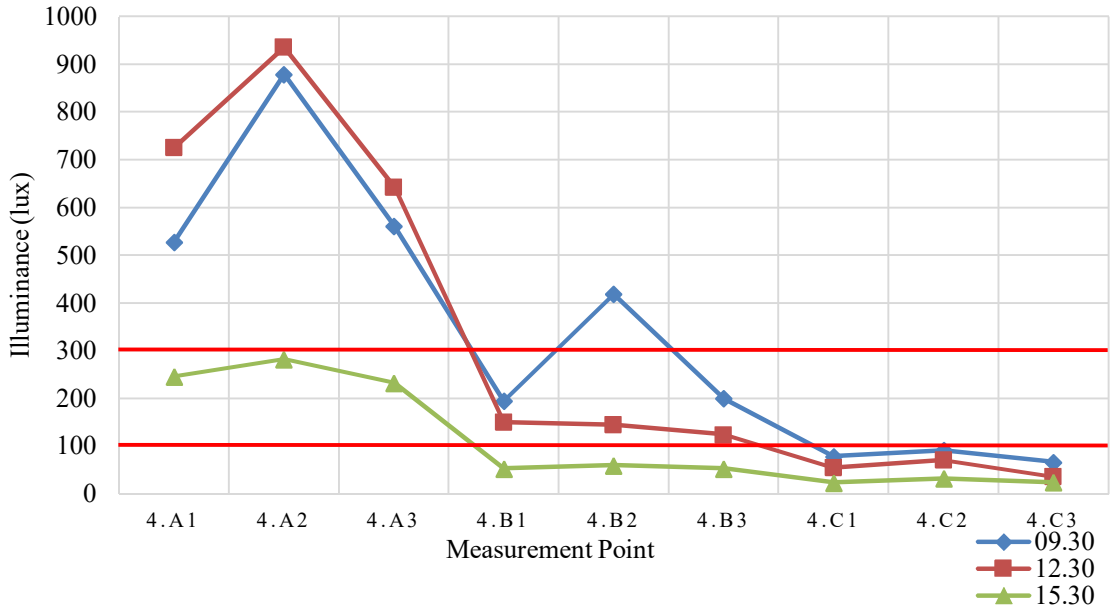


Figure 5.84. Measured interior illuminance (lux) (October 2, 2019).

5.4.8. Daylight Performance Evaluation in the Main Room

The lowest value of the main room illuminance for the four seasons is 3.4 lux (Figure 5.81) at 15.30 in December and the highest value is 1640 lux at 12.30 at noon in October (Figure 5.84). The average of the measurements taken is 112 lux in winter, 217.1 lux in spring, 238.1 lux in summer and 256.2 lux in autumn (Figure 5.85). This value is below 300 lux which is the standard value. The average of the measurements taken in the morning for four seasons is higher than the average of the values taken at noon and in the afternoon. The main reason is that the main room is located in the northeast. The fact that the sun is located in the east of the morning increases the intake of daylight.

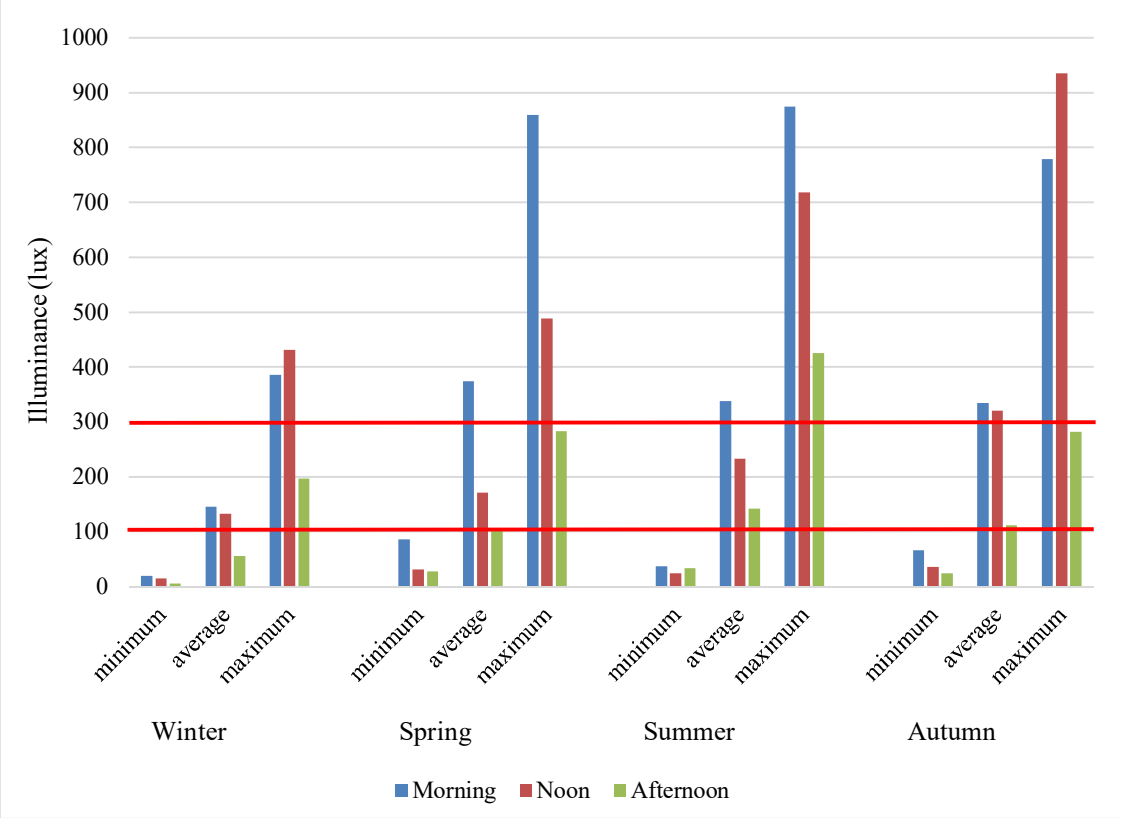


Figure 5.85. Illuminance of main room in Zühtü Bey House.

Considering the measurements taken under the eaves (4.O1), the main room is located at a point where four streets meet, the front is open, the ratio of the window glass area to the floor area (WGFR: 5% <6.26 <30%) are among the standard values, the

finishing material (4.W) is in cream tone and its reflection factor is high (p: 71.2). All of these are the main reasons that the daylight level is close to the standard value (300 lux). In the measurements taken from the *seki* (4.O2), it is observed that insufficient light is received from the semi-open space (from the south). In addition, the built-in cupboard located to the west of the south wall is thought to be in its original state, and its window to the south of the east wall has a top window like the others, but was later closed, which adversely affects daylight performance.

CHAPTER 6

COMPARATIVE STUDY

In studied Kaçıklar, Zabunlar, Kestaneciler and Zühtü Bey Houses, when comparing the ratio of the window glass area to the floor area (WGFR), the ratio of the window glass area to the wall area (WGWR), the reflectance values, the width of the eaves, the number, the size and type of windows, the illuminance taken at noon when the sun reached its highest position are used. In order to examine the effect of the location on daylight intake, the illuminance taken in the morning when the sun was positioned in the east and in the afternoon when it was located in the west were compared. The daylight performance of the houses examined was also compared to the studies investigating the daylight level of the main rooms in traditional houses in the literature. In this comparison, the location of the buildings, the climate zone, the direction of the room, the design parameters (the floor area of the room, the wall area, the ratio of the glass area to the floor area, the ratio of the glass area to the wall area), performance parameters (daylight factor, illuminance, reflectance of surface materials) and the results were evaluated and they were compared with the measurement results obtained from Kula houses.

6.1. Comparison of Main Room Daylight Performance in Historical Kula Houses

The main room of Kaçıklar House (6.90 x 4.50 x 2.98 m) is larger in volume when compared to the main room of Zabunlar (5.10 x 4.80 x 2.27 m), Kestaneciler (5.90 x 4.25 x 2.96 m) and Zühtü Bey (4.38 x 4.56 x 2.50 m) Houses. The front areas of the houses are between 10.0-15.0 m^2, the window areas are between 2.50-5.0 m^2 and the window glass areas are between 1.0-3.0 m^2 (Table 6.1). The window mullions affect the rates and cause the glass area to be lower than the window area. As the window glass area decreases, the daylight intake decreases as well. As a result of studies, the ratio of the window glass area to the floor area is expected to be in the range of 5-30% (Foytonont and Berruto, 1997; Foytonont, 1999). The ratio of the glass area to the floor area in the examined Zabunlar House is 6.08%, 11.44% in Kestaneciler House and 6.26% in Zühtü

Bey House, and these are between the recommended values (5-30%). However, this ratio was calculated as 4.51% in Kaçıklar House and it is below the recommended range. The level of illumination in Kaçıklar House was not observed above 300 lux, one of the reasons is that although the volume is large, the ratio of the window glass area to the floor area (WGFR) is low. The ratio of the window glass area to the wall area (WGWR) is 10.44% in Kaçıklar House, 12.87% in Zabunlar House and 11.42% in Zühtü Bey House, and close values have been determined; however, this ratio is higher in Kestaneciler House than other houses with 22.81% (Table 6.1).

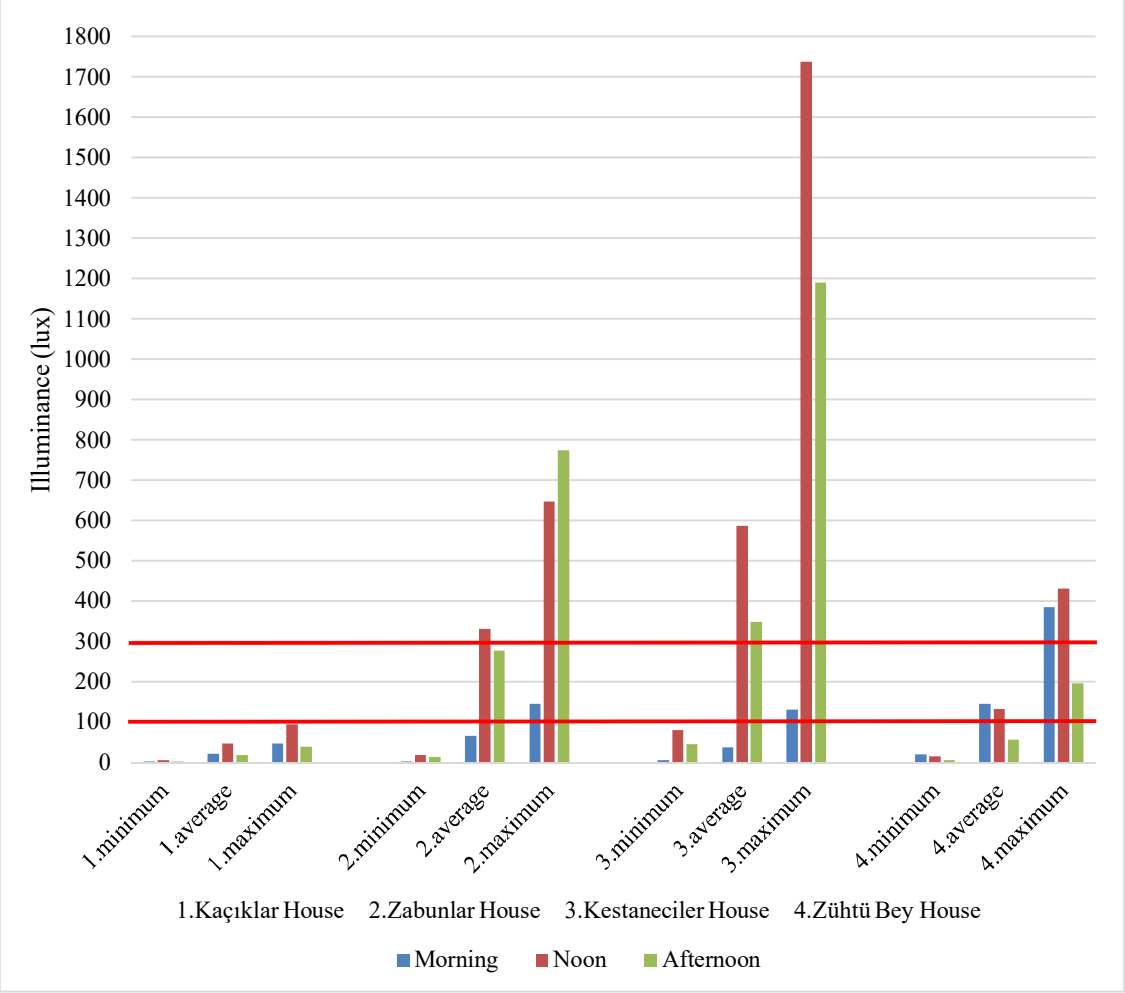


Figure 6.1. Minimum, average and maximum values of the measured houses according to the hours in the winter season

In the winter season, which provides the overcast sky condition, the sun rays are more diffuse than the other seasons and the average illuminance (587.9 lux) of restored

Kestaneciler House, during the noon measurements this season, are higher than other houses (Figure 6.1). In Kestaneciler House, the ratio of the glass area to the wall area (WGWR: 22.81%) and the reflectance (p: 93.3) of the wall finishing materials (3.W) being higher than other houses are the reasons for the average illuminance (587.9 lux) to be higher at noon in winter; in addition, another reason is to preserve the original window openings and dimensions when making restoration decisions. Although the specified parameters are high, the average lighting level of the measurements taken at noon is lower since the eaves type and length of Kestaneciler House break the sunlight coming at right angles in the other three seasons (spring, summer, autumn) compared to the winter season (Figure 6.2; Figure 6.3; Figure 6.4).

