CONSIDERATION OF ADAPTIVE REUSE PROCESS WITHIN THE CONTEXT OF ENERGY-EFFICIENT BUILDING DESIGN STRATEGIES: THE EXAMPLE OF TRADITIONAL ŞANLIURFA HOUSE

EDA NUR BUCAK

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ABSTRACT

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BUCAK, EDA NUR

M.Sc. in Interior Architecture

Supervisor: Assoc. Prof. Dr. GÜLSER ÇELEBİ

Co-Supervisor: Assist. Prof. Dr. NAFİZE MİNE ÇELEBİ YAZICIOĞLU

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Nowadays, sustainability has come to a very important point in construction, as it is in every subject. In the context of sustainability in construction, it is very important to extend the useful life of existing buildings until the end of their physical life and to prevent them from being idle. The reasons such as the outdated function of the buildings and the inability to answer the needs of the users of the building are among the reasons for the end of the building's using life. Elimination of these reasons by applying building conversion strategies instead of demolishing and rebuilding the building can reduce the negative environmental effects and energy consumption that will occur in the demolition and reconstruction of the building. This thesis focuses on increasing the sustainability of the building with adaptive reuse one of the building conversion strategies, improving the thermal and lighting comfort of the building with energy-efficient solutions, the processes of adaptive reuse and retrofitting strategies, and the importance of planning both strategies together. In this thesis, a traditional residential building, which was restored after being idle, and whose function was transformed with adaptive reuse, was chosen for the field study. The sustainability of the selected building after restoration and adaptive reuse, the current state of user comfort, and the energy consumption of the building were determined by on-site research, measurements, and simulation method. As a result of the determinations made, improvement suggestions were developed to improve the thermal and lighting comfort in the building in an energy-efficient way.

Keywords: Adaptive Reuse, Retrofitting, Indoor Thermal Comfort, Indoor Lighting Comfort, Energy Efficiency

ÖZET

ENERJİ VERİMLİ BİNA TASARIM STRATEJİLERİ KAPSAMINDA UYARLANABİLİR YENİDEN KUL LANIM SÜRECİNİN DEĞERLENDİRİLMESİ: GELENEKSEL ŞANLIURFA EVİ ÖRNEĞİ

BUCAK, EDA NUR
İç Mimarlık Yüksek Lisans

Danışman: Prof. Dr. Gülser Çelebi
Ortak Danışman: Doç. Dr. Nazife Mine Çelebi Yazıcıoğlu
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Günümüzde sürdürülebilirlik her alanda olduğu gibi inşaat alanında da oldukça önemli bir noktaya gelmiştir. İnşaat alanında sürdürülebilirlik bağlamında mevcut binaların fiziksel ömrünün sonuna dek kullanım ömrünün uzatılması ve atıl kalmasının önlenmesi oldukça önemlidir. Binaların işlevinin güncelliğini yitirmesi, binanın kullanıcılarının ihtiyaçlarını sağlayamaması gibi nedenler binanın kullanım ömrünün sonlanmasının sebeplerindendir. Bu sebeplerin binanın yıkılıp yeniden yapılması yerine bina dönüşüm stratejileri uygulanarak ortadan kaldırılması binanın yıkım ve yeniden yapımında ortaya çıkacak olumsuz çevresel etkilerin ve enerji tüketiminin azaltılmasını sağlayabilir. Bu tez çalışması, bina dönüşüm stratejilerinden adaptive reuse ile bina sürdürülebilirliğinin arttırılması, retrofitting stratejileri ile binanın kullanıcılarının ısıl ve görsel konforunun enerji verimli çözümlerle iyileştirilmesi, adaptive reuse ve retrofitting stratejilerinin süreçleri ile her iki stratejinin birlikte planlanmasının önemine odaklanmıştır. Bu bağlamda daha önce atıl durumuna geldikten sonra restorasyon yapılmış, adaptive reuse ile işlev dönüşümü yapılmış geleneksel konut binası üzerinden saha çalışması yapılarak restorasyon ve adaptive reuse sonrasında binanın sürdürülebilirliği, kullanıcı konforunun güncel durumu, binanın enerji tüketimi yerinde ölçümler ve simulasyon yöntemi ile belirlenmiştir.

Yapılan belirlemeler sonucunda binada ısıl ve görsel konforu enerji verimli şekilde iyileştirmek üzere iyileştirme önerileri geliştirilmiştir.

Anahtar Kelimeler: Yeniden İşlevlendirme, Bina İyileştirme, İç Mekan Termal Konforu, İç Mekan Aydınlatma Konforu, Enerji Verimliliği

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LIST OF SYMBOLS AND ABBREVIATIONS

SYMBOLS

°C	: Cantigrade Degree

ABBREVIATIONS

ASHRAE	: American Society of Heating, Refrigerating and Air-Conditioning Engineers
CFL	: Compact Fluorescent Lamp
FSEK	: Fikir ve Sanat Eserleri Kanunu
HVAC	: Heat, Ventilation, Air Condition
IEQ	: Indoor Environmental Quality
IESNA	: Illuminating Engineering Society of North America
LCA	: Life Cycling Assesment
LED	: Light Emitting Diode
TSE	: Türk Standartları Enstitüsü
UNEP	: United Nations Environmental Programme

CHAPTER I
INTRODUCTION

The concept of sustainability has come to the fore in every sector and every field with the problems that arise as a result of problems such as increasing excessive resource use. The concept was first accepted and signed in 1972 at the United Nations Conference on the Human Environment, which was the first global assessment of the socioeconomic environment. The concept of sustainability is often defined as meeting our own needs without compromising the ability of future generations to meet their own needs. The concept of sustainability has economic, environmental, and social contexts. Sustainability is also very important in terms of architecture. It is inevitable for a sustainable built environment to be addressed in economic, environmental, and social dimensions. Considering the changing needs and living conditions for a sustainable built environment, existing buildings should be adapted to this.

In this sustainability approach, which is discussed under the name of Adaptive Reuse, the elements that require harmony in the economic, environmental, and social context should be examined in the renovation projects to be made in buildings and regions. Buildings with adaptive reuse serve the economy both by reducing demolition and rebuilding costs during the new building phase and by shortening the time of new building construction (Aydın and Okuyucu 2009: 36). It also serves environmental sustainability by saving resources during demolition and rebuilding. When the results of adaptive reuse are examined in the social context, it is seen that it is possible for societies that can keep their buildings from the past alive, to make their historical and cultural values sustainable with these buildings, and to transfer their cultural accumulation to future generations.

Buildings built according to past functions and construction techniques may be insufficient to meet current needs and fulfill new functions. In this case, improvements to be made to make changes without interfering with the authencity of the structures can be realized with the adaptive reuse strategy.

Retrofitting, on the other hand, is a terminology covering the conversion and change projects to be applied to the building to increase indoor user comfort, energy efficiency, and user capacity. Retrofitting and adaptive reuse are two parameters that need to be worked together like all other structure conversion parameters. Only in this way, a successful building adaptation project can be made and the useful life of the buildings can be extended and brought closer to their physical life.

1.1. DEFINITION OF PROBLEM

Buildings harm the environment from the stage of existence to the stage of extinction. In order to minimize this damage to the environment, the definition of sustainable architecture has emerged (Gökdağ 2019: 85). Sustainable architecture theory predicts the long-term use of buildings (Othman and Elsaay 2018: 18). Adaptive reuse within the scope of sustainable architecture aims to extend the life of buildings by renewing structures that have completed their functional life before their physical life is completed.

It is known that life-specific houses located in Eyyübiye district, one of the central districts of Şanlıurfa province, were abandoned by their users over time and the region lost its former value. It has been observed that some of the Şanlıurfa Houses with hayat in the region have remained idle, while others have been used by gaining new functions such as hotels, workplaces, and restaurants by transforming their functions with adaptive reuse.

It is a well-known fact by the local people that the Şanlıurfa Houses with hayat in Şanlıurfa are insufficient in terms of user comfort and, at the same time, the buildings cannot meet the current economic expectations if they are used as residences at the same time, since a lot of energy is required to reach the level of comfort necessary for life in buildings with existing functions. In the region, Şanlıurfa Houses with hayat is trying to be made more economically sustainable by converting it into buildings such as hotels and offices. The sample building in this study is a building converted from a residence to a hotel. It is known that the building, which started to be used as a hotel building with the functional conversion, was preferred to be transformed into a hotel building due to the high energy cost so the building's expenses were wanted to be met, but after the adaptive reuse project implemented, the building was not at the desired level in terms of user comfort.

It may be possible to get rid of problems such as abandonment, inactivity and demolition of the regional houses by renewing the regional buildings according to the interior user comfort and by following the energy efficient methods and in line with the sustainable design principles. By providing interior user comfort with energy efficient solutions, the buildings that have undergone functional conversion in the region can provide benefits in the environmental context of the definition of sustainability.

1.2. AIM

The aim of this study is primarily to examine the concept of adaptive reuse in buildings, to examine the concept of retrofitting, which is another building conversion strategy, in the context of energy-efficient solutions through indoor thermal comfort and lighting comfort, and to discuss the principles of an energy-efficient building by considering user comfort in the context of adaptive reuse on an example building in Şanlıurfa. For this purpose, it is aimed to make suggestions for providing indoor thermal comfort and lighting comfort in an energy-efficient way by examining the Nuran Elçi Mansion structure, which has been converted into a hotel structure with the function conversion in Eyyübiye district of Şanlıurfa province. As a result of this study, it is aimed to set an example for other structures in the region and to shape the region with sustainable architecture. In order to achieve this aim, the following research questions were tried to be answered.

1. Do adaptive reuse and retrofitting strategies have an impact on sustainability?
2. What is the importance of applying adaptive reuse and retrofitting strategies while preparing restoration projects?
3. How should the application principles of adaptive reuse and retrofitting strategies be determined?
4. Which limits should be adhered to when implementing building conversion strategies within the scope of sustainability in buildings whose authencity should be preserved?
5. What are the basic principles that affect indoor user comfort?
6. How are indoor lighting comfort indicators determined?
7. How are indoor thermal comfort indicators determined?
8. What are the relationships between increasing indoor comfort and integrating energy-efficient solutions into the building under the retrofitting strategy?

9. In the context of retrofitting strategies, what are the effects of energy-efficient interventions to increase indoor lighting comfort and indoor thermal comfort on the life of buildings?

1.3. SCOPE

The scope of the work done for the above-mentioned purpose includes adaptive reuse, retrofitting, renovations that can be made to provide indoor user comfort and building conversion parameters to examine energy efficient conversions, indoor user comfort parameters, and providing interior user comfort with energy efficient solutions. It also covers the application of all the mentioned items to Şanlıurfa Houses with hayat. The suggestions and researches to be made in this study will be in the context of the sustainability goal.

This study consists of 5 parts. The introduction consists of 5 titles. Under these headings, the importance of the study, the definition of the problem, the research questions, purpose, method and scope are discussed and explained in this section. Information about the titles and sub-titles of this study as well as the limits of the study is given. The ways and methods of the study, the methods of obtaining qualitative and quantitative information are explained.

As mentioned before, the subject of this study does not include the conversion of functions in buildings, interior user comfort, retrofitting, and energy-efficiency. Data were collected in the 2nd part of the study, the Literature Study. Keywords were researched, and theses, articles, and qualitative information obtained from national and international standards were included. In the literature review section, data were collected under three sub-headings. In the first sub-title, the functional and physical life of the buildings were examined and the factors affecting the life of the buildings and building conversion strategies were examined. In the second sub-title, Adaptive Reuse, one of the main topics of this study, which is one of the building conversion strategies, is discussed in detail and the design and implementation processes of Adaptive reuse approaches and adaptive reuse projects are examined. The 3rd Subtitle and one of the main topics of the study, retrofitting applications, which is one of the building conversion strategies, indoor comfort parameters, energy efficiency, indoor thermal comfort, indoor lighting comfort, and energy efficiency in these contexts and energy efficiency applications in traditional buildings are examined.

The Methods and Materials section, which is the 3rd part of the study, by giving information about the data obtained in the study, the determinations made on-site, and the modeling and simulation programs used in the field study part of this thesis. Groundwork has been established for the next section, the fieldwork. In Chapter 4 of the study, the field work done is explained. This section consists of 4 titles. The first title is the title that contains geographical and climatic data about the city of Şanlıurfa, the city where the sample building where the fieldwork was conducted, and information about the traditional residential architecture of the region. Nuran Elçi Mansion, which was chosen as an example building in the 2nd title, is included in the information about the construction history and features, interior spaces and exterior. In the 3rd title, it includes the modeled simulation of the current situation, in which the measurements made to determine the current state of indoor comfort in 6 spaces selected from the sample building in terms of façade and elevation. The simulation results created to verify the improvement suggestions to increase the indoor comfort of the building and the results that will arise if these suggestions are implemented are included in the 4th title.

Part 5 of the study is the conclusion part. In this part, the results obtained and the level of success were discussed by referring to the research questions in line with the purpose of the study as a result of the qualitative and quantitative data and simulation analyzes obtained in the study.

1.4. RESEARCH PROCESS

The data in this study were obtained by 3 different methods. The first of these methods is the literature review in which qualitative data obtained from national and international standards, articles, and theses on retrofitting and adaptive reuse and methods, indoor user comfort, and energy efficiency titles are obtained in the 2nd part of the study. The second method is the personal determination method in which the data obtained from the Şanlıurfa Conservation Board about the area and building that is the subject of the study, the measurements and examinations made by the author herself on site. In the third method, modeling and simulation were used in order to verify the theoretical suggestions created in the field study. The qualitative data obtained in the literature review and the personal determinations made afterward formed the basis of the applications such as modeling and simulation made during the fieldwork.

For the field study, a mansion that was restored and re-functionalized in Urfa, but whose comfort requirements could not be increased, was chosen.

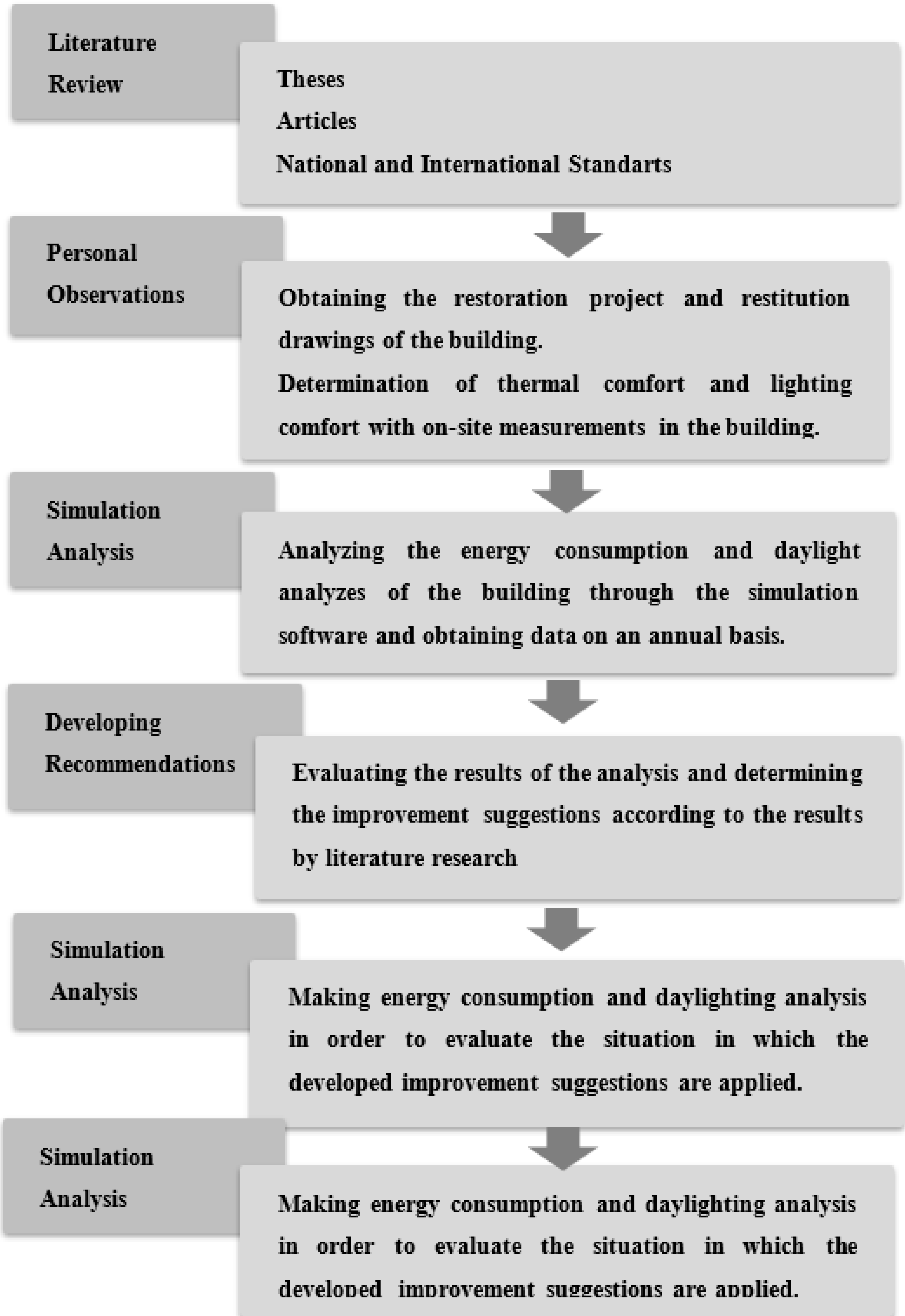


Figure 1: Process chart

CHAPTER II
LITERATURE REVIEW

In this section, research made from the literature about the concept of functioning and its sub-titles mentioned in the method section will be included. The results of the research in this section and the results to be obtained in the following sections will be evaluated and propositions will be formed in light of this research.

2.1. CONCEPTUAL APPROACH TO BUILDING ADAPTATION

Like all other assets, after it is built in buildings, over time, Physical obsolescence, functional obsolescence, etc. kind of obsolescence is observed. While physical obsolescence is related to the problems related to the survival of the structure, functional obsolescence is related to the fact that the existing function can no longer be fulfilled. The life span of the building can be extended by eliminating the negativities caused by aging. Obsolescence can be eliminated if the structural system can do its job. It is not possible to talk about the economic sustainability of a functionally obsolete building. Because such buildings result in insufficient indoor comfort, high building operating costs, and energy and resource consumption. For this reason, it is necessary to make the building more useful and comfortable with various interventions to be applied to the buildings in this situation. These methods, which will make the building more suitable for use, are called building adaptation projects. Building adaptation projects are projects that are sensitive to the use of resources and energy, aiming to prolong the life of buildings, and also focusing on providing user comfort (Conejos et al. 2013:75; Noorzalifah and Kartina 2016: 83).

In addition, the use of old buildings instead of new buildings reduces waste material, preserves natural resources, and reduces energy use and carbon emissions. (Yung and Chan 2012: 46). To understand why building adaptation projects are needed and why they are more effective methods, first of all, it is necessary to examine the aging processes and causes of buildings.

2.1.1. Building Life Cycle

Just like living things, structures have a life cycle. This cycle was first determined by the concept of LCA (Life Cycling Assessment), which emerged in the 1960s with the concerns of the limitation of material resources and overconsumption, but the LCA guide, which was initially put forward for products in the last 25 years, has been used in construction, automotive, etc. customized by the industry. According to the architectural LCA, the cycle starts with the material and progresses as the construction phase, the use phase (AIA). In this cycle, as a result of the completion of the useful life of the structure, the demolition/destruction phase takes place (Giresun and Tönük 2018: 112). The useful life of buildings is divided into physical and functional life. In general, the functional life of the structures is completed in a shorter time than the structural life of the structures, and the structures that are still standing structurally become unusable as they complete their functional life. During use, the structure loses its function or does not respond to the current function. In the subsequent phase, a period of temporary use or abandonment emerges. Abandoned buildings become unusable over time and enter a demolition phase. It is possible to see these stages in Figure 2 (Figure 2 Building Life Chart Without Adaptation). However, the life cycle of buildings can be repeated with re-functioning applications and the time to reach the demolition stage can be extended until the structural life is completed. With such an application, the life cycle of buildings is as in Figure 3 (Figure 3 Building Life Chart with Adaptation) (Giresun and Tönük 2018: 126).

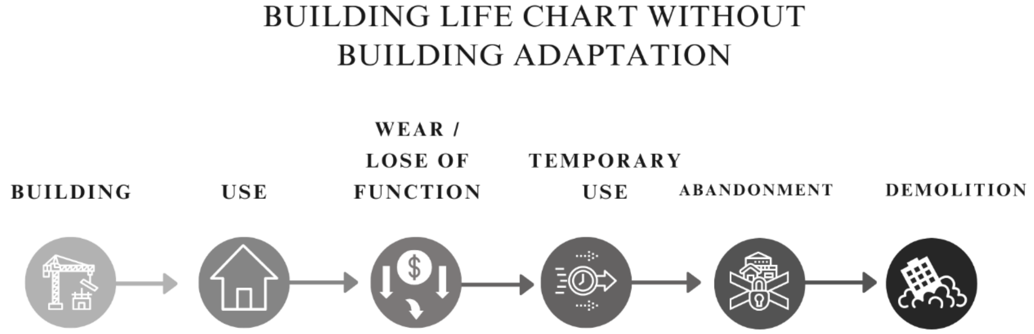


Figure 2: Building life chart without adaptation (Adapted from Giresun and Tönük 2018:128)

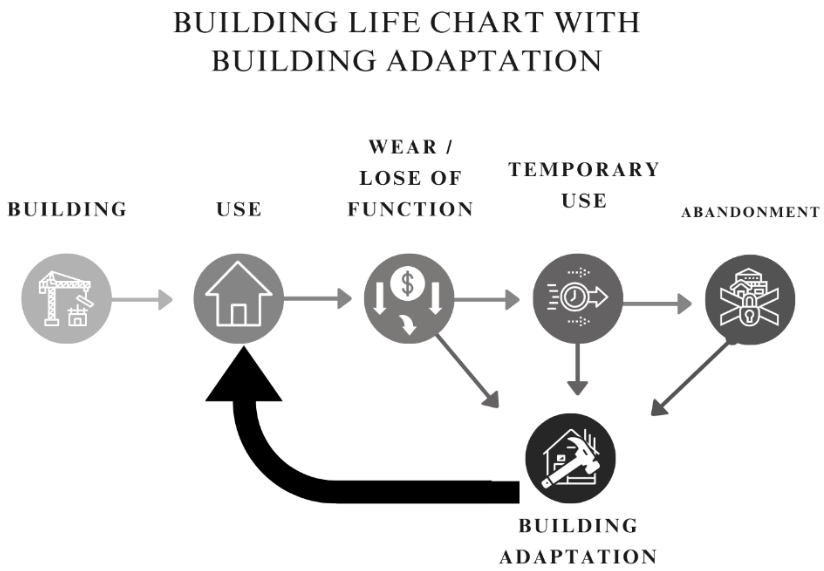


Figure 3: Building life chart with adaptation (adapted from Giresun and Tönük 2018:133)

As mentioned before, there are two types of physical and functional aging in buildings. There are several reasons for the completion of the functional life of the structures;

- Structural Factors: The structure no longer has enough features to satisfy users.
- Environmental Factors: The building has failed to respond to user needs, and requires a functional change point.
- Economic Factors: The maintenance costs of the building are higher than the earnings structure.
- Legal Factors: The structure does not comply with the updated legal procedures (Arabacıoğlu and Aydemir 2007:74).

With major changes in societies, the building groups needed vary. One of the most important examples of such changes is the Industrial Revolution. While many building groups are no longer needed in Europe with the industrial revolution, the need for some new building types has emerged. After this change, the defunct building stocks were re-functionalized and transformed into needed building groups, and the existing buildings were used until they completed their physical life. Although the concept of building conversion became popular with the Industrial Revolution, it is a method used before. Building Conversion is a process that transforms an unused, non-functional building into a new and usable structure for a different purpose (Othman and Elsaay 2018:25). This process aims to reuse traditional architectural and urban values whose physical life has not yet been completed, and thus to meet the need for new buildings with a more sustainable approach without demolition and reconstruction. (Arabacioglu and Aydemir 2007:65).

2.1.2. Consideration of Building Adaptation Aspects

The scope of building retrofit projects is diverse and may include repairing problematic structures, improving environmental performance, and replacing functional uses. An aged building that has reached the end of its current functional life may not give the expected and/or desired performance in many ways. These buildings are often economically unsustainable and have low indoor occupant comfort and increased energy use and water consumption. Environmentally friendly and timely building adaptation and renovation is essential to prolonging the effective life of a building. Adaptation projects can also increase the quality and comfort of existing buildings and ensure the satisfaction of building users, as well as the preservation and survival of the cultural and social values of historical buildings (Chan et al. 2015: 16; Remøy and Wilkinson 2012: 45).

The scope of building adaptation projects may vary for each project. Coverage differences depend on many factors, such as the type and scale of buildings, existing conditions, adaptation requirements, and construction activities undertaken during these projects (Thuvander et al. 2012:28). Many different terminologies are used in the literature and industry to describe the scope of building retrofit projects. These terminologies are often used interchangeably because of their overlapping scopes and lack of clarity regarding their appropriate use (Douglas 2006:113). It has been determined that there is conceptual confusion in the researchs. For this reason, it was deemed necessary to explain the contents of the concepts. The projects to be implemented are separated according to their scope, as in Figure 3 In this study, terminological concepts will be discussed in a non-structural way.

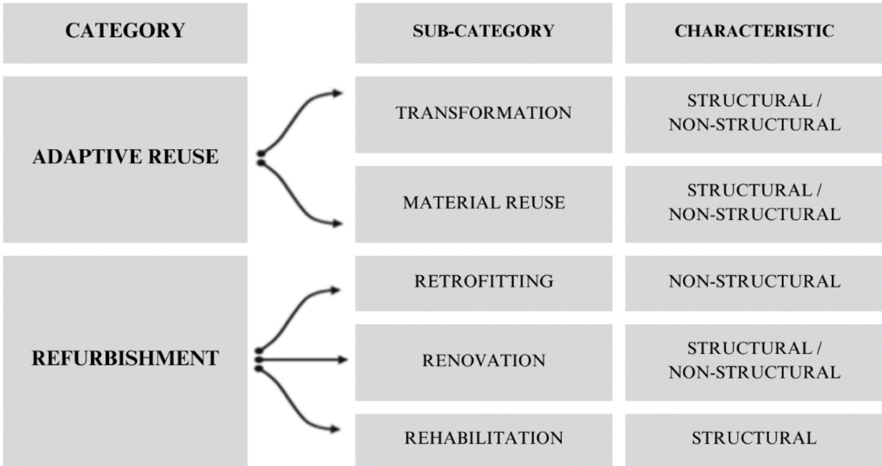


Figure 4: Building adaptation projects categorization (Adapted from Shahi et al. 2020:122)

The terminology of building conversion projects can be defined as follows;

- *Refurbishment:* In these projects, improvement works are carried out to adapt the deficiencies in the life of the building, the necessary improvements for longer use, and the adaptation of new technologies to the structure. Examples of these improvement studies are applications such as repair, maintenance, building improvement, and into, grating energy-efficient systems. Refurbishment includes the terms retrofitting, renovation,n and rehabilitation. All of these are different terminologies separated according to the applications made within the scope of the project (Ghose et al. 2017: 145; Institute of Historic Building Conservation 2019: 6; Passer et al. 2016: 18).
    - *Retrofitting:* In these applications, it is aimed to strengthen the structure, add new technology-appropriate systems to the structure or increase the capacities of existing systems, increase indoor user comfort, and increase energy efficiency. Examples of these applications include the addition of renewable energy systems, building envelope, and updating of HVAC systems (Albatici et al. 2016: 145; Antoine et al. 2016: 145; Ma 2012:183).
    - *Renovation:* This application aims to replace the outdated components of the buildings or to remake the interior spatial arrangement of the existing buildings. Examples of these applications are remodeling, interior arrangement, and design, energy efficiency applications, and

aesthetic appearance applications (Ástmarsson et al. 2013: 88; Jensen and Maslesa 2015: 75).

    - *Rehabilitation:* These applications aim to repair, replace or add applications to make the structure compatible with use, to prolong the usage period of the structure. These practices aim to replace more damaged and deteriorated elements of the building, but can sometimes also include building openings and the building envelope. With these practices, demolition can be prevented and building safety increased (Brás et al. 2017: 165; Garrido et al. 2016: 48).

- *Adaptive Reuse*: Adaptive reuse practices are the second main topic of building adaptation terminology. Adaptive reuse applications aim to reuse and protect structures that are in temporary use, outdated, and/or abandoned with existing materials and structures by changing their function. These applications include giving a new function to the building, the reuse of materials, and all applications under the title of refurbishment. Under the heading Adaptive reuse, the terms material reuse and building conversion are included (Bullen and Love 2011: 133; Conejos et al. 2011: 123; Langston et al. 2008: 203). We will discuss this concept in more detail in the following sections.
    - *Material Reuse:* With this application, it aims to use the materials of the existing building one or more times by repairing, recycling, and renewing. With this application, the amount of waste can be reduced and the use of materials and energy can be reduced (Kralj and Markic 2008: 38; Park and Tucker 2017: 48).
    - *Building Conversion:* This application aims to extend the service life of the structures by changing the function of the structures that cannot meet the needs of their users or whose functions have lost their competence. This practice aims to reduce the use of materials and energy and to reduce greenhouse gas emissions (Purwantiasning et al. 2013: 21; Živković et al. 2015: 18).

The term retrofitting under the title of adaptive reuse and retrofitting, which is one of the building adaptation terminologies, which is especially taken into consideration in the content of this study, will be examined in more detail in the following parts of the study.

2.2. ADAPTIVE REUSE

As mentioned before, Adaptive reuse is an application that aims to extend the service life until the physical life is completed by giving a new function to buildings that have lost their current function. These applications are often accompanied by significant physical changes in the structure (Conejos et al. 2011:12).

Adaptive reuse is not a new concept. (Camocini and Rebaglio 2012); This conversion has been done many times in ancient societies (Fitch 1990). We can give examples of these structures in cities that changed hands after the conquests. For example, Hagia Sophia, and Parthenon. These are examples of pre-modern adaptive reuse. In the contemporary period, there is a huge building stock created by industrial buildings. These are the most common examples of adaptive reuse in the modern period.

While adaptive reuse projects can be implemented in a single building, they can also be considered at larger scales. Building groups and neighborhoods can also be handled in adaptive reuse applications.

Adaptive reuse is defined as the process of extending the useful life of historic, old, and abandoned buildings. Adaptive reuse is planned by considering new use requirements, socio-cultural demands and environmental regulations. Adaptive reuse projects aim to maximize the reuse and conservation of existing structures and materials and improve the economic, environmental, and social performance of buildings (Bullen and Love 2011:22; Conejos et al. 2011: 85; Langston et al. 2008: 122; Larkham 2002: 136). These features make adaptive reuse a sustainable alternative to demolition and new construction (Sanchez and Haas 2019:48; Sugden and Khirfan 2017: 62). Adaptive Reuse is a process that transforms an unused, non-functional structure into a new and usable structure for a different purpose (Othman and Elsaay 2018: 78). With all these benefits, Adaptive reuse is a sustainable approach.

The concept of sustainability is one of the most used concepts today. Sustainability is often defined as meeting our own needs without compromising the ability of future generations to meet their own needs. Especially since the 1980s, a wider area has also been used. In today's developing and increasing population, problems such as rapid and wrong urbanization and excessive resource use have come to the fore. The concept of sustainability, which was created to leave a more livable world to future generations, is examined under 3 main headings. As mentioned before, Adaptive Reuse is one of the sustainable solutions for resource use in the construction industry. Adaptive reuse is an environmental solution that is more sustainable in terms of energy and resource use than demolition and rebuilding. In addition, the sustainable benefits of adaptive reuse are not limited to environmental benefits (Elsorady 2013: 23).

- *Social Benefits:* One of the most important values that make a society a society is cultural values. It is necessary to transfer the cultural accumulation of rapidly changing needs, living conditions, and socio-economic structures to future generations in a healthy way. In an environment bearing traces of the past, the individual instinctively and intellectually acquires historical consciousness. For this reason, architecture, which is a formal indicator of the spaces and spaces in which the person is located, is also the cultural continuity of the society it serves (Gökçe 2018: 35). Additionally, building conversion can improve the safety, quality of life, and health of building occupants (Aigwi et al. 2018: 18; Shen and Langston 2010: 23). For example, the reuse of a historical, traditional building in the city center that the public can easily access is of great importance. Thanks to the Adaptive Reuse project, unused buildings will be brought back to life, the region will be revitalized, and the crime rates will be reduced positively.
- *Economic Benefits:* Reusing the existing structure is cheaper than demolishing and rebuilding the old structure. This method saves energy, labor, material, and time. High land prices also increase the economic benefit of using the existing building (Gökçe 2018: 46). Building conversion can also increase the property value of a building and surrounding buildings, increase the building's economic sustainability, and create 25% more jobs per square meter. (Chan et al. 2015a: 18; Sanchez and Haas 2019: 26). In this way, new investments can be made in the region (Langston et al. 2008: 28).
- *Environmental Benefits:* Resource efficiency is one of the most important environmental benefits of adaptive reuse. Using the existing structure in the adaptive reuse method minimizes resource and energy consumption, and there is a waste management benefit as the wastes from demolition are not in the adaptive reuse method (Celadyn 2019: 42). Less greenhouse gas emissions, controlling urban sprawl, and conserving embodied energy are

other environmental benefits of adaptive reuse (Conejos et al. 2013: 122; Langston et al. 2008: 77; Sanchez and Haas 2019: 47; Yung and Chan 2012: 62).