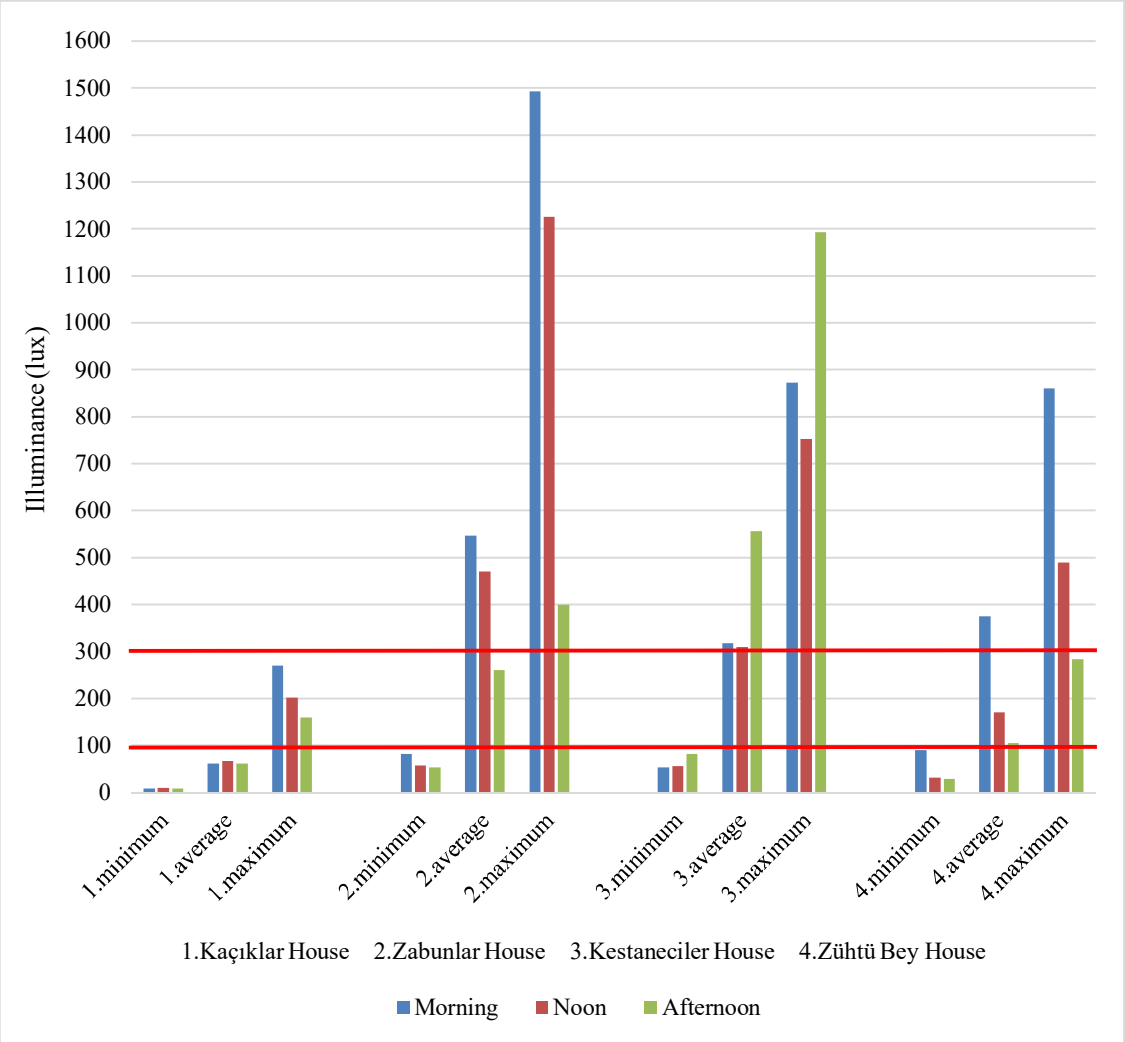


Figure 6.2. Minimum, average and maximum values of the measured houses according to the hours in the spring season

The average illuminance of the measurements taken in the spring, summer and autumn seasons are higher than the other houses in Zabunlar House (spring: 470.5 lux; summer: 419.8 lux; autumn: 390.8 lux) (Figure 6.2; Figure 6.3; Figure 6.4). The reason why the average illuminance is higher than other houses at noon is that the two facades are facing the road, the number of windows (8 units) is higher than the other houses, the eaves type and length (the wood-lath concave eave), and the window openings and partitions are in the original condition.

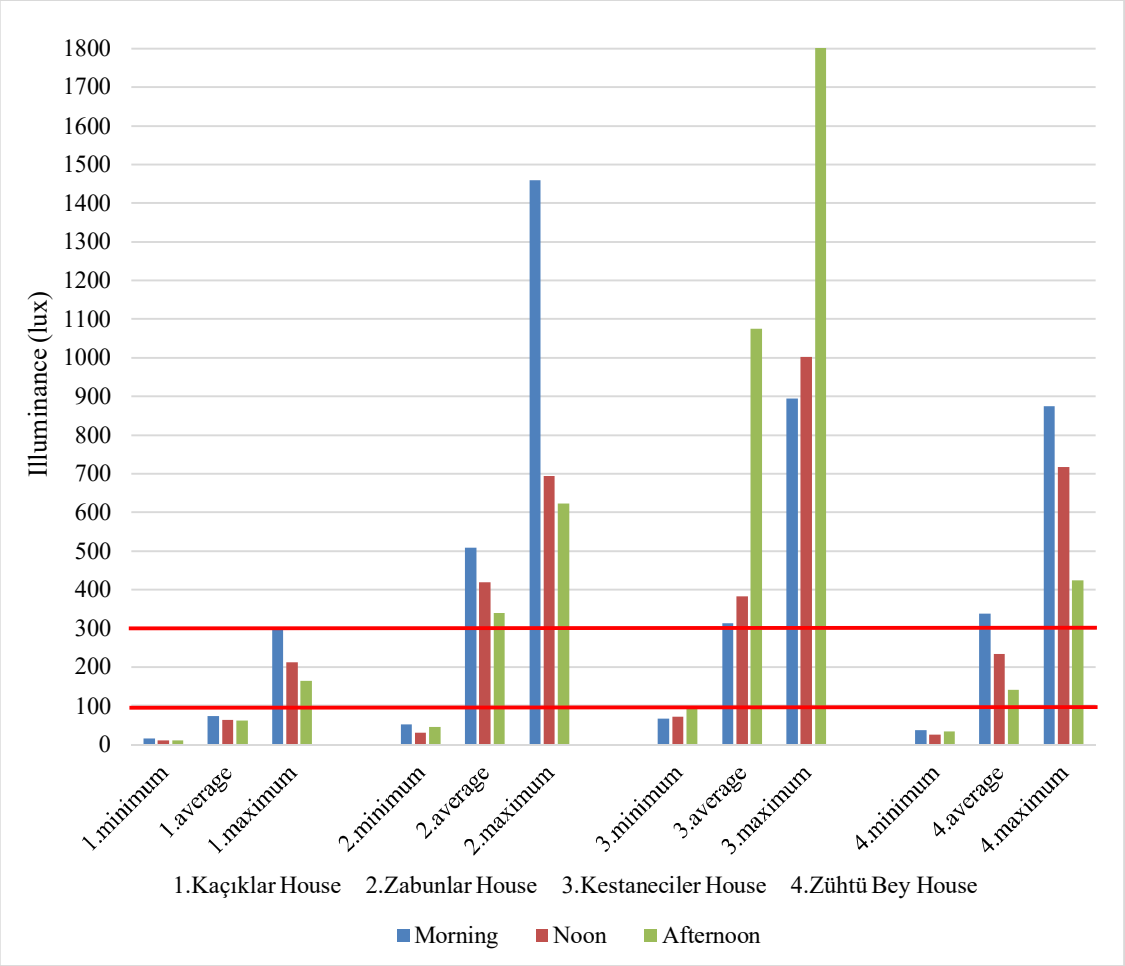


Figure 6.3. Minimum, average and maximum values of the measured houses according to the hours in the summer season

When the effect of the location on daylight intake for four seasons (winter, spring, summer and autumn) is examined, in the morning measurements, the average illuminance

of Zabunlar (winter: 66.8 lux; spring: 546.9 lux; summer: 510.2 lux; autumn: 682 lux) and Zühtü Bey (winter: 145.7 lux; spring: 375.2 lux; summer: 338.3 lux; autumn: 391.7 lux) Houses, whose main room is located in the northeast, is higher than Kestaneciler House (winter: 38.9 lux; spring: 318.5 lux; summer: 314.8 lux; autumn: 268.9 lux), whose main room is located in the northwest. In the afternoon measurements, the average illuminance of Kestaneciler House (winter: 349.6 lux; spring: 557.3 lux; summer: 1075.5 lux; autumn: 346.3 lux), whose main room is located in the northwest, is higher than Zabunlar (winter: 332.1 lux; spring: 260.7 lux; summer: 340.2 lux; autumn: 152.6 lux) and Zühtü Bey (winter: 56.6 lux; spring: 104.7 lux; summer: 142.2 lux; autumn: 112.2 lux) Houses whose main room is located in the northeast (Figure 6.1; Figure 6.2; Figure 6.3; Figure 6.4).

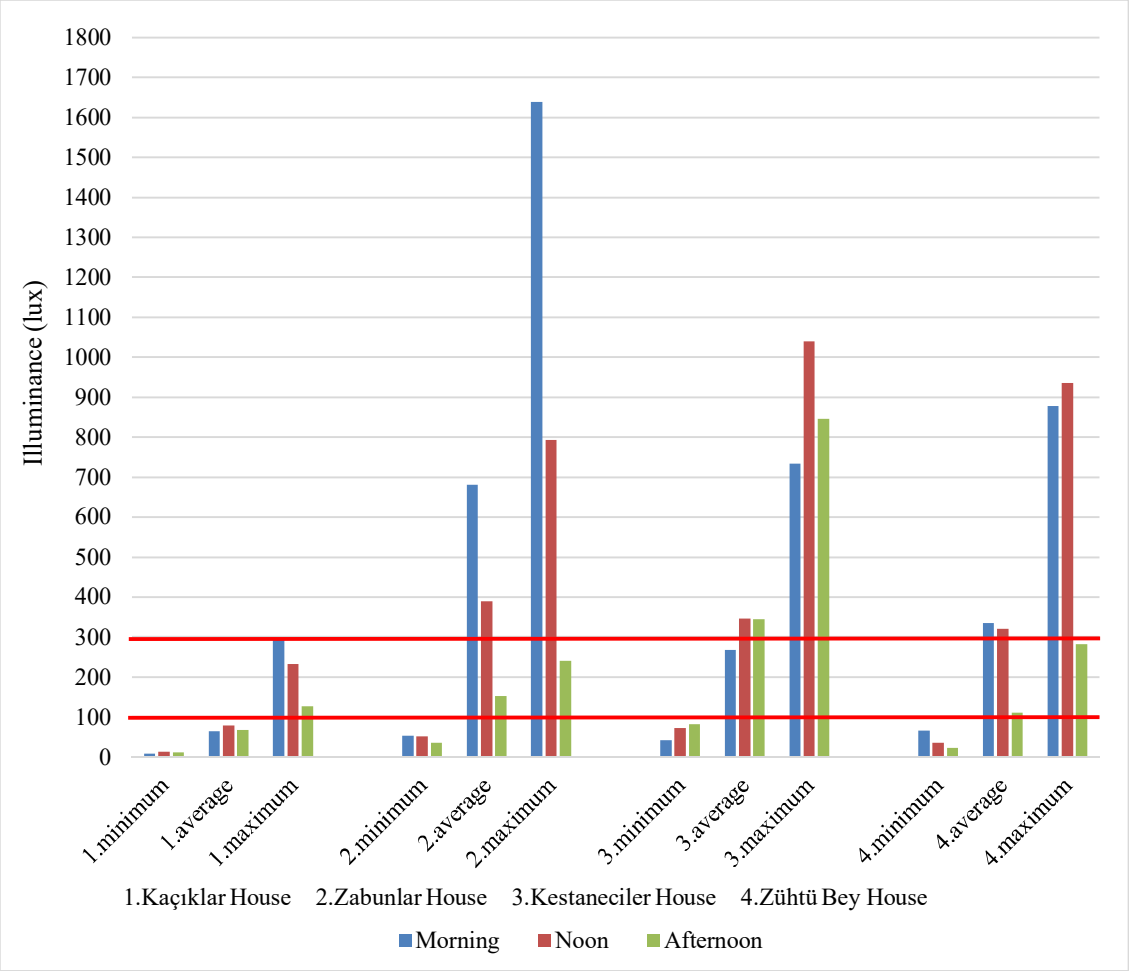


Figure 6.4. Minimum, average and maximum values of the measured houses according to the hours in the autumn season

In the houses examined, evaluations were made by comparing the changes in the illuminance in the main room during the time of the day depending on the seasons.

When the average illuminance of the morning, noon and afternoon are examined during the day in the main room of Kaçıklar House, located in the northwest, the illuminance values taken at noon (Win: 48.1 lux) in the winter are higher; however, the illuminance values taken in the morning (Win: 22.3 lux) and afternoon (Win: 19.2 lux) are lower. In the summer, the average illuminance value in the morning (Sum: 74.4 lux) is higher, whereas, the illuminance values at noon (Sum: 63.6 lux) and in the afternoon (Sum: 62.4 lux) are close to each other. In spring and autumn, the average illuminance value obtained at noon (Sp: 67.7 lux, Au: 80.0 lux) is higher; however, the illuminance values taken in the morning (Sp: 61.4 lux, Au: 64.6 lux) and afternoon (Sp: 61.6 lux, Au: 68.7 lux) are close to each other (Table 6.3, Table B.1).

When the average illuminance of the morning, noon and afternoon are examined in the main room of Zabunlar House located in the northeast, the illuminance value taken at noon (Win: 332.1lux) in the winter is higher, but lower in the morning (Win: 66.8 lux). The main reason for this is that the fog is intense in the measurements taken in the morning in winter. In the spring, summer and autumn, the average illuminance values in the morning (Sp: 546.9 lux, Sum: 510.2 lux, Au: 682.0 lux) are higher; on the other hand, the values in the afternoon (Sp: 260.7 lux, Sum: 340.2 lux, Au: 152.6 lux) are lower (Table 6.3, Table B.2).

When the average illuminance values of morning, noon and afternoon are examined during the day in the main room of Kestaneciler House located in the northwest, the illuminance value taken at noon (Win: 587.9 lux) in winter is higher, but lower in the morning (Win: 38.9 lux). In the spring and summer, the average illuminance values in the afternoon (Sp: 557.3 lux, Sum: 1075.5 lux) are higher, and the values in the morning (Sp: 318.5 lux, Sum: 314.8 lux) and at noon (Sp: 310.6 lux, Sum: 382.9 lux) are close to each other. Although the average illuminance values in the morning (Au: 268.9 lux), at noon (Au: 327.9 lux) and in the afternoon (Au: 346.3 lux) taken in autumn are close to each other, they are observed higher in the afternoon and lower in the morning (Table 6.3, Table B.3).

When the average illuminance values in the main room of Zühtü Bey House located in the northeast are examined during the day, the illuminance values in the morning (Win: 145.7 lux, Sp: 375.2 lux, Sum: 338.3 lux, Au: 335.4 lux) are higher;

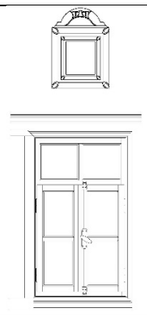
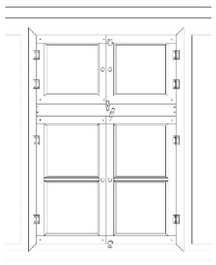
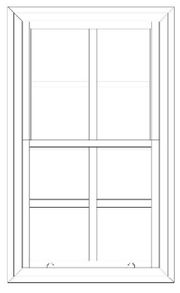
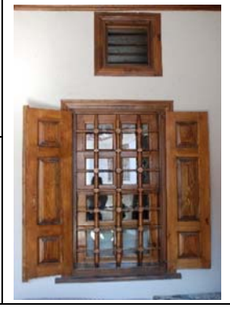
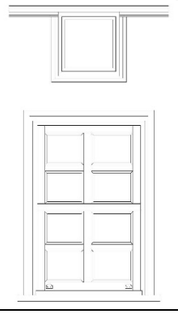
however, the values in the afternoon (Win: 56.6 lux, Sp: 104.7 lux, Sum: 142.2 lux, Au: 112.2 lux) are lower (Table 6.3, Table B.4).

In the unrestored Kaçıklar House of which the main room is located in the northwest, due to the fact that the roofs join with the house in the west and the street between them is narrow, daylight reception is largely prevented. In addition, the average illuminance of measurements in the morning, at noon and in the afternoon for the four seasons is lower than the one in Kaçıklar House. Although it is related to the environment, other reasons of this situation are that the ratio of the window glass area and the floor area (WGFR: 4.51% < 5-30%) is not sufficient, there is a window closed in the north and the top windows are painted and have lost their permeability. These parameters should be considered when making restoration decisions.

The average illuminance of Zühtü Bey House, which has been restored, is higher than Kaçıklar House for four seasons and lower than Zabunlar and Kestaneciler House. The reason for the average illuminance in the measurements taken at noon is higher than Kaçıklar House, is because of the distance to the surrounding buildings, the ratio of the window glass area to the floor area (WGFR: 5% < 6.26% < 30%) and high reflection factor (p: 71.2%) of the wall finishing material. The reason that the average illuminance in the measurements taken at noon is lower than Zabunlar and Kestaneciler Houses is that the built-in cupboard located in the west of the south wall was a window in its original state and the top window on the south of the east wall were closed later. Since these changes, which will affect the original daylight properties, are not taken into consideration in the restoration decisions, the daylight performance was negatively affected.

As a result of the measurements taken in December, the regular transmittance of glass of the main room is 85.9% in unrestored Kaçıklar House and 79.6% in unrestored Zabunlar House. It is 86.6% in restored Kestaneciler House and 81.3% in Zühtü Bey House replaced with double glass. The regular transmittances of glass (79.6-86.6%) are close for four houses (Table 6.1). Therefore, it can be said that the use of double glass had no favorable or unfavorable effect on the lighting performance.

Table 6.1. The quantitative features of the main rooms

Space (Location of the main room)	Size (m) (w) (l) (h)	Number of Windows (vertical rectangular window and top window)	Floor Area (m^2)	Location of the wall / Wall Area (m^2)	Window Area (m^2) / Window Glass Area (m^2)	Ratio of Window-Floor (%) / Ratio of Window Glass-Floor (%)	Ratio of Window-Wall (%) / Ratio of Window Glass-Wall (%)	Window (Photograph-Technical Drawing)	Regular transmittance of glass % (Dec. 2018)	Reflection factor % (average)
Main Room of Kaçıklar House (Northwest) 	6.90 4.50 2.98	7 vertical rectangular window 6 top window	31.05	West	2.93	9.44	21.84	 	1.G 85.9	1.W : 61.8 1.T1 : 88.0 1.T2 : 64.7 1.F : 47.1 1.C : 95.8
				13.41	1.40	4.51	10.44			
Main Room of Zabunlar House (Northeast) 	5.10 4.80 2.27	8 vertical rectangular window	24.48	East	2.86	11.68	24.70	 	2.G 79.6	2.W : 44.1 2.T1 : 73.2 2.T2 : 47.7 2.F : 39.1 2.C : 30.1
				11.58	1.49	6.08	12.87			
Main Room of Kestaneciler House (Northwest) 	5.90 4.25 2.96	7 vertical rectangular window	25.08	West	4.96	19.78	39.43	 	3.G 86.6	3.W : 93.3 3.T1 : 24.9 3.T2 : 51.2 3.F : 26.9 3.C : 56.2
				12.58	2.87	11.44	22.81			
Main Room of Zühtü Bey House (Northeast) 	4.38 4.56 2.50	6 vertical rectangular window 4 top window	19.97	East	3.49	17.48	31.87	 	4.G 81.3	4.W : 71.2 4.T1 : 71.0 4.T2 : 8.7 4.F : 57.4 4.C : 41.0
				10.95	1.25	6.26	11.42			

6.2. Comparison of Daylight Performance of the Area which has the Feature of the Main Room in Traditional Houses

In the literature, when the daylight performance of traditional houses is examined, both the architectural features of the room, which has the feature of the main room, and the illumination parameters, which are the illuminance, daylight factor and the reflection factor of the materials, may be compared with the evaluation in historical Kula houses.

In the Karagiannopoulos House (Vysitsa Village), which represents the traditional house of Mount Pelion in Greece, the daylight factor (AvDF) of the area, which has the feature of the main room, facing the southwest and used in the summer was found to be 1.97% (Sakarellou-Tousi and Lau, 2009) (Table 6.2). The daylight factor of Kestaneciler House, which performs best from the measured Kula houses, is 3.58-7.10% and the value of Zabunlar House is 4.23-6.88%. The values range from 3-8% and perform better. The moving shutters and colorful windows can be said to control the daylight values of the houses in Greece (Table 6.3).

In the town of Florina, Greece, it has been suggested that in the evaluation of the daylight situation in forty traditional residences, daylight conditions tend to be better in terms of lighting performance compared to the winter with overcast sky conditions in the summer with clear sky conditions. On the ground floor, regardless of the season, it has been determined that the main living areas with many openings are quite good in the immediate vicinity of the openings, however, generally weak in secondary areas with few and small openings. In the main living areas of the upper floor, it has been shown that daylight conditions are generally better compared to the ground floors due to increased openings (Oikonomou and Bougiatioti, 2011; Oikonomou, 2015). It was observed that the average daylight performance taken at noon in Kula Houses examined was higher in Zabunlar House, where the number of windows was higher, in the spring, summer and autumn seasons compared to other houses (Table 6.3).

In Cyprus, in traditional houses, the main rooms, are located in the northeastern in the coastal areas, in the east in the lowland and in the north in the mountainous area, and the ratio of the window glass area to the floor area (WGFR) is 15%, 11% and 8%, respectively. The ratio of window glass to floor area (WGFR) is expected to be in the range of 10-15% (Giovanni, 1998; Michael et al. 2015). WGFR is within the expected values in the houses located in the coastal areas and in the lowland, while it is below this

value in the houses located in the mountainous area. The daylight factor is 1.5% determined as ideal value. The daylight performance measurements are taken in all of the main rooms (0.8-0.1-0.2%) of traditional houses located in different climatic zones are under this value (Michael et al. 2015) (Table 6.2). The daylight factor of Kaçıklar House (0.63-0.88%) is below the specified value; however, the daylight factor of Zabunlar (4.23-6.88%), Kestaneciler (3.58-7.10%) and Zühtü Bey (1.75-4.24%) Houses are above the specified value (Table 6.3).

On the first floor of a traditional two-storey residential complex in Nicosia, Cyprus, the *Sahnisi*, which has the feature of the main room, has been taken in the morning, at noon and in the afternoon in winter (December), spring (March) and summer (June) seasons. The illuminance of the area, which has the feature of the main room, in winter are 635.7 lux in the morning, 302.5 lux at noon and 104.3 lux in the afternoon. It is 903.2 lux in the spring, 329.2 lux at noon and 345.8 lux in the afternoon. In summer, it is 1533.8 lux in the morning, 403.7 at the noon and 453.4 lux in the afternoon. The daylight factor (AvDF) in this place is 4.00%. The central courtyard, semi-open spaces (iliakos, portico) and the s*ahnisi* of the first floor play an important role in traditional daily life as they provide adequate daylight levels. On the other hand, the interiors at ground level are not at sufficient daylight level throughout the year and therefore have secondary functions (Michael et al. 2017) (Table 6.2). In the measurements made from the Kula Houses examined, the average of the measurements taken in the winter is between 22.3-145.7 lux in the morning, 48.1-587.9 lux at noon and 19.2-349.6 lux in the afternoon. In the spring, this value is between 61.4-546.9 lux in the morning, 67.7-470.5 lux at noon and 61.6-557.3 lux in the afternoon. In the summer, this value is between 74.4-510.2 lux in the morning, 63.6-419.8 lux at noon and 62.4-386.6 lux in the afternoon. The daylight factor (AvDF) is between 0.63-7.10% (Table 6.3). For this reason, Kaçıklar House does not provide the standard value of daylight factor, which is 1.5%; however, the main rooms in Zabunlar, Kestaneciler and Zühtü Bey Houses provide this value (Table 6.3).

Investigation was carried out in traditional houses in different climatic regions of Turkey which are Kemaliye district of Erzincan, Birgi district of İzmir and Safranbolu district of Karabük, and it was stated that if the illuminance is above 100 lux, it is sufficient. It has been suggested that the illumination level taken in the cold climate zone from the selected climate zones is 99.2 lux in the autumn and insufficient whereas 547 lux in spring and sufficient. It is 682 lux in the warm climate zone and 1513 lux in the

temperate climate zone; besides, it is stated that daylight performance is sufficient for the seasons that are measured. In the study, the adequacy of these values was also evaluated for the new function proposals of the spaces (Sayın, 2014) (Table 6.2). Similar results are seen when the standard value is taken as minimum 300 lux. The average illuminance is between 48.1-80.0 lux in Kaçıklar House, 332.1-470.5 lux in Zabunlar House, 310.6-587.9 lux in Kestaneciler House and 133.7-321.1 lux in Zühtü Bey House. According to these data, the average values of luminous level measurements differ depending on the measurement time of each season and day for four houses due to the different location and architectural characteristics of the building (Table 6.3).