2.2.1. Different Approaches of Adaptive Reuse

As mentioned before, Adaptive Reuse applications can be preferred with two different approaches: material reuse and building conversion. Which of these approaches is suitable for the building, or the applicability of both, is decided by examining each building.

2.2.1.1. Material Reuse

Sustainable buildings are buildings that support the natural environment and support the efficient use of resources as part of sustainable development (Raynsford, 2000: 16). Both sustainability and green buildings have gained momentum since the 2000s and the material reuse is an important factor at this point. In today's conditions, sustainable buildings are at the center of the construction industry and become an increasing trend (Glavanich 2008: 16). Environmental awareness also comes to the fore with these applications, which include functionality to include the reuse of materials.

In adaptive reuse, it is accepted that with the reuse of materials, less carbon dioxide emissions and air pollution occur, a low amount of fossil-based fuel is used, and the production and consumption of fossil fuels are affected on a lesser scale (Kibert 2008: 99).

The construction industry is responsible for 40% of global resource consumption (Pacheco-Torgal et al. 2014: 88) and accounts for the main majority of waste generation. (Zhao et al. 2010: 11). Material Reuse is a sustainability strategy that helps reduce resource consumption and waste generation by maximizing the recovery of waste materials and minimizing waste as much as possible.

Reuse of materials is defined as the process of partially repairing and renovating the materials obtained from the building, whose lifespan is completed, for different purposes (Kralj and Markic 2008: 122; Park and Tucker 2017: 36). This method can be applied as shown in Figure 4 (Figure 4 Scope of application associated) (Shashi et al. 2020: 22). As a priority option, if the building is being converted or remodeled, it can be reused in the same building during conversion or refurbishment.

As a second option, if the building is not suitable for adaptation and needs to be demolished, it can be sent to a place for sale and reuse in different projects within or outside the construction industry, or it can be recycled. (De Brito and Dekker 2004: 23; Hosseini et al. 2015: 17).

Recycling aims to transform waste materials into new materials or objects through extensive regeneration, but both quantity and quality are lost as these new materials are created. In addition, reusing materials consumes less energy and resources than recycling, resulting in greater cost savings. Therefore, recycling should only be considered when the material cannot be reused (Stahel 2016: 54).

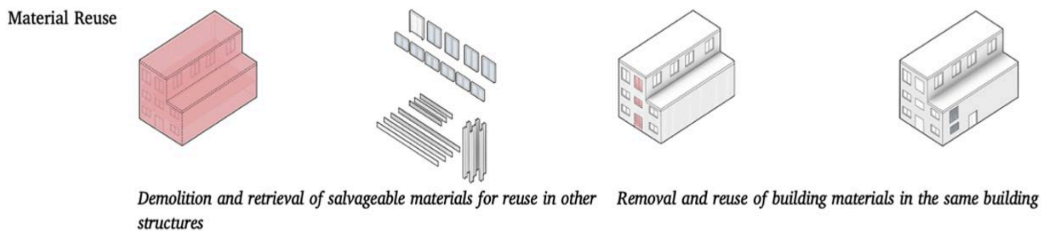


Figure 5: Scope of application associated (Shashi et al. 2020: 45)

2.2.1.2. Building Conversion and Process

Building conversion, another method of adaptive reuse is an adaptation strategy by changing the functions of old and abandoned buildings that cannot meet the needs of their users or are no longer used (Purwantiasning et al. 2013: 23). Conversion can be partial or complete.

As mentioned above, the adaptive reuse heading under the building adaptation terminologies is divided into two building conversion and materials reuse applications. After this distinction, the building conversion method, which is a method that increases the service life of buildings that have lost their function and function, is two-stage. In the building conversion method, it is very important to choose a function that is suitable for the existing structure, the location of the building, the society in the location, and the needs of the society. Project Process is the first phase of the Adaptive Reuse conversion method. At this stage, first of all, a new function suitable for the structure is selected and a conversion project is prepared accordingly. After the project process is completed, some interventions are applied to the existing structure according to the project prepared following the new function. The Implementation process, in which these interventions are made, is the second stage of the building conversion method. It is possible to see the aforementioned divergences in Figure 5 (Celadyn 2019: 124; Shashi et al. 2020: 85).

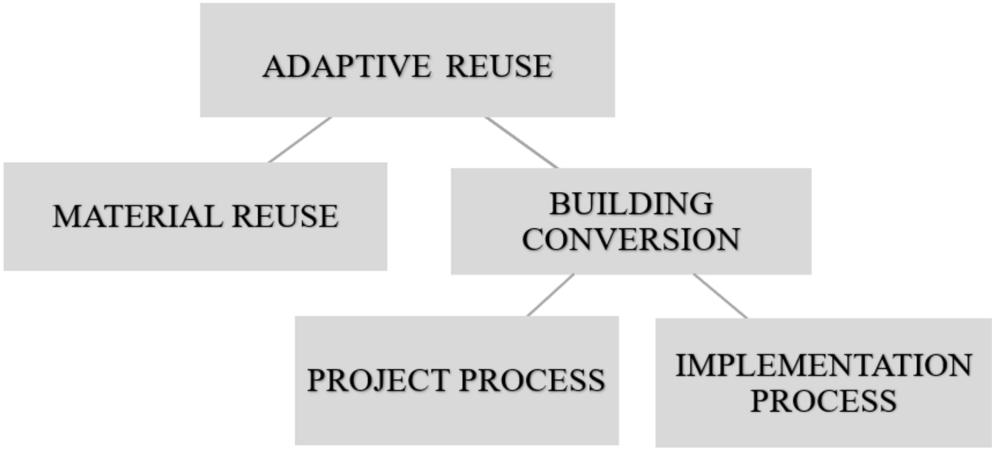


Figure 6: Adaptive reuse categorization (Adapted from Shahi et al. 2020: 13)

2.2.1.2.1. Project Process in Building Conversion

- This stage is the stage where detailed research, planning, and programming are done before starting the implementation, such as planning the building conversion process, deciding on the new function, and preparing the building projects suitable for the new function. At this stage, while deciding on the post-conversion function of the building, examining the area where the building is located and the types of buildings needed in the region, preparing financial reports, and analyzing them economically, including the conversion project, implementation and usage process, conducting market research, especially if the new function to be selected is commercial, characteristics of the building. A long-lasting function selection should be made by determining its compatibility with the environment as well as its spatial arrangement and environment, determining the needs of the users of the new function in the determined function, and determining whether the existing building meets these needs with the changes to be made. If the function determination is made before these investigations and determinations are completed, it may result in an unsuccessful adaptive reuse application, the building may complete its reuse life in a short time and reach the process of temporary use and/or abandonment, and even cause negative consequences on the urban scale

(Alagöz 2015: 23). According to the new function evaluation mechanism, the process should be as follows.

- Implementation of a survey before installation and improvement regarding the project,
- Energy audit and performance evaluation,
- Defining options for empowerment (Ma et al. 2012: 891)
- Creation of architectural reports
- Preparation of the current study area and proposal project
- Creating a cost report (Eley and Worthington 1984: 222).
- Preparation of the project according to the authencity of the building
- Designing the surrounding buildings in accordance with the new laws, regulations, architectural and aesthetic qualities

2.2.1.2.2. Implement Process in Building Conversion

After the appropriate function is selected and the project drawings are completed for the applications required to meet the needs following the new function, the application process to be carried out in accordance with the projects begins. The interventions need to be made to the buildings to preserve the authenticity of the building and to make the interventions reversible. These interventions can be listed as follows:

- *Realize Spatial Fiction:* In case of need in the new function, interventions such as adding a mezzanine, connecting existing spaces, and adding new dividers are within this scope. For the building to be opened to the public after it is operational again, it must comply with certain laws and rules, and therefore, compulsory spatial interventions must be made. For example, spatial intervention is required in cases where fire escape halls and fire stairs are mandatory, but these areas cannot be used for this purpose since this is not allowed in areas considered protected areas (Selçuk 2006: 22).
- *Structural Enhancements:* During the adaptive reuse process, changes may be required to interfere with the structural elements of the building, such as retrofitting the building, adding vertical circulation areas, or constructing outbuildings. For example, the building may need to be strengthened

according to the earthquake code. However, some of these interventions may not be possible in registered buildings (Selçuk 2006: 113).

- *Installation Practices*: During the adaptive reuse process, the old building's plumbing systems must also be updated. If the building is very old, it may even need to be completely renovated. It is a difficult area to intervene, especially since the interventions related to the installation are made flush-mounted. At the same time, any intervention in the building in this area may cause the building to lose its authencity. Opening channels and gaps in various parts of the building, on wall surfaces for electrical installations and fire protection installations, will damage the original material (Selçuk 2006: 122).

2.2.2. Adaptive Reuse Regulations

Adaptive reuse of historic buildings can provide social, environmental and economic benefits. However, these benefits need to be balanced with the cultural and historical significance of the building. Historic building conservation regulations and laws are of critical importance to achieve this balance and ensure the sustainability of the adaptive reuse process.

2.2.2.1. International Council on Monuments and Sites (ICOMOS)

ICOMOS is an international non-governmental organization that promotes the conservation and protection of cultural heritage sites and landscapes. Founded in 1965, it is headquartered in Paris, France. According to ICOMOS, adaptive reuse is "the process of changing a disused or redundant item or place into a new use or function, with the aim of retaining its cultural significance and value while enabling it to be used for a different purpose" (ICOMOS 2021: 6). The organization recognizes that adaptive reuse can be an effective way to preserve historic buildings and sites but emphasizes the importance of careful planning and implementation to ensure that the heritage significance of the building or site is respected (ICOMOS 2011: 12). This may involve conducting extensive research and analysis to understand the historical and cultural context of the building, as well as developing a detailed conservation plan that balances preservation with the needs of the new use.

“ICOMOS (International Council on Monuments and Sites) is a global non-governmental organisation associated with UNESCO. It is founded in 1964 in Warsaw and has its headquarters in Paris. ICOMOS works for the conservation and protection of cultural heritage places. It is the only global non-government organisation of this kind, which is dedicated to promoting the application of theory, methodology, and scientific techniques to the conservation of the architectural and archaeological heritage. Its work is based on the principles enshrined in the 1964 International Charter on the Conservation and Restoration of Monuments and Sites (the Venice Charter). Its mission is to promote the conservation, protection, use and enhancement of monuments, building complexes and sites. It participates in the development of doctrine, evolution and distribution of ideas, conducts advocacy. ICOMOS is the Advisory Body of the World Heritage Committee for the Implementation of the World Heritage Convention of UNESCO. As such, it reviews the nominations of cultural world heritage of humanity and ensures the conservation status of properties. In light of numerous studies, conferences, symposia and discussions led by its National Committees and International Scientific Committees, ICOMOS has gradually built through philosophical and doctrinal heritage internationally.

ICOMOS is a network of experts that benefits from the interdisciplinary exchange of its members, among which are architects, historians, archaeologists, art historians, geographers, anthropologists, engineers and town planners.

The members of ICOMOS contribute to improving the preservation of heritage, the standards and the techniques for each type of cultural heritage property: buildings, historic cities, cultural landscapes and archaeological sites"

2.2.2.2. Turkish Regulation

In Turkey, the Law on Conservation of Cultural and Natural Heritage (No. 2863) regulates the maintenance and repair of historic buildings. According to this law, any maintenance or repair work on a historic building must be approved by the relevant authorities before it can be implemented to ensure that it is compatible with the building's cultural significance and authenticity (Law on Conservation of Cultural and Natural Heritage No. 2863)

To obtain the necessary permissions for maintenance and repair work, property owners or managers must submit a detailed application, including plans, drawings, and specifications, to the local Cultural Heritage Preservation Board or the Provincial Directorate of Culture and Tourism, depending on the building's location. The authorities will then review and assess the proposed work and issue a permit if it meets the required standards and criteria (Ministry of Culture and Tourism 2023).

Property owners or managers are also required to hire qualified professionals, such as architects and engineers with expertise in historic building preservation, to carry out the maintenance or repair work (Koşan 2020: 56)

Overall, the maintenance and repair process for historic buildings in Turkey aims to protect and preserve these buildings for future generations while addressing the current needs of the society.

According to Turkish law, historical buildings can undergo various types of maintenance and repairs, which include maintenance, simple repair, fundamental repair, and reconstruction. The definitions of types of maintenance and repairs are based on the Regulation on the Protection of Cultural and Natural Assets (Kültür ve Tabiat Varlıklarını Koruma Yönetmeliği), are as follows:

Maintenance refers to the regular and routine upkeep of historical buildings to prevent deterioration and ensure their longevity. This includes activities such as cleaning, inspection, minor repairs, and replacement of deteriorated elements.

Simple repair involves the restoration of historical buildings using original materials and techniques without altering the original design or appearance. This type of repair aims to address minor damages and deterioration caused by wear and tear or environmental factors.

Fundamental repair, on the other hand, refers to the restoration of historical buildings using original materials and techniques. However, it may also involve the replacement of severely damaged or deteriorated elements with compatible materials. This type of repair addresses significant damage or deterioration caused by natural disasters or long-term neglect.

Reconstruction, the most drastic option, involves completely rebuilding a historical building using modern materials and techniques. Reconstruction is only considered when the original structure is completely lost or destroyed. It should be carried out based on the authenctic original design and appearance of the historical building (Ministry of Culture and Tourism 2023).

In the context of adaptive reuse, the use of copyrighted works, such as photographs, drawings, or other visual representations, must be authorized by the creator or copyright owner, in accordance with the Law on Intellectual and Artistic

Works (Fikri Sanat Eserleri Kanunu) in Turkey (Law on Intellectual and Artistic Works, No. 5846, Fikri Sanat Eserleri Kanunu).

The FSEK Law is a legal framework governing intellectual property rights in Turkey, which regulates the rights of creators of artistic and intellectual works. Under this law, creators of copyrighted works have the exclusive right to reproduce, distribute, and publicly display their works. This means that any use of a copyrighted work, including in the context of adaptive reuse, must be authorized by the creator or copyright owner.

In the context of adaptive reuse, the use of copyrighted works may be necessary to guide the design and construction of the adaptive reuse project. However, permission to use a copyrighted work may be obtained through a license or other agreement with the copyright owner. The scope of fair use, which allows for limited use of copyrighted works without permission for certain purposes, is determined on a case-by-case basis, considering factors such as the purpose and character of the use, the nature of the copyrighted work, and the amount and substantiality of the portion used in relation to the whole work (Ministry of Culture, Copyright, General Directorate of Copyrights 2023)

The FSEK Law plays a crucial role in protecting the intellectual property rights of creators in Turkey, including in the context of adaptive reuse. Therefore, it is important for designers and developers to obtain proper authorization and licensing for any copyrighted works used in adaptive reuse projects.

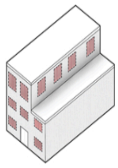
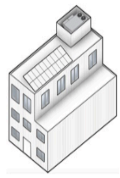
2.3. RETROFITTING

Retrofitting, which is another strategy we have seen under the title of building adaptation, is another building adaptation method that is frequently applied in cases where existing buildings cannot meet user needs and are insufficient in terms of energy efficiency. It is an important problem that it cannot satisfy the users in the interior comfort of historical and old original buildings in most parts of the world. Smaller changes and renewals are sufficient to preserve and make these structures usable (Abdelrazek 2019: 148).

Retrofitting activities cover topics such as reducing heating and cooling demands, increasing HVAC efficiency, and actively integrating renewable energy systems. As seen in Figure 6, it includes adding improvement features or increasing the capacity of the existing building during the initial project and construction process

(Antoine and Rofaïda 2016: 37; Eames et al. 2014: 51; Imaz 2019: 23; Historic Building Conservation Institute 2019; Ma et al. 2012: 17).

Table 1: Retrofitting application scope (Shashi 2020: 23).

	Structural Improvements		Other Improvements	
	Existing Building	Adapted Building	Existing Building	Adapted Building
Retrofitting	——	——		
			Replacing windows, increasing insulation and addition of renewable energy sources and efficient HVAC	

For a correct Retrofitting application, the structure should be considered as a whole. While determining the parameters (indoor user comfort, building user capacity, energy efficiency, etc.) to be considered while preparing the retrofitting project, a priority order should be made at the same time. Since each building is different, the priority list of each building should be unique. In this order of priority, many factors such as the construction technique of the building and the materials used, the location of the building (geographical and topographic structure), the direction, the form of the building, the climate of the region where the building is located and the duration of sunshine should be taken into consideration. After these examinations and determinations, the retrofitting strategy or strategies suitable for the building should be selected and applied by evaluating the situation of the building.

Retrofitting applications are divided into passive and active strategies;

- *Passive Strategies:* These strategies include adding energy-free systems to the building. Examples of this strategy are insulation and green roof applications.
- *Active Strategies:* This strategy includes integrating systems with energy consumption into the building. However, when choosing the added systems, it is for energy efficient and/or efficient use of energy. Examples of these strategies are applications such as adding more energy-efficient automation systems.

2.3.1. Retrofitting and Energy Efficiency

Energy efficiency, which is one of the most important issues in today's conditions, should not be ignored when retrofitting applications are made to a building. In recent years, the depletion of resources, the greenhouse effect, and the rapid increase in global warming concerns have led the authorities in the energy sector to encourage the efficient use of existing resources while seeking alternatives for energy production from renewable resources. While buildings generally provide shelter for people to carry out many daily activities, they also pose a great danger to the environment with their high energy consumption. According to UNEP (United Nations Environmental Programme 2011), approximately 40% of global energy, 25% of global water, and 40% of global resources are consumed, in addition to the energy used in buildings producing one-third of greenhouse gas emissions.

In order to minimize these global effects, the concept of energy efficiency, which means reducing the energy consumed by a product or service, has been introduced. While aiming to reduce energy consumption, cost savings are also achieved.

Existing buildings built before energy conservation became a topical issue make up the largest part of the built environment and therefore do not meet modern energy efficiency standards. (Albatici et al. 2016: 145; Paradis 2012: 118). In the current building stock, 50% of the energy used is spent on space heating and cooling, and more than 15% on water heating (Pasichnyi et al. 2019: 17). Therefore, reducing the demand for space heating and cooling and initiating active energy generation can contribute positively to the reduction of carbon dioxide emissions from buildings. In addition, energy losses in this regard can be prevented with improvements in lighting. In addition to improving the building's energy efficiency, the inclusion of passive systems and technologies, including smart metering systems and smart occupant controls, is part of the retrofit to increase occupant comfort. Other benefits include a reduction in maintenance and repair costs and overall improved socio-economic well-being of the existing building stock (Pardo-Bosch et al. 2019: 23).

Since in this study, retrofitting applications, those aimed at improving indoor user comfort and energy efficiency, will be examined, it will be useful to examine indoor environmental comfort together with energy efficiency at this stage.

2.3.2. Indoor Environmental Comfort and Energy Efficiency

The term indoor environmental quality "(IEQ)" refers to the suitability of many sub-topics that affect human life within a building. Some of the Indoor Environmental Quaility titles and their focus are as seen in the table 2.

Table 2: Indoor environmental quality components (Drawn by Author)

IEQ COMPONENT	FOCUS	REFERENCE
Indoor Air Quality	Indoor Air Quality (IAQ) examines the air quality in and around buildings and structures, specifically for the health and comfort of building occupants.	EPA,2022
Acoustic Comfort	Acoustic comfort is the reduction of values that may cause discomfort to users.	Antoniadou, Papadopoulos, (2017)
Thermal Comfort	Examines thermal comfort standards to help building designers maintain an indoor climate that occupants will find thermally comfortable.	Nicol, Humphreys, (2002)
Lighting Comfort	Lighting quality aims to provide excellent vision while providing high comfort.	Kruisselbrink, Dangol, Rosemann, (2018).
Odor	It examines reducing exposure to chemicals and related odors, a preventive action that can lead to improved outcomes for human health and the environment.	CDC,2021.

IEQ should be prioritized when designing new buildings and preparing building adaptation projects. Inadequate indoor environment quality can cause many health and psychological problems for building users. Since the two IEQ parameters based on this study will be thermal comfort and lighting comfort from IEQ headings have been examined in detail in the context of energy efficiency.

2.3.2.1. Indoor Thermal Comfort and Energy Efficiency

Thermal comfort in a building is a parameter that changes depending on environmental and human factors. Environmental factors include air temperature, air velocity, humidity, radiant temperature, and relative humidity, while key human factors include clothing and metabolic heat, physical health, mental state, food and beverage availability, and air conditioning (Szokolay 2014: 122). Since the human factor is also a factor, this parameter is mostly personal and cannot be measured directly (Nicol and Humphreys 1973: 83) It has been determined that the thermal comfort level is acceptable when at least 80% of the users feel comfortable. In ASHRAE, 1997, thermal comfort is defined as a state of mind that expresses satisfaction with the thermal environment and requires subjective evaluation of factors beyond physical/physiological (Szokolay 2014: 25). However, Air temperature is the dominant environmental factor (Szokolay 2014: 33). In this regard, the American Society of Heating, Refrigerating, and Air Conditioning Engineers, Inc (ASHRAE 2017: 12) recommended 20-24 °C in winter and 22-26 °C in summer as a suitable indoor thermal comfort value. The ASHRAE guidelines recommend a relative humidity of 30-60%. Indoor thermal comfort in buildings is one of the most important reasons for user satisfaction and energy consumption. (Nicol et al., 2012). In addition to the heating and cooling systems used in buildings, heat control automation systems are among the elements that help the user in thermal comfort.

This large share of the energy consumed in buildings is due to thermal comfort cooling (50%) and lighting (32%). Therefore, it is very important to be energy efficient while providing thermal comfort (Ramesh and Khan 2013: 24). Heat loss and gain in buildings come mostly from the outer shell. Heat losses in buildings may vary according to the architecture of the building project, the materials used, and the construction techniques. In most cases, heat loss in buildings occurs from the exterior walls, ceiling (roof in single-story buildings), windows, and basement (floor in buildings without basements) (Balo and Ulutaş 2023: 28). For this purpose, the first arrangements to be made in these parts are important (Diri and Çağrır 2012: 17).

2.3.2.1.1. Walls

The most effective way to reduce the energy consumed for heating and cooling buildings is to prevent heat gains and losses. Some of the applications for these purposes are as follows. (Figure 8).

Table 2: Energy efficient retrofit methods applied to the walls, (Diri and Başarır 2012: 183)

RETROFIT METHOD	
Insulation Application	Exterior of the Exterior Wall
	Interior of the Exterior Wall
Use of Solar Shading Elements	
Transparent Insulation Application	
Photovoltaic Panel Application	

- *Insulation:* In order to prevent the previously mentioned heat losses, the thermal conductivity coefficient of U is reduced to increase the thermal resistance of an existing building. The most effective method for this is the application of thermal insulation. 30-60% of heat loss occurs in uninsulated buildings, depending on the location and quality of the building. Insulation can be applied on the interior or exterior wall. In reducing the thermal transmittance value, the regionally determined standard U value in the TSE 825 standard valid in our country can be considered.
- *Shading:* Integration of shading elements into walls is also an energy-efficient improvement method. Thanks to the shading elements, unwanted heat gain is prevented and the load on the mechanical cooling system is reduced (Diri and Basarir 2012: 167). While applying this method, indoor lighting comfort should be taken into consideration and the required amount of lighting should be provided in the interior.
- *Transparent Insulation*: The most important feature of transparent insulation is that it transmits at least 40% of the sun's rays to the solid wall and provides additional heat gain from solar energy during the warming periods of the year (Yeşildal et al. 2004: 22). The use of solar energy in heating spaces with transparent insulation applications provides environmentally sustainable benefits with less fossil fuel consumption (Özbalta et al. 2003: 17).
- *Photovoltaic:* Integration of photovoltaic panels into the facade of the building is one of the methods used to take advantage of solar energy. Depending on the structure of the solar cells, solar energy can be converted into electrical energy with an efficiency of 5 - 20% (Diri and Basarir 2012: 143).

2.3.2.1.2. Roofs

In order to keep the heat transfer at the desired level, it must provide a level of thermal resistance. As mentioned in the insulation section of the previous wall title, prevention of heat loss and gain on roofs is important in terms of the amount of energy consumed in heating and cooling the building. In addition, energy consumption can be reduced by different measures. Some of the practices aimed at reducing energy consumption and using renewable energy are as follows in Figure 9.

Table 3: Energy efficient retrofit methods applied to the roofs (Diri and Başarır 2012: 137).

RETROFIT METHOD	
Insulation Application	
Green Roof Application	
Painting the Roof	Dark Colors at the Cold Climate Zones
	Light Colors at the Warm Climates Zones
Use of Renewable Energy Sources by Roof Integrated Systems	Photovoltaic Panels
	Thin-film Photovoltaic Roofing Materials
	Solar Collectors

- *Insulation:* With a continuous and successful thermal insulation application that does not allow heat leakage, heat flow can be prevented on the roof, just like on the walls. Unwanted heat losses and gains can be avoided.
- *Green Roofs:* Green roofs are passive cooling techniques that prevent sunlight from reaching the building structure in hot weather conditions and provide an additional thermal insulation layer with soil in cold weather conditions. Lui and Minor (2005) conducted a study comparing the thermal performance of a green roof system in Toronto, Canada... According to the measurements, they found that the heat gain with green roof systems decreased by 70-90% in summer and 10-30% in winter (Castleton et al. 2010: 23).
- *Painting Roofs*: According to the analysis, it has been shown that painting the roof with light colors in warm climates and dark colors in cold climates is more effective in terms of energy and cost in high-rise buildings with less roof area (Klerks 2010: 45).
- *Renewable Energy Systems*: The use of renewable energy sources with integrated roof systems increases the energy efficiency of existing buildings. Some of the domestic hot water and space heating loads can be achieved by placing solar collectors.

2.3.2.1.3. Windows

Windows, which must be transparent due to their function of providing adequate lighting to the interior spaces and visually linking the interior and exterior environment, are at least the insulated building envelope component. Therefore, a large amount of heat loss occurs through the windows. As mentioned before, one of the factors affecting thermal permeability is the material. Since windows consist of two different products and material combinations frame and glass, the changes made to increase energy efficiency in windows are also divided into two recommendations for frame and glass. It is possible to see different suggestions for both products in Figure 10 (Diri and Basarir 2012: 22).

Table 4: Energy-efficient retrofit methods applied to the windows (Diri and Başarır 2012: 36).

<table>
<tr><td colspan="5">RETROFIT METHOD</td></tr>
<tr><td colspan="2">APPLICATON REGION</td><td colspan="3"></td></tr>
<tr><td rowspan="16">WINDOW</td><td rowspan="5">FRAME</td><td colspan="3">Renovation of the Seal</td></tr>
<tr><td rowspan="4">Rennovation of Frame</td><td colspan="2">Aluminum</td></tr>
<tr><td colspan="2">Wood</td></tr>
<tr><td colspan="2">Vinyl (PVC)</td></tr>
<tr><td colspan="2">Fiberglass</td></tr>
<tr><td rowspan="11">GLASS</td><td colspan="3">Low – E Glass</td></tr>
<tr><td colspan="3">Film Coating</td></tr>
<tr><td rowspan="4">Colored Glass Application</td><td>Green</td><td>Blue-Green</td></tr>
<tr><td>Smoke-colored</td><td>Azurlite</td></tr>
<tr><td>Bronze</td><td>Evergreen</td></tr>
<tr><td colspan="2">Blue</td></tr>
<tr><td rowspan="2">Multi Layered Glass Application</td><td colspan="2">Double Layered Glass</td></tr>
<tr><td colspan="2">Triple Layered Glass</td></tr>
<tr><td rowspan="2">Filling Gass Between the Layers of Glass as a Insulation Material</td><td colspan="2">Argon</td></tr>
<tr><td colspan="2">Krypton</td></tr>
<tr><td colspan="3">Integrated Concentranting Dynamic Solar System Application</td></tr>
</table>

- *Glass:* There are three basic approaches applied in the production of window glass to ensure high energy performance. The first is to change the physical properties or chemical structure of the glass material. An example of this is colored glass. The second approach is to cover the surface of the glass material with a reflective film to reduce glare and solar heat gains. In recent years, a low-emissivity coating has been developed to provide both cooling and heating. The third approach is to create spaces between layers of glass whose properties can be controlled. These windows consist of two or more layers and the space between them is filled with low-conductivity gas. Window performance in double-layer applications increases by 11% with the use of argon gas and 22% with the use of krypton gas (Esin 2007: 187).

- *Frames:* The main types of frames used in the market are wood, vinyl (PVC), and aluminum. Among these frames, aluminum frames are the most disadvantageous frame type in terms of heat losses and gains due to their higher heat transfer coefficients compared to other frame materials (Aycam et al. 1999: 145). PVC and aluminum frames can be replaced with wood, vinyl, or fiberglass frames with a lower heat transfer coating. In addition, today it is possible to convert solar energy into electrical energy thanks to concentrated integrated solar energy systems that can be placed in window openings (Guiney et al. 2008: 24; Wang 2010: 88).

2.3.2.2. Indoor Lighting Comfort

Lighting is a parameter that affects the visual comfort of users. Lighting comfort is primarily evaluated over three concepts: intensity, contrast, and glare.

In the concept of intensity, the amount of illumination is taken into account. The lighting intensity requirement depends on the function; For example, operating rooms need a brighter level than living rooms. The amount of density is expressed in lux. Lux is the number of dots falling over a given area, while the lumen is the total number of dots emanating from the light source. The closer and more intense the light source, the higher the lux. This is because light scatters as you move away from the light source. According to the guide prepared by the North American Society of Lighting Engineers (IESNA), the required LUX value in the rooms should be 300 LUX (Rea 2000). The concept of contrast means ease of understanding or readability; higher IESNA 9th Edition Handbook, 2000, Illuminating Engineering Society of North America contrast provides higher clarity. Glare is not always desirable as it causes high levels of discomfort in viewing objects and affects the retina.

2.3.2.2.1. Daylighting

Daylight is to use natural light from the sky as a complement to electric lighting in buildings (Ahearn 1982: 17). Daylight design is one of the key components of any improvement. Daylight design should be evaluated functionally and spatially since daylight plays an important role in the perception of space apart from its functional aspect (Sezer 2013: 134). In addition, efficient use of the sunlight is very important for energy efficiency in buildings, as it will reduce the use of artificial lighting and, accordingly, the amount of energy to be spent for indoor lighting comfort. Sunlight intake targets should be as follows;

- Efficient use of daylight,
- To provide as homogeneous lighting as possible,
- To provide wedge control by protecting from direct sunlight,
- Establishing a visual relationship with the external environment,
- To feel the quantitative and qualitative differences in the outdoor lighting level during the day,
- A design compatible with other physical environmental issues such as climate control and noise control Reduction of lighting, heating, and cooling loads (Yener 2007: 141)
- It is important to choose the details that make the daylight design effective. Decisions affecting daylight can be listed as follows;

Window glass selection: The material of the window, the condition of the glass, and whether it is insulated or not are the factors that affect the daylight. For example, for light gain, overheating, and brightness control in hot climates; Transparent window glass, transparent angle selector system, opaque panels and coatings, mirrors, and solid light guides are options that can be used in daylight design (Tatar 2014: 113).

- *Shading systems;* Shading elements in the building; can be used to reduce the warming effect gained from sunlight and to reduce glare caused by sunlight. Shading elements are divided into three interior, exterior, and alternative glass. Rings, canopies, blinds, awnings, light shelves, and exterior roller blinds are examples of exterior shading elements. Curtains and blinds are examples of interior shading elements. Electrochromic and liquid crystal glass, photochromic glass, and thermochromic glass are examples of alternative glass shading elements (Tatar 2014: 122).
- *Use of light shelves:* Light shelves are systems that provide illumination by making use of daylight, thus contributing to energy saving and not consuming energy. Light shelves are elements that can be designed as

horizontal or angled plates, the upper surface of which is covered with a reflective layer. Just as shading systems are used to prevent glare, the light shelf is used in façade openings, in the areas where daylight enters the building, and in the window areas, to ensure that the light is distributed more homogeneously in the interior. They can be positioned inside or outside the window and can also be used as a shading element. It will reflect the natural light entering the space by directing it to the ceiling and floor and dispersing it to areas not close to the window in the space. Thus, the excess light in front of the windows is distributed towards the areas far from the window, resulting in a more homogeneous illuminance level (Kontadakis et al. 2017: 203). By reflecting the incoming light to the space, they reduce the need for artificial lighting by ensuring that the desired area is brought to the appropriate light level, thus contributing to energy savings. It can be an integral element with the facade, or it can be an element that can be mounted and removed later (Demir et al. 2020: 23).