In Cahit Sıtkı Tarancı House, which has been refunctioned in the traditional house texture of Diyarbakır, Turkey, the floor area of the main room in the north is 32.2 m^2, the wall area is 41.2 m^2 and the total glass area is 14.8 m^2. According to these data, the ratio of window glass area to floor area (WGFR) is 46% and ratio of window glass area to wall area (WGWR) is 36%. The average illumination level was calculated as 402.6 lux in this space. When the space, which has adequate daylight in its original function (main room), has been refunctioned as the organic product exhibition, the illumination level has been evaluated as high (Aykal et al. 2011) (Table 6.2). In Kestaneciler House, which has similar characteristics among the samples examined, the floor area is 25.08 m^2, the wall area is 12.58 m^2, the ratio of the window glass area to the floor area (WGFR) is 11.44% and the ratio of the window glass area to the wall area (WGWR) is 22.81%. On the other hand, the illumination level in Kestaneciler House is between 310.6-587.9 lux (Table 6.3).

In the Al Suhami House, one of the 17th century traditional houses in Cairo, Eygpt, the illumination level varies between 115-1600 lux in the north-facing side of the courtyard in Maka'ad, which has a main room feature. The illumination level taken from outside is between 1500-60000 lux (Almaiyah et al. 2010) (Table 6.2). Similarly, in the Kula Houses examined, the main room is located in the northeast or northwest and the average illumination level of the main rooms varies between 48.1-587.9 lux. The illumination level taken from outside is between 759.3-9925 lux (Table 6.3). The high level of illumination of the example in Cairo can be explained by the climate features and the mashrabiya design, which consists of cages and passes through the daylight.

In Guizhou province in China, the floor areas of the room, which has the feature of the main room, in three different houses are 15 m^2 in Jiangchang House, 24.8 m^2 in Sanbao Dong House and 23.5 m^2 in Xijiang Miao House. The ratio of the window area to the floor area is 17% in Jiangchang House, 8% in Sanbao Dong House and 34% in

Xijiang Miao House. It has been suggested that the current illumination level is gloomy but acceptable. A simulation study has been demonstrated using ECOTECT software, where renovation suggestions such as cleaning wooden walls, moving grilles and window glass replacement will improve daylight status. It has been suggested that reducing the depth of the room in newly built houses using the traditional style will positively affect the level of illumination (Xuan et al. 2014) (Table 6.2). In Kula Houses examined, it was determined that the daylight performance decreases as it moves away from the front of the room.

In Tangkonan House, which carries traditional house features in Indonesia, the average illumination of the area, which has the feature of the main room, is 96.1 lux in the morning, 209.3 lux at noon and 155.8 lux in the afternoon. The results suggest that although the Toraja people designed according to the beliefs of ancestors, all interior spaces in Tongkonan House fulfill the principles of daylight. It is stated that the direction of the building, the narrow and long plan based on the zoning status and the roof design optimize the amount and quality of daylight inside the building and provide the functional requirements of the house (Manurung, 2017) (Table 6.2). However, considering the standard values (300 lux), the lighting level of Tongkonan House is below this value. The average illumination level of Kestaneciler House in winter is 587.9 lux and 382.9 lux in summer. Due to the fringe type and length, it has been determined that while diffused daylight is moving into the space in winter, it breaks the daylight coming upright in summer and optimizes the light (Table 6.3).

Table 6.2. In the literature review, architectural features and daylight performance of the area, which has the feature of the main room.

	(Sakarellou-Tousi and Lau, 2009)	(Oikonomou and Bougiatioti, 2011; Oikonomou, 2015)	(Michael et al. 2015)			(Michael et al. 2017)	(Sayın, 2014)			(Aykal et al. 2011)	(Almaiyah et al. 2010)	(Xuan et al. 2014)	(Manurung, 2017)
Location	Greece; Pelion Mount	Greece; Florina	Cyprus			Cyprus	Turkey; Erzincan, İzmir and Karabük			Turkey; Diyarbakır	Cairo	China; Guizhou	Indonesia
Climate	Summers are mild, winters are cold	Continental climate	Coastal	Lowland	Mountain	Mediterranean climate (Summers are hot and dry, winters are mild and rainy)	Cold (Kemaliye)	Hot (Birgi)	Temperate and moist (Safranbolu)	Hard terrestrial climate	Hot and dry	Monsoon climate	Hot and humid
Direction of the Room	Southwest	-	North-east	East	North	East	East	South	Northeast	North	North	South	North
Design Parameters	The ceiling height varies between 2.70m-6.30m.	-	WGFR: 15%	WGFR: 11%	WGFR: 8%	WGFR: 23%	WGWR: 19%	WGWR: 24%	WGWR: 14%	WGFR: 46% WGWR: 36%	-	WGFR: 17% WGFR: 08% WGFR: 34%	-
Performance Parameters	AvDF (W): 0.60% AvDF (S): 1.84%	Due to the presence of increased windows in the main living areas of the upper floor, daylight conditions are above 1000 lux near the window.	(p) W:35% C:44% F:59%	(p) W:56% C:44% F:45%	(p) W 56% C:44% F:45%	Win (lux) M 635.7 N 302.5 AN 104.3	Sp (lux) M 903.2 N 329.2 AN 345.8	Sum (lux) M 1534 N 403.7 AN: 453.4	(p) W:89% C:14% F:14% Au (lux) 99.2	(p) W:42% C:12% F:18% Sum (lux) 682	(p) W:90% C:53% F:36% Au (lux) 1513	E: 402.6 lux	E: 1340 lux	AvDF : 1.77%	M (lux) 96.1	N (lux) 209.3	AN (lux) 155.8
			AvDF: 0.8%	AvDF: 0.1%	AvDF: 0.2%	AvDF: 4.00%			Sp (lux) 547							
Result	Moving shutters, colored skylights and roof eaves provide controlled light reception.	In the main living areas of the upper floor, daylight conditions are generally better compared to ground floors due to the presence of increased openings.	WGFR: 10-15% (Givoni, 1998) 0.1-0.8 <DF 1.5% (CIBSE, 2006)			Ideal daylight value between 100-2000 lux (Reinhardt and Wienold, 2011) All measurements taken in the morning, at the noon and in the afternoon during winter, spring and summer are between 100-2000 lux.	99.2 <100 lux <547-1513 Daylight performance is insufficient in the cold season in autumn; however, sufficient in spring. The daylight performance in the warm and temperate climate zone is sufficient for the seasons that are measured.			Daylight performance of 200 lux and above is ideal (CIE, 2002) 200 lux <402.6 lux	Daylight performance is sufficient.	DF 0-1% :Under standard DF 1-2% :Dismal but acceptable DF above 2% :Ideal	It has been argued that the amount and quality of daylight can be optimized to meet the functional requirements of the house.		
	(M: Morning, N: Noon, AN: Afternoon; Win: Winter, Sp: Spring, Sum: Summer, Au: Autumn)															

Table 6.3. The illuminance and daylight factors of historical Kula Houses (E (lux); AvDF (%))

			Kaçıklar House	Zabunlar House	Kestaneciler House	Zühtü Bey House
Winter	Morning	minimum	E: 3.8	E: 3.4	E: 6.4	E: 20.4
		average	E: 22.3	E: 66.8	E: 38.9	E: 145.7
		maximum	E: 48.5	E: 147.0	E: 132.6	E: 386.5
	Noon	minimum	E: 7.0 AvDF: 0.09	E: 19.8 AvDF: 0.27	E: 81.9 AvDF: 0.99	E: 15.4 AvDF:
		average	E: 48.1 AvDF: 0.63	E: 332.1 AvDF: 4.59	E: 587.9 AvDF: 7.10	E: 133.7 AvDF: 2.83
		maximum	E: 95.4 AvDF: 1.25	E: 637.0 AvDF: 8.81	E: 1739 AvDF: 21.00	E: 432.4 AvDF: 9.16
		external	E: 759.3-7623	E: 1283-7231	E: 3415-8282	E: 4720
	Afternoon	minimum	E: 3.2	E: 14.4	E: 46.7	E: 5.5
		average	E: 19.2	E: 277.5	E: 349.6	E: 56.6
		maximum	E: 39.9	E: 548.4	E: 1191	E: 197
	Average		E: 29.9	E: 225.5	E: 325.5	E: 112
Spring	Morning	minimum	E: 8.7	E: 81.5	E: 53.5	E: 86.7
		average	E: 61.4	E: 546.9	E: 318.5	E: 375.2
		maximum	E: 270.6	E: 1494	E: 603.2	E: 860.2
	Noon	minimum	E: 10.3 AvDF: 0.10	E: 57.5 AvDF: 0.66	E: 56.5 AvDF: 0.65	E: 32.1 AvDF: 0.33
		average	E: 67.7 AvDF: 0.69	E: 470.5 AvDF: 5.37	E: 310.6 AvDF: 3.58	E: 171.3 AvDF: 1.75
		maximum	E: 202.5 AvDF: 2.05	E: 1226 AvDF: 13.99	E: 753.0 AvDF: 8.68	E: 489.6 AvDF: 5.00
		external	E: 1043-9858	E: 8755-8763	2711-8671	E: 9785
	Afternoon	minimum	E: 8.9	E: 53.8	E: 82.3	E: 28.6
		average	E: 61.6	E: 260.7	E:557.3	E: 104.7
		maximum	E: 159.5	E: 399.9	E: 2083	E: 283.5
	Average		Average	E: 426.0	E: 395.5	E: 217.1
Summer	minimum	minimum	E: 17.0	E: 52.8	E: 67.4	E: 37.9
		average	E: 74.4	E: 510.2	E: 314.8	E: 338.3
		maximum	E: 297.5	E: 1460	E: 896	E: 875
	Noon	minimum	E: 11.7 AvDF: 0.12	E: 31.2 AvDF: 0.31	E: 72.4 AvDF: 0.73	E: 25.2 AvDF: 0.25
		average	E: 63.6 AvDF: 0.65	E: 419.8 AvDF: 4.23	E: 382.9 AvDF: 3.86	E: 233.8 AvDF: 2.36
		maximum	E: 212.8 AvDF: 2.19	E: 694.4 AvDF: 7.00	E: 1003 AvDF: 10.11	E: 718.9 AvDF: 7.24
		external	E: 1412-9734	E: 975-9339	E: 4365-9921	E: 9925
	Afternoon	minimum	E: 10.7	E: 45.7	E: 94.2	E: 34.2
		average	E: 62.4	E: 340.2	E: 386.6	E: 142.2
		maximum	E: 164.7	E: 623.4	E: 1075.5	E: 425.8
	Average		Average	E: 423.4	E: 591.1	E: 238.1
Autumn	minimum	minimum	E: 9.8	E: 53.3	E: 43.6	E: 66.5
		average	E: 64.6	E: 682	E: 268.9	E: 335.4
		maximum	E: 295.3	E: 1640	E: 675.6	E: 879
	Noon	minimum	E: 13.4 AvDF: 0.15	E: 52.0 AvDF: 0.92	E: 72.9 AvDF: 0.96	E: 36.8 AvDF: 0.49
		average	E: 80.0 AvDF: 0.88	E: 390.8 AvDF: 6.88	E: 327.9 AvDF: 4.33	E: 321.1 AvDF: 4.24
		maximum	E: 232.7 AvDF: 2.55	E: 793.2 AvDF: 13.96	E: 1040 AvDF: 13.74	E: 936 AvDF: 12.37
		external	E: 1642-9117	E: 4523-5682	E: 5116-7568	E: 8151
	Afternoon	minimum	E: 11.7	E: 35.8	E: 82.9	E: 24.1
		average	E: 68.7	E: 152.6	E: 346.3	E: 112.2
		maximum	E: 132.3	E: 241.1	E: 846.7	E: 282.9
	Average		Average	E: 408.5	E: 314.4	E: 256.2

CHAPTER 7

CONCLUSION

In this study, the daylight performance of the main rooms of the historical houses, which are Kaçıklar, Zabunlar, Kestaneciler and Zühtü Bey Houses, in Kula, located between the Mediterranean and the Terrestrial climate region in the Central-Western Anatolia, have been examined in order to take into account the original daylight features in restoration and re-functioning decisions. For this purpose, restored Kestaneciler Evi and Zühtü Bey Houses with unrestored Kaçıklar House and Zabunlar Houses, which have original windows, were selected as examples of the research. Daylight performance measurements were taken in the main rooms of these houses in the winter, spring, summer and autumn seasons, as well as in the morning, at noon and in the afternoon using illuminance meter. In daylight reception, it was studied that the ratio of the window glass area to the floor area, the reflectance values, the width of the eaves, the number of windows, the size and the type, the illuminance taken at noon when the sun reached its highest position. To examine the effect of the location on daylight intake, the illuminance taken in the morning when the sun was positioned in the east and those taken in the afternoon when it was located in the west were compared. As a result of the study, according to the daylight performances received, it was determined that the level of illumination was not sufficient for the four seasons in unrestored Kaçıklar House, was sufficient for four seasons in unrestored Zabunlar and in restored Kestaneciler House, was sufficient in restored Zühtü Bey House in autumn whereas insufficient for the other seasons. When the average illuminance of the main room of Kestaneciler House located in the northwest and the main room of Zabunlar and Zühtü Bey Houses located in the northeast were compared, it was identified that the values of Zabunlar and Zühtü Bey Houses are higher than Kestaneciler House in the morning measurements, and the values of Kestaneciler House is higher than Zabunlar and Zühtü Bey Houses in the afternoon measurements.