- *Window sizes and proportions;* The size and proportions of windows directly affect the amount of daylight. Window height is one of the most important issues when designing daylight. For the place to benefit from optimum daylight and keep glare to a minimum, the depth of the room should not be more than 2.5 times the height of the window.
- *Bio-regional effects;* Daylighting, can be significantly affected by various bioregional factors. These factors comprise the natural characteristics of a specific region or location, including climate, topography, vegetation, and weather patterns (Cimcöz 2002: 67)
- *Room Color:* Light or dark surfaces absorb less or more sunlight. Accordingly, properly painted surfaces affect visual performance. Light colors reflect more light indoors and increase the amount of light.

2.3.2.2.2. Artificial Lighting

The most important element of creating visual comfort is lighting. The purpose of lighting is to provide sufficient illumination level in the interior (Rea 2000: 21). With the right level of illumination, users are able to perceive the environment and perform their actions effectively without any fatigue and visual disturbance (Bayram et al. 2021: 186) In cases where daylight is not sufficient to provide the required brightness level to provide user comfort and during hours when daylight is not available. Artificial lighting systems are used to create a sufficient level of illumination. Artificial lighting systems are systems with energy consumption.

Reducing the electrical energy consumed for artificial lighting of interior spaces in buildings can be achieved by using more efficient lamps and making appropriate use of daylight whenever possible. One of the methods of making artificial lighting energy efficient in the interior is the use of energy efficient lighting elements. The following examples of energy efficient lighting elements can be given.

- *Fluorescent Lamp:* Fluorescent lamps' high luminous power, not getting too hot while being used, and regular light distribution are the reasons why they are preferred. Fluorescent lamps produce more light and are more energy efficient than other conventional lighting types. (Santamouris et al. 1996: 45).
- *Compact Fluorescent Lamp (CFL):* CFLs combine the luminous efficiency of a fluorescent lamp with the convenience of an incandescent lamp and fit the most commonly used incandescent lamp fixtures. It is durable for up to 6,000-15,000 hours. Energy savings are high compared to traditional lamps. When comparing conventional and compact fluorescent lamps that provide four hours of illumination per day for three years, the lifetime of the compact lamp is both longer (Demir et al. 2020: 25)
- *LED (Light Emitting Diode):* Recently, LED lighting systems are frequently preferred because they have low energy consumption, can be used for many years, and are environmentally friendly. LEDs also stand out with their high efficiency, easy control, and simple integration (Santamouris et al. 1996: 113).

The application of energy-efficient solutions for artificial lighting is very important, especially for buildings such as hotels, which are used 24/7 and by many users with different habits.

2.3.3. Traditional Architecture and Energy Efficiency

Traditional architectural buildings, traditional construction techniques, local materials, and technologies available at the time of construction are the factors that affect energy consumption throughout their life cycle. In order to understand the energy consumption of these buildings and to make successful applications for energy saving, it is very important to determine these factors in the building. As mentioned before, optimizing energy consumption in buildings constructed before the concept of energy saving, which constitutes a large part of the existing building stock, will also reduce energy consumption at the national level. Traditional architectural buildings are also among these buildings. Although traditional architectural buildings are exempted from the regulations determined for energy saving, these buildings need to meet the needs of the modern world, to develop and renew them with energy-efficient solutions, both for energy saving and for successful building conversion projects. (Abdelrazek 2019: 205). Energy-efficient solutions applied in new buildings may not apply to traditional buildings. It is more correct to proceed with solutions that will not lose the authencity of the building and the texture of the region where it is located (Webb 2017: 89). As a rule that can be taken as a basis in this regard, a retrofitting project can be implemented (European Commission 2010: 12) if it "will not change its character or appearance unacceptable". Apart from that, it must comply with local rules. For this, the method to be applied in our country is to evaluate the projects with improvement proposals in the Conservation Boards and get their suitability. Since the preservation of traditional buildings is implemented with regional and local rules (Abdelrazek 2019: 126).

In recent years, Turkey has taken significant steps towards promoting energy efficiency in historic buildings. The Building Energy Performance Regulation (BEP-TR), introduced in 2017, sets minimum energy performance requirements for buildings, including historic ones, and requires a standardized methodology to calculate energy performance (Republic of Turkey Ministry of Environment and Urbanization 2017: 42). The BEP-TR recognizes that some features of historic buildings may be protected under heritage regulations and allows for flexibility in the implementation of energy efficiency measures.

In addition to the BEP-TR, the Turkish Standards Institution (TSE) has developed standards and certification schemes for energy-efficient buildings, including historic ones. The TSE certification process involves an energy audit and assessment of the building's energy performance against established criteria, resulting in an energy performance certificate that demonstrates compliance with the BEP-TR (Turkish Standards Institution 2023: 3). The TSE standards provide guidance on topics such as the calculation of energy use for heating and cooling and the measurement and verification of energy savings.

2.3.3.1. Improving the Energy Performance of Building Envelope

The performance of the building envelope should be determined in proportion to the U value of the elements such as walls, roofs, and windows that make up the building envelope, as previously mentioned in the thermal comfort section. This performance can be improved by bringing the U value of elements such as roof, wall, and even floor to appropriate values with the insulation application to be made. Insulation should not change the character of the building, at this point, if it is not possible to apply it on the exterior, it can be achieved by making applications that will increase the U value in the interior. On the contrary, if the protection of the interior is at the forefront, the interior can not be applied and the exterior can be insulated. In both cases, if the building is not allowed to intervene, the insulation may not be applied. In these cases, it is necessary to get approval from the regional protection boards for the interventions that can be made in our country. Traditional buildings generally have a large thermal mass because they have high material density. Buildings with high thermal mass heat up slowly and cool down slowly. For this reason, changing the indoor temperature requires more time and, accordingly, more energy. In this case, it is very important to reduce the heat loss and gains of these buildings. Insulation methods that can be applied to traditional buildings should be done for each building and especially considering the climatic characteristics of the region where the building is located. For this reason, there is no general recommendation for insulation (Abdelrazek 2019: 103).

One of the improvements to be made in the building envelope is the improvements to be made in the windows. In addition to the solution to reduce the U value of the windows previously mentioned in the indoor thermal comfort section in window improvements, considering that the heat loss and gain caused by the windows is also due to air passing through the gaps, it is necessary to fill the gaps in this regard without interfering with the authencity of the building.

Green roof application, which is another of the improvements previously suggested in the roof section for indoor thermal comfort, can also be applied on the roofs of traditional buildings if done within local permits, but at this point, there are factors other than local permits to be considered. One of them is that the existing building can carry the loads that will occur on the roof due to the green roof. In addition to the structural support, the applications required for the formation of a green roof such as vapor tightness, insulation, root barrier, drainage layer, and root barrier can be made on the roof. Another factor is the type of vegetation to be chosen, and the climate characteristics of the building. If all these factors are appropriate and the Conservation Boards allow the application, the green roof to be applied in the traditional building will create an additional barrier on the roof of the existing traditional building and significantly reduce the roof U-value (Abdelrazek 2019: 138).

2.3.3.2. Active Systems Efficiency

The systems that were previously suggested to be made from the building envelope are passive proposals. Apart from passive systems, there are active systems in existing buildings that affect the energy efficiency of the building. Unlike passive systems, which are adapted to the architectural design of the building and do not use energy, active systems require energy to use. Active systems can be added to the building during or after construction. While these systems are integrated using up-to-date methods and technologies in the period when the building is built or later when the active system is integrated into the building, they lose their currency over time with the development of technology. Especially in the buildings built during the period when the concept of energy saving came to the fore, the use of outdated, energy-inefficient active systems is frequently encountered. The energy consumption of these active system elements is considerably higher than today's current energy-efficient active system elements. We can give lighting systems as an example. Since there were no energy-efficient bulbs such as LED and fluorescent in the past, replacing the bulbs in the buildings built in these periods with new energy-efficient LED and fluorescent bulbs will save the amount of energy used for lighting comfort. In most retrofitting projects, if intervention is limited to the traditional structure, improvement suggestions are limited to replacing existing fixtures (Ciampi et al. 2015: 136).

The Lighting Energy Numerical Indicator (LENI) measures the efficiency of the lighting system, expressed in kWh/m2/year. The larger the value of this index, the greater the use of electrical energy. To reduce this value, in addition to the use of energy-efficient active systems, methods such as controlling the lighting from a single source from the building central management, and controlling the building with automation systems depending on the busy hours can also be used.

Active systems are also used for thermal comfort conditions. The HVAC systems used for this purpose greatly affect the overall energy consumption of buildings. The HVAC system undertakes tasks such as heating, cooling, supplying fresh air, humidification, and dehumidification. Most of the traditional buildings do not have this system or are built with very old technology and no energy-efficient systems. Although updating or adding these systems is an important method of providing energy-efficient thermal comfort in traditional buildings, it is generally not implemented or restricted because it is not allowed due to legal limitations. In addition, if allowed by local institutions, a thermostat can be placed in each room in traditional buildings and integrated into the existing system, ensuring that the heating/cooling needs are used in line with the needs of the users of the room in question, and preventing heating or cooling in areas where it is not needed or less needed can also be a solution that will provide energy efficiency. Another heating and cooling system control management system, just like the management of active systems used for lighting, is the automation system that allows the building to work centrally depending on the density of the users.

2.3.3.3. Renewable Energy Generation Systems

While one way of energy efficiency in traditional buildings is to reduce energy use, another method is renewable energy generation in the building. Renewable energy generation solutions can be integrated much more easily in new buildings, while in traditional buildings it is essential to stay true to authenticity. Solutions such as solar heating and photovoltaic panels that can be applied to the building and not have a permanent effect on the building that can be removed later are the methods that can be applied in line with the permissions of the regional protection boards to meet the energy needs of the building and thus reduce the energy costs. The most important issue to be considered while integrating these systems into the building is that the harmony with the building architecture and the environment of the building is not disturbed. It should be especially taken into account that the aesthetics of the façade is not deteriorated (Abdelrazek 2019: 118).

CHAPTER III
METHODOLOGY AND MATERIALS

3.1. THERMAL COMFORT, LIGHTING COMFORT AND ENERGY EFFICIENCY INDICATORS

The concept of adaptive reuse and retrofitting are concepts that should be considered together, even if they are different concepts under the same title, only in this way an efficient design can be created. In order to ensure the sustainability of traditional architectural residential buildings, continuity of use can be ensured by retrofitting. In this thesis, the indoor thermal comfort, lighting comfort and energy consumption of a building where adaptive reuse was applied before but IEQ (Indoor Environment Quality) and energy efficiency improvements during the adaptive reuse project were not addressed in the retrofit concept in this process will be discussed.

There are standards set by authorized institutions that must be taken into account when considering indoor comfort. When these standards are applied, the comfort level of the user in the space will reach a successful point. These standards were used in the comparisons to be made in this thesis. The standards to be used for comparisons in the analyzes to be made within the scope of this thesis are ASHRAE 55-2017 Thermal Environmental Conditions for Human Occupancy for thermal comfort standards, IES ANSI/IES RP-9-23 Recommended Practice: Lighting Hospitality Spaces an American National Standard, and TSE 17067 Conformity Assessment - Fundamentals of Product Certification and Guidelines for Product Certification Schemes for lighting comfort and daylight standards.

Indoor environmental quality and energy efficiency are within the scope of the concept of retrofitting. In this study, another issue considered in the suggestions and studies aimed at improving indoor user comfort parameters is energy efficiency.

The U-value, also known as the U factor, measures how much heat dissipation or heat loss is due to the protective properties of materials or the difference between indoor and outdoor temperatures. U Value is the amount of heat passing through 1 m² of the building element consisting of layers of material per unit time. In order to reduce h eat loss and gain, building elements must reduce their U-shields (Szokolay 2014: 123).

The R value is used to measure the thermal resistance performance of materials. Materials with a high R value are used to create structural elements with a lower U value. In climates with a large temperature difference indoors and in temperature, thermal insulation in building envelopes is the most important control method. With the rules determined by the countries, the maximum U value that can be reached in the building elements or the minimum R value that the construction should be used in frames (Szokolay 2014: 78).

Conduction is influenced by a material characteristic called conductivity (λ), which quantifies the heat flow density (measured in W/m²) through a body with a thickness of 1 meter (i.e., heat flow path length of 1 meter) and a temperature difference of one degree, expressed in units of W/m·K. Materials exhibiting low conductivity are categorized as insulating materials. Such materials typically possess a fibrous or porous structure and are highly susceptible to changes in moisture content. When the pores of these materials become filled with water, the conductivity experiences a significant increase (Szokolay 2014: 88).

The TS 825 TSE 825 Thermal Insulation Requirements for Buildings standard, developed by the Technical Committee for Thermal Insulation of the Turkish Standards Institution (TSE), provides comprehensive guidelines for the design and implementation of thermal insulation in buildings (TSE 2019: 5). This standard takes into account the climatic variations across the country and divides it into four distinct regions. Each region is assigned specific U-values, which represent the thermal transmittance requirements for building elements within these regions.

The primary objective of TSE 825 is to ensure that buildings in different climatic zones are adequately insulated to optimize energy efficiency and thermal comfort (TSE 2019: 8). To achieve this, the standard recommends employing thermal insulation materials with varying levels of thermal resistance, depending on the specific region or zone within a building (TSE 825 Thermal Insulation Requirements for Buildings 2019: 7). By defining minimum thermal resistance values for each region, the standard facilitates the selection and installation of appropriate insulation materials to meet the prescribed requirements (TSE 2019: 8).

The illuminance, denoted as E or illuminance level, is a measure of the amount of light that falls onto or illuminates a given surface. It is quantified in lux (lx), which represents the amount of light flux (in lumens) per unit area (1 square meter). The luminous flux, denoted as Φ (phi), is measured in lumens (lm) and represents the total amount of light emitted by a point source of 1 candela (cd) uniformly in all directions within 1 steradian (sr) (Szokolay 2014: 23).

Achieving visual comfort, which refers to the state where sufficient and appropriate lighting conditions are provided in a given space, is crucial. Illuminance and glare plays a significant role in ensuring visual comfort. As illuminance represents the amount of light falling onto a surface, achieving an adequate illuminance level is essential for maintaining visual comfort (Szokolay 2014: 62).

Glare can occur due to the saturation effect or excessive contrast. Depending on the magnitude of the effect, we can distinguish between discomfort glare and disability glare. Saturation glare occurs when the average luminance of the field of vision exceeds a certain threshold. In such cases, when the light level in the field of vision is high and the adaptation of the eyes is disrupted, glare can occur. Examples include being on a white sandy beach or looking directly at a bright light source. Glare can manifest in two different forms. Discomfort glare occurs when there is a significant difference in brightness, resulting in a level of contrast that is discomforting to the vision. On the other hand, disability glare occurs when the glare is severe enough to impair vision. The formation of glare is influenced by the saturation effect andexcessive contrast. Saturation glare arises when the average luminance of the field of vision surpasses a certain threshold, while excessive contrast affects vision when there is a significant difference in brightness beyond a specific limit. Glare is an important factor to consider for eye health and visual comfort, and it should be controlled through appropriate lighting design and adjustments (Szokolay 2014: 82).

The human eye requires different levels of lighting for various activities. Therefore, ideal illuminance values have been determined for different spaces based on their functions, as specified by the IES ANSI/IES RP-9-23 Recommended Practice: Lighting Hospitality Spaces an American National Standard, and TSE 17067 Conformity Assessment - Fundamentals of Product Certification and Guidelines For Product Certification Schemes for lighting comfort and daylight standards. standards.

These values ensure the visual comfort of users in the respective areas. In the assessment phase of this study, the ideal illuminance values for different spaces according to these standarts are presented in Table 6.

Table 6: Ideal Illuminance Values

SPACE	IDEAL ILLUMINANCE
Room	300 Lux
Storage	75 Lux
Restaurant	75 Lux

In light of this information stated from the literature data, on-site measurements were made in order to determine the current status of indoor user comfort during the field study.

3.2. THERMAL COMFORT AND LIGHTING COMFORT MEASUREMENT METHODS

In the field study part of this thesis, interior user comfort thermal and lighting parameters will be examined through the adaptive reuse project and a sample building converted from a residential structure to a hotel structure with restoration. In order to examine the building according to IEQ (Indoor Environmental Quality) parameters, first of all, in line with the information obtained from the meteorology website, on-site measurements were made in 6 places selected by determining the facade differences and floor differences between 15.07.2022 and 18.07.2022, which is the hottest period of the region where the sample building is located.

The measurements were repeated 4 times a day for 4 days, at 10.00 (morning), 13.00 (noon), 16.00 (afternoon), and 19.00 (evening), so that the values formed at different times of the day were determined.

The places to be measured in the building are selected from the north, east, west, and south sides of the building, a total of 4 spaces, plus 2 more spaces, from the basement floor and the 1st floor, by choosing a total of 6 spaces. In these 6 places, humidity, and room temperature were taken from 3 different heights, and surface temperatures (walls and flooring), lighting amount, and sound measurements were made. The courtyard temperature and airflow measurements were taken in the middle of the building.

Lighting measurement scope was made based on illuminance value (lux). While measuring the lighting, the room was divided into squares, and measurements were taken from the middle points of these squares. In this way, observing the LUX values in front of the windows and at the back of the room was possible.

While measuring, the TESTO 435-2 multifunctional measuring device and probes in Figure 6 and the TESTO 175T2 Temperature measuring device were used.

Figure 7: Measurements are made a) Multi-functional measuring device TESTO435-2, b) TESTO 435 -2 Tribulence probe meter probe), c) TESTO 435 -2 Lux meter probe, d) Temperature measuring device TESTO 175T2, e) Wall surface temperature measuring probe (TESTO 2023: 17).

Thanks to more than one add-on probe, TESTO 435-2 can be used for lighting and air flow measurements with a single device in these measurements. For airflow measurements, the probe in Figure 6b meets the requirements of EN 13779 (TESTO 2023: 32).

The lux meter probe used in the illumination measurements seen in Figure 6c can measure between 0-100000 lux and its accuracy according to DIN 13032. f1 = 6% =V(Lambda) setting such as f2 = 5% = cos- weight, Class It is C-shaped.

175T2 EU-directive 2014/30/EU used during temperature measurements seen in figure 6d; 2011/65/EU; It complies with DIN EN 12830. (TESTO 2023: 23). With the device, measurements can be made between -35 and +55 °C degrees internally, and between -40 … +120 °C degrees externally (TESTO 2023: 28). Wall surface temperature probe (NTC), which works integrated with the device shown in figure 6e, was used to measure wall surfaces and floor temperatures with this device.

Since the building is still serving and used as a hotel, the rooms that were not used on the specified dates were preferred by obtaining permission and information from the hotel owners, and active air conditioning systems were not used in the areas where measurements were made for a period of 4 days during the measurement period. In lighting measurements, artificial lighting was not used only at the time of measurement and the amount of natural illumination of the space was measured.

3.3. THERMAL COMFORT, LIGHTING COMFORT, AND ENERGY EFFICIENCY SIMULATION METHODS

The entire building was modeled in 3D with the plans and sections in the restoration project of the building obtained from the Şanlıurfa Cultural Heritage Preservation Board (APPENDICES 1-13). The used building materials and all other data required for the desired analyzes were processed into the software, and the current thermal comfort, lighting comfort, and energy consumption analyses of the space were obtained separately for the 6 determined spaces by simulation.

With this anaylsis it is observed that an annual energy consumption for the building. To have simulated model, first, the thermal and lighting comfort level of the building were obtained during the summertime. After evaluating these data simulation model was created using the specified software. The annual amount and rate for the energy consumption and the effects of thermal losses and gains in energy consumption for thermal comfort on heating and cooling loads have been analysed.

The courtyard temperature and airflow measurements were taken in the middle of the building.

In the simulated model was desting energy consumption

WWhen creating a simulation, it is important to use the right simulation program first. In recent years, a building simulation program has been developed. During the selection of simulation, issues such as the use of simulation tools, model realism, input parameters, the sources that the programs use and store data, the amount and accuracy of the data that the program can provide to the user and the user can integrate on the model, simulation program capabilities and design variations should be evaluated. As a result of this evaluation, it is necessary to select the program suitable for the analyzes desired to be obtained as a result of the simulation and for the building to be modeled and analyzed.

According to the criteria described, the programs used in the last period were compared and evaluated as shown in Table 7.

Table 7: Comparison of energy simulation programs

PROGRAM AND DEVELOPER	KEY CAPABILITIES	ADVANTAGES	DISADVANTAGES
Revit (Autodesk)	Collaborative design, building system analysis, energy analysis, daylighting and lighting analysis and modeling, renewable energy modeling	User-friendly interface, integration with other Autodesk software, supports BIM workflows	Limited to building information modeling, not a standalone simulation tool, may require additional software for analysis
EnergyPlus (US Department of Energy)	Thermal comfort modeling, renewable energy technologies, control strategies	High level of detail, free and open source, widely used in research and industry	Steep learning curve, requires detailed input data, not suitable for all building types
DesignBuilder (DesignBuilder Software)	Advanced modeling features for HVAC systems, thermal comfort, lighting, daylighting	User-friendly interface, advanced modeling capabilities, supports BIM workflows	Costly, requires a powerful computer, may require additional software for analysis

This study will use the Autodesk Revit program for energy simulation Revit is a program used to produce both 2D and 3D drawings and analyzes during the design process (Gerber and Lin 2014: 36) Yanksari (2020), It is also a BIM (Building Information Modeling) software application (Slotkis, 2017: 85). Revit has a well-organized, user-friendly interface, tips for each tool, and animated graphics that introduce the tool function to users. The user-friendly menu makes it easy to create drawings and has the ability to import models from many different programs (Eastman et al. 2011: 56; Yanksari 2020: 22). As seen in Johansson, et al. (2013), In this study, three-dimensional based on the following parameters; climate, climatic load at the location of the wall, wall thickness, mansory type, mortar type. The simulations are used to investigate the energy efficiency and daylight performance. With the plans and sections of the building, a 3D model was created over the Autodesk REVIT Program, and the material information used in the restitution project, which was also obtained from the Şanlıurfa Conservation Board, was used in the wall, floors, roofs, and windows were processed as data into the program. The accuracy of the material information was confirmed by the author during on-site measurements.

The Revit program, Autodesk Revit software, enables the design of energy-efficient structures through three-dimensional models and the planning of measures to be taken to make existing structures energy efficient. The applications planned thanks to the software offer the opportunity to observe the effects of the planned applications on the building with the results of the analysis before the implementation phase (Tulukçu and Oral 2021: 122). Provides support for sustainable design through design option features that allow exploration of different sustainability strategies. By integrating plugins, lighting analysis programs and cost estimation are available (Stine and Hansen 2018: 65; PR Newswire 2008: 89; Yanksari 2020: 22).

For the analysis to reflect the truth in Revit, the building model must be created correctly and the elements that make up the building must be processed correctly during modeling. The correct and complete processing of this information is very important so that the planned analyzes do not yield false and incomplete results (Tulukçu and Oral 2021: 33).

For some analyses to be made, it is important to create the model correctly and enter the materials correctly and the building location into the software. This is very important in the analysis of climate-based data.

After the building is modeled accurately and completely with the Revit software, analyses such as lighting status, thermal conditions, and energy performance can be taken within the existing software and/or by integrating the add-on applications software. In this type of analysis, the whole or part of the building can be divided into spaces, and analyses specific to the selected spaces can be taken. In analyzes involving active systems such as energy performance, Autodesk Revit software also allows processing data about active systems in the building into the model before analysis. In lighting measurements, analysis can be obtained in this way by integrating artificial lighting data depending on the model and the desired analysis.

On the model in which the correct material data is processed, 6 places where measurements were made were processed in the Autodesk Revit program, and the compatibility of the temperature, the amount of light, thermal conductivity, and the energy comp of the walls in these areas were confirmed in the measurements.

In light of the information obtained with the current measurements and the simulation method, compliance with the standards determined by IESNA, TSE, and

ASHRAE, which was mentioned in the literature section, was evaluated. After this evaluation, due to the lack of conformity, energy-efficient suggestions were developed to increase user comfort, and the suggestions determined in the same simulation environment were applied. As a result of the improvements applied, the temperature, lighting amount, and thermal transmittance coefficient data taken in the current state were reconsidered and their effects on the current situation and their contributions to the solution of the problem were evaluated.

In the conclusion part of the study, in the light of the data obtained as a result of the evaluation, solution proposals are presented that will be designed in a way that both comfort parameters will be energy efficient and at the same time not interfere with the local architectural authencity, by keeping the lighting comfort to a minimum, while ensuring the lighting comfort.

CHAPTER IV
CASE STUDY

The traditional architectural structures in the province of Şanlıurfa, the mansion (Şanlıurfa House with hayat) structures will be evaluated in terms of thermal comfort and lighting comfort, which are interior comfort headings, on the sample building, which has been converted into a boutique hotel by making restoration and adaptive reuse before.

Before this evaluation, it would be useful to address the reasons for the building's obsolesans and the adaptive reuse process it has undergone. Economic, environmental, and social factors are seen together because of the reasons for the completion of the life of the building mentioned in the Building Adaptation section in the general causes of obsolescence in the building and other buildings in its location. Since the building is also structurally old, restoration work has been done before. At the same time, as it is functionally obsolete, it has started to be used as a boutique hotel while it was a traditional residential building with a functional change. In this way, although it is desired to prevent economic obsolescence, today's economic costs of buildings, especially energy expenditures, are quite high, and interior comfort conditions are not provided, so it can turn into obsolescence in a short time.

Before examining this building where the fieldwork was done, it is necessary to examine the traditional building type and climatic and geographical characteristics of the province of Şanlıurfa where the building is located.

4.1. CASE STUDY AREA

It is located in the Southeastern Anatolia Region of Turkey, at 37'8" north latitude and 38'46" east longitude. Gaziantep in the west, Adıyaman in the northwest, Diyarbakır in the northeast, Mardin in the east, and the Syrian border determined by the Ankara Agreement in the south of the city. It has a history reaching the oldest known date (12.000 BC) with Göbeklitepe.

It is important to preserve the traditional architecture, urban texture, and authencity of Şanlıurfa province, which is a region valuable for tourism with its historical and traditional values.

4.1.1. Climate and Geographical Features

Since it is landlocked and far from the sea, dry air is effective. At certain times of the year, especially in summer, sand and dust storms from the desert are seen in the region. According to the meteorological data in summer, the average temperature reaches about 40 degrees. However, the temperature felt and affected by the factors caused by dry air and climate change is much higher. The hottest month is July. Spring and autumn seasons are quite short. The summer season lasts for about 6 months. In winter, air temperatures below 0 do not occur much. Snowfall is extremely rare. Rains are seen especially in January, February, and March (Akbıyık 1998: 133).

4.1.2. Traditional Şanlıurfa Houses

Şanlıurfa's traditional houses with hayat are among the touristic and culturally important buildings that provide the texture of the region. They were built following the local climate of the region and the cultural and Islamic values of the local people. These buildings carry the cultural values of the society to future generations. However, it is seen that these structures are no longer used in their former functions and densities.

Due to the planning decisions taken by the administrations, some of the traditional Şanlıurfa houses were demolished in the 1950s and turned into wide roads. As a result of these changes, the neighborhoods where traditional Şanlıurfa houses are located have now turned into business centers and idle areas (Akbıyık 1998: 135). At the same time, with the ban on the use of wood stoves in houses following the announcement made by Şanlıurfa Metropolitan Municipality in 2013, Şanlıurfa Houses with hayat, which does not have a central heating system and cannot be integrated, has turned into a type of housing that cannot provide thermal comfort and is not preferred. Another reason is that during the migration from the village to the city, people with a high level of economy leave Şanlıurfa Houses with hayat and move to modern apartments due to the ease of use of modern apartments, and families with lower economic levels prefer to live in Şanlıufa Houses with hayat Over time, the low-income profile in the area made the houses even more worthless, and the owners found a solution by dividing the large houses into several parts and earning rental income from more than one family. At the same time, theft and other crimes began to be committed in these houses, where security measures could not be taken, as the income level of the neighborhood decreased.

In this case, some of the houses in the neighborhoods where Şanlıurfa Houses with hayat are located were abandoned to their fate, and some of them were restored and converted into buildings such as boutique hotels and museums. There are still too many Şanlıurfa Houses with hayat in idle state.

4.1.3. Plan and Spatial Elements

In traditional Şanlıurfa Houses with hayat, the planning scheme directly overlaps with family life. In these houses, where more than one generation usually lives together, the main formation of the planned scheme is room + iwan + room. Thanks to this plan scheme, extended families can live together for several generations (Buyukmichı 2000: 65). Due to Islamic belief and the social structure of the region, the order of harem and selamlik is dominant in the houses. Generally, the harem area constitutes 75% of the building and the selamlık area 25% (Büyükmışhi 2000: 22; Turan, 2009).

The houses are usually built as units placed around a rectangular or square courtyard and are 2 floors + basement, with a maximum height of 7.5 m. The basement and ground floors usually serve the service areas, while the upper floor has living areas. The distribution of the spaces of the houses according to the floors is shown in Figure 8 (Büyükmışhi 2000: 85; Turan 2009: 45).

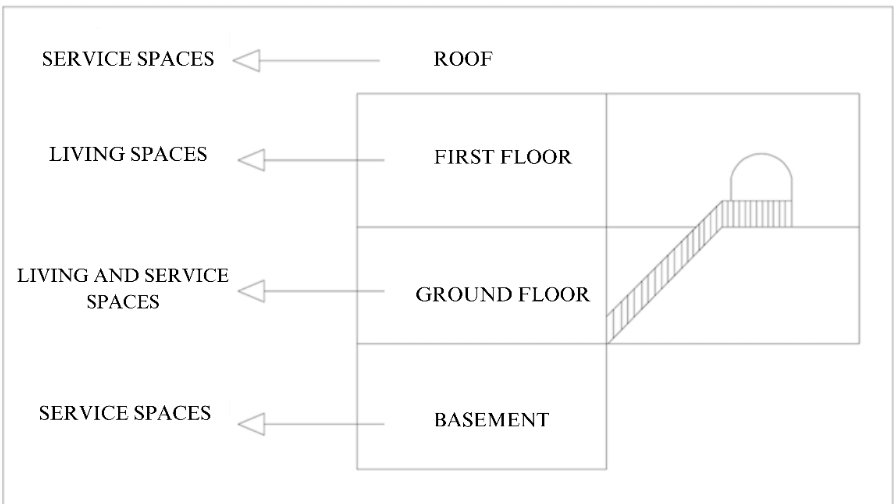


Figure 8: The distribution of the spaces of the houses according to the floors (Turan 2009: 45).

The determining element of the plan scheme in these houses is the iwans. The iwans are arched sections with 3 sides closed and one side open, created for the building users to spend time outside while staying inside the building. Architect typology differs according to the location and number of iwans in houses (Büyükmiçhi 2000: 77). The two most common types are single iwan and double iwan houses. The iwans are generally located to the north. The reason for this is to keep cool in the summer. If there are two iwans in the building, the other one becomes the winter iwan and is placed in the south. The southern iwan is aimed to be warmer in winter. In addition, the architectural typology may vary according to the number of building wings around the courtyard. Plan schemes according to the number of wings positioned around the courtyard are shown in Figure 9. (MEU 2022: 12).

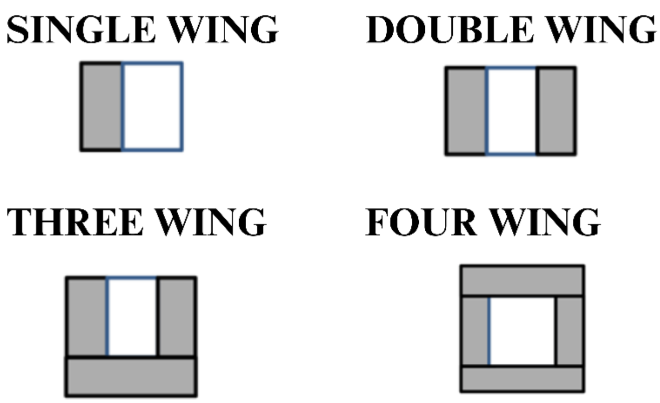


Figure 9: Plan schemes (MEU 2022: 12)

4.1.3.1. Building Characteristics According to Climate

The climate is one of the biggest factors in shaping the Sanliurfa residential architecture. Since the province of Sanliurfa is far from the effect of the sea and the annual precipitation is low, the amount of humidity is low. For this reason, the temperature differences between night and day, summer and winter months are quite high. While the winter season is warmer, the summer season is very difficult with the temperatures getting very high. In Şanlıurfa, both the traditional buildings and the street are planned in accordance with the hot and dry summer climate. In Sanliurfa, adjacent and narrow streets were created in the urban texture in areas dominated by traditional architecture, so that the streets were protected from the heat and shaded areas were tried to be provided. In order to be protected from the hot desert winds coming from the summer months, traditional residential buildings are designed as low-rise, closed to the outside, and with a certain area facing the ground. The only reason for the closure of the houses is not the climate, but also the social structure. The courtyard plan scheme, which is generally seen in Şanlıurfa and similar hot-arid climates, is also dominant in Şanlıurfa as a climatic requirement. It is aimed to increase the humidity and create cooler living spaces thanks to the planted area and pool created in the courtyard.