In the winter, the average illuminance is higher in Kestaneciler House, which was restored by preserving the original window ratios when compared to other houses, with the effect of the ratio of the window glass area to the wall area (WGWR), the reflection

factor of the wall finishing material and the eave type. In the spring, summer and autumn seasons, the average illuminance is higher in unrestored Zabunlar House, which has the original window ratios, with the effect that the two facades are facing the road, the number of windows (8 units) is higher than the other houses, the eaves type and length, and the window openings and partitions are in the original condition. In unrestored Kaçıklar House, the main reasons for the daylight performance being lower than other houses for four seasons are that the roofs which join with the house in the west and the street between them is narrow, the ratio of the window glass to the floor area is insufficient, the top windows are painted, and a rectangular window is closed in the north. In restored Zühtü Bey House, the main reasons for the average illuminance at noon being higher than Kaçıklar House are the distance to the surrounding buildings, the ratio of the window glass area to the floor area and the high reflection factor of the wall finishing material. In restored Zühtü Bey House, the built-in cupboard located in the west of the south wall was the window in its original state and the top window on the south of the east wall was closed later; besides, the original situation has been not taken into account when developing restoration decisions. For this reason, the average illuminance of Zühtü Bey House, which has been restored but whose original condition is not taken into account, is lower at noon than the restored Kestaneciler and unrestored Zabunlar Houses that maintain their original state.

The daylight performance of the main room in Kaçıklar House for four seasons is below the standard. For this reason, while making restoration decisions, in Kaçıklar House, it may be considered that opening the closed window, cleaning the paint on the top windows and increasing the reflecting factor value by choosing the lighter color of the wall finishing material will positively affect the daylight performance. In unrestored Zabunlar House, the illuminance taken from the *sofa* are lower than the other points. For this reason, it may be argued that the existing wooden joinery glass system in the *sofa* is removed and closed with a folding glass balcony system and the reflective factor value is increased by selecting the wall finish material in light color. Thus, these will positively affect the illuminance of the space. In Zühtü Bey House, which has been restored but not considered original features, the window transformed into a built-in closet and the top window, which is thought to be closed later, will gain the window function again, and if unqualified paints on the top windows on the south wall of the main room are cleaned, these will affect the illuminance positively. While the restoration decisions of Zühtü Bey House were being developed, the lighting adequacy was not considered and the evaluation

of this parameter in the decisions affected the lighting performance negatively after the restoration. The regular transmittance of glass are close to for four houses; therefore, replacing only the missing and broken parts in the unrestored buildings, protecting the glass without broken cracks may be important in terms of preserving the original glass properties of the buildings. While the original qualities of the glass have been preserved in restored Kestaneciler House, they have been replaced with double glass in restored Zühtü Bey House.

In this study, quantitative (luminance level and distribution) parameters have been handled and daylight performance has been determined and also related with window design, dimensions, number and separations. The results obtained at noon are compared with the standard value of 300 lux, and it is determined that the level of illumination is not sufficient for the four seasons in unrestored Kaçıklar House, is sufficient for four seasons in unrestored Zabunlar and in restored Kestaneciler House, is sufficient in restored Zühtü Bey House in autumn whereas insufficient for the other seasons. It has been observed that as the volume of the main rooms increased, the distribution of daylight became difficult and the level of illumination decreased, especially as we moved away from the windows. It is in light tones of textures and colors in the wall finish material, the wooden mullion of the window, the cupboard door timber, the ceiling and floor covering materials so the reflectance values of the surface materials become higher. This situation positively affects the distribution of daylight. However, the reflectance values of the surface materials selected in dark tones is low and it has been determined that it negatively affects the distribution of daylight. For example, in restored Kestaneciler House, the wall finishing material is white, the reflectance values of the surface material is high, which provides the distribution of light inside the main room. In unrestored Kaçıklar House, the reflectance values of the surface material of the dark-colored the wall finishing material is low, so the distribution of light in the main room becomes difficult. As the window design, sizes, numbers and directions affect daylight intake surface, they also affect daylight performance. These evaluations show that the determination of the original daylight characteristics of the historical houses will ensure that the interventions are directed correctly in restoration and conservation decisions.

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APPENDICES

APPENDIX A

INFORMATION IN LAND REGISTRATION RECORDS

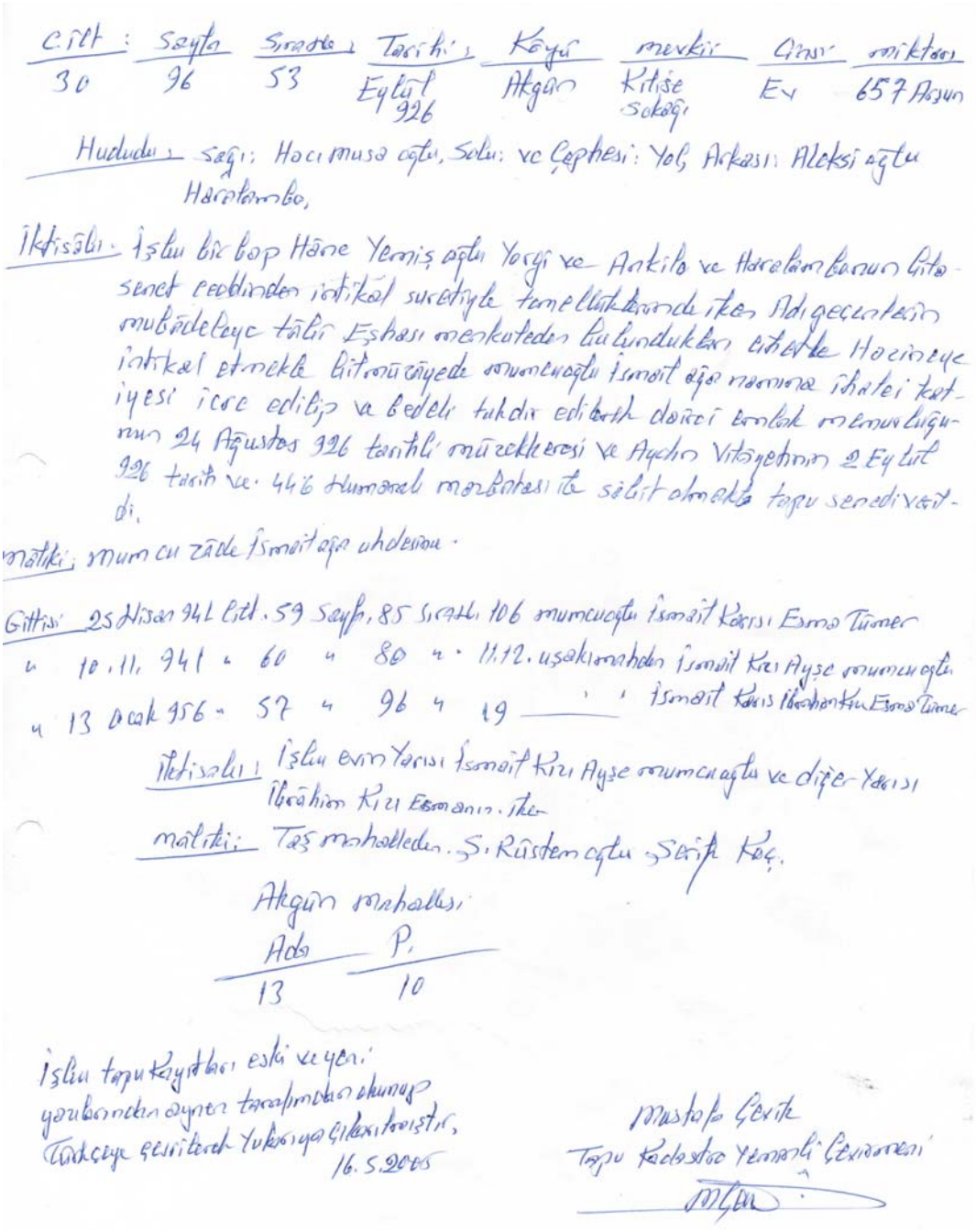


Figure A.1. The land registration of Kaçıklar House in 1956.

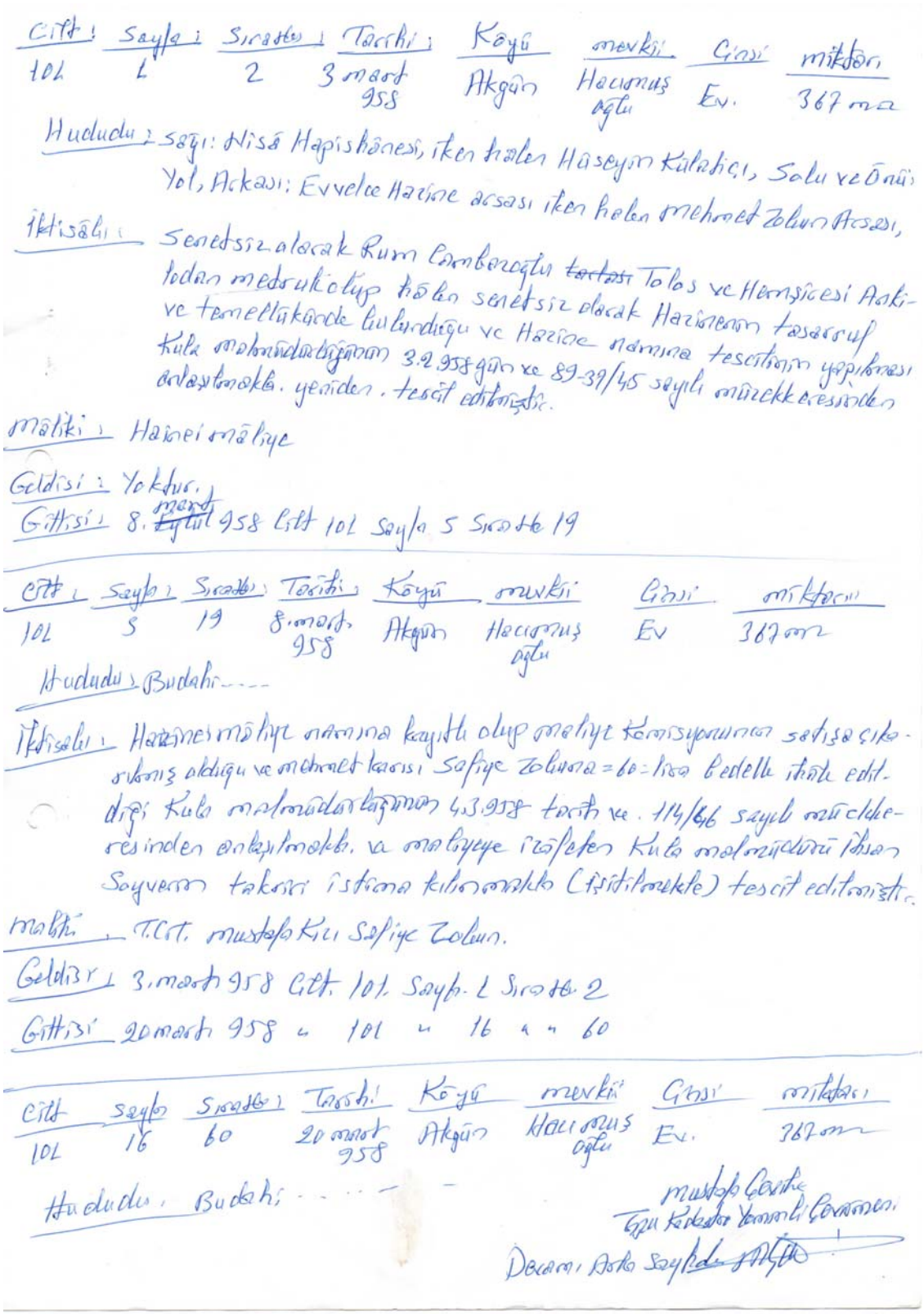
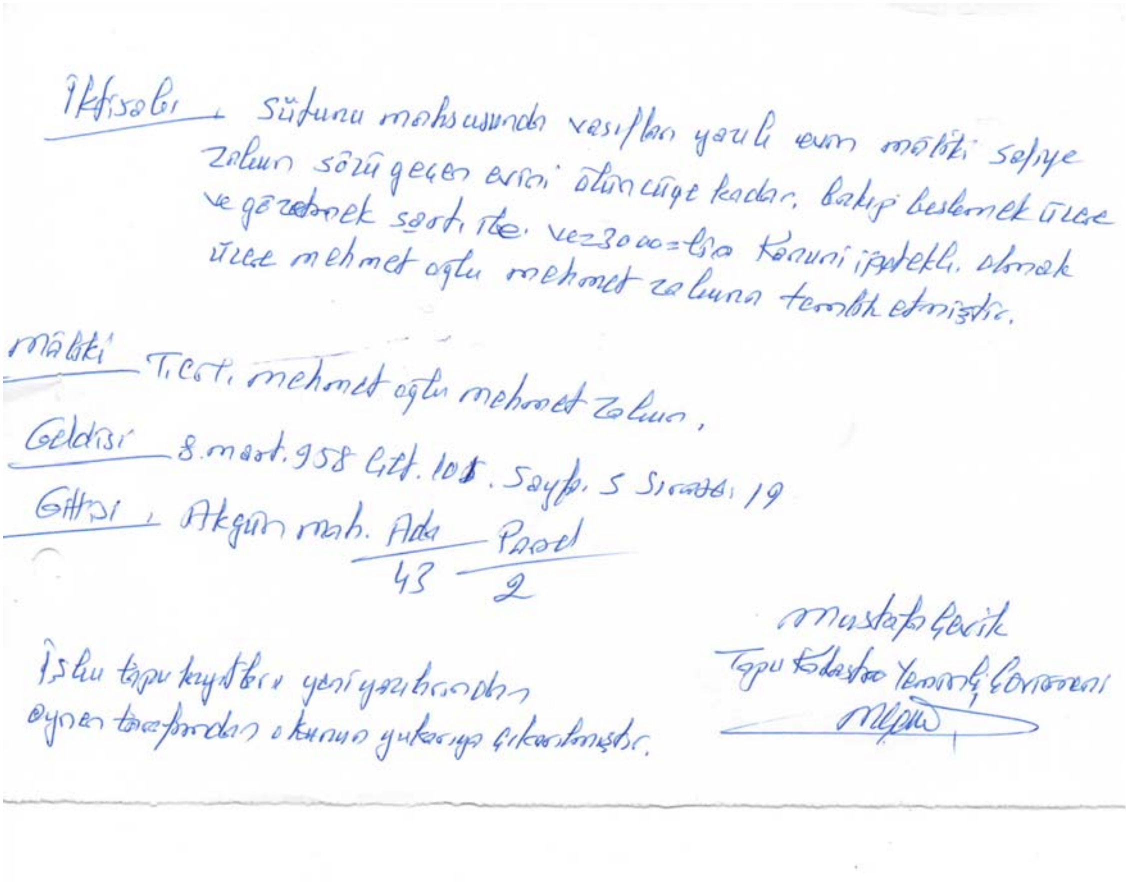


Figure A.2. The land registration of Zabunlar House in 1958 (Page 1).



İktisabı, sütunu mahsusunda vasıfları yazılı evin maliki safiye zabun sözü geçen evini ölünceye kadar, bakıp beslemek üzere ve gözetmek şartı ile, ve 30000= lira kanuni ipotekli olmak üzere mehmet oğlu mehmet zabuna temlik etmiştir.

Maliki T.C.T. mehmet oğlu mehmet Zabun,

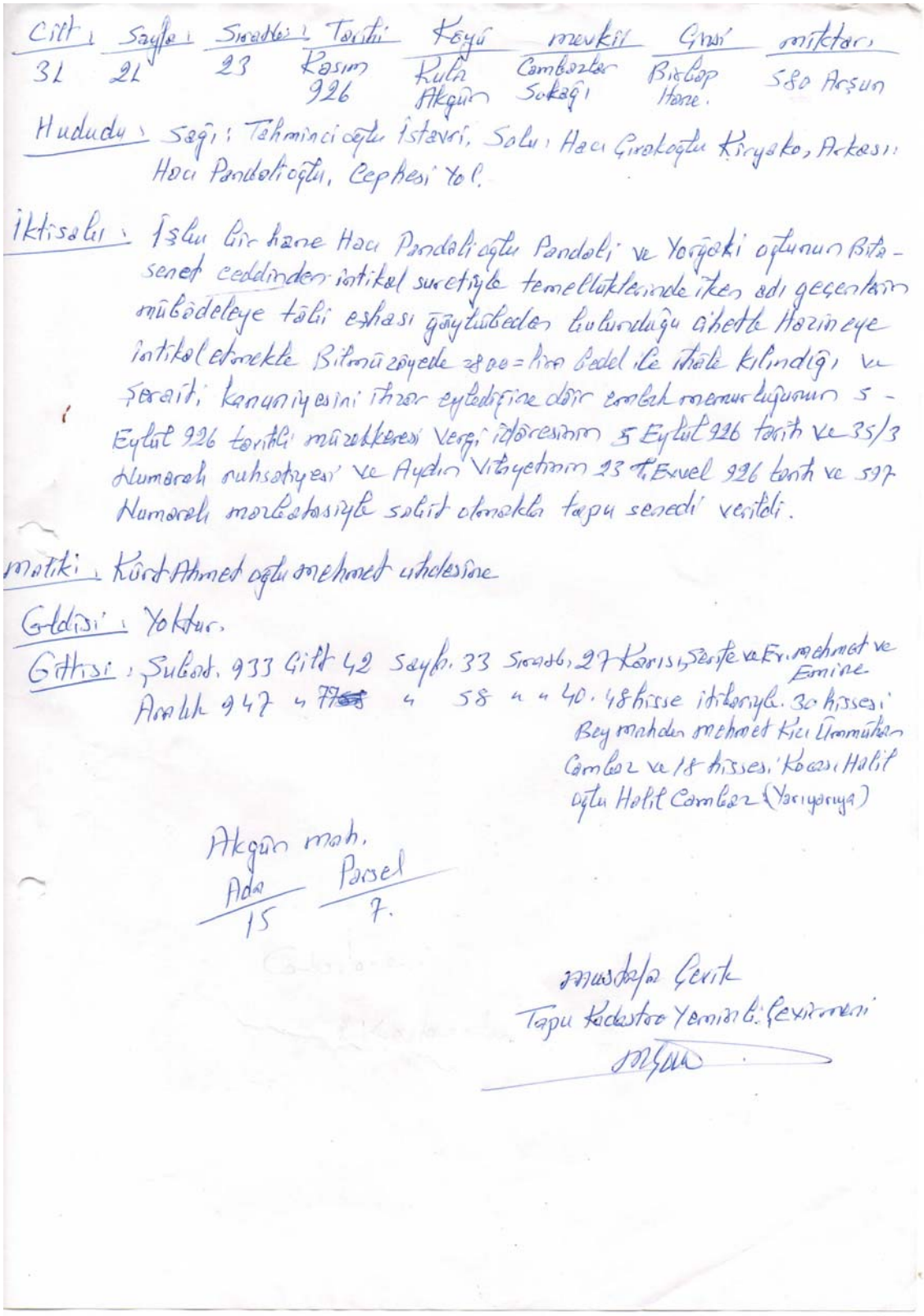
Geldisi 8.mart.958 Cilt. 10[illegible]. Sayfa. 5 Sırası. 19

Gittisi, Akgün mah. Ada 43 Parsel 2

İşbu tapu kayıtları yeni yazılarından aynen tarafımdan okunup yukarıya çıkarılmıştır.

mustafa Çevik
Tapu Kadastro Yeminli Çevirmeni
[signature]

Figure A.3. The land registration of Zabunlar House in 1958 (Page 2).



Cilt: 31 | Sayfa: 21 | Sıranın: 23 | Tarihi: Kasım 926 | Köyü: Kulu Akgün | mevkii: Cambazlar Sokağı | Cinsi: Bir Kap Hane. | miktarı: 580 Arşun

Hududu: Sağı: Tahmincioğlu İstavri. Solu: Hacı Girakoğlu Kiryako, Arkası: Hacı Pandeli oğlu, Cephesi: Yol.

İktisabı: İşbu bir hane Hacı Pandeli oğlu Pandeli ve Yorgaki oğlunun Bitasenet ceddinden intikal suretiyle temelliklerinde iken adı geçenlerin mübadeleye tabi eshası gayrimübadelerden bulundukları cihetle Hazineye intikal etmekle Bilmüzayede 2800=kuruş bedel ile ihale kılındığı ve şerait, kanuniyesini ihzar eylediğine dair emlak memurluğunun 5-Eylül 926 tarihli müzekkeresi Varidat idaresinin 5 Eylül 926 tarih ve 35/3 numaralı ruhsatiyesi ve Aydın Vilayetinin 23 Teşrinievvel 926 tarih ve 597 Numaralı mukabalesiyle sabit olmakla tapu senedi verildi.

Matiki: Kürt Ahmet oğlu mehmet uhdesine

Geldisi: Yoktur.

Gidisi: Şubat. 933 Cilt 42 Sayfa. 33 Sıranda, 27 Karısı, Şerife ve Er. mehmet ve Emine
Aralık 947 " 77 " 58 " " 40. 48 hisse ibtiyaıla. 30 hissesi Beymahdan mehmet kızı Ummühan Cambaz ve 18 hissesi Kocası Halit oğlu Halit Cambaz (Yarıyarıya)

Akgün mah.
Ada 15 Parsel 7.

mühürdar Çevik
Tapu Kadastro Yeminli Çevirmeni
imza

Figure A.4. The land registration of Canbazlar House in 1926.

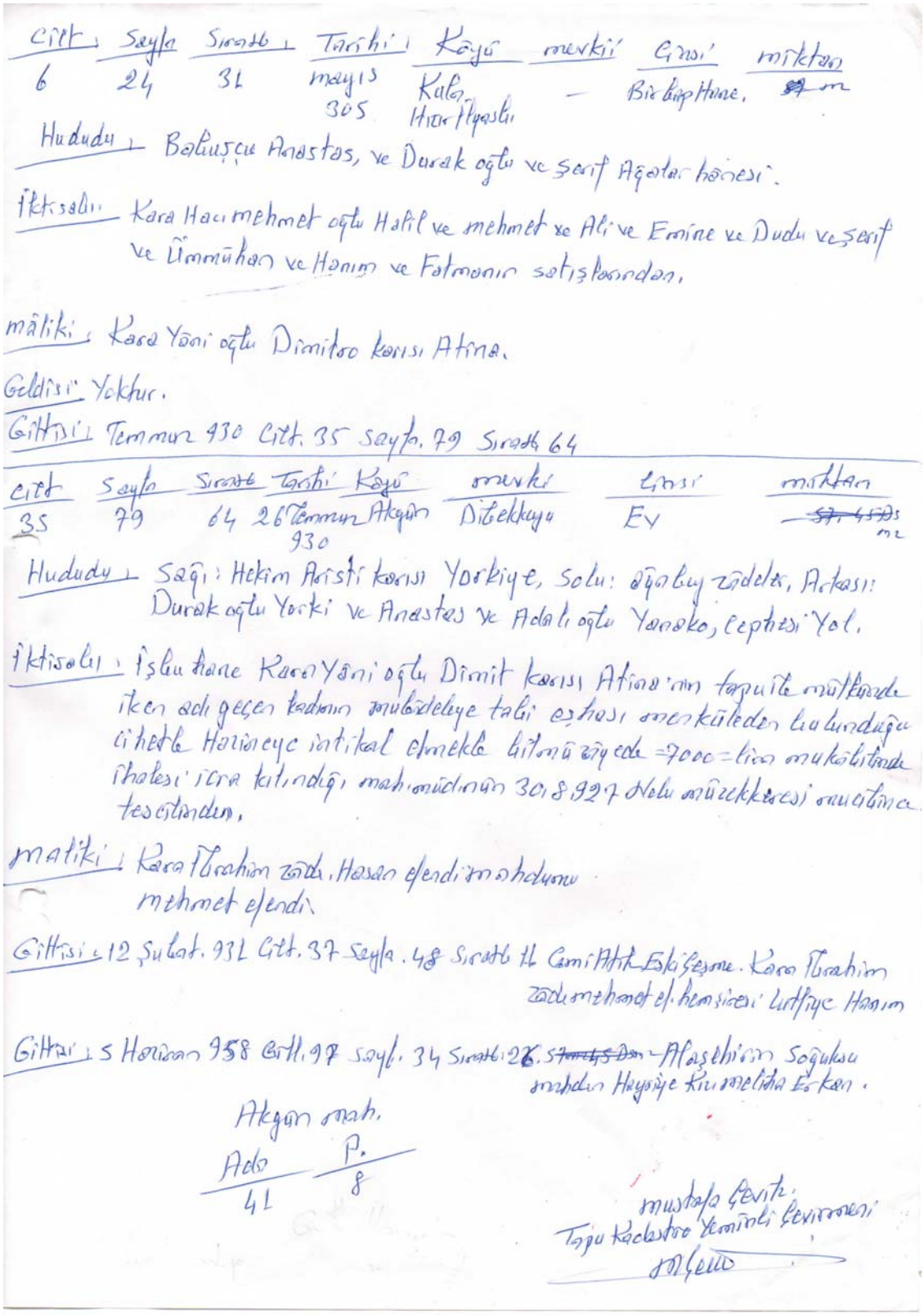


Figure A.5. The land registration of Architect Kri House in 1926.