In order to turn the climatic effects into an advantage, the residential buildings are divided into two north and south. The spaces on the north façade have been tried to be suitable for summer use, and the spaces on the south façade have been tried to be suitable for winter use.

It has been tried to keep the insulation value high by using massive materials in the construction of the buildings. Since it is very important to provide air circulation in the spaces in this climate, the ceiling heights are high. In addition, ceilings and skylights are used to provide air circulation. Since the iwans, which are among the most important areas of the house we mentioned before, are the areas where time is spent most frequently, air channels are created from the niches opened in the wall on the closed side of the sink to provide air circulation to the roof. The wind hitting the mihrab-shaped chimneys on the roof oriented to the west passes through these channels to the iwan and air circulation is provided. This application is application that is not seen in all residences.

4.1.3.2. Exterior Characteristics

Due to the social structure, it was preferred that their houses be close to the street. Usually, there are flat and high walls. The biggest opening of the building to the narrow streets is the arched stalactite entrance door (Figure 10). In addition, the main room of the selamlık section has an projection with a window facing the street. This projections is caused by overlapping made by the overlapping stone beams method. (Buyukmichi 2000: 56).

Figure 10: Entrance door (Tema 2008: 66)

The facades of the building facing the courtyard are much more ostentatious. The most spectacular façade element of the courtyard is the iwan. The facade of the iwans facing the courtyard has an arched structure. Courtyard windows are usually in groups of 3 or 4. The windows are rectangular or arched. Outside the Windows, there may be small openings without glass facing the courtyard. These openings are called "matar" (Buyukmichı 2000: 45).

4.1.3.3. Construction Techniques

The traditional construction technique used in buildings in the region is stone masonry with stone material. Volcanic limestone, locally called "havara" is the main material of the houses. The material is a soft and workable limestone. Ash-lime mortar, which is a mixture of havara powder, lime, and water, is used as a binder between the stones. A mesh system is created by filling 30-40 cm thick rubble between 15 cm thick cut stones on the bearing walls. The walls of the building are approximately 60-100 cm thick. The stones are cut into 24 cm sizes and 25 cm modules are formed by placing 1 cm of mortar in between. Stones are shifted to create an projection of more than 25 cm in the projections of the building (Figure 14).

Figure 11: Projection (Turan 2009: 45)

Some room walls and ceilings of the buildings are plastered. This plaster is created by mixing hemp fiber, lime, ash, and water. Ceiling elements are usually barrel or cross vault. In some places, there are timber covered ceilings (Gayberi and Dalkılıç 2021: 23). Timber coverings are also used on walls, niches, and cabinets. Window and door lintels are flat or pointed vaulted (Büyükmışhi 2000: 85; Turan 2009: 33). Timber material was also preferred for windows and doors (Gayberi and Dalkılıç 2021: 12). The ground parts of the building consist of stones called nahit, 25-35 cm is wide, 35-65 cm long, and 5-8 cm thick (Büyükmışhi 2000: 78; Turan 2009: 23). Nahit stone is a limestone resistant to high temperatures, which has different appearances with spots and veins, which bleaches as it is exposed to the climatic characteristics of the region.

4.2. SAMPLE BUILDING “NURAN ELÇI MANSION”

Nuran Elçi's mansion is a traditional residential building and is used as a boutique hotel after building adaptation. The building is located on the New Fırfırlı Street on Vali Fuat Caddesi (Great Road) within the borders of Eyyübiye district of Şanlıurfa province. The area where the building is located in one of the districts of the city where historical and traditional residential buildings are located. After the restoration of the building in 2008, the street images are as in Figure 12. The site plan of the building is shown in Figure 13.

Figure 12: Nuran Elçi mansion street view (TEMA 2008: 12)

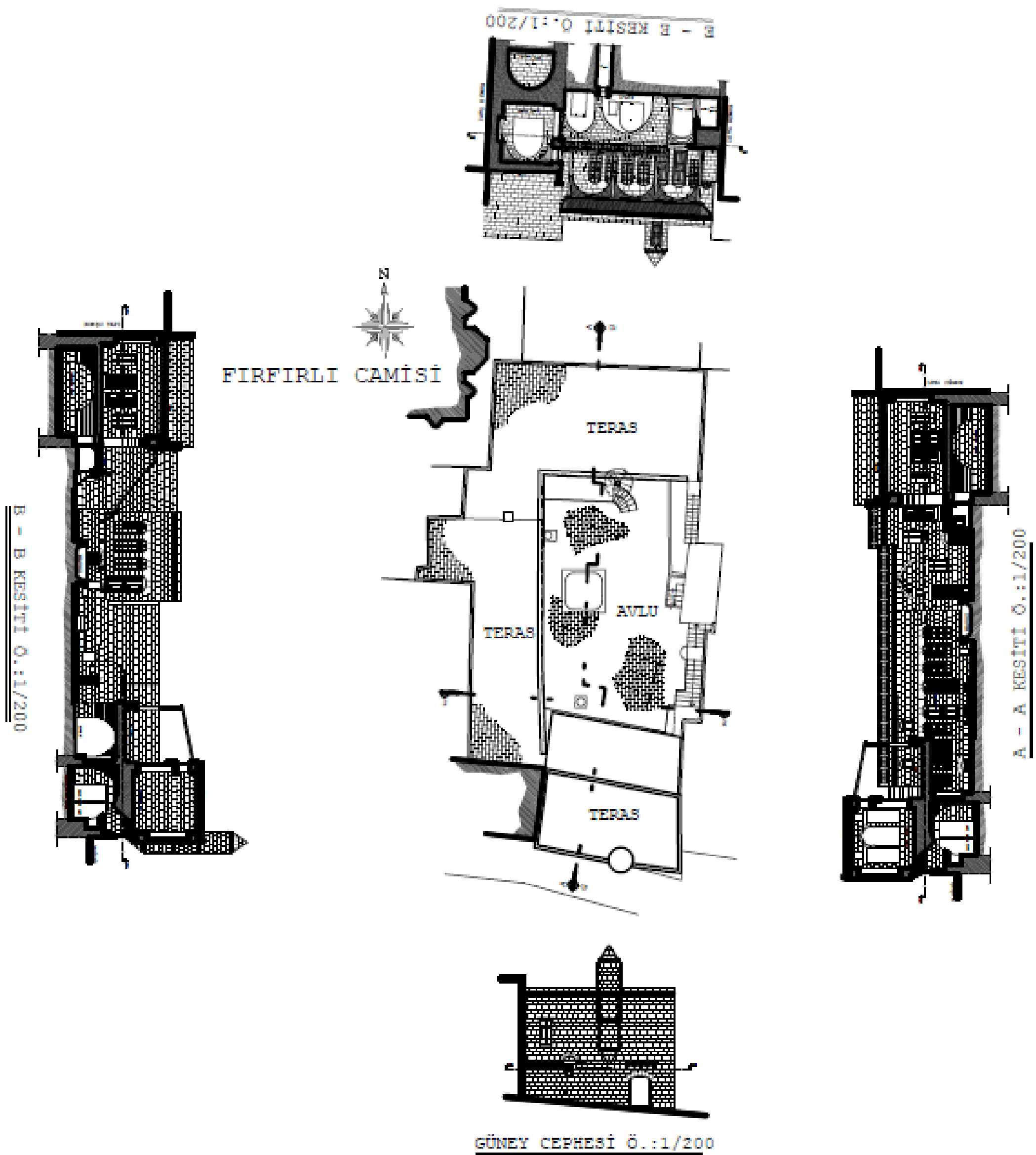


Figure 13: Nuran Elçi mansion site plan (TEMA 2008: 15)

4.2.1. History and Features

It is not known by whom and when it was built, as there is no inscription of construction and repair. However, it is thought that the old 12 Apostles Church, located in the northeast of the building, was built after the Fırfırlı Mosque. Although the construction date of the 12 Apostles Church is not known, it was rebuilt from the ground up in 1865 with the edict of the Ottoman Sultan of the Period, Abdulaziz I. There is no document about whether the old structure was complied with in terms of the plan during the reconstruction. The building was used as a prison in the 1930s, but no changes were made during this use that could affect its nature. One of the south windows of the building, which was converted into a mosque in 1956, was turned into a mihrab, and a stone pulpit was built in front of the half-column in the middle of the south wall. The Fırfırlı Mosque and the Nuran Elçi Mansion are the neighboring buildings on the middle facade. It is seen that some of the decoration elements of the mosque were inspired by the Nuran Elçi Mansion. For this reason, it can be said that the building was built after the construction of the church. The current photo of the Fırfırlı Mosque is as in Figure 14. The image in Figure 14 was shot from Nuran Elçi Mansion.

Figure 14: Fırfırlı Mosque (TEMA 2008: 16)

The building is historically registered and has the characteristics of traditional Urfa houses. In 2008, a restitution and restaurant project was prepared for the building by TEMA Proje, and some parts of the project were renewed in accordance with the project. The image of the building, taken by the art historian Cihat Kürkçüoğlu, whose shooting date is unknown, is as in Figure 15.

Figure 15: Nuran Elçi mansion, Cihat Kürkçüoğlu

Nuran Elçi Mansion has the characteristics of traditional Şanlıurfa Houses with hayat with its exterior, interior, and construction techniques. The building is a masonry building made of massive limestone (limestone). The masonry structure was made using lime ash as a mortar. The courtyard facade of the building, which has a very plain appearance on the street facades, is highly ornamental. While the rooms, which are planned as Selamlık, have windows to the street front, all other areas have windows to the courtyard. The building only faces the street in the south direction. It is surrounded by neighboring buildings from other facades. There are wooden windows of the entrance door with muqarnas in traditional Şanlıurfa mansions on the south facade, the torment room on the ground floor (used as a toilet today), and the Selamlık room on the 1st floor. The Selamlık room is designed with a cross projection to see the street. There is a stair minaret that reaches the roof from the Selamlık room. This minaret is a feature not found in most Traditional Şanlıurfa Residential buildings. Current exterior images of the building after restoration Figure 19 and given in Figure 16. Figure 17 In the South Facade image of Nuran Elçi Mansion, the entrance door with muqarnas and the stair minaret can be seen in the exterior view of the south façade of the building. Figure in the image of Nuran Elçi's Mansion South Facade 2, the windows of the selamlık areas of the building can be seen from the same facade.

Figure 16: Nuran Elçi mansion south facade (TEMA 2008: 20)

Figure 17: Nuran Elçi mansion south facade 2 (TEMA 2008: 21)

There are windows in all rooms, including the rooms on the basement floor, from the courtyard front. There are overhead openings on the courtyard facades to provide air circulation in the kitchen and rooms. The overhead openings in the kitchen area are planned as larger and more numerous depending on the function of the space. Figure 19 In the image of Nuran Elçi Mansion Courtyard North and West, the hill openings overlooking the courtyard from the kitchen are seen. No material was used in these openings and they were left completely open. As seen in Figure 18, the windows are wooden framed and the doors are wooden.

Figure 18: Nuran Elçi mansion courtyard north and west facades (TEMA 2008: 23)

There is a pool in the courtyard to increase humidity and cool down. In addition, the muqarnas and the balustrades seen on the facades of the terraces and terraces facing the courtyard in the building are of the type frequently seen in traditional Urfa houses. The balustrades and muqarnas are also made of chipped stone (limestone) material used in the building itself. Figure 19. In the image of Nuran Elçi Mansion Courtyard South and West, the pool in the courtyard, the walkways, and the balustrades and muqarnas on the terraces are seen. In addition to this, the overhead openings of the selamlık rooms on the 1st floor can be seen in Figure 19. It is smaller and more ornamental than the overhead openings seen in the kitchen space before. In the same image, the windows of the zerzembes located on the basement floor on the west facade are also seen.

Figure 19: Nuran Elçi Mansion courtyad south and west (TEMA 2008: 24)

Figure 20 on the eastern façade of the building facing the courtyard. As seen in the Nuran Elçi Mansion Courtyard East image, there are stairs providing circulation between floors, a harem room, and a zerzembe (today's oriental room) in the basement of the same room. Unlike other zerzembes, this zerzembe has a more ostentatious entrance. In the building, window groups are facing the courtyard in the form of three groups of traditional Şanlıurfa Houses with hayat,

Figure 20: Nuran Elçi mansion courtyard east (TEMA 2008: 26)

Indoor and north iwan Figure 24 As seen in the image of Nuran Elçi Mansion North Eyvan, wooden coverings are used on walls, niches, cabinet edges, and ceilings for decoration purposes in certain places. The majority of the decorations in the interior are wooden coverings. Figure 21 Nuran Elçi Mansion Harem Room, is an example of wooden decorations in the interior of the rooms.

Figure 21: Nuran Elçi mansion north eyvan (Photo by Author)

Figure 22: Nuran Elçi mansion harem room (TEMA 2008: 27)

The ceilings in the interior are vaulted. In certain areas, Khorasan plaster was used on the interior ceilings. Khorasan plaster is a type of plaster applied with a thickness of 1-2 cm, which is formed by adding additional additives to a mixture of lime and water. Figure 23. In the Nuran Elçi Mansion Dining Hall visual, the ceiling was applied in 2008 and it can be seen in its worn form over time. The same obsolescent was observed in other places in the building where Khorasan plaster was applied on the ceiling.

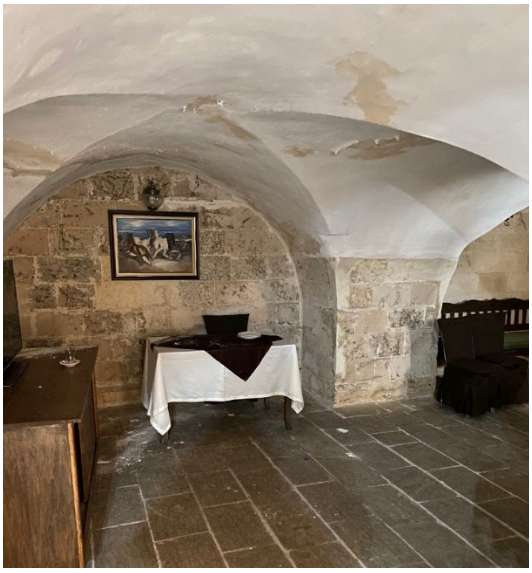


Figure 23: Nuran Elçi mansion dinning hall (TEMA 2008: 29)

4.2.2. Spatial Editing of the Building

The mansion has a planning scheme with 4 facades around the courtyard, which was previously mentioned in the section on traditional residential buildings in Şanlıurfa, and has 2 iwans. It was built as a basement with 2 floors. On the basement floor, there are 3 zerzembe (B1-B2-B5) (pantry) rooms on the east and west facades separately, and the manger and Develik (B3-B4) (the area used for animals - barn) on the north facade. Today, Develik serves as the indoor dining hall of the boutique hotel. The manger, on the other hand, has been converted into a dining room service room. In addition, zerzembes are used as oriental rooms. The ground floor of the building consists of two different levels. For this reason, a part of the Develik area remains above the lower ground level. On the ground floor of the building, there are the entrance area (Z10), the kitchen (Z6-Z11), the kitchen, 8 rooms (Z1-2-3-4-5-7-8-9), and the courtyard (Z13). The iwan (Z6) on the northern façade, the 4 rooms (Z4-5-7-8) located around this iwan, and one room (Z9) on the eastern façade are high in elevation, and these areas can be accessed from the stairs in the courtyard. There are a pool and flower beds in the courtyard. Today, the south iwan (Z11) has been converted into a beverage service area, it continues to be used as a bedroom, except for one of the rooms, and one room has been converted into an administrative room (Z2). The northern house was preserved as a living space. On the 1st floor of the building, there are 2 rooms (F1-2) and 3 terraces (F3-4-5). The plan drawings of the building as taken from the restitution project and the space codes specified in the text as written on the plans Figure 24, Figure 25, Figure 26 given in. Section drawings as taken from the restitution project, with the space codes specified in the text written on the sections Figure 27, Figure 28 Figure 29, and Figure 30. It is in the form given. In these drawings, the procedures applied in the restoration of the structure are indicated.

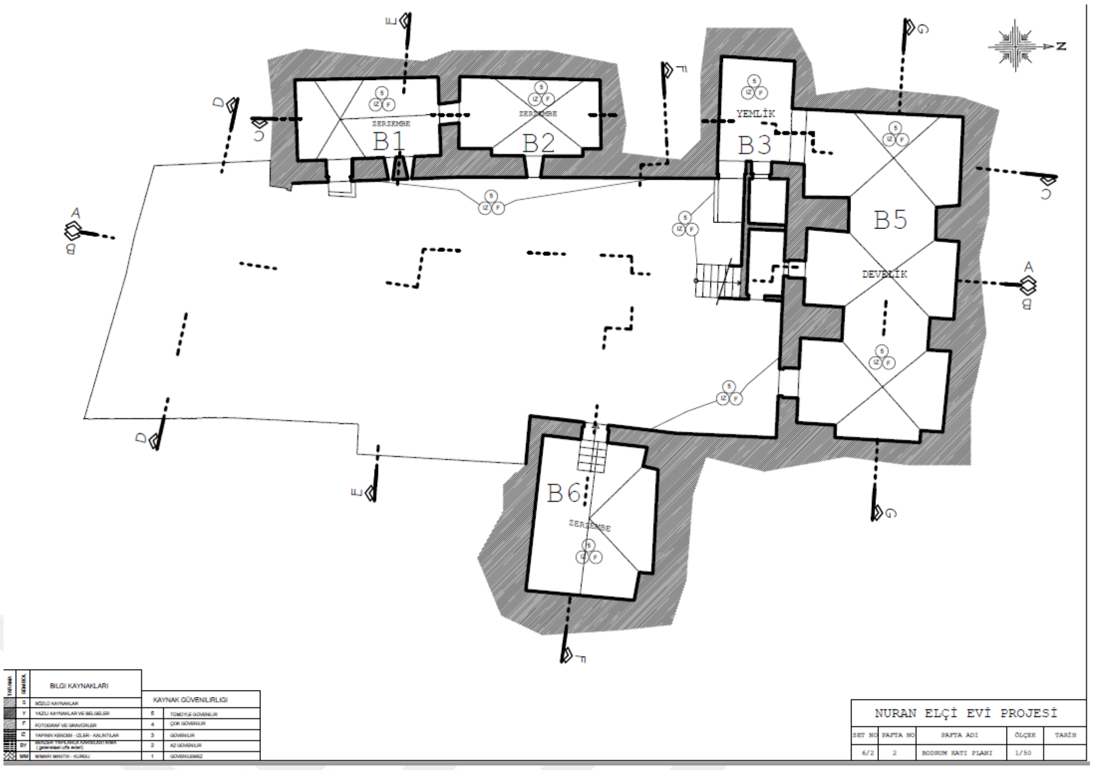


Figure 24: Nuran Elçi mansion restitution project basement floor plan (TEMA 2008: 33)

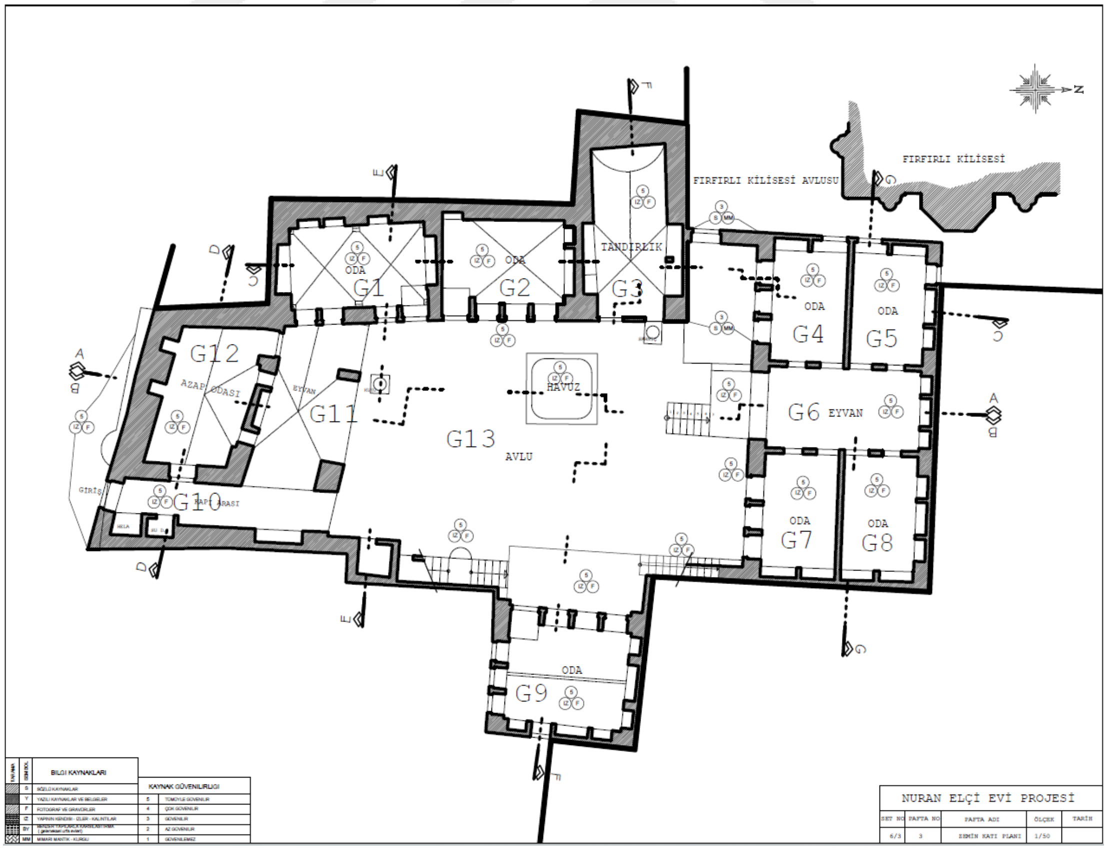


Figure 25: Nuran Elçi mansion restitution project ground floor plan (TEMA 2008: 38)

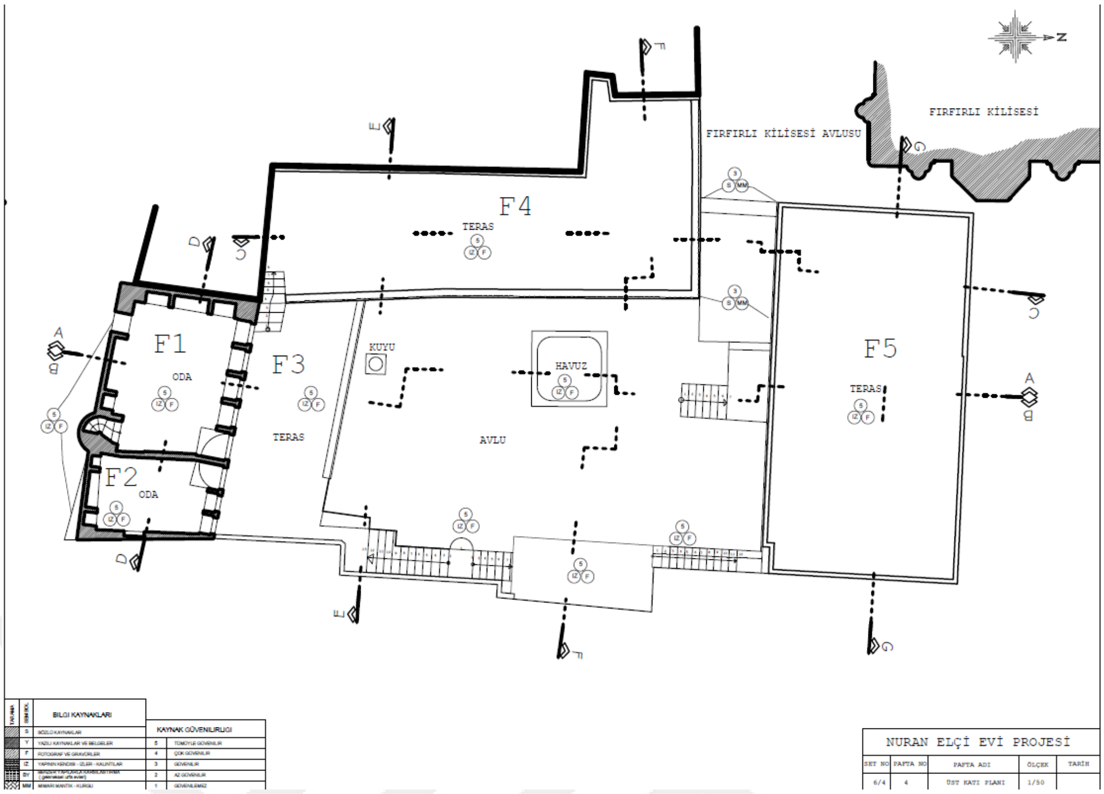


Figure 26: Nuran Elçi mansion restitution project first floor plan (TEMA 2008: 42)

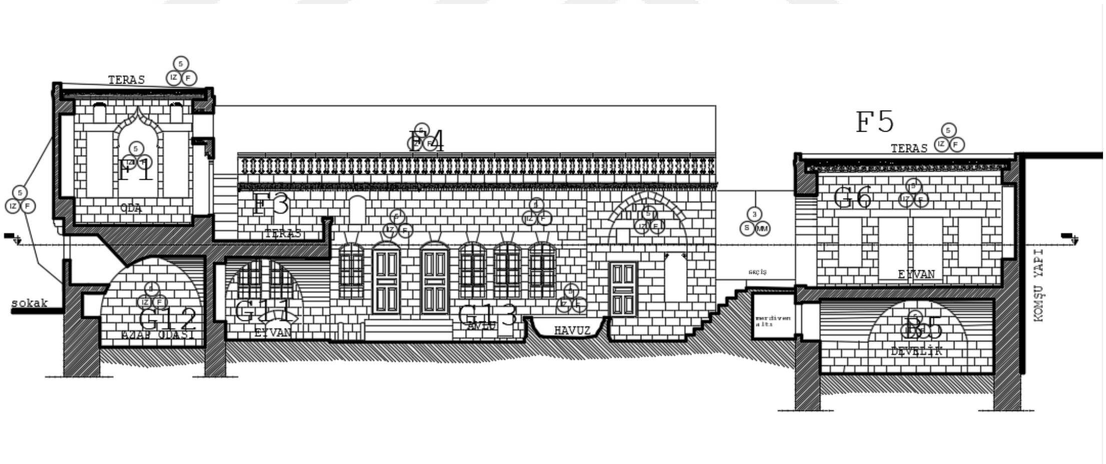


Figure 27: Nuran Elçi mansion restitution project section A-A (TEMA 2008: 43)

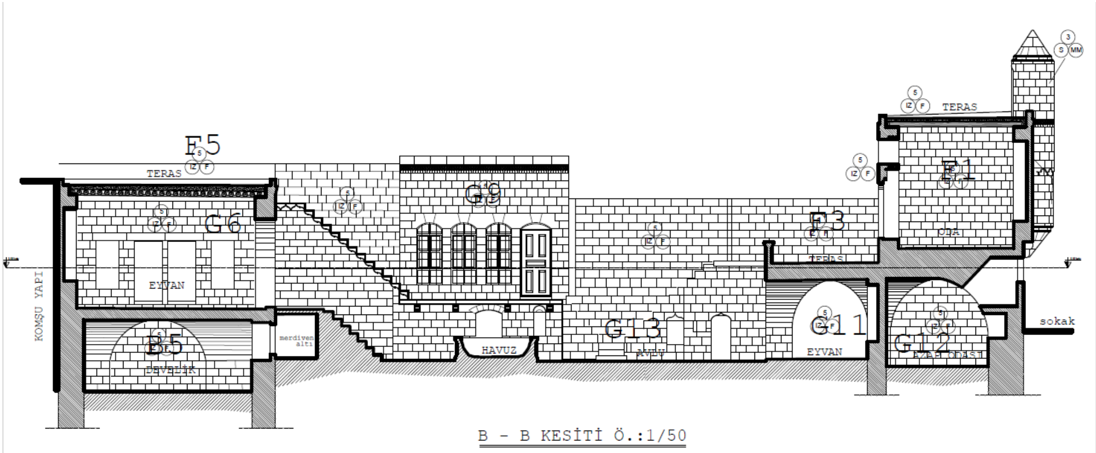


Figure 28: Nuran Elçi mansion restitution project section B-B (TEMA 2008: 42)

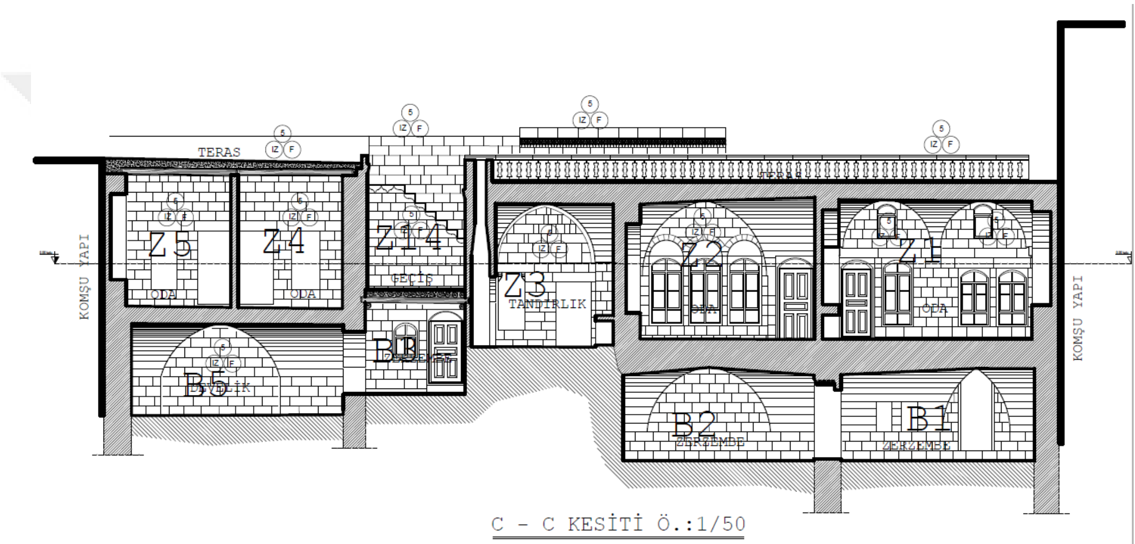


Figure 29: Nuran Elçi mansion restitution project section C- C (TEMA 2008: 43)

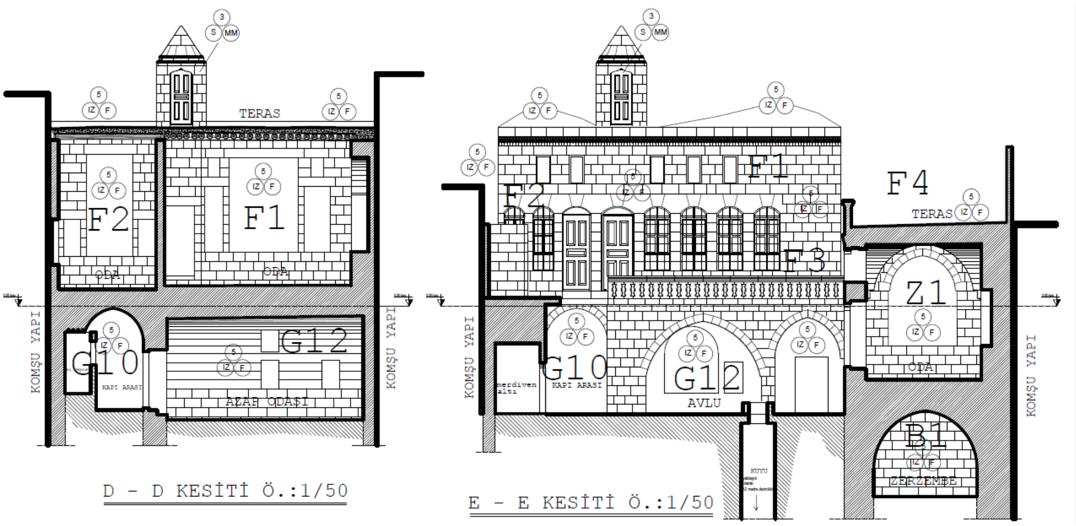


Figure 30: Nuran Elçi mansion restitution project section D-D and E-E (TEMA 2008: 42)

The plan drawings prepared in order to adapt from the residential building to the boutique hotel building by applying restoration and adaptive reuse after restitution are shown in Figure 31, Figure 32, and Figure 33 Section drawings used in the Adaptive reuse project are given in Figure 34, Figure 35, Figure 36, Figure 37.

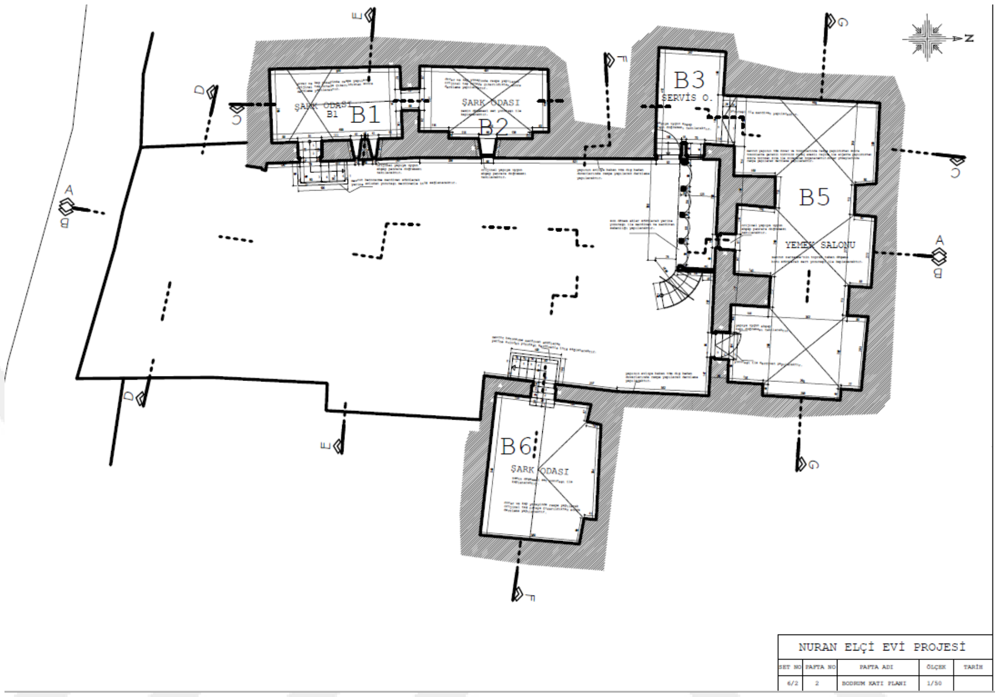


Figure 31: Nuran Elçi mansion restoration project basement floor plan (TEMA 2008: 50)

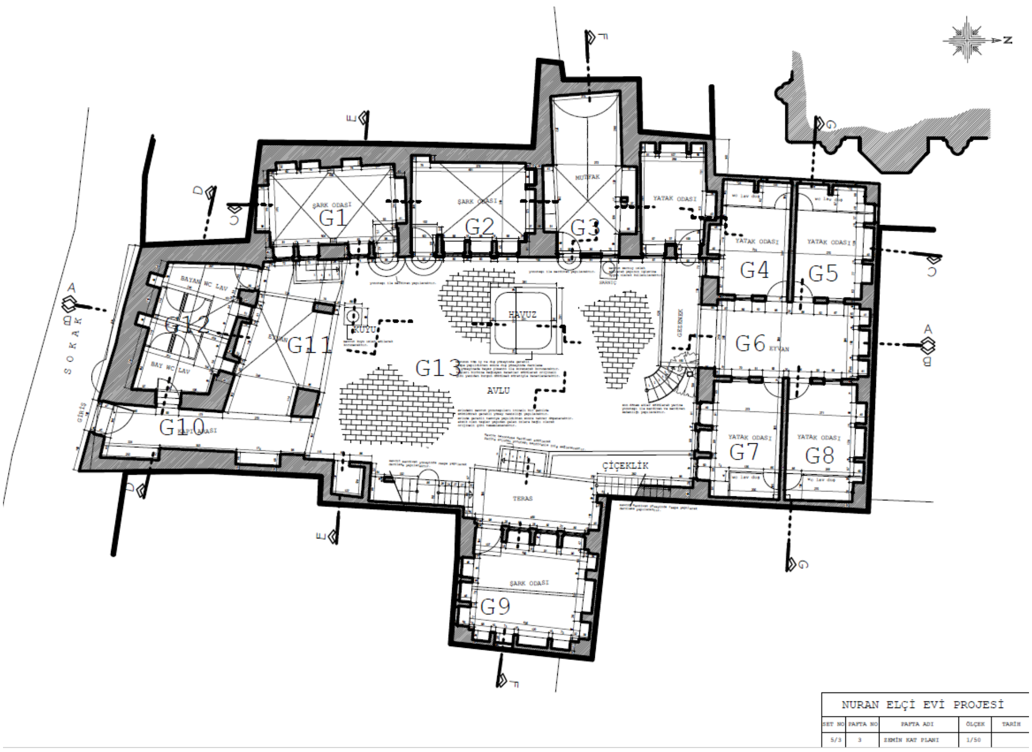


Figure 32: Nuran Elçi mansion restoration project ground floor plan (TEMA 2008: 50)

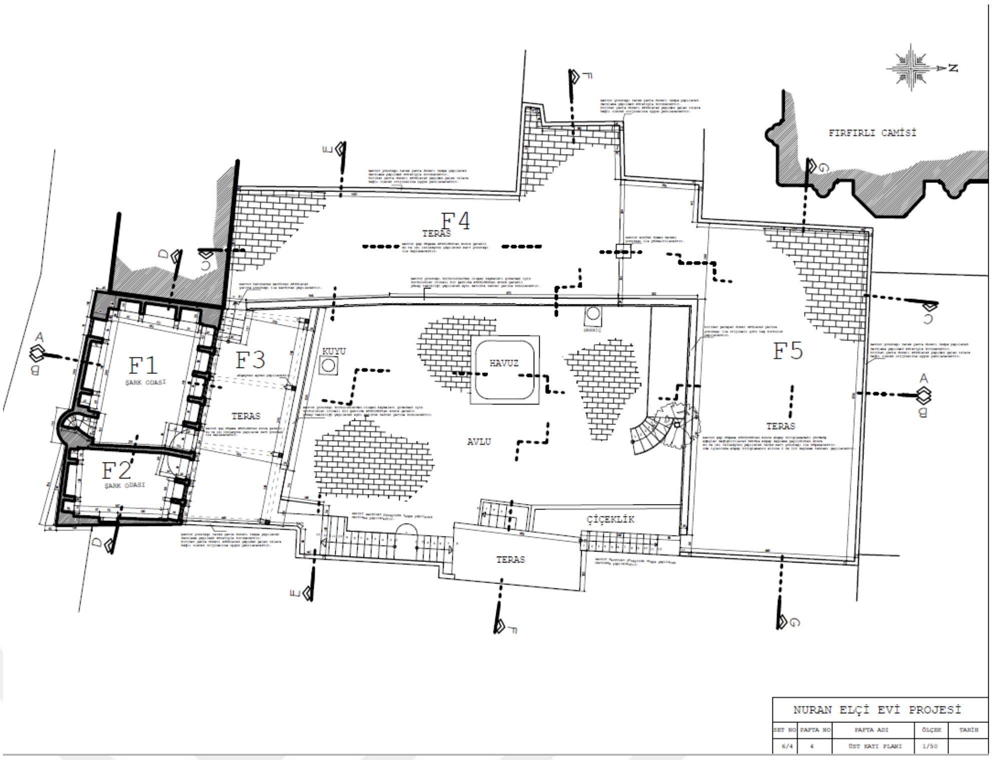


Figure 33: Nuran Elçi mansion restoration project first floor plan (TEMA 2008: 51)

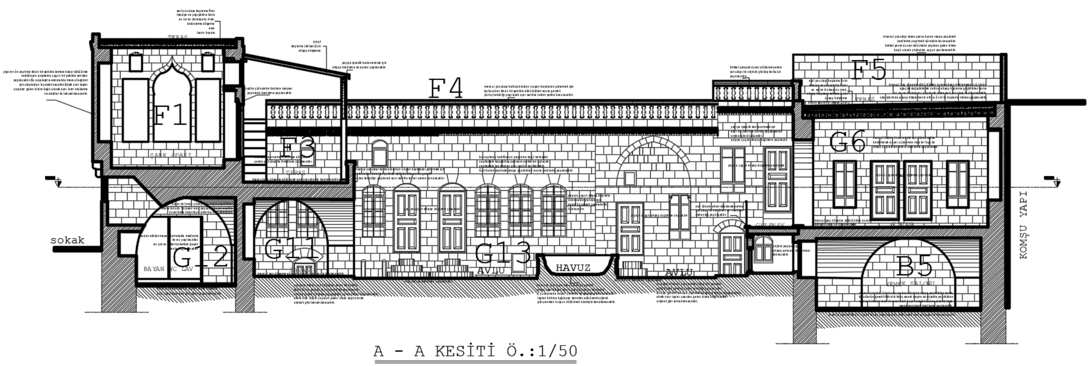


Figure 34: Nuran Elçi mansion restoration project section A-A (TEMA 2008: 52)

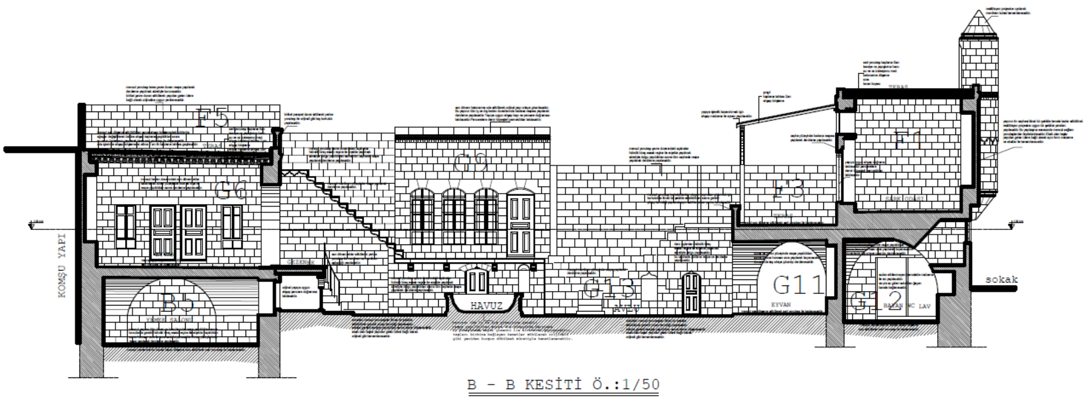


Figure 35: Nuran Elçi mansion restoration project section B-B (TEMA 2008: 53)

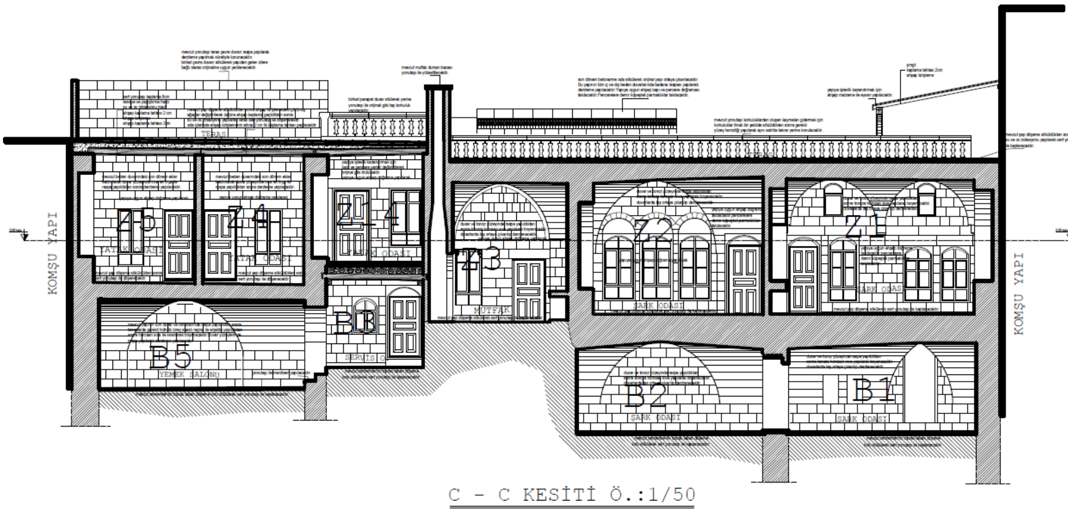


Figure 36: Nuran Elçi mansion restoration project section C-C (TEMA 2008: 54)

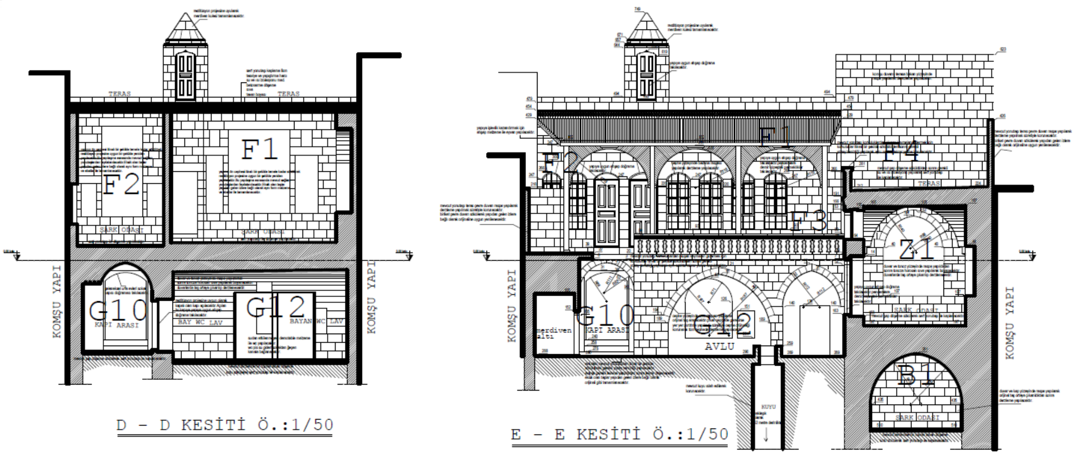


Figure 37: Nuran Elçi mansion restoration project section D-D and E-E (TEMA 2008: 56)

As indicated in these drawings, the processes applied to the building for restoration and adaptive reuse, and adapt to the new function are as follows;

- The aging determined during the restitution has been corrected in accordance with its original form.
- The last period of building annexes determined by the restitution, especially the reinforced concrete annexes, were removed and made with stone material suitable for their original form.
- Stone stairs have been added in front of the doors of Z1 and Z2 spaces between the ground floor rooms and the courtyard for the hotel users to reach more easily.
- Mortar cavities determined on the outer walls are filled with hydraulic lime-based resin.

- The wooden frames of the building windows were renewed in accordance with the original and iron-wrought irons were installed.
- The last period annex screeds observed in certain areas of the building were removed and chipped stones suitable for the original were laid instead.
- A hard floor suitable for use in the new function was prepared on the soil cover in the zerzembe, Develik, and manger sections in the basement. This hard floor is made of hard chipped stone suitable for the whole building.
- The original chipped stones in the courtyard were removed, leveled, and re-laid after the original stones were cleaned.
- Insulation and heat insulation were applied on the terraces. Terraces are reinforced concrete slabs.
- The slips determined in the balustrades of the terraces have been corrected.
- In The last period attached briquette parapets, which were partially built on the terraces, were removed and chipped stone balustrades suitable for the original were made.
- The ground floor Room of Torment (G12) was divided into two and used as male and female toilets.
- Although G1 and F1 spaces are shown as oriental rooms in the restoration project, it was observed by the author during the on-site measurement that they are currently used as bedrooms for hotel guests to stay.
- Although it was stated that a wooden iwan suitable for use in the new function would be created on the F3 Terrace of the 1st Floor, it was not observed during on-site measurements.
- All electrical and water systems have been renewed.

As can be seen in the drawings and during the on-site measurements, the wooden frames of the windows were renewed with energy-efficient solutions for thermal and lighting comfort to increase user comfort during the restoration and adaptive reuse project and applications in the building, and the gaps formed by aging were reduced in the frame. In this way, the heat flow created by the air passing through the gaps is prevented. Heat and water insulation has been made on the flooring of the terraces. A comprehensive retrofitting strategy evaluation was not carried out in the project.

4.2.1. On-Site Indoor Thermal and Lighting Comfort Measurements

As previously mentioned in the section on methodology and materials, on-site measurements were made for 4 days between 15.07.20222 and 19.02.2022 within the scope of the fieldwork in the sample building, and the indoor comfort values of the building were measured on the hottest days of the area where the building is located. During the measurement, sound measurements were also added to obtain data to be used in further studies. In order to collect the data regularly during the measurement, the table shown in the Table 8 Example of Measurement Table was used to be used in each of the 16 measurements made in total.

Table 8: Example of measurement table

NURAN ELÇİ MANSION INDOOR COMFORT PARAMETERS MEASUREMENT DATE : TIME: COURTYARD TEMPERATURE: COURTYARD AIR FLOW:															
FIELDS	TEMPERATURE		HUMIDITY	SOUND	COURTYARD WALL SURFACE	EXTERIOR WALL SURFACE	NEIGHBORING WALL 1 SURFACE	NEIGHBORING WALL 2 SURFACE	FLOORING	LIGHTING					
										AREA 1					
	HİGH 1									AREA2					
										AREA 3					
										AREA 4					
SPACE 1	HİGH 2									AREA 5					
										AREA 6					
										AREA 7					
	HİGH 3									AREA 8					
										AREA 9					
	TEMPERATURE		HUMIDITY	SOUND	COURTYARD WALL SURFACE	EXTERIOR WALL SURFACE	NEIGHBORING WALL 1 SURFACE	NEIGHBORING WALL 2 SURFACE	FLOORING	LIGHTING					
										AREA 1					
	HİGH 1									AREA2					
										AREA 3					
										AREA 4					
SPACE 2	HİGH 2									AREA 5					
										AREA 6					
										AREA 7					
	HİGH 3									AREA 8					
										AREA 9					
	TEMPERATURE		HUMIDITY	SOUND	COURTYARD WALL SURFACE	EXTERIOR WALL SURFACE	NEIGHBORING WALL 1 SURFACE	NEIGHBORING WALL 2 SURFACE	FLOORING	LIGHTING					
										AREA 1					
	HİGH 1									AREA2					
										AREA 3					
										AREA 4					
SPACE 3	HİGH 2									AREA 5					
										AREA 6					
										AREA 7					
	HİGH 3									AREA 8					
										AREA 9					
	TEMPERATURE		HUMIDITY	SOUND	COURTYARD WALL SURFACE	EXTERIOR WALL SURFACE	NEIGHBORING WALL 1 SURFACE	NEIGHBORING WALL 2 SURFACE	FLOORING	LIGHTING					
										AREA 1					
	HİGH 1									AREA2					
										AREA 3					
										AREA 4					
SPACE 4	HİGH 2									AREA 5					
										AREA 6					
										AREA 7					
	HİGH 3									AREA 8					
										AREA 9					
	TEMPERATURE		HUMIDITY	SOUND	COURTYARD WALL SURFACE	EXTERIOR WALL SURFACE	NEIGHBORING WALL 1 SURFACE	NEIGHBORING WALL 2 SURFACE	FLOORING	LIGHTING					
										AREA 1					
	HİGH 1									AREA2					
										AREA 3					
										AREA 4					
SPACE 5	HİGH 2									AREA 5					
										AREA 6					
										AREA 7					
	HİGH 3									AREA 8					
										AREA 9					
	TEMPERATURE		HUMIDITY	SOUND	COURTYARD WALL SURFACE	EXTERIOR WALL SURFACE	NEIGHBORING WALL 1 SURFACE	NEIGHBORING WALL 2 SURFACE	FLOORING	LIGHTING					
										AREA 1		AREA 10		AREA 19	
	HİGH 1									AREA2		AREA 11		AREA 20	
										AREA 3		AREA 12		AREA 21	
										AREA 4		AREA 13		AREA 22	
SPACE 6	HİGH 2									AREA 5		AREA 14		AREA 23	
										AREA 6		AREA 15		AREA 24	
										AREA 7		AREA 16		AREA 25	
	HİGH 3									AREA 8		AREA 17		AREA 26	
										AREA 9		AREA 18		AREA 27	

As can be seen in the sample table during the measurements, since different results may occur at different heights in temperature measurements, measurements were taken from 3 different heights in each place. Heights start from the heighest at High 1 and decrease towards High 3. In the illumination measurements, the illumination values were taken from 9 points in each measurement space by dividing each of them into 9 parts into 5 measurement spaces as A1-A9 shown in Figure 38 Sample Room Dividing Plan 1. Only Space 6 (B5), since the area of the space, is very large, this space was divided into 27 parts as A1-A27 and the illumination value was obtained from 27 points as shown in Figure 39 Sample Room Dividing Plan 2.

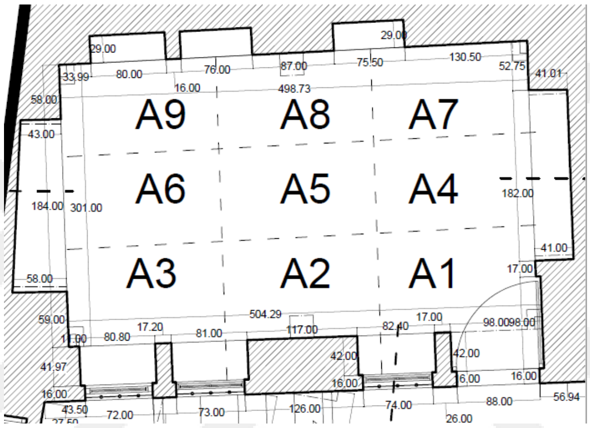


Figure 38: Sample room dividing plan 1 (TEMA 2008, Organized by Author)

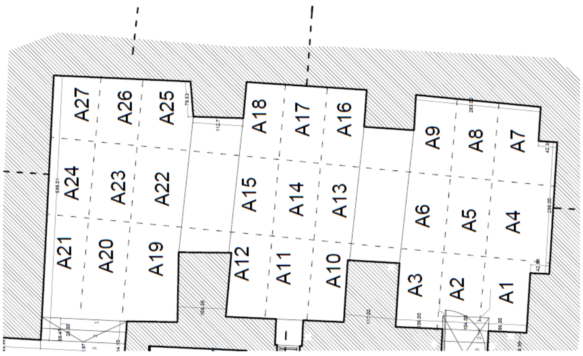


Figure 39: Sample room dividing plan 2 (TEMA 2008, Organized by Author)

During the measurements, 6 places were selected from different directions and floors in the building and these measurements were applied to all places at 4 different times during the day. While choosing the measurement locations, it was preferred that they be on different facades and floors, especially the absence of equipment that works and emits heat, and that there is a room that is not used during the measurement period since it is used as a hotel. The preferences made for room selections can be seen in the

Table 9 Measurement Locations Selection Table. The spaces selected to be used in the measurements, the spaces included in the building plans, are as seen in Table 3 Table of Measurement Places.

Table 9: Measurement Locations Selection Table

SPACE CODE (based on plan)	DIRECTION ON BUILDING	FLOOR LOCATION	SELECTED / NOT SELECTED	CAUSES
B1	East	Basement	Selected	
B2	East	Basement	Not	Entrance is forbidden.
B3	East	Basement	Not	A very small room
B5	North	Basement	Selected	
B6	West	Basement	Not	There are refrigerators that work and distribute heat
G1	East	Ground	Selected	
G2	East	Ground	Not	Refrigeration equipment is used in regular use as an administrative office.
G3	East	Ground	Not	Kitchen (there are heating and cooling loads.)
G4	North	Ground	Not	For hotel guest use.
G5	North	Ground	Not	For hotel guest use.
G6	North	Ground	Not	For hotel guest use.
G7	North	Ground	Selected	
G8	North	Ground	Not	For hotel guest use.
G9	West	Ground	Selected	
F1	South	First	Selected	
F2	South	First	Not	It has the same features as the F1 room and is for guest use.

Table 10: Table of measurement places

	SPACE CODE (based on plans)	DIRECTION ON BUILDING	FLOOR LOCATION	NEIGHBORING SPACES						FUNCTION (Before Adaptive Reuse)	FUNCTION (After Adaptive Reuse)
				NORTH	SOUTH	EAST	WEST	BOTTOM	TOP		
SPACE 1	G1	EAST	GROUND	G2 - ROOM	NEIGHBORING BUILDING	G13 COURTYARD	NEIGHBORING BUILDING	G9 STORAGE	F4-TERRACE	BEDROOM	BEDROOM + WC
SPACE 2	G9	WEST	GROUND	NEIGHBORING BUILDING	NEIGHBORING BUILDING	NEIGHBORING BUILDING	G13 COURTYARD	SOIL	G1-ROOM	BEDROOM	BEDROOM + WC
SPACE 3	F1	SOUTH	FIRST FLOOR	F3 - TERRACE	STREET	F2 - ROOM	NEIGHBORING BUILDING	G12-TOILET	ROOF	LIVING ROOM	BEDROOM + WC
SPACE 4	G7	NORTH	GROUND	NEIGHBORING BUILDING	G13 COURTYARD	NEIGHBORING BUILDING	G6 -IWAN	B5 RESTAURANT		BEDROOM	BEDROOM + WC
SPACE 5	B1	EAST	BASEMENT	B2 STORAGE	SOIL	SOIL	G13 COURTYARD	SOIL	G1 ROOM	STORAGE	STORAGE
SPACE 6	B5	SOUTH	BASEMENT	SOIL	G13 COURTYARD	SOIL	SOIL	SOIL	G4,5,7,8 ROOM G6 IWAN	BARN	RESTAURANT

SPACE 1- G1 (Room): It was planned as an oriental room according to the restoration project, but today it is used as a bedroom. The room has no window and door openings other than the courtyard. It has a cross-vaulted ceiling, 3 windows, and 2 skylights. Limestone, which is the building material, was left as it is in the remaining areas where plaster was applied on the ceiling in the interior. Artificial lighting in the room is provided by a ceiling chandelier (fluorescent bulb). A split air conditioner is used for heating and cooling the room. The visuals of the room are shown in Figure 40 Room G1. The plan of the room and the division made for the lighting measurement during the measurement can be seen in Figure 41 G1 Room Plan image.

Figure 40: G1 Room Photos (A,B,C) (Photo by Author

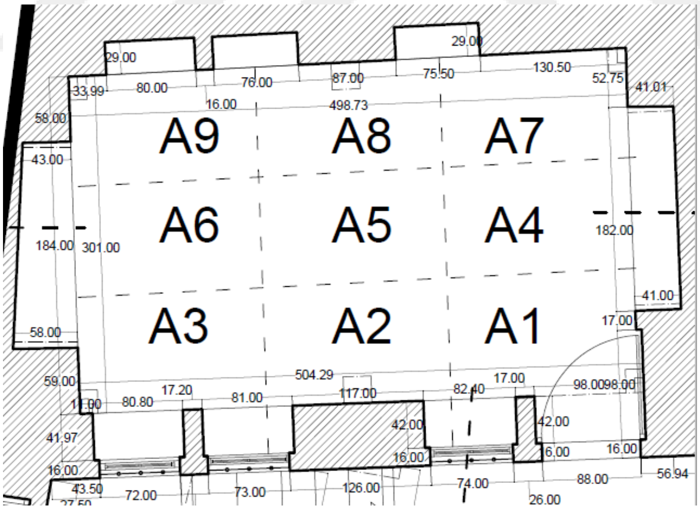


Figure 41: G1 Room plan (TEMA 2008, Organized by Author)

SPACE 2 - G9 (room): The room is now used as a bedroom. Since the room is above the ground floor in elevation, the room is accessed from the courtyard by stairs. The room has no window and door openings other than the courtyard. It has a wooden veneer ceiling and 3 flat and floor-to-ceiling wooden windows. Artificial lighting in the room is provided by a ceiling chandelier (fluorescent bulb). A split air conditioner is used for heating and cooling the room. The visuals of the room can be seen in Figure

42 Figure G9 Room photos. The plan of the room and the division made for the lighting measurement during the measurement can be seen in Figure 43 G9 Room Plan visual.

Figure 42: G9 Room Photos (A,B,C) (Photo by Author)

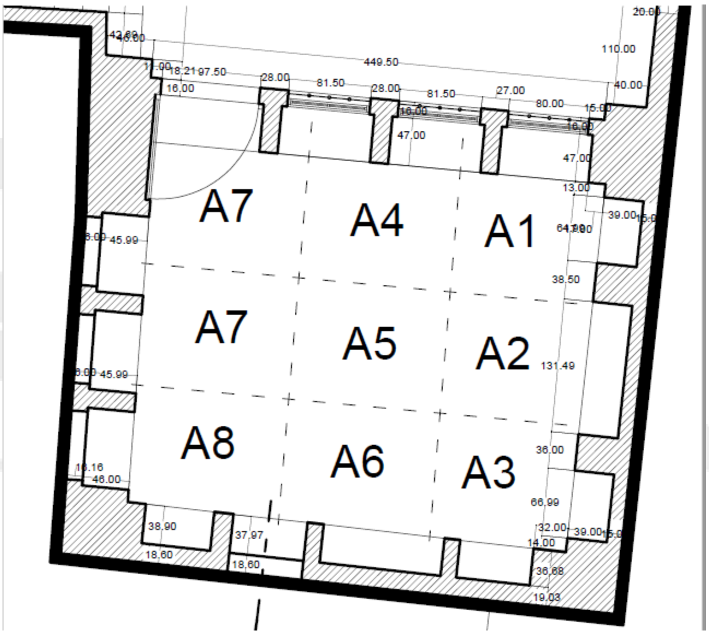


Figure 43: G9 Room Plan (TEMA 2008, Organized by Author)

SPACE 3 – F1 (room): The room that used to be in the selamlık section of the house is now used as a bedroom. Unlike other rooms in the past in the selamlık section, there is another window on the street front in addition to the 3 windows opening to the courtyard. The windows to the courtyard are flat and low to the ground. There are 3 skylights on the windows. Wood veneer ceiling, Artificial lighting in the room is provided by a ceiling chandelier (fluorescent bulb). A split air conditioner is used for heating and cooling the room. Images of the room are shown in Figure 44 F1 Room. The plan of the room and the division made for the lighting measurement during the measurement can be seen in Figure 45 F1 Room Plan visual.

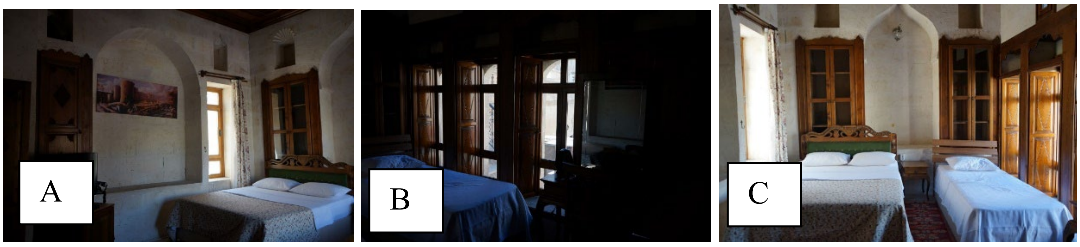


Figure 44: F1 Room Photos (A,B,C) (Photo by Author)

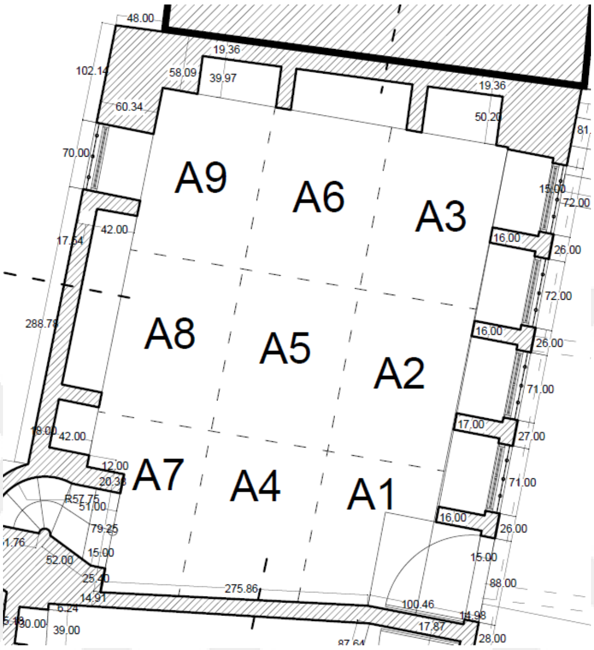


Figure 45: F1 Room plan (TEMA 2008, Organized by Author)

SPACE 4 – G7 (room): The room is now used as a bedroom. Unlike the other rooms, it has a window opening to the northern iwan in addition to the 3 windows opening to the courtyard. The door of this room also opens towards the iwan, not the courtyard. The windows to the courtyard are flat and low to the ground. In addition to the wood veneer ceiling, the east façade wall is also wood veneered. Artificial lighting in the room is provided by a ceiling chandelier (fluorescent bulb). A split air conditioner is used for heating and cooling the room. Images of the room are shown in Figure 46. The plan of the room and the division made for the lighting measurement during the measurement can be seen in Figure 47 G7 Room Plan visual.