APPENDIX B

ORIENTATION OF THE MAIN ROOM AND THE CHANGES IN THE ILLUMINANCE DURING THE TIME OF THE DAY DEPENDING ON THE SEASONS

Table B.1. Illuminance (lux) of main room in Kaçıklar House.

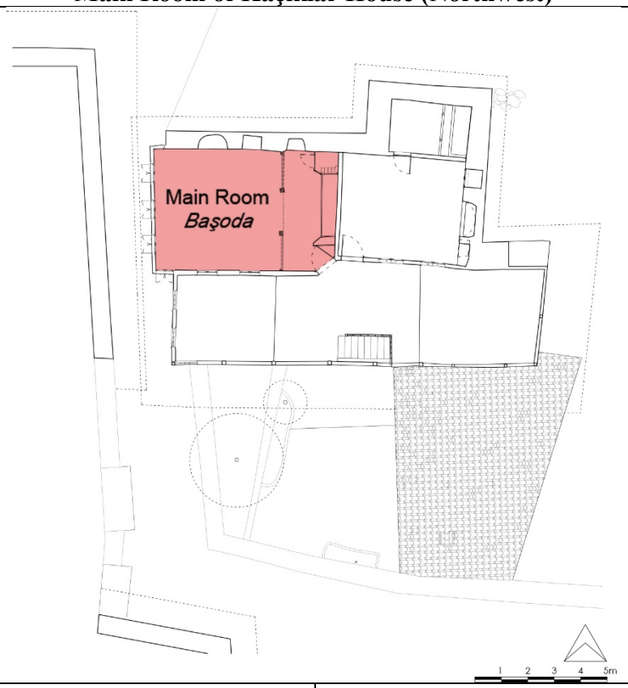
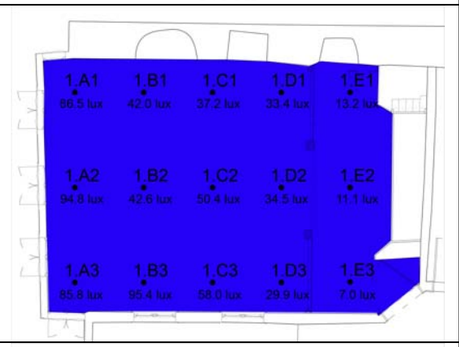
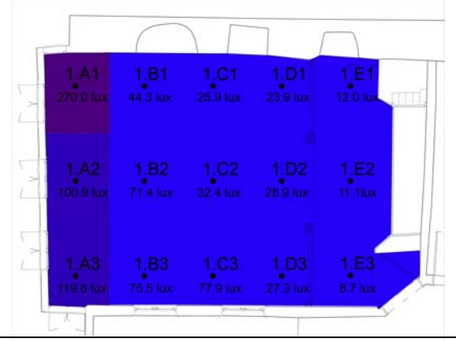
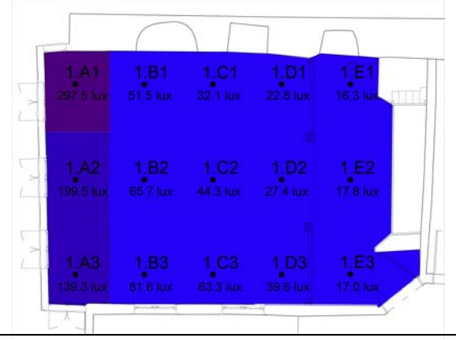
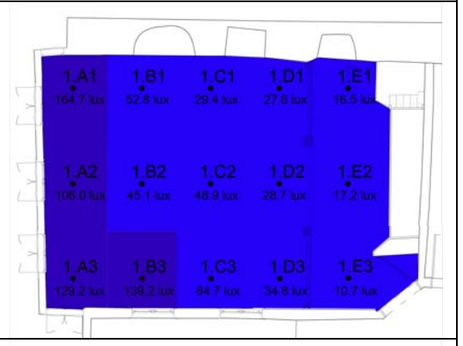
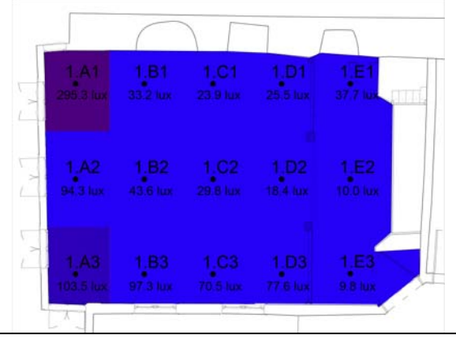
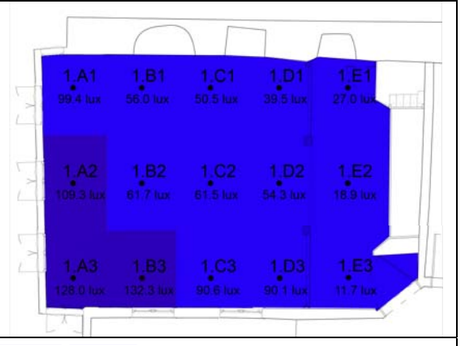
Main Room of Kaçıklar House (Northwest)			Morning	Noon	Afternoon
		Winter			
		Spring			
Size (m) **(w x l x h)**	6.90 x 4.50 x 2.98	Summer			
Number of Windows **(vertical rectangular window and top window)**	7 vertical rectangular window 6 top window				
Ratio of Window-Floor **(%)**	9.44				
Ratio of Window Glass-Floor **(%)**	4.51				
Ratio of Window-Wall **(%)**	21.84	Autumn			
Regular transmittance of glass % **(Dec. 2018)**	1.G 85.9				
Reflection factor % **(average)**	1.W : 61.8, 1.T1 : 88.0, 1.T2 : 64.7, 1.F : 47.1, 1.C : 95.8				

Table B.2. Illuminance (lux) of main room in Zabunlar House.

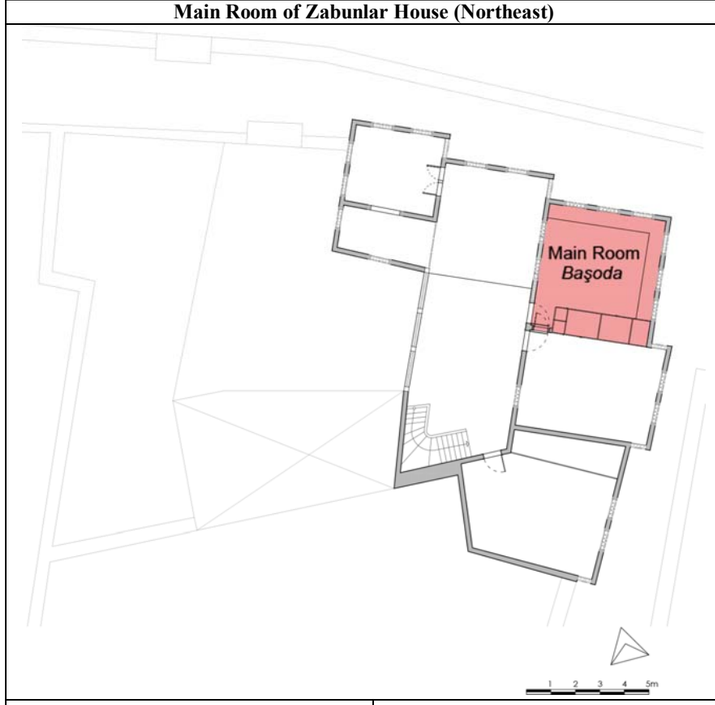
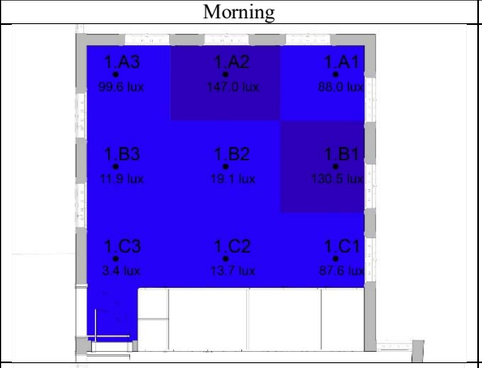
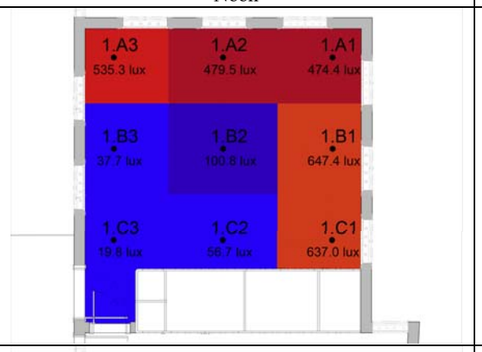
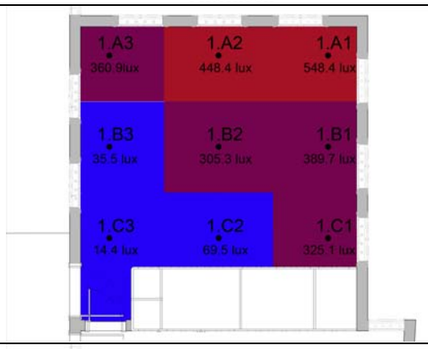
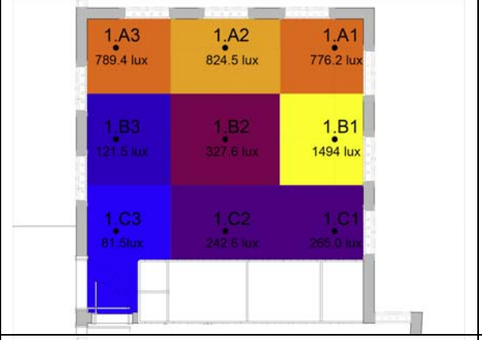
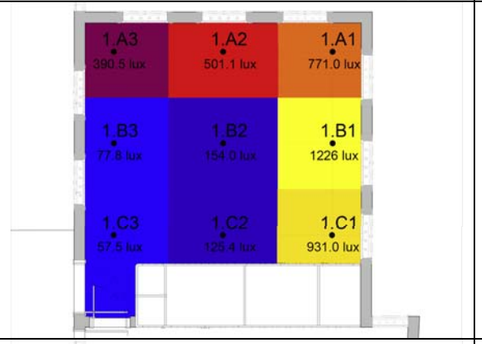
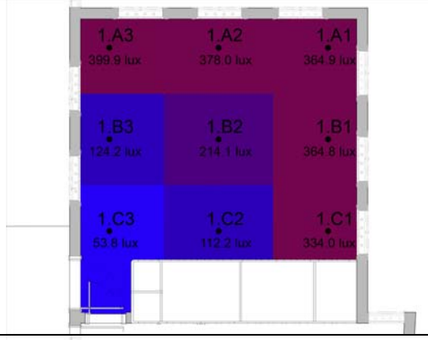
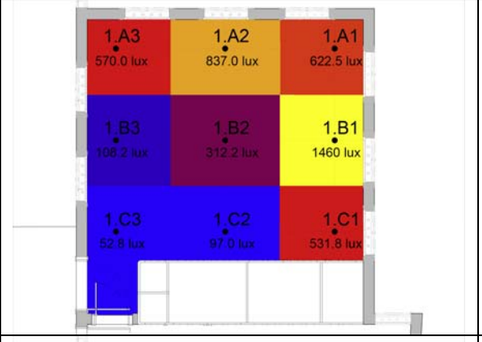
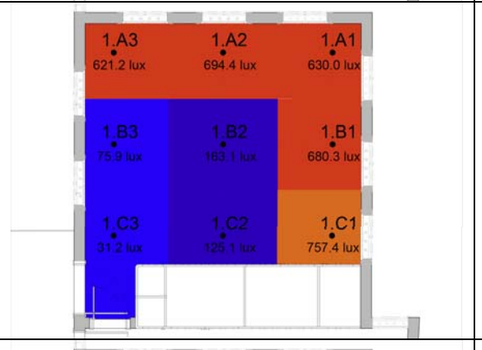
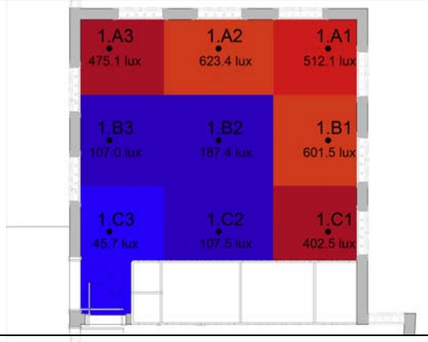
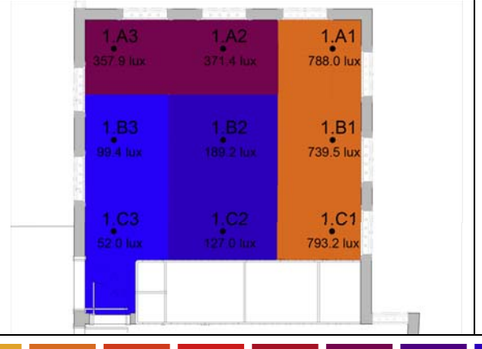
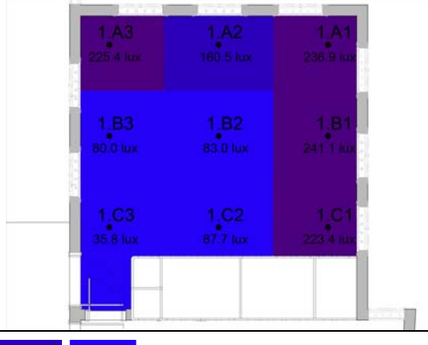
Main Room of Zabunlar House (Northeast)			Morning	Noon	Afternoon
		Winter			
		Spring			
Size (m) **(w x l x h)**	5.10 x 4.80 x 2.27	Summer			
Number of Windows **(vertical rectangular window and top window)**	8 vertical rectangular window				
Ratio of Window-Floor **(%)**	11.68				
Ratio of Window Glass-Floor **(%)**	6.08				
Ratio of Window-Wall **(%)**	24.70	Autumn			
Regular transmittance of glass % **(Dec. 2018)**	2.G 79.6				
Reflection factor % **(average)**	2.W : 44.1, 2.T1 : 73.2, 2.T2 : 47.7 2.F : 39.1, 2.C : 30.1		1000+ 1000-900 900-800 800-700 700-600 600-500 500-400 400-300 300-200 200-100 100-0 Lux		