Figure 46: G7 Room Photos (A,B,C) (Photo by Author)

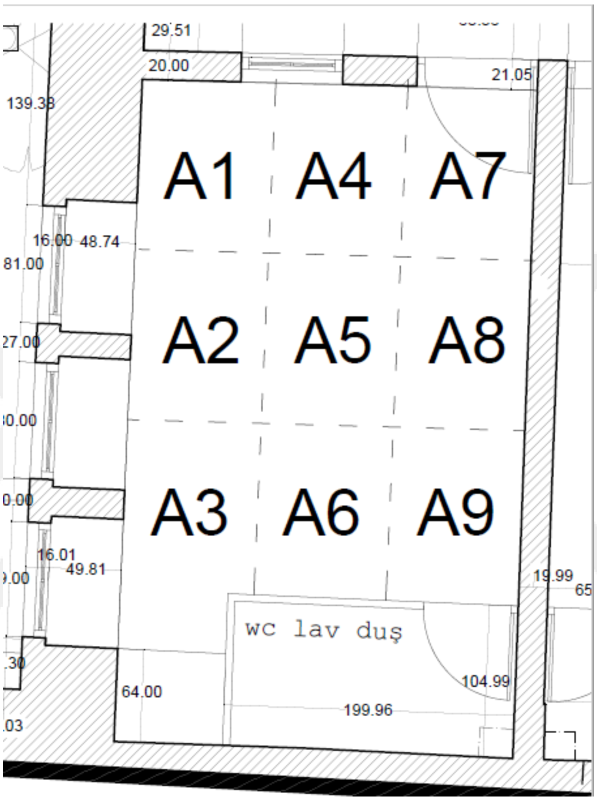


Figure 47: G7 Room plan (TEMA 2008, Organized by Author)

SPACE 5 – B1 (Storage): Space is used as storage today. Since the house is in the basement, it has 2 half windows opening to the courtyard, unlike the other rooms. From these windows, the natural light that will leave an opening in the quadrangles style wall is carried to the lower levels of the room. The application is seen in Figure 48 B1 Room Window Application image. Half of the room, not the whole, remains under the floor. In this way, it can receive natural light from the courtyard.

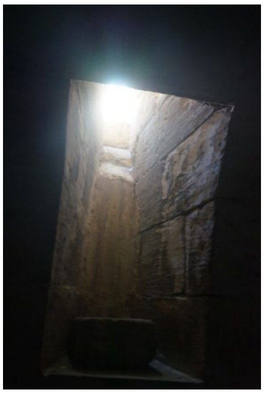


Figure 48: B1 Room window (Photo by Author)

Its vaulted ceiling was covered with Khorasan plaster in 2008 (TEMA 2008: 56). Artificial lighting in the room is provided by a ceiling light fixture (fluorescent bulb). Active systems for heating and cooling are not used in the room. Images of the room can be seen in Figure 49 Room B1 photos. The plan of the room and the division made for the lighting measurement during the measurement can be seen in Figure 50 B1 Room Plan image.

Figure 49: B1 Room Photos (A,B) (Photo by Author)

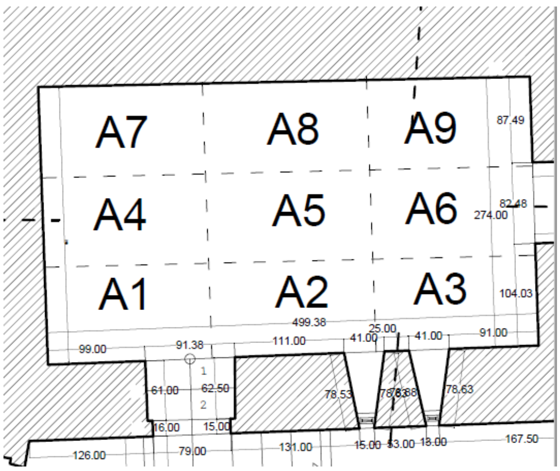


Figure 50: B1 Room plan (TEMA 2008, Organized by Author)

SPACE 6 – B5 (Restaurant): The place is used as a restaurant today. Since this place used to be a barn, the window is quite small. Its 3 cross-vaulted ceilings were covered with Khorasan plaster in 2008. Artificial lighting in the room is provided by a ceiling light fixture (fluorescent bulb). Active systems for heating and cooling are not used in the room. Images of the room can be seen in Figure 64 Room B5 1, Figure 51 Room B5 photos. The plan of the room and the division made for lighting measurement during measurement can be seen in Figure 52 B5 Room Plan image.

Figure 51: B5 Room Photos (A,B) (Photo by Author)

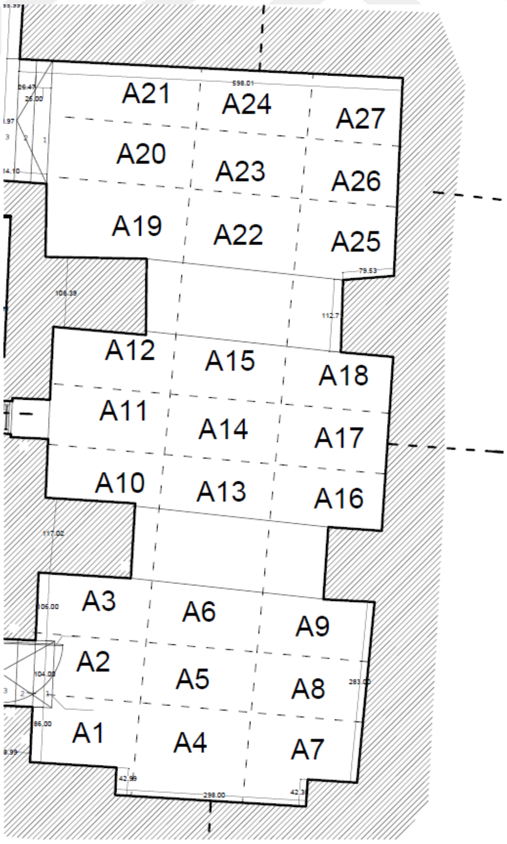


Figure 52: B5 Room plan (TEMA 2008, Organized by Author)

CHAPTER V
RESULT DISCUSSION

5.1. NURAN ELÇI MANSION INDOOR ENVIRONMENTAL QUALITY MEASUREMENT AND SIMULATION RESULTS

As of 15 July 2022, the simplified tables of the results obtained from the measurements made to measure the thermal condition and lighting amount at 10:00, 13:00, 16:00 and 19:00 for 4 days in the Sample Building are as follows. The original tables are included in Appendices 13-28.

Thermal Measurements:

Table 11: Measurements of thermal conditions at 10.00

MEASUREMENTS OF THERMAL CONDITIONS AT 10.00								
	15.07.2022 COURTYARD TEMPERATURE: 34.1 AİR FLOW: 0.21 m/s		16.07.2022 COURTYARD TEMPERATURE: 33.2 AİR FLOW: 0.18 m/s		17.07.2022 COURTYARD TEMPERATURE: 35.1 AİR FLOW: 0.42 m/s		18.07.2022 COURTYARD TEMPERATURE: 35.4 AİR FLOW: 0.34 m/s	
	LOW °C	HIGH °C	LOW °C	HIGH °C	LOW °C	HIGH °C	LOW °C	HIGH °C
SPACE 1 (G1)	32.9	33	32.9	33.0	32.8	32.9	34.1	34.1
SPACE 2 (G9)	34.1	34.2	31.9	32.0	33.9	34.1	34.4	34.5
SPACE 3 (F1)	32.9	33.1	32.8	32.9	33.1	33.2	33.7	33.9
SPACE 4 (G7)	33.8	33.9	33.8	34.0	34.2	34.4	34.9	35.0
SPACE 5 (B1)	32.7	32.8	32.1	32.2	32.9	33.0	33.2	33.3
SPACE 6 (B5)	31.8	31.9	31.8	31.9	31.5	31.7	32.3	32.1

Table 12: Measurements of thermal conditions at 13.00

MEASUREMENTS OF THERMAL CONDITIONS AT 13.00								
	15.07.2022 COURTYARD TEMPERATURE: 39.8 AİR FLOW: 0.20 m/s		16.07.2022 COURTYARD TEMPERATURE: 38.9 AİR FLOW: 0.20 m/s		17.07.2022 COURTYARD TEMPERATURE: 40.4 AİR FLOW: 0.30 m/s		18.07.2022 COURTYARD TEMPERATURE: 42.4 AİR FLOW: 0.10 m/s	
	LOW °C	HIGH °C	LOW °C	HIGH °C	LOW °C	HIGH °C	LOW °C	HIGH °C
SPACE 1 (G1)	37.5	37.8	36.2	36.3	37.6	37.7	38.1	38.2
SPACE 2 (G9)	37.2	37.8	34.4	34.6	37.3	37.5	37.6	37.6
SPACE 3 (F1)	37.7	37.8	37.5	37.6	37.8	37.9	38.4	38.6
SPACE 4 (G7)	37.3	37.7	35.1	35.2	37.5	37.6	37.9	38.1
SPACE 5 (B1)	28.4	28.6	30.1	30.2	29.2	29.3	30.2	30.4
SPACE 6 (B5)	30.1	30.2	32.2	32.4	30.3	30.4	31.1	31.4

Table 13: Measurements of thermal conditions at 16.00

MEASUREMENTS OF THERMAL CONDITIONS AT 16.00 AM								
	15.07.2022 COURTYARD TEMPERATURE: 43.4 AİR FLOW: 0.30 m/s		16.07.2022 COURTYARD TEMPERATURE: 41.6 AİR FLOW: 0.40 m/s		17.07.2022 COURTYARD TEMPERATURE: 44.7 AİR FLOW: 0.10 m/s		18.07.2022 COURTYARD TEMPERATURE: 45.8 AİR FLOW: 0.10 m/s	
	LOW °C	HIGH °C	LOW °C	HIGH °C	LOW °C	HIGH °C	LOW °C	HIGH °C
SPACE 1 (G1)	38.8	38.9	36.8	36.9	38.7	38.8	39.2	39.4
SPACE 2 (G9)	36.7	36.8	34.9	35.1	36.5	36.6	37.1	37.3
SPACE 3 (F1)	38.2	38.3	37.9	38.1	38.5	38.6	39.8	40.1
SPACE 4 (G7)	37.8	37.9	35.9	36.1	37.8	37.9	38.1	38.3
SPACE 5 (B1)	32.5	32.7	31.9	32.1	32.4	32.6	32.7	32.8
SPACE 6 (B5)	32.9	33.0	31.4	31.5	32.7	32.8	32.9	33.1

Table 14: Measurements of thermal conditions at 19.00

MEASUREMENTS OF THERMAL CONDITIONS AT 19.00 AM								
	15.07.2022 COURTYARD TEMPERATURE: 34.6 AİR FLOW: 0.21 m/s		16.07.2022 COURTYARD TEMPERATURE: 34.4 AİR FLOW: 0.21 m/s		17.07.2022 COURTYARD TEMPERATURE: 34.4 AİR FLOW: 0.20 m/s		18.07.2022 COURTYARD TEMPERATURE: 34.9 AİR FLOW: 0.20 m/s	
	LOW °C	HIGH °C	LOW °C	HIGH °C	LOW °C	HIGH °C	LOW °C	HIGH °C
SPACE 1 (G1)	35.9	36	35.6	35.7	35.8	35.9	36.5	36.7
SPACE 2 (G9)	34.2	34.3	34.0	34.1	34.0	34.2	34.9	35.1
SPACE 3 (F1)	37.1	37.2	36.8	36.9	36.8	36.9	37.7	37.8
SPACE 4 (G7)	37.8	37.9	37.5	37.6	37.5	37.6	38.1	38.2
SPACE 5 (B1)	32.9	33.0	32.7	32.8	32.7	32.8	36.8	36.9
SPACE 6 (B5)	33.0	33.1	32.6	32.8	32.8	32.9	33.2	33.3

After these measurements, it has been observed that the temperature of 24-26 °C, which is determined by ASHRAE and considered suitable for user comfort in summer, could not be reached in any place where measurements were taken, without using active systems at the time of measurement. In the current situation, in order to reach the desired temperature in the spaces, the room temperature should be lowered by 2-4 °C in the coolest hour in the coolest room, and by 14-16 °C in the hottest room in the hottest hour. Since only split air conditioners are used for cooling in places, a high amount of electrical energy is consumed to reach ideal temperatures. The coolest places are B1 and B5 spaces located at the lower ground level, on the west and north facades, while the warmest room is the F1 room on the 1st floor. This room is located on the south side of the building. Among the rooms on the ground floor, the coolest room on average is the one on the north façade, coded G7. On the ground floor rooms with codes G9 and G1 on the east and west facades, the rooms become the coolest room and the warmest room depending on the hourly changes.

Lighting Measurement:

Table 15: Lighting measurements 10:00

LIGHTING MEASUREMENTS AT 10:00 (BASED FOR AREA 2,5,8)												
	15.07.2022			16.07.2022			17.07.2022			18.07.2022		
	A2	A5	A8	A2	A5	A8	A2	A5	A8	A2	A5	A8
SPACE 1 (G1)	317	169	117	315	170	110	318	168	114	319	171	113
SPACE 2 (G9)	97	62	58	91	63	58	98	71	63	92	67	61
SPACE 3 (F1)	211	78	51	211	79	54	217	79	57	216	76	52
SPACE 4 (G7)	271	51	54	269	54	54	282	58	51	278	52	49
SPACE 5 (B1)	18	0	0	18	0	0	16	0	0	24	1	0
SPACE 6 (B5)	10	2	0	9	1	0	10	1	0	11	2	1

Values in the table are given in LUX.

Table 16: Lighting measurements 13:00

LIGHTING MEASUREMENTS AT 13:00 (BASED FOR AREA 2,5,8)												
	15.07.2022			16.07.2022			17.07.2022			18.07.2022		
	A2	A5	A8	A2	A5	A8	A2	A5	A8	A2	A5	A8
SPACE 1 (G1)	354	214	224	325	210	227	365	225	233	334	221	229
SPACE 2 (G9)	77	26	17	81	28	19	79	32	19	85	38	24
SPACE 3 (F1)	634	157	68	642	178	72	654	174	74	657	185	78
SPACE 4 (G7)	115	48	58	121	52	62	121	54	67	124	61	74
SPACE 5 (B1)	23	6	6	25	6	7	28	9	8	31	10	9
SPACE 6 (B5)	19	21	5	18	20	7	21	24	7	20	25	7

Values in the table are given in LUX.

Table 17: Lighting measurements 16:00

LIGHTING MEASUREMENTS AT 16:00 (BASED FOR AREA 2,5,8)												
	15.07.2022			16.07.2022			17.07.2022			18.07.2022		
	A2	A5	A8	A2	A5	A8	A2	A5	A8	A2	A5	A8
SPACE 1 (G1)	288	189	124	296	197	132	301	194	129	305	197	131
SPACE 2 (G9)	21	18	41	29	25	49	28	28	47	27	23	52
SPACE 3 (F1)	476	186	81	659	201	97	662	195	94	671	201	98
SPACE 4 (G7)	102	31	30	104	35	36	106	33	32	111	36	32
SPACE 5 (B1)	13	3	3	18	4	2	16	4	4	18	5	4
SPACE 6 (B5)	5	6	2	4	7	4	6	7	4	7	7	4

Values in the table are given in LUX.

Table 18: Lighting measurements 19:00

LIGHTING MEASUREMENTS AT 19:00 (BASED FOR AREA 2,5,8)												
	15.07.2022			16.07.2022			17.07.2022			18.07.2022		
	A2	A5	A8	A2	A5	A8	A2	A5	A8	A2	A5	A8
SPACE 1 (G1)	18	7	4	14	7	3	11	5	2	17	8	2
SPACE 2 (G9)	7	2	0	7	1	0	6	0	0	9	2	0
SPACE 3 (F1)	7	0	0	6	0	0	6	0	0	7	0	0
SPACE 4 (G7)	0	0	0	0	0	0	0	0	0	0	0	0
SPACE 5 (B1)	1	0	0	0	0	0	0	0	0	1	0	0
SPACE 6 (B5)	0	0	0	0	0	0	0	0	0	0	0	0

Values in the table are given in LUX.

The evaluation of the data obtained in these measurements according to the places is as follows.

SPACE 1(G1): It is the place where the amount of illumination is homogeneously distributed among the places where the measurement is made. The highest illuminance level during the day is observed at 13.00 in the place. Although the amount of light in front of the window meets the 300 Lux value, which is suitable for the rooms specified in IESNA and TSE 17067, it remains below this value in the rest of the room.

SPACE 2 (G9): The venue provided the highest illumination value in the measurements made at 10:00. However, the highest value is 92 lux in front of the glass. This value is well below the desired 300 lux value in the rooms. In order to achieve the ideal lighting comfort in this place, it is necessary to get support from artificial lighting at all hours of the day. This situation causes electrical energy consumption in the place throughout the day.

SPACE 3 (F1): Although the lighting values in the space are in good condition compared to other rooms, since there is no homogeneous spread, there is high illumination in the parts of the room near the window, and there is a serious decrease in the amount of light in other areas. There is glare in front of windows at 13 o'clock measurements. Due to the lack of lighting in the back of the room, it may be necessary to have an active system continuously during the day.

SPACE 4 (G7): The venue cannot meet the 300 Lux value suitable for the rooms specified in IESNA and TSE 17067 in any area at any time of the day. In order to achieve the ideal lighting comfort in this place, support from artificial lighting is required at all hours of the day. This situation causes electrical energy consumption in the place throughout the day.

SPACE 5 (B1): The highest illumination value obtained during all measurements in B1, which is one of the basement floor spaces, was measured as 31 Lux at 13.00 measurements. Artificial lighting is required continuously if the space is used for the desired 200 Lux value for the storage areas in IESNA and TSE 17067.

SPACE 6 (B5) : Since this area was used as a barn in the past, it was designed without considering the lighting. Considering the values measured today, the highest illumination value obtained during all measurements of the place is the 25-lux value determined at 13.00. This value does not meet the ideal lighting value of 75 lux specified in IESNA and TSE 17067 Conformity assessment — Fundamentals of product certification and guidelines for product certification schemes, which is determined for restaurant areas. In order for the space to reach the ideal lighting value, the existing wall lighting should be used actively as long as the space is used.

At 19.00 measurements, sufficient lighting level cannot be reached in any area in any of the spaces. In the measurements made in this time zone, most of the measurement results were determined as 0. As of this hour, artificial lighting should be used in all places.

After the measurements, in order to determine the thermal comfort conditions, lighting conditions, and energy consumption in the current situation of the places where the measurements were made, as mentioned in the methodology section, the building was modeled and analyzed via Autodesk Revit software.

In the analyzes made to determine the lighting status of the building, the user was examined separately as the amount of daylight and the amount of illumination, and the amount of lighting when daylight and artificial lighting are used together. In order to get the correct data in the software where the analyzes are made, it is necessary to enter the location of the building and the day and time information for which the analysis is requested. The time zones used in the lighting analysis of the building are 08:00, 12:00, 18:00, and 21:00 on the 15th of each month in the spaces used as rooms, based on the density of users obtained from the hotel management, and on the 15th of each month in the spaces used as restaurant and storage. It was applied at 09:00, 13:00, 19:00, and 21:00.

In the analyzes made to determine the thermal situation, location and time information is very important, just like the analyzes in which the lighting situation is determined. In these analyses, the hours used in the measurements made on-site were determined, and the analyzes were applied separately for the 15th of each month.

Energy consumption analysis was made on an annual basis separately for each place since it was desired to consider the annual consumption amount. Energy consumption analysis was made on an annual basis separately for each place since it was desired to consider the annual consumption amount.

5.2. CURRENT STATE ENERGY AND DAYLIGHT SIMULATION ANALYSIS AND RESULTS

In the on-site measurements, it has been determined that none of the measurement rooms in the building are sufficient to provide user comfort without the use of thermal comfort and lighting comfort active systems. For this reason, it is aimed to determine the energy consumption used for thermal and lighting comfort by creating an energy analysis of the building and to offer suggestions for reducing the energy consumption of the building according to the results obtained. Daylight simulation was applied to the building in order to determine the suggestions to be made in terms of lighting comfort.

5.2.1. Energy Analysis and Results

In the energy analyzes applied in the building, the REVIT software was used as stated in the methodology section. The energy simulations were made on an annual measurement basis, with the modeling of the structure in the software and the correct integration of its location. The targeted results at this stage are to determine the annual amount of energy consumption, the consumption shares of active systems that provide thermal comfort and lighting comfort in annual energy consumption, and the causes of cooling and heating loads that cause thermal energy consumption.

The annual energy consumption obtained as a result of the simulation and the energy consumption shares used to provide thermal comfort and lighting comfort are as in Table 19 and Figure 53.

Table 19: Annual electiricity consumptions (Adapted from REVIT Analysis)

	ELECTIRICITY (GJ)
Annual Heating Consumption	69.05
Annual Cooling Consumption	177.95
Annual Lighting Consumption	27.76
Annual Interior Equipments Consumption	31.44
TOTAL ANNUAL CONSUMPTİON	306.2 (85,055.55 kw/h)

GJ: Gigajoule, which is a unit of measurement used to quantify energy, with 1 gigajoule equal to 1 billion joules.

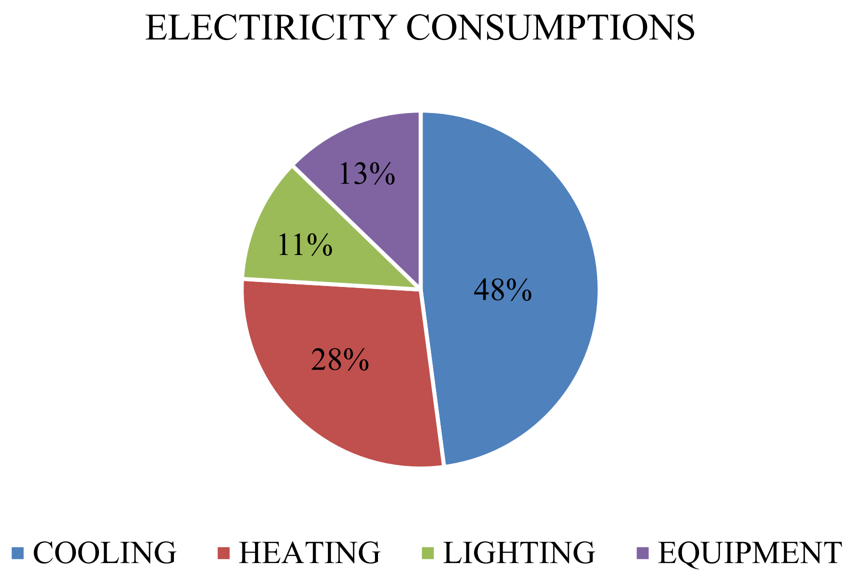


Figure 53: Electiricity conpsumption shares graphic

As can be seen in the graph and table prepared with the analysis results, the majority of the annual electricity consumption in the building is used to provide thermal comfort. This ratio reaches 76% of the total consumption in total heating and cooling loads. Considering this situation, the structural elements that cause the heating and cooling loads given in Table 20 Estimated Cooling Peak Components and Table 21 Estimated Heating Peak Components. were examined in order to determine the improvements to be suggested for reducing the heating and cooling loads.

Table 20: Estimated cooling peak components (Adapted from REVIT Analysis)

	ESTIMATED COOLING PEAK LOAD COMPONENTS						
		EXTERIOR WALL (W)	ROOF (W)	SLAB (W)	GLASS CONDUCTION (W)	GLASS SOLAR (W)	DOOR (W)
B1	INSTANT						
	DELAYED	628	64	-352			34
B5	INSTANT				175		
	DELAYED	1156	2	-963		306	169
G1	INSTANT				30		
	DELAYED	816	106	81		49	65
G7	INSTANT				103		
	DELAYED	352		18		545	
G9	INSTANT				304		
	DELAYED	352		16		1379	34
F1	INSTANT				75		
	DELAYED	665		81		254	73

Glass Conduction: The process of heat transfer through solid glass material via molecular vibrations and collisions.
Glass Solar: Solar energy passing through the window refers to the energy of sunlight that enters the indoor space through the window and is used for lighting or thermal gain purposes.

Table 21: Estimated heating peak components (Adapted from REVIT Analysis)

	ESTIMATED HEATING PEAK LOAD COMPONENTS						
		EXTERIOR WALL (W)	ROOF (W)	SLAB (W)	GLASS CONDUCTION (W)	GLASS SOLAR (W)	DOOR (W)
B1	INSTANT						
	DELAYED	- 362	-100	10			-31
B5	INSTANT				-124		
	DELAYED	-973	-19	77			-62
G1	INSTANT				-34		
	DELAYED	-566	-127	-91			-64
G7	INSTANT				-34		
	DELAYED	-218		-54			
G9	INSTANT				-272		
	DELAYED	-459		-84			-8
F1	INSTANT				52		
	DELAYED	-634		-92			-71

Glass Conduction: The process of heat transfer through solid glass material via molecular vibrations and collisions.
Glass Solar: Solar energy passing through the window refers to the energy of sunlight that enters the indoor space through the window and is used for lighting or thermal gain purposes.

As seen in the tables, the building elements that affect the heating and cooling loads negatively and cause heat losses and gains are the walls and windows. These building elements will be taken into account in the application proposals to reduce the energy consumption used to provide thermal comfort in the building. Analysis results of simulation analyzes made with Revit software are given in Appendices 29-43.

5.2.2. Thermal Comfort Energy Consumption Improvement Recommendations

Transfer of outside heat through heat gains and loses roof, wall and floor; receiving direct sunlight from windows ; It is caused by air movements inside the building (Thorpe 2017: 32). In buildings, the highest cooling and heating needs are mostly directly related to solar gains and heat loses. Some of the cooling load can be avoided by avoiding solar gains (Ahearn 1982: 22). As stated before, the most important cause of solar gains and loses in this building is the walls and windows. At this point, first of all, improvement suggestions for the insulation of these two building elements will be discussed.

5.2.2.1. Wall Insulation

When proposing insulation for historical buildings, it's important to consider factors like the location and type of insulation material used. The preservation of the building's original appearance should also be taken into account, with a focus on maintaining its authenticity as per the Venice Charter of 1964. Evaluating the appropriate location for insulation is crucial, as exterior facades are a key feature that reflect a building's historical character. It's generally preferable to avoid modifying the exterior facades and instead make changes to the interior. Any intervention should also avoid significantly altering the building's proportions or its relationship with its surroundings, according to the Venice Charter (Posani et al. 2021: 12).

In cases where original surface details hold value or where there are window and door openings, it may not be acceptable to make changes that would cause dimensional alterations (The Venice Charter 1964: 4). Therefore, it is often necessary to limit the thickness of the insulation adopted in the intervention.

In addition, the damages caused by the insulation-fixing supports to the walls should be minimized.

Reversibility is very important so new additions to historic buildings must be removable with minimal or no damage to the original texture (Posani et al. 2021: 15).

When evaluating and comparing insulation systems and materials, the thermal properties of the materials are the primary parameters of interest. Studies have shown

When evaluating the effectiveness of insulation systems and materials, their thermal properties, such as thermal conductivity and specific heat capacity, are commonly analyzed and compared. Thermal conductivity is an important parameter to consider when assessing the potential improvement in thermal resistance that can be achieved through retrofitting.

In hot and dry climates, the choice of wall insulation material is critical for maintaining a comfortable indoor environment and reducing energy consumption. Among the various options available, three commonly used insulation materials are Expanded Polystyrene Insulation (EPS), mineral wools and Slica Aerogel Rendering.

(Expanded Polystyrene) EPS foam panels are insulation materials produced by expanding polystyrene particles under steam or hot water. Still air has a very low thermal conductivity and polystyrene foam materials contain almost 98% air. The heat-conducting solid phase (foam skeleton) constitutes 2% of the total volume. In addition, polystyrene material, which conducts heat, is a very insulating material. The weight of the material varies between 10-100 kg/m3. In addition, the thermal conductivity value changes according to the production intensity. (Yücel et al. 2003: 23). EPS insulation provides high thermal performance and can significantly reduce energy consumption due to its high R-value and low water absorption rate. However, proper installation is crucial to avoid thermal bridging and ensure optimal performance.

Mineral wool is produced from the basic materials of sand and basalt rocks. Only slag and basalt can be used to produce stone wool. In the production process, the materials are melted in an oven heated to 1300-1500 °C and then subjected to fiberization. This is accomplished using centrifugal-driven discs with small holes or rotating nozzles. Binding products and additives such as dust reducing oil and phenolic resin are used in the rockwool composition (Freudenberg 2019: 45).

Aerogel renders are various plaster systems with a thermal conductivity of around 28 mW/(m K) developed by combining aerogel granulation with inorganic binders. It is less than half of the thermal conductivity of traditional insulation plasters. Aerogel renders are a particularly suitable material for historically irregular surfaces-interior and exterior - and for applications where varying insulation thickness is advantageous, such as window sills or near beams in wood frame structures (Ganobjak et al. 2020: 55)

The comparison of the mentioned materials in terms of material features, thermal conductivity, suitability for historical buildings, example articles and results of this studies is given in Table 22.

Table 22: Wall ınsulation materials comparission table

Insulation Material	Material Features	Thermal Conductivity	Suitability for Historical Buildings	Example of Article	Results of Study
EPS (Expanded Polystyrene Insulation)	Uniform closed-cell foam structure	0,030 W/mK With a density of 19 kg/m3 (Ganobjak et al. 2020: 11).	Not recommended Water vapor diffusion is not suitable (Historic England, 2016: 17)	Alemdağ et al. (2023: 36)	Since 3 cm mortar + 4 cm EPS was applied, an average of 54.2% thermal loss improvement was achieved in warm winters.
				Khoukhi et al. (2019: 43)	In an extremely hot climate, the cooling load of the building increases, not decreases. The minimum increase is 5%.
Stone Wool	Spun fibers bonded together to form a mat	0.034 W/mK With a density of 48 kg/m3 (Ganobjak et al. 2020: 11).	May be suitable but requires thick layers, can cause moisture build-up (Ganobjak et al. 2020: 18).	Alemdağ et al. (2023: 28)	When applied between 7 cm walls, it provides an average of 54.9% heat loss improvement. It provides a maximum saving of 68.8% in annual heating energy.
				Khoukhi et al. (2019: 85)	As it dissipates heat, it causes a 3% increase in cooling load.
Slica Aerogel Rendering	Spray thermal plaster	0.028 W/mK With a density of 220 kg/m3 (Ganobjak et al. 2020: 12).	Since there is no application fixing apparatus, it is more suitable than materials that require assembly. It can be applied thinner. They can also be distinguished from the original structure due to the presence of lightweight aggregates and can be easily removed. (Posani, Veiga, de Freitas, 2021).	Wakili et al. Wernery, (2015: 17).	Based on dry air, the U value decreased by 30%. improvement.
				Fenoglio et al. (2020: 25)	%60 reduction in heat transfer coeffient and (Karim et al 2022: 88)

Considering the comparisons and material data given in the table, Slica Aerogel rendering, which has a lower U value and was found to be suitable for use in historical buildings, is preferred as an insulation material in this study. In addition, McCaig et al (2018) has found Slica Aerogel-style spray insulation materials suitable for use in historical buildings as a low risk. After the Slica Aerogel render is applied indoors, timber ornamental coatings, which were frequently used in the space before, are recommended so that the surface can be finished in accordance with the authencity of the building. In this way, both the additional insulation feature of the wood will be used and a solution compatible with the authencity of the building will be obtained. Timber coating thermal conductivity is 0.13 W/mK (Thorpe 2017: 23).

After the insulation application to be applied to the sample building, the wall section is as shown in figure 54.

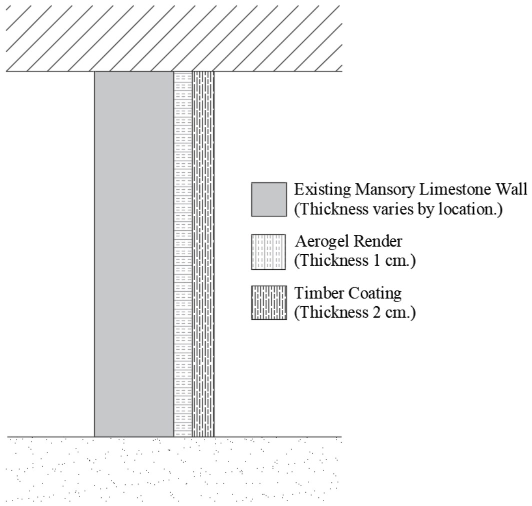


Figure 54: Wall section after ınsulation

After the insulation material, which can be suitable for use in the historical building and can reduce the existing thermal conductive value of the walls, is preferred for the walls, there are areas where insulation will be applied in another important location. Although it is planned to create an effect that is compatible with the originality of the building with wooden coating on the insulation to be applied, it is recommended to apply only one facade in each room, since applying this application to all facades of the rooms may eliminate the original interior.

For the application of the insulation results has been shown in Table 18. The obtained results showed that there was a significant decrease in U value. For every rooms, the U value decreased almost 1 of 3 for the value before the insulation. For example, the U value decreased from 3.6250 W/(m^2.K) to 1.2505 W/(m^2.K) fort he room B1.

Table 23: Walls U value comparission table

	BEFORE INSULATION	AFTER INSULATION
B1	3.6250W/(m²·K)	1.2505 W/(m²·K)
B5	3.8667W/(m²·K)	1.2781W/(m²·K)
G1	5.0000 W/(m²·K)	1.3816 W/(m²·K)
G7	4.4615 W/(m²·K)	1.3370 W/(m²·K)
G9	4.6774 W/(m²·K)	1.3557W/(m²·K)
F1	4.8333 W/(m²·K)	1.3685W/(m²·K)

The reasons for choosing the facades to be applied are as follows:

Rooms B1 and B5 are completely underground except for the courtyard facades, and mostly under the ground on the courtyard facades. In these places, the insulation will be provided from the facades facing the courtyard, taking into account the effect of reducing the heating and cooling load in the rooms in the rooms.

In rooms G1, G7 and G9, the facades that are open to the outside are only the walls facing the courtyard facade. The other facade, which does not have a neighboring room connection, is surrounded by the neighboring building, so it does not act as an external wall. For this reason, insulation in these rooms will be provided from the walls facing the courtyard facade.

Room F1 is the only room with two façades facing the street and the courtyard. Previously, Ayçam et al. The courtyard effect was investigated in Traditional Diyarbakır Houses with similar climate and building type investigated in the 2020 study, and the courtyard effect of 4-armed (central courtyard) buildings, such as the sample building of this study, increased by 12% for cooling energy load, 14% for heating energy load, and as % of average annual heating-cooling load. 13 decreased (Ayçam et al. 2020: 17). Also, Zhu et al. 2023 and Diz Melloda et al. In the 2023 studies, it has been determined that the annual heating - cooling loads of the buildings are reduced by the shading obtained thanks to the courtyard, depending on the change of factors such as courtyard geometry, plan ratio, and facade ratio. For this reason, in order to prevent the gains coming from the street facade to the building, the insulation will be provided by the outer wall on the street facade in room B1.

The insulation walls to be applied in the selected rooms are as shown in Figure 76.

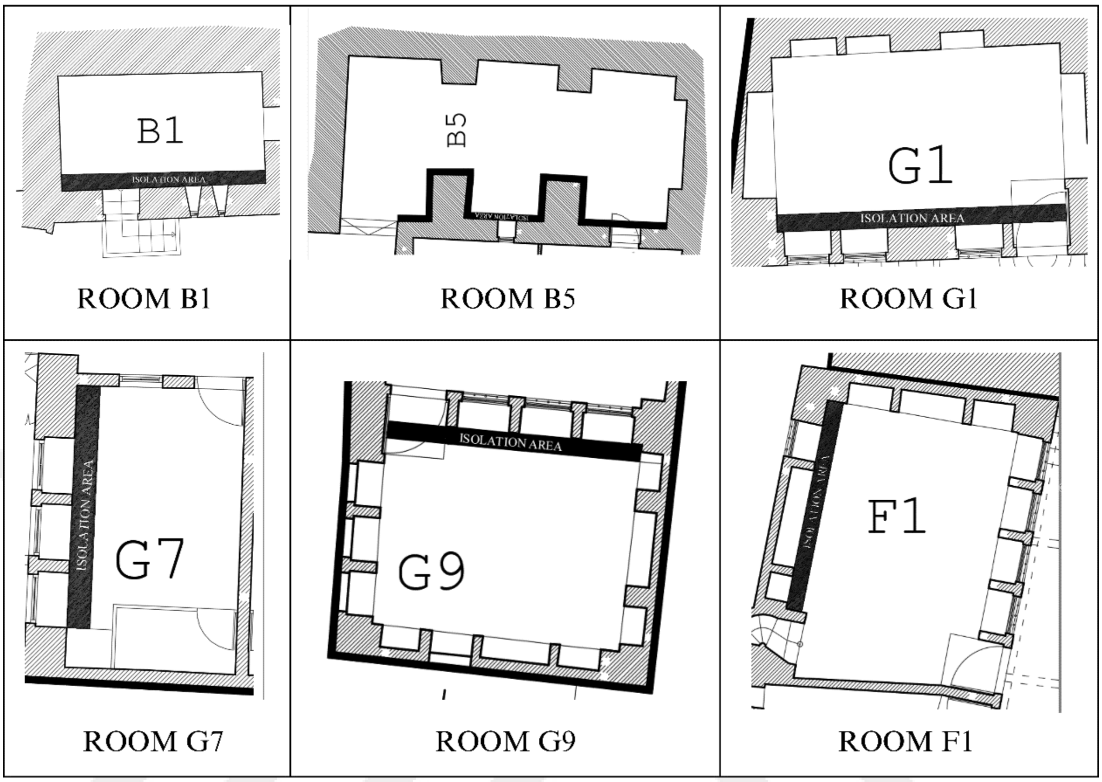


Figure 55: Isolation walls

In addition in terms of energy savings for buildings with thick stone walls, the effects of thermal inertia and night cooling should be considered. These features can provide passive cooling in summer in climates with high temperatures during the hot hours of the day. Walls with thermal mass provide lower internal temperatures during the day and effectively attenuate the buffered heat through natural ventilation when suitable conditions are provided (Godwin 2011: 44). This situation is in the source of Szokolay (2014: 16). the mass effect provided by the heavy construction is particularly beneficial in many situations, without the need for special devices. In places with a typical hot-dry climate with a large diurnal variability, when the temperature is very high or very cold during the day, if the average of the day is within the comfort zone, the mass building can provide comfortable indoor conditions even without mechanical cooling (Szokolay 2014: 23). On the other hand, when historic buildings are conditioned using an intermittent heating system, walls with high thermal mass may not be suitable for providing rapid heating can increase the energy required and extend the preheating time.

Interior insulation solutions separate the thermal capacity of the wall from its connection with the indoor air, so it can have a negative impact on passive summer cooling (Posani et al. 2021: 26). However, in study Thorpe (2017: 22), thermal mass buildings help prevent overheating by absorbing internal heat and a certain amount of humidity. However, considering thermal bridges, external insulation is required to maintain the internal temperature (Thorpe 2017: 17). Thermal bridging is when a conductive material conducts heat undesirably from indoor to outdoor or vice versa. As the airtightness and insulation standard in a building increase, thermal bridging becomes an increasingly important factor in heat transfer. Insulation is added on the inside or outside of a thermal bridge (Thorpe 2017: 18).

In addition to energy savings, thermal insulation can increase the thermal comfort indoors by increasing the surface temperatures of the interior walls during the heating season, while it can create a risk of overheating in the hot climate during the summer months. In this respect, internal insulation may increase the risk of discomfort in summer, as it has a stronger effect on thermal mass (Posani et al. 2021: 45).

Therefore, insulation solutions must be carefully analyzed, comparing the benefits achieved during the winter months with the potentially increased cooling demands and increased risks of overheating during the summer months. For this purpose, after applying the recommended insulation applications, the energy consumption analysis to be applied to the building gains importance regarding the evaluation of this issue.

5.2.2.2. Window Isolation

Historic buildings often have single-pane or poorly insulated windows, resulting in high levels of heat loss and gain. However, improving the thermal insulation of historic windows can be difficult due to the need to preserve the building's historic character and appearance. Sahin et al. In the 2015 study, energy efficient proposals were examined in a sample building located in the Aegean region of Turkey. In this study, changing the glass type of the existing building is defined as a high-risk intervention that may damage the originality and appearance of the building. Making use of this information, in this study, transparent insulation coatings that will not only change the appearance of existing glasses for window insulation are presented. These materials are designed to reduce the amount of heat gained or lost through windows, which can significantly impact the energy efficiency of a building. Careful consideration and consultation with experts are important when choosing and implementing thermal insulation solutions in historic buildings.

There are several types of insulation materials that high transparent thermal coating including low-emissivity coatings, spectrally selective films (Martín-Palma 2009: 17).

Low-E coatings contain microscopically thin transparent coatings that can reflect unwanted IR rays or energy. The purpose of low emissivity (low E) films is to support thermal insulation by reducing the thermal transmittance of the glass plate. The use of coating material on windows increases heat conservation performance by reducing heat loss compared to flat glasses. In order to achieve a better performance in these films, it should be applied to the outer surface in hot climates and to the inner glass surface in cold climates (Lee et al. 2013: 22).

Spectral selective coatings are highly transparent and thermally reflective coatings. Spectral selective glazing system is a glazing system that allows some solar spectra to enter buildings while blocking others. This high-performance glass lets in as much daylight as possible while preventing the transmission of as much solar heat as possible. By controlling solar heat gains in the summer, preventing the loss of internal heat in the winter, and reducing the use of maximum daylight and electric lighting, spectral selective glazing significantly reduces the energy consumption and peak demand of buildings (U.S. Department of Energy 2012: 13). Suitable types are available for different climatic conditions and building types (Ayçam and Utkudtuğ 1999: 18).

Table 24: Window films comparission table

Film Type	Features	Benefits	Example Study	Results
Low-E Film	Reflects infrared radiation. Reduces heat transfer through windows.	It saves energy by reducing heating costs in winter. Low-E coated glasses block UV rays and reduce problems such as fading of furniture, curtains, and carpets. These coatings also make the glass more durable and more resistant to scratches.	(Ayçam and Utkudtuğ 1999: 45)	Compared to double-layered flat glass (insulating glass), it provides 23-26% performance increase in heat preservation and 13% in solar control.
			Anderson et al. (2016: 23)	It can provide 6-15% less annual energy consumption compared to the use of standard glass.
Selective Film	Reflects infrared radiation. Allows visible light to pass through.	It is also beneficial for buildings in cold climates, as solar heat gains in summer and internal heat loss in winter are considered, as well as buildings in hot climates with solar heat gain problems (U.S. Department of Energy, 2012).	U.S. Department of Energy, (2012: 17)	It can block 30% more solar heat than standard low-E coatings in dry hot climate.
			(Ayçam, Utkudtuğ, 1999: 23)	It provide 33% performance increase in heat protection and 38% in sun control compared to normal double-glazed glasses

Considering the information obtained and the comparison table, the appropriate options were determined as Low-E coating and Selective Films, since the building is historically registered. Selective Films was among these two materials. This is because

Low-E coating is more effective in reducing the heating load, while Selective Films is more effective in reducing cooling loads. Since the biggest energy consumption of the building is due to the cooling load, the correct window insulation method was the application of selective film on the original glass.

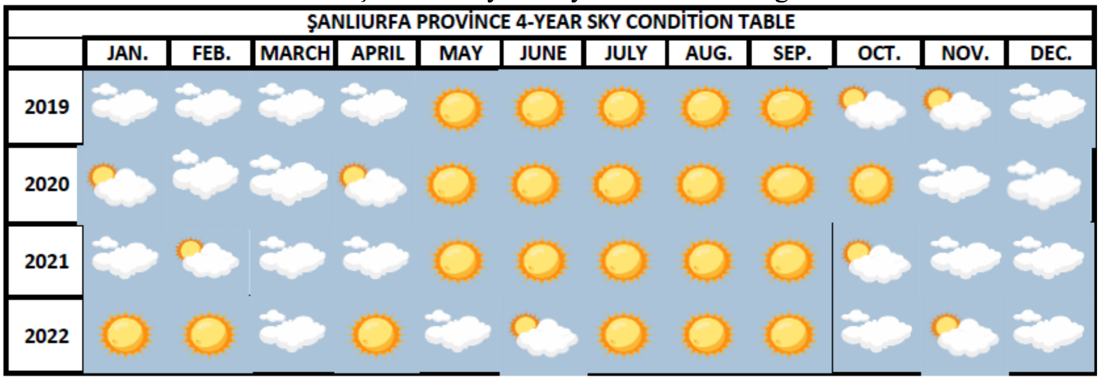
5.2.3. Daylight Analysis and Results

According to the energy consumption analysis applied in the building, the amount of energy spent for lighting comfort constitutes approximately 10% of the annual total energy consumption. Considering the measurements made in situ, it has been observed that the spaces cannot be adequately illuminated with daylight alone and the daylight entering the rooms is not sufficiently dispersed.

As mentioned before in the literature section, the use of daylights is very important for energy efficiency while providing lighting comfort. Although the building's use of daylight was determined for 4 days in the summer by on-site measurements, in addition to the energy analyzes for the building to be analyzed on an annual basis, daylight analyzes were also carried out through the revit software. B1, B5, G1, G7, G9 and F1 rooms where on-site measurements and energy analyzes were made were selected. While making these analyzes, the hours when the places are used the most were taken as a basis in line with the information received from the hotel management. According to this, the analysis hours were 8-12-15 and 19 in other venues other than the B5 venue, while the B5 venue was 9-13-16-20 hours since it was a restaurant. It is very important to specify the sky condition during the daylight analysis.

Available light is determined by sky conditions. The overcast sky, that is, the entire sky hemisphere, acts as the light source. In clear sky conditions, direct sunlight can provide 100 klks (1 kilo-lux 1000 lux) of illumination, but excluding sunlight itself, the sky can give 40-50 klks diffuse illumination. In clear sky conditions, sky brightness is considered uniform. In addition to these in many climates, partly sky conditions often occur (Szokolay 2014: 63). In order to determine the skycondition parameter before it is processed into the software, the 4-year skycondition average of Şanlıurfa was made based on the 15th of each month. The average creation work done is as seen in table 25.

Table 25: Şanlurfa 4-year sky condition avarage table



As a result of the averaging research, January, February, March, November and December were chosen as overcast, May, June, July, August and September as clearsky, and April and October as partially. Accordingly, the skycondition parameter is specified in the Revit software.

The results of the daylight analysis obtained with the specified parameters were examined and evaluated on the basis of rooms.

5.2.3.1. B1 Room Daylight Analysis

Room B1 is a room located in the basement of the building, on the west side, and receives light only thanks to 2 windows from the courtyard. The plan of the room is as seen in Figure 56. Daylight analysis of the room on the 15th of each month throughout the year is as seen in Table 26.

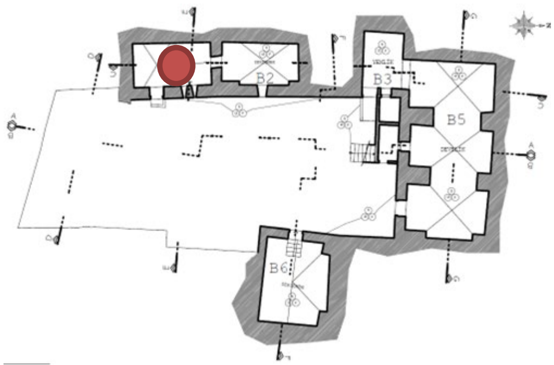
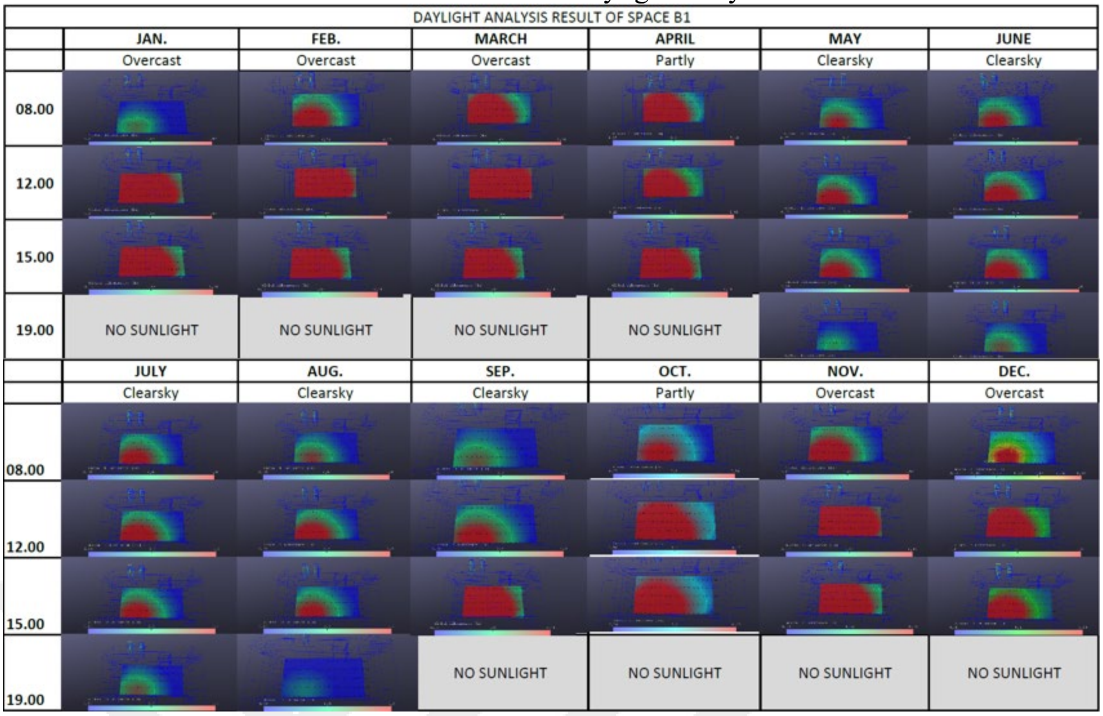


Figure 56: B1 Room location

Table 26: B1 Room daylight analysis



DAYLIGHT ANALYSIS RESULT OF SPACE B1						
	JAN.	FEB.	MARCH	APRIL	MAY	JUNE
	Overcast	Overcast	Overcast	Partly	Clearsky	Clearsky
08.00						
12.00						
15.00						
19.00	NO SUNLIGHT	NO SUNLIGHT	NO SUNLIGHT	NO SUNLIGHT		
	JULY	AUG.	SEP.	OCT.	NOV.	DEC.
	Clearsky	Clearsky	Clearsky	Partly	Overcast	Overcast
08.00						
12.00						
15.00						
19.00			NO SUNLIGHT	NO SUNLIGHT	NO SUNLIGHT	NO SUNLIGHT

The illuminance values decrease from red to blue in the table.

The ideal lighting value required for this room is determined as 300 lux by the standards. The room does not provide the 300 lux required at any time of the year. The highest lux value in the room is provided in July. The most homogeneous light distribution in the room is provided in spring and autumn. The biggest problem of the room was determined as the insufficient amount of illuminance and insufficient daylight distribution in the spring months as a result of the analysis.

5.2.3.2. B5 Room Daylight Analysis

Room B5 is a room located in the basement of the building, on the north façade, and receives light from the courtyard thanks to only one window. The room is divided into 3 wings with only the vaults on the ceiling without the use of walls. The plan of the room is as shown in Figure 57. Daylight analysis of the room on the 15th of each month throughout the year is as seen in Table 23.

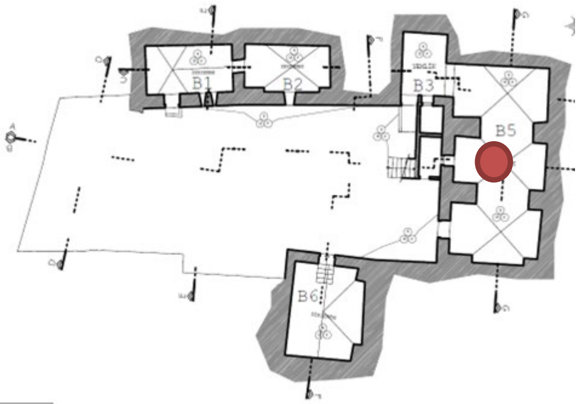
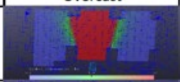
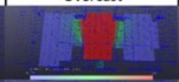
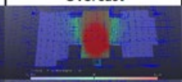
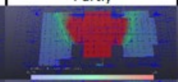
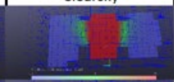
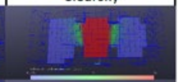
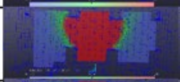
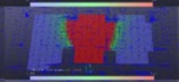
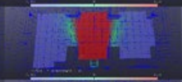
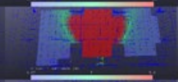
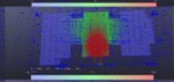
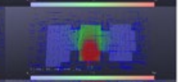
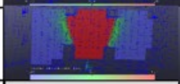
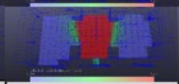
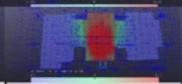
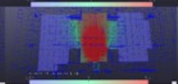
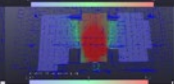
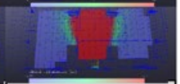
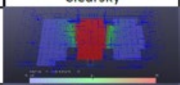
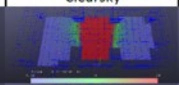
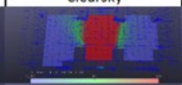
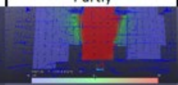
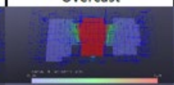
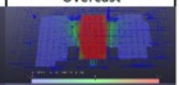
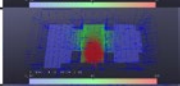
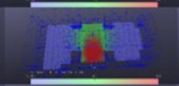
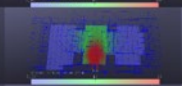
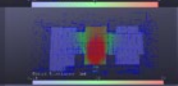
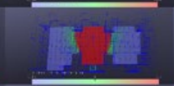
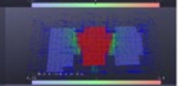
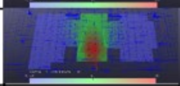
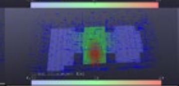
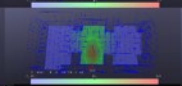
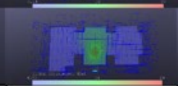
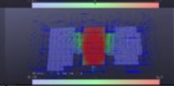
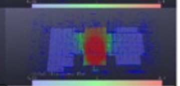


Figure 57: B5 Room location

Table 27: B5 Room daylight analysis

DAYLIGHT ANALYSIS RESULT OF SPACE B5						
	JAN.	FEB.	MARCH	APRIL	MAY	JUNE
	Overcast	Overcast	Overcast	Partly	Clearsky	Clearsky
09.00						
13.00						
16.00						
20.00	NO SUNLIGHT	NO SUNLIGHT	NO SUNLIGHT	NO SUNLIGHT	NO SUNLIGHT	NO SUNLIGHT
	JULY	AUG.	SEP.	OCT.	NOV.	DEC.
	Clearsky	Clearsky	Clearsky	Partly	Overcast	Overcast
09.00						
13.00						
16.00						
20.00	NO SUNLIGHT	NO SUNLIGHT	NO SUNLIGHT	NO SUNLIGHT	NO SUNLIGHT	NO SUNLIGHT

The illuminance values decrease from red to blue in the table.

This room is used as a restaurant. The ideal illuminance value for restaurants has been determined as 75 lux. Although the maximum brightness value reaches 90 lux in the morning between April and September, the desired 75 lux value in accordance with the function of the room cannot be achieved in 50% of the room at any time of the year. In addition, the right and left wings of the place cannot benefit from natural light throughout the year. The biggest problem of the place is the insufficient amount of illumination and insufficient distribution of daylight.

5.2.3.3. G1 Room Daylight Analysis

Room G1 is a room on the ground floor of the building, located on the west side, and receives light from the courtyard thanks to its three windows. The ceiling of the room is in the form of an arch. The ceiling is white plaster. The plan of the room is as in Figure 58. The daylight analysis of the room on the 15th of each month throughout the year is as in Table 28.

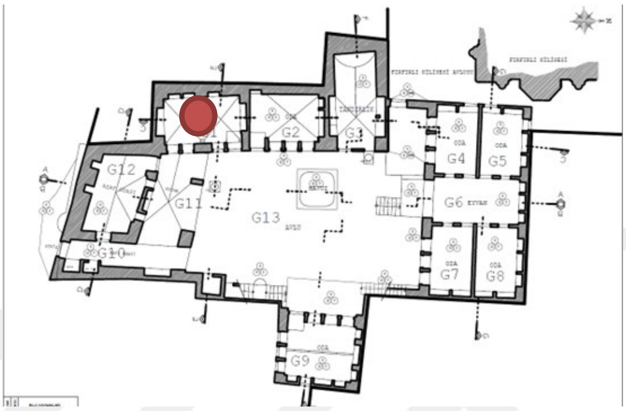


Figure 58: G1 Room location

Table 28: G1 Room daylight analysis

DAYLIGHT ANALYSIS RESULT OF SPACE G1						
	JAN.	FEB.	MARCH	APRIL	MAY	JUNE
	Overcast	Overcast	Overcast	Partly	Clearsky	Clearsky
08.00						
12.00						
15.00						
19.00	NO SUNLIGHT	NO SUNLIGHT	NO SUNLIGHT	NO SUNLIGHT		

	JULY	AUG.	SEP.	OCT.	NOV.	DEC.
	Clearsky	Clearsky	Clearsky	Partly	Overcast	Overcast
08.00						
12.00						
15.00						
19.00			NO SUNLIGHT	NO SUNLIGHT	NO SUNLIGHT	NO SUNLIGHT

The illuminance values decrease from red to blue in the table.

Since G1 room is used as a bedroom in the hotel, the ideal illuminance value desired in this room is 300 Lux. In the G1 room, adequate illuminance value is observed in 50% of the room, except for the winter months. The light distribution is not homogeneous in this room, too, although less than that observed in other rooms. The problem of the room is the ideal illuminance value, which is not provided during the winter months.

5.2.3.4. G7 Room Daylight Analysis

Room G7 is a room on the ground floor of the building, on the north façade, and thanks to its three windows, it receives light from the courtyard on the south side of the room and from the iwan thanks to the window on the west side. The ceiling of the room is in the form of flat wood veneer. The plan of the room is as in Figure 80.

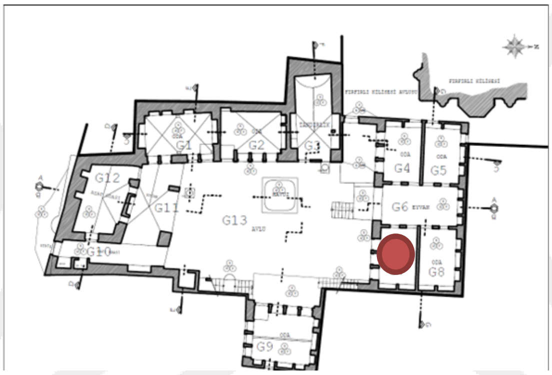


Figure 59: G7 Room location

Table 29: G7 Room daylight analysis

DAYLIGHT ANALYSIS RESULT OF SPACE G7						
	JAN.	FEB.	MARCH	APRIL	MAY	JUNE
	Overcast	Overcast	Overcast	Partly	Clearsky	Clearsky
08.00						
12.00						
15.00						
19.00	NO SUNLIGHT	NO SUNLIGHT	NO SUNLIGHT	NO SUNLIGHT		
	JULY	AUG.	SEP.	OCT.	NOV.	DEC.
	Clearsky	Clearsky	Clearsky	Partly	Overcast	Overcast
08.00						
12.00						
15.00						
19.00			NO SUNLIGHT	NO SUNLIGHT	NO SUNLIGHT	NO SUNLIGHT

The illuminance values decrease from red to blue in the table.

Just like the G1 room, the ideal value in this room is 300 lux. In this room, insufficient amount of lighting was observed in the morning hours at certain times of the year, while excessive illuminance, glare was observed in other periods. In this room in January, the amount of lighting in the morning is quite insufficient. Maximum 63 lux observed in January at 08.00 am. During the summer months (between April and October), a large amount of brightness is seen in the morning hours. A situation over 10000 lux was observe. In both cases, the high and low brightness experienced in the morning becomes balanced and sufficient in the afternoon.

5.2.3.5. G9 Room Daylight Analysis

Room G9 is a room on the ground floor on the eastern façade of the building and receives light from the courtyard thanks to its three windows on the eastern façade of the room. The ceiling of the room is in the form of flat wood veneer. The plan of the room is as in Figure 60. The daylight analysis of the room on the 15th of each month throughout the year is as in Table 26.

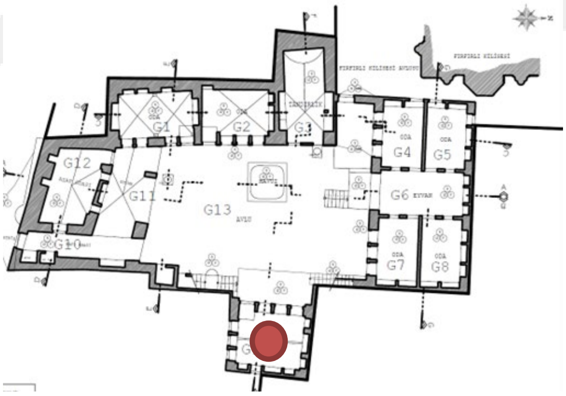
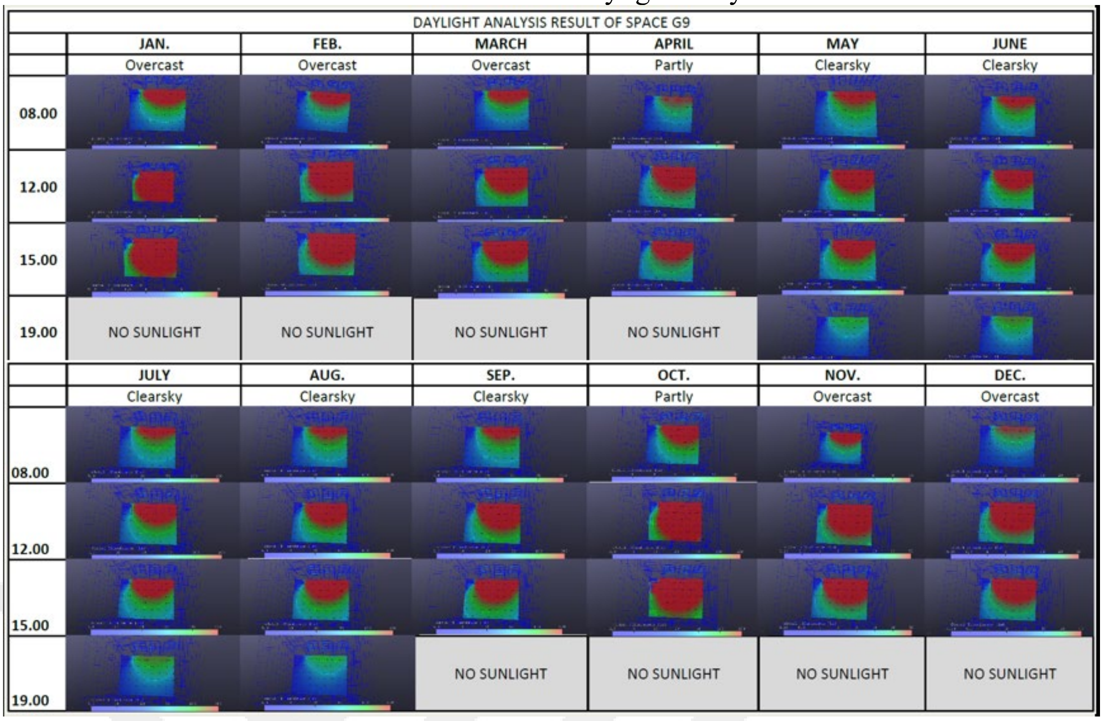


Figure 60: G9 Room location

Table 30: G9 Room daylight analysis



DAYLIGHT ANALYSIS RESULT OF SPACE G9						
	JAN.	FEB.	MARCH	APRIL	MAY	JUNE
	Overcast	Overcast	Overcast	Partly	Clearsky	Clearsky
08.00						
12.00						
15.00						
19.00	NO SUNLIGHT	NO SUNLIGHT	NO SUNLIGHT	NO SUNLIGHT		
	JULY	AUG.	SEP.	OCT.	NOV.	DEC.
	Clearsky	Clearsky	Clearsky	Partly	Overcast	Overcast
08.00						
12.00						
15.00						
19.00			NO SUNLIGHT	NO SUNLIGHT	NO SUNLIGHT	NO SUNLIGHT

The illuminance values decrease from red to blue in the table.

The primary issue identified regarding the daylight in this room is its lack of homogeneityThe primary issue with the daylight in this room is its lack of homogeneity. For instance, during the summer months, while a brightness value of 400 lux was measured in front of the window, at the same period, a value of 50 lux was observed in the back of the room, specifically 4 meters away from the window.