Table B.3. Illuminance (lux) of main room in Kestaneciler House.

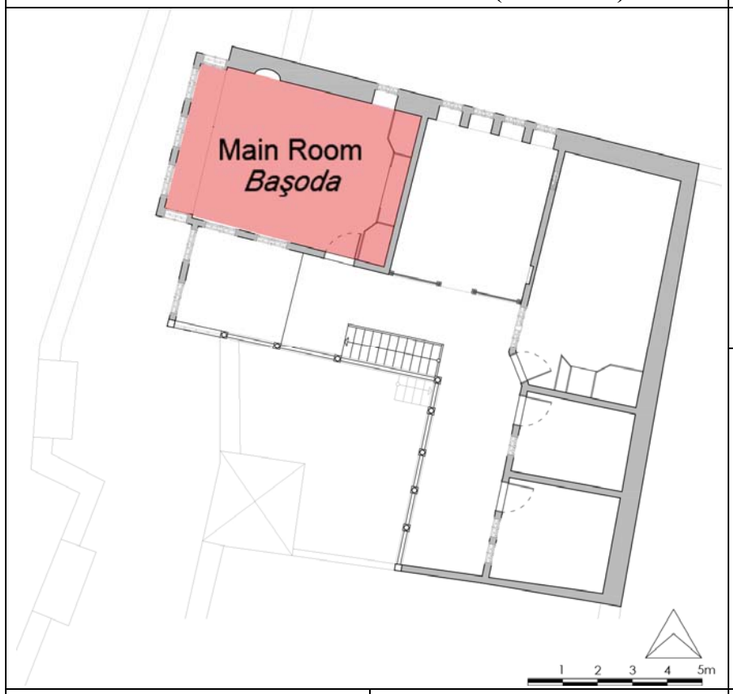
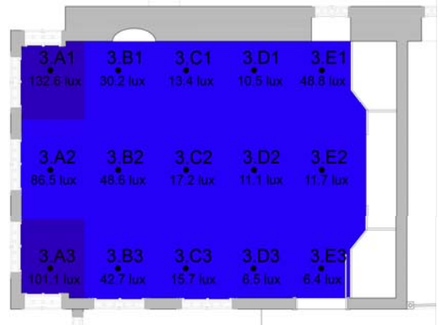
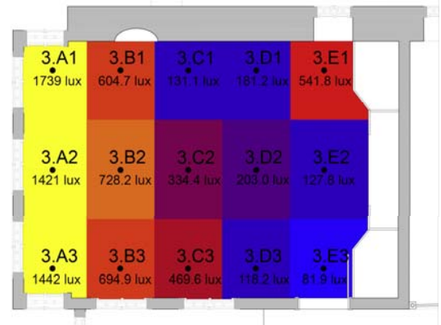
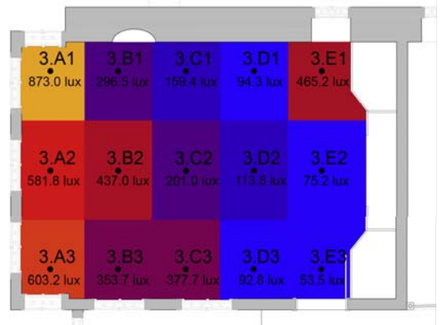
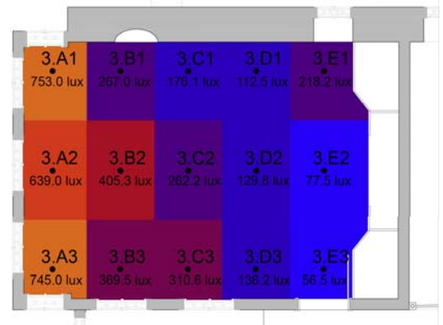
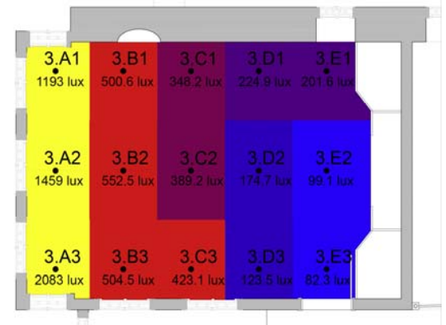
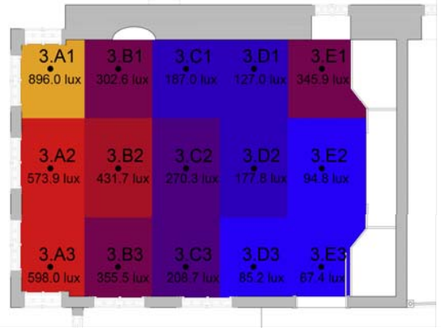
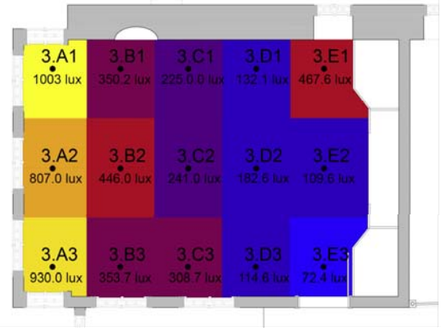
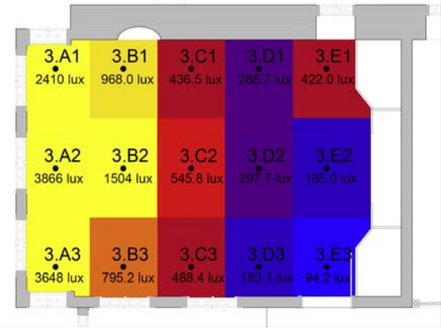
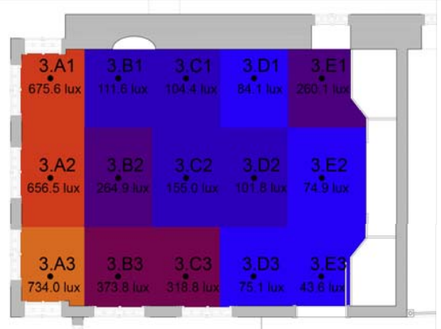
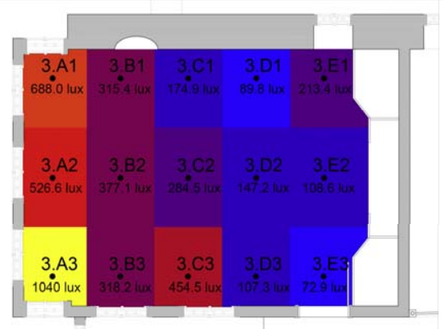
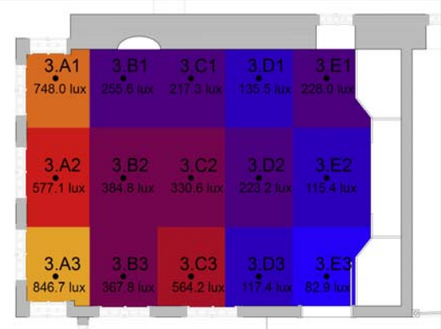
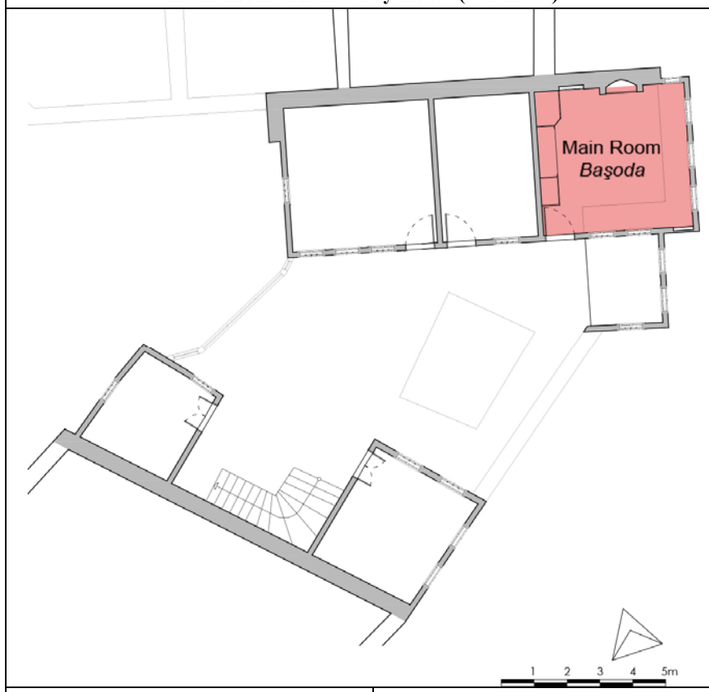
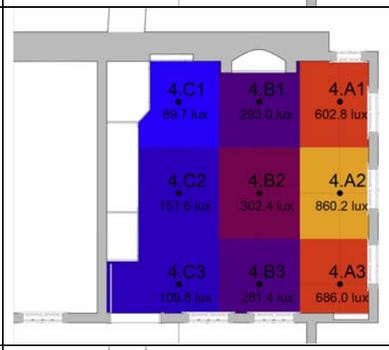
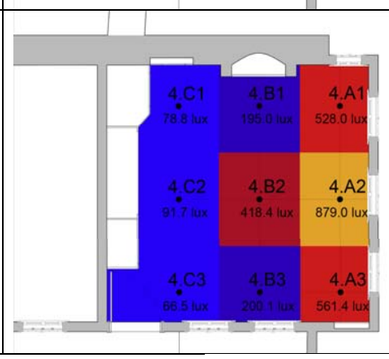
Main Room of Kestaneciler House (Northwest)			Morning	Noon	Afternoon
		Winter			
		Spring			
Size (m) **(w x l x h)**	5.90 x 4.25 x 2.96	Summer			
Number of Windows **(vertical rectangular window and top window)**	7 vertical rectangular window				
Ratio of Window-Floor **(%)**	19.78				
Ratio of Window Glass-Floor **(%)**	11.44				
Ratio of Window-Wall **(%)**	39.43	Autumn			
Regular transmittance of glass % **(Dec. 2018)**	3.G 86.6				
Reflection factor % **(average)**	3.W : 93.3, 3.T1 : 24.9, 3.T2 : 51.2 3.F : 26.9, 3.C : 56.2				

Table B.4. Illuminance (lux) of main room in Zühtü Bey House.

Main Room of Zühtü Bey House (Northeast)			Morning	Noon	Afternoon
		Winter			
		Spring			
Size (m) (w x l x h)	4.38 x 4.56 x 2.50	Summer			
Number of Windows (vertical rectangular window and top window)	6 vertical rectangular window 4 top window				
Ratio of Window-Floor (%)	17.48				
Ratio of Window Glass-Floor (%)	6.26				
Ratio of Window-Wall (%)	31.87	Autumn			
Regular transmittance of glass % (Dec. 2018)	4.G 81.3				
Reflection factor % (average)	4.W : 71.2, 4.T1 : 71.0, 4.T2 : 8.7 4.F : 57.4, 4.C : 41.0