Furthermore, during winter, the desired illuminance level of 300 lux cannot be achieved. Despite observing a more uniform distribution of light during the winter months, the overall illumination level in the room falls short of the necessary 300 lux, which is deemed appropriate for the room's intended purpose.

5.2.3.6. F1 Room Daylight Analysis

Room G9 is a room on the first floor on the south side of the building, and it receives light from the courtyard thanks to the three windows on the north side of the room and from the outside environment thanks to its single window on the south side. Among the rooms where analysis and measurement are made, this room is the only room that receives light from the outside (except the courtyard) of this room. The ceiling of the room is in the form of flat wood veneer. The plan of the room is as in Figure 61.

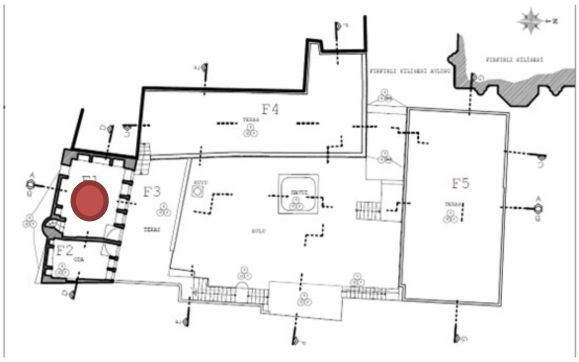


Figure 61: F1 Room location

Table 31: F1 Room daylight analysis

DAYLIGHT ANALYSIS RESULT OF SPACE F1						
	JAN.	FEB.	MARCH	APRIL	MAY	JUNE
	Overcast	Overcast	Overcast	Partly	Clearsky	Clearsky
08.00						
12.00						
15.00						
19.00	NO SUNLIGHT	NO SUNLIGHT	NO SUNLIGHT	NO SUNLIGHT		
	JULY	AUG.	SEP.	OCT.	NOV.	DEC.
	Clearsky	Clearsky	Clearsky	Partly	Overcast	Overcast
08.00						
12.00						
15.00						
19.00			NO SUNLIGHT	NO SUNLIGHT	NO SUNLIGHT	NO SUNLIGHT

The illuminance values decrease from red to blue in the table.

Although there is a balanced and adequate distribution of light from the front to the back of the room, facilitated by the presence of double-sided glass on the west side, the utilization of daylight is limited due to the absence of any openings on the east side. This discrepancy in daylight utilization is evident during the month of January, particularly at 08:00, when the room receives the least amount of light in its western region, measuring at a minimum illuminance value of 5.8 lux. In contrast, the illuminance level diminishes significantly to 0.65 lux in the eastern section of the room. Although the desired 300 lux value cannot be met in the morning in the room, this value is approached at noon. The primary concern identified within the room pertains to inadequate daylight dispersion along the west-east axis and insufficient illuminance levels during the morning hours. The maximum and minimum illuminance values measured in the rooms are as seen in Table 32.

Table 32: F1 Room daylight analysis

	MAXIMUM ILLUMINANCE			MINIMUM ILLUMINANCE		
	Lux	Time		Lux	Time	
		Month	Hour		Month	Hour
B1	1,6	August	12.00	0,01	January	08.00
B5	110	April	09.00	0,01	December	16.00
G1	511	June	12.00	2.8	January	08.00
G7	22000	June	08.00	6.7	January	08.00
G9	1530	April	12.00	0.4	January	08.00
F1	650	August	15.00	1	January	08.00

5.2.4. Daylight Sufficient Improvement Recommendations

As a result of the daylight measurements and analyzes made, although it varies in each place, the problem of not homogeneous distribution of daylight and insufficient illuminance was observed in most of the rooms. At this point, many solutions can be offered in the construction of new buildings. For example: changing the window to wall ratio, light tubes, skylights, etc.). However, since the model building is a registered building, suggestions should be made without causing permanent changes to the registered building, without causing changes in the exterior of the building and without causing deterioration in the urban texture, just like thermal comfortu energy's efficient improvement suggestions. For this purpose, suggestions were made with light shelves and reflective ceiling applications in this study.

5.2.4.1. Light Shelfs

Light shelf is an architectural element that allows daylight to penetrate deep into buildings. In practice, a horizontal, light-reflecting projection is placed above eye level and its upper surface is highly reflective, thus reflecting daylight onto the ceiling. Light shelves can allow daylight to penetrate up to four times the distance between the window and the ceiling. They are generally not used in tropical, or desert climates exposed to intense sunlight (Thorpe 2017: 45). Light shelves use the upper part of the aperture (zenith) as a source of daylight, while the lower part (observation) is used for landscape observation. Also acting as an externally mounted shading device by blocking out excessive sun rays. Sunlight reflected indoors is usually reflected on the ceiling, allowing the space to breathe more deeply (Kontadakis et al. 2017: 26). Light shelves do not increase the daylight factors in a room but change the distribution and help light reach further into the room. Indoor light shelves are less damaged and relatively inexpensive to install than outdoor light shelves, but they need to be cleaned regularly (Philips 2004: 17). Kontadakis et al. Conditions to be considered for light shelf application according to 2017; geometry of window, projection type, material type, location setting, building data and climatic conditions. The criteria used when evaluating the performance of a light shelf are; an increase in illumination, an increase in uniformity, improvement of visual comfort and adequate shading, especially in areas that do not receive daylight. In this study, since only the light shelf material, geometry and positioning parameter can be changed or selected in the study, these three parameters will be taken into consideration in creating a proposal.

As mentioned before, the priority in every intervention planning to be made is that there is no change in the external appearance of the building. For this reason, this study will proceed through the recommendations of internal light shelves. In this way, it is aimed to develop proposals that can be approved by the regional protection boards.

In the Hosseini et al. (2022: 24) study, the percentages of user comfort of light shelves of different depths were also examined. According to the data obtained from this study, the user comfort percentages of the internal light shelves with different depths, facades and seasons are as in Table 33.

Table 33: User comfort rate - light shelf depth chart (Adapted from Hosseini et al. 2022: 25)

	45 cm			60 cm			75 cm			90 cm		
	Sm	Sp	Wn	Sm	Sp	Wn	Sm	Sp	Wn	Sm	Sp	Wn
East	%56	%48	%33	%52	%48	%30	%56	%48	%30	%54	%54	%30
West	%61	%56	%30	%63	%57	%33	%63	%57	%33	%65	%50	%33
South	%61	%37	%41	%65	%37	%41	%61	%39	%48	%61	%33	%44

Sm: Summer, Sp: Spring, Wn: Winter

When the table and the daylight analysis of the rooms are evaluated together, the result is as follows:

Since the illuminance deficiency in rooms F1 and G7 with south-facing windows is mostly in winter, according to the table, the most efficient light shelf depth will be 75 cm in this room. According to Hosseini et al. (2022: 23) study, a 9% increase in user comfort was observed when using a light shelf at this depth compared to not using a light shelf. Room B5 is another room with south-facing windows. In this room, the best depth value in the table will be 60 cm, since the illuminance deficiency problem is mostly experienced in the summer months. According to the reference study, the use of 60 cm deep light shelves on south-facing facades in summer provides a 6% increase in user comfort compared to no light shelf.

According to the results of daylight analysis, the problem of insufficient illuminance is experienced mostly in the winter months in the G1 room, whose windows face the east facade. In this case, the light shelf depth to be used in the G1 room should be 90 cm. The use of a 90 cm light shelf during the winter months causes a 4% increase in user comfort compared to the situation when the light shelf is not used. The same problem is experienced in the summer months in room B1, which has windows facing east. According to Hosseini et al. (2022: 27) study, it is not recommended to use a light shelf here, since not using a light shelf in summer months is more effective for user comfort than all other internal light shelf applications.

On the other hand, in the G9 room, whose windows face west, the most problematic season is summer. In this case, the ideal light shelf depth to be chosen is 90 cm. According to Hosseini et al. (2022: 28) study, the use of a 90 cm deep light shelf on the west façade in summer provides a 2% increase in user comfort compared to not using it at all.

The decision of the height of the light shelves, whose depths are determined, is also important during the positioning phase. The lightshelf layout representation, which includes the terms to be used for specifying the heights of the light shelves, is given in Figure 62.

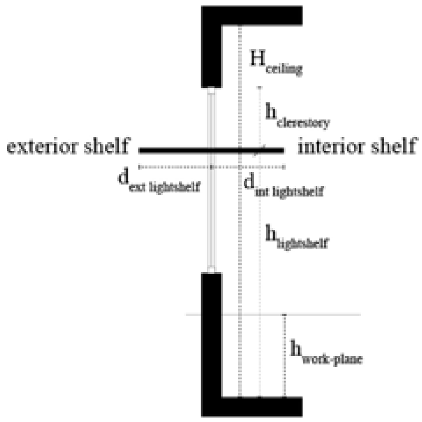


Figure 62: Lightshelf positioning layout display (Kontadakis et al. 2017: 85).

According to Abdulmohsen et al. (1994: 45) study, when determining the appropriate height for the Lightshelf, the depth of the lightshelf should be 2-3 times the height of the clerestory (Kontadakis et al. 2017: 86). In this study, the depth of the lightshelf will be used as 2.5 times the height of the celestory. Based on the results based on this data, the clerestory height of the 60 cm deep lightshelf in room B5 will be 24 cm, the appropriate clerestory height for the 90 cm lightshelf in rooms G1 and G9 will be 36 cm, and the appropriate clerestory height for the 75 cm lightshelf in rooms G7 and F1 will be 30 cm.

Another issue in lightshelf selection is material selection. The choice of reflectivity is especially important in material selection. It was applied in the Berardi and Anaraki (2015: 33) study study on this subject, and the reflective rate of 80% was chosen as the baseline in this study. As the form of lightshelfs, lightshelfs with Anidolic form, which were shown to be useful in Kontadakis et al. (2017: 45) and Mustafa and Sabry (2006: 23) studies, were preferred.

5.2.4.2. Reflective Ceiling

Lee et al. (2011: 45) and Freewan et al. (2008: 25) studies, it was determined that the application of light shelves together with a sloping ceiling application in increasing daylight performance achieved more efficient results than using them alone.

While planning the ceiling application, a selection was made by taking into account the reflectivity degree, form and mounting height parameters, in accordance with the lightshelf used, taking into account previous studies.

Reflectivity is one of the important factors affecting the performance in a ceiling application to be used in addition to the lightshelf. At this stage, Freewan et al. In the (2008) study, when examining the lightshelf and reflective ceiling application in terms of performance, the recommended reflectivity value was specified as 80-90%. At the same time, IESNA stated that the reflectivity value found suitable for ceilings in an ideal daylight distribution is 90% (Soleimani et al 2021: 85). The reflectivity value to be applied in the ceiling application proposal made in line with these data has been determined as 90%.

The form of the reflective ceiling to be applied is also a factor affecting performance, just like reflectivity. Regarding this issue, Freewan et al. (2008: 23) created a comparison chart in Figure 63, which indicates the lux value of curved, chamfered and flat reflective ceiling applications according to the distances moving away from the glass front.

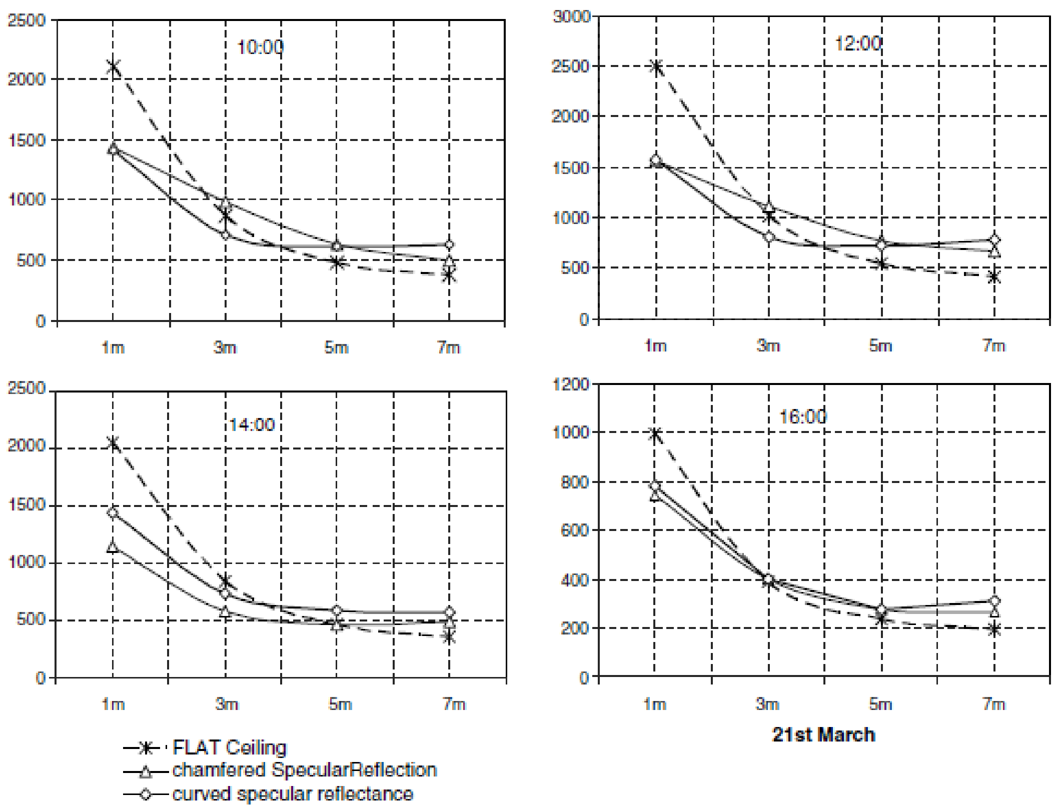


Figure 63: Illuminance levels across the midline under curved and chamfered ceiling with to a flat ceiling. (Freewan et al. 2008: 45)

The depth of the sample chambers in this study varies between 3 - 4.5 m. When this graph is examined, it is observed that the flat ceeling application will be more efficient than the curved and chamfered ceeling applications in the dimensions of the sample rooms of this study.

In the study of Soleimani et al. (2021: 16), a performance comparison was made between the horizontal (flat) ceiling and the inclined ceiling on a historical building in Iran. The shape of the compared ceiling forms is as shown in Figure 64.

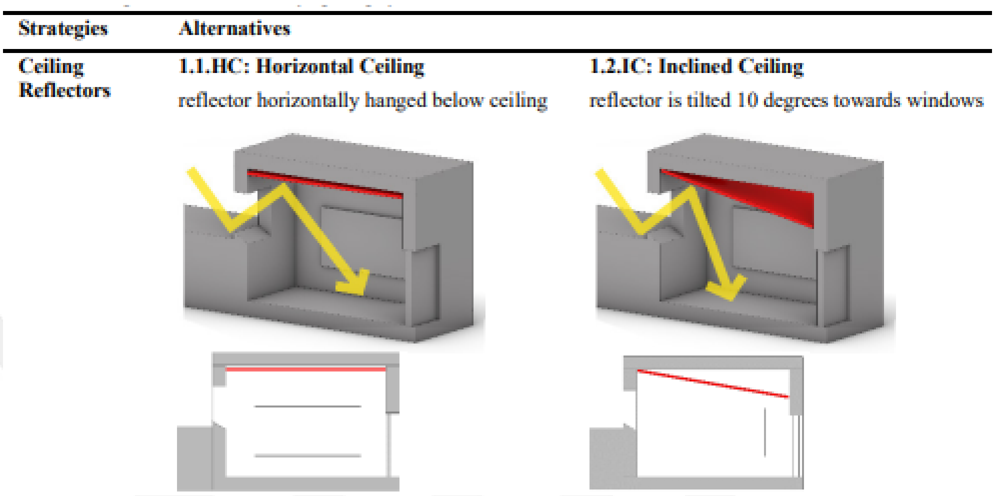


Figure 64: Designed scenarios of daylighting systems (Soleimani et al. 2021: 33)

As a result of this comparison, flat ceiling was found to be 33.5% more effective in terms of effective percentage, while inclined ceeling was found to be 34.7% more effective (Soleimani et al. 2021: 45).

In the same study, when performance comparison is made according to months, as shown in figure 1, inclined ceeling was observed to be much more effective than the untreated ceiling in every month of the year.

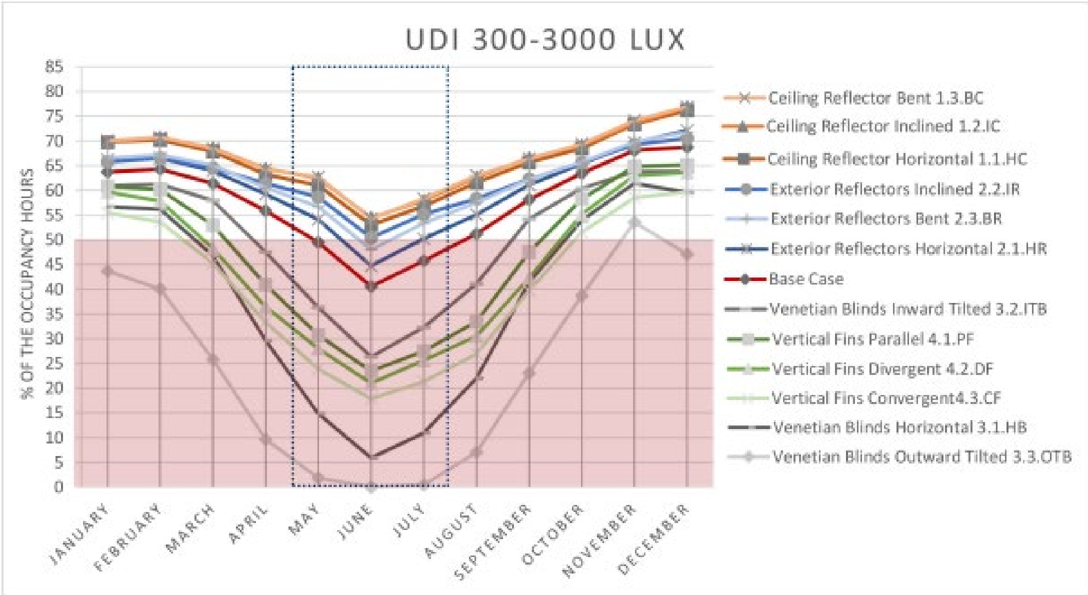


Figure 65: Daylighting systems performance in different seasons (Soleimani et al. 2021: 87)

Since the ceiling form researches and the results of the performance comparisons were taken into consideration, it was determined to use an inline reflective ceiling as the form to be applied in the rooms in the sample building. The ceiling proposal will be constructed as the ceiling height increasing from the front of the window to the back of the room in G1, G7, G9 rooms with daylight distribution problem from front to back. In rooms with lateral distribution problems such as F1 and B5, the ceiling height will increase from the midline to the side lines.

Lee et al. In the 2014 study, considering the depth of field as 3 m, a performance comparison of the inlined reflective ceiling height to be applied according to the lightshelf dimensions used was made. Accordingly, the results are as given in Table 34.

Table 34: Daylighting systems performance in different seasons (Lee et al. 2014: 23)

	Ceeling Height 245 cm		Ceeling Height 260 cm		Ceeling Height 2750 cm	
Lighshelf Deep/Angle	Average Illuminance (Lux)	Uniformity Factor	Average Illuminance (Lux)	Uniformity Factor	Average Illuminance (Lux)	Uniformity Factor
30 cm /0	15619	0.067	15556	0.063	155517	0.063
60 cm /0	15553	0.069	15491	0.067	15432	0.063
90 cm /0	12732	0.077	12659	0.075	12596	0.074

When the table is examined, the ceiling height of 245 cm has reached higher performance at each lightshelf depth. Considering these data, 245 cm was determined as the ideal reflective ceiling height to be used together with the 60cm-75cm-90cm lightshells in the sample building of this study.

5.3. ENERGY EFFICIENCY IMPROVEMENT IN INDOOR QUALITY APPLIED SIMULATION RESULTS

Improvement applications aimed at reducing energy consumption while improving the thermal and lighting comfort in the building mentioned in the previous section, just as it was done before to determine the annual energy consumption of the original state of the building, energy was analyzed through simulation in the Revit software. In addition to the original model of the building, the proposed improvement application was modeled in the program, and after the physical properties of the materials used were entered into the simulation parameters, both energy and lighting analyzes were applied again and it was aimed to determine the results of the improvement proposals that were decided to be implemented.

5.3.1. Energy Analysis and Results

The energy analysis application has been conducted in a manner consistent with its implementation on the original building. The annual energy consumption obtained as a result of the analysis and the energy consumption shares used to provide thermal comfort and lighting comfort are as in Table 35 and Figure 66.

Table 35: Annual electiricity consumptions (Adapted from REVIT Analysis)

	ELECTIRICITY (GJ)	**DIFFERENCE**
Annual Heating Consumption	44.15	14.90
Annual Cooling Consumption	113.38	64.57
Annual Lighting Consumption	27.76	
Annual Interior Equipments Consumption	31.44	
TOTAL ANNUAL CONSUMPTION	216.93 (60,258.33 kw/h)	89.27

GJ: Gigajoule, which is a unit of measurement used to quantify energy, with 1 gigajoule equal to 1 billion joules.

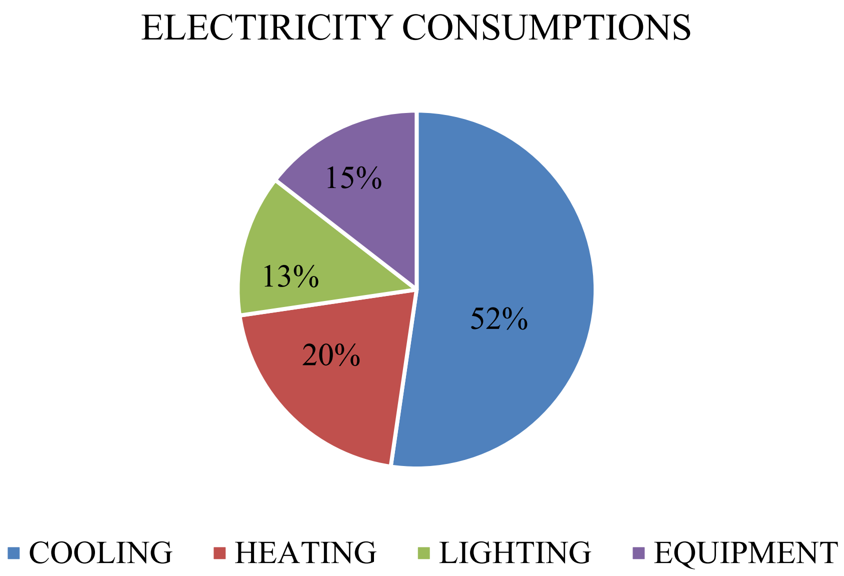


Figure 66: Electiricity conpsumption shares graphic

According to the table prepared with the results of the analysis, a decrease in the heating and cooling loads and accordingly a decrease in the total energy load were observed. When the graph showing this according to the ratios is examined, although the cooling energy load has increased proportionally, it has decreased numerically and a 4% decrease has been observed in the ratio of heating and cooling total loads. Considering this situation, the effects of improvement suggestions on cooling heating loads can be observed by examining the structural elements that cause heating and cooling loads given in Table 36 Estimated Cooling Peak Components and Table 37 Estimated Heating Peak Components.

Table 36: Estimated cooling peak components (Adapted from REVIT Analysis)

	ESTIMATED COOLING PEAK LOAD COMPONENTS						
		EXTERIOR WALL (W)	DWB	GLASS CONDUCTION (W)	DWB	GLASS SOLAR (W)	DWB
B1	INSTANT						
	DELAYED	204	-424				
B5	INSTANT			21	-154		
	DELAYED	632	-524			15	-291
G1	INSTANT			30	0		
	DELAYED	755	-61			47	-2
G7	INSTANT			54	-49		
	DELAYED	273	-311			144	-301
G9	INSTANT			273	-31		
	DELAYED	349	-3			744	-635
F1	INSTANT			243	0		
	DELAYED	621	-44			251	-3

DWB: Difference with Before
Glass Conduction: The process of heat transfer through solid glass material via molecular vibrations and collisions.
Glass Solar: Solar energy passing through the window refers to the energy of sunlight that enters the indoor space through the window and is used for lighting or thermal gain purposes.

Table 37: Estimated heating peak components (Adapted from REVIT Analysis)

	ESTIMATED HEATING PEAK LOAD COMPONENTS					
		EXTERIOR WALL (W)	DWB	GLASS CONDUCTION (W)	DWB	GLASS SOLAR (W)
B1	INSTANT					
	DELAYED	- 103	259			
B5	INSTANT			-18	106	
	DELAYED	-498	475			
G1	INSTANT			-34	0	
	DELAYED	-445	121			
G7	INSTANT			-34	0	
	DELAYED	-122	96			
G9	INSTANT			-272	222	
	DELAYED	-341	118			
F1	INSTANT			-52	0	
	DELAYED	-441	192			

DWB: Difference with Before
Glass Conduction: The process of heat transfer through solid glass material via molecular vibrations and collisions.
Glass Solar: Solar energy passing through the window refers to the energy of sunlight that enters the indoor space through the window and is used for lighting or thermal gain purposes.

When the heat gains that cause the cooling loads after the improvement were examined on the basis of the building elements. It is observed that the heat gains after the insulation applied to the walls were reduced in rooms B1 and B5 located in the basement and in the room G7 located on the north facade. The reduces were eliminated as 424W for B1, 524W for B5 and 311W for G7. In the G9 room, located on the western facade of the building, the insulation did not change the heat gain when comparing other rooms. G9 showed only 3W decreases.

After the spectrally selective film application on the windows, the greatest decrease in heat gains was observed in the G9 room located on the west side of the building. On the other hand, the same application, which is the spectrally selective film method, did not provide sufficient reduction in the F1, G7 and G9 rooms. No significant variation was observed in the glass conduction values between the original state of the rooms where no improvement was implemented in the building and the state after the implementation of improvements.

Considering the source thermal losses from the walls that cause the heating load, a decrease was observed in the thermal losses in all rooms after the insulation. The greatest decrease occur in the B1 and B5 rooms in the basement, just as in the cooling loads, while a decrease in direct proportion to the wall surfaces of the rooms in the rooms located on the ground and above ground levels has been observed. It is observed that fort he heat loss, 259W for B1 and 475W for B5.

When the heat loss from the windows was evaluated after spetrally selective film application on the windows, a decrease was observed in B5 and G9 spaces. Moreover, no change for the heat loss was observed in other rooms. It is observed that fort he heat loss, 106W for B5 and 222W for B5.

By looking at the energy analysis data obtained after the improvement suggestions, it can be said that the applications made reduce the annual energy consumption. When looked that at numerically, there was a decrease in the heating and cooling loads to provide thermal comfort. When the building elements that cause heat losses and gains were examined, it has been seen that the improvement suggestions applied depending on variable parameters such as facade and floor vary according to the rooms. Also, some improvement suggestions were not effective for every room. The results of simulation analyses were made with Revit software are given in Appendices 43-55.

5.3.2. Daylight Analysis

Daylight efficiency in the rooms was evaluated in the previous on-site measurements and daylight analyzes applied to the building, and accordingly, recommendations were developed with a literature review. After integrating the prepared suggestions into the original 3D model prepared in Revit software, the same simulation analysis was applied to the building to determine the current situation in order to determine how the distribution and efficiency of daylight in the rooms changed. The application hours, skycondition data and all other parameters of the new analysis are the same as the first analysis. Room B1 was not included in the new analyses, as no recommendations were made.

5.3.2.1. B5 Room Daylight Analysis

In line with the suggestions developed in the room located in the basement of the building and in the first analysis, it was determined that there is almost no daylight especially in the right and left wings of the room, a 60 cm light shelf application was applied to the only window facing the south façade in the simulation. The reflectivity of the light shelf is 80% and the clerestory height is 24cm. In addition to the light shelf, it is aimed to increase the daylight distribution on the right and left wings by applying the reflective ceiling, which descends with a 10% tendency from the middle point to the right and left wings. The plan of the room is as shown in Figure 67. Daylight analysis of the suggestions made in simulation applied of 15th of each month throughout the year is as seen in Table 38.

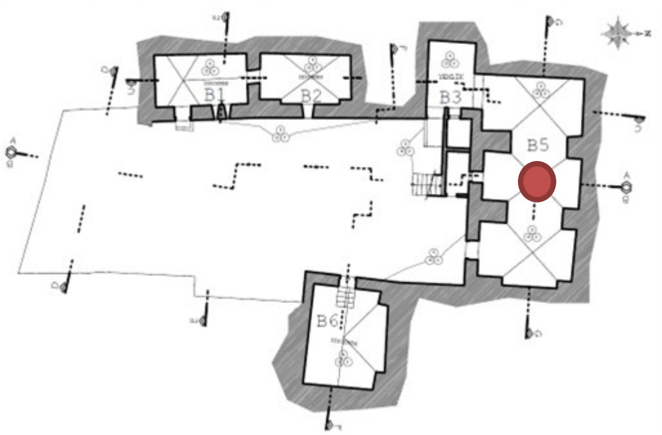
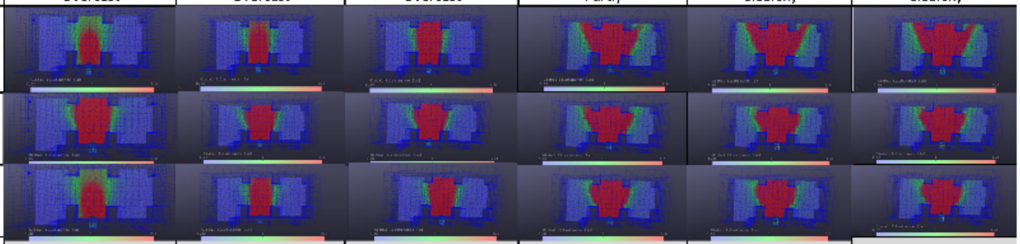
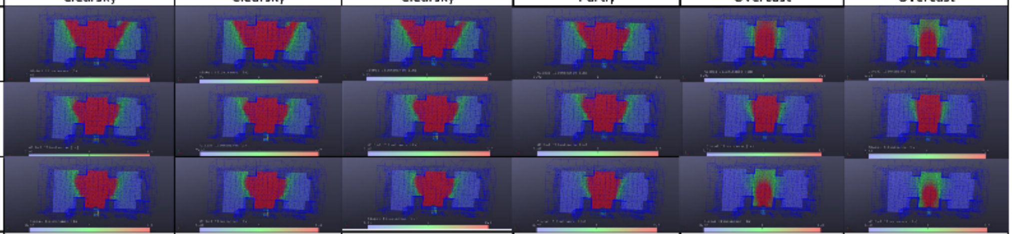


Figure 67: B5 Room location

Table 38: B5 Room daylight analysis

DAYLIGHT ANALYSIS RESULT OF SPACE B5						
	JAN.	FEB.	MARCH	APRIL	MAY	JUNE
	Overcast	Overcast	Overcast	Partly	Clearsky	Clearsky
09.00						
13.00						
16.00						
20.00	NO SUNLIGHT	NO SUNLIGHT	NO SUNLIGHT	NO SUNLIGHT	NO SUNLIGHT	NO SUNLIGHT

	JULY	AUG.	SEP.	OCT.	NOV.	DEC.
	Clearsky	Clearsky	Clearsky	Partly	Overcast	Overcast
09.00						
13.00						
16.00						
20.00	NO SUNLIGHT	NO SUNLIGHT	NO SUNLIGHT	NO SUNLIGHT	NO SUNLIGHT	NO SUNLIGHT

The illuminance values decrease from red to blue in the table.

When comparing the initial analysis table for Room B5 with the analysis table generated after implementing the suggested improvements, it is evident from the red color distribution in the table that the daylight distribution within the room's right and left wings increases between the months of March and October (inclusive). Although the amount of daylight entering the room remains constant, the expansion of the distribution area results in a decrease in the current concentrated luminance value along the central axis of the room, instead dispersing towards the right and left wings. Conversely, during winter, an opposite trend occurs, with reduced distribution towards the right and left wings compared to the current situation. This decrease in distribution during winter months leads to increased illuminance values along the central axis. In both scenarios, as the amount of daylight entering the room cannot be increased, and the room still fails to achieve the desired illuminance level, artificial lighting should be employed.

5.3.2.2. G1 Room Daylight Analysis

In the first analysis, it was observed that the daylight on the ground floor of the building was not as homogeneous as in the other rooms, and the 300 lux value, which is suitable for the lighting standards especially in winter, could not be achieved in 50%

of the room. In line with the suggestions developed in the room, 90 cm light shelves were applied to the three windows facing the west façade in the simulation. The reflectivity of the light shelf is 80% and the height of the clerestory is 36cm. No reflective ceiling is applied to the room. The plan of the room is as shown in Figure 68. Daylight analysis of the applied suggestions in simulation of 15th of each month throughout the year is as seen in Table 39.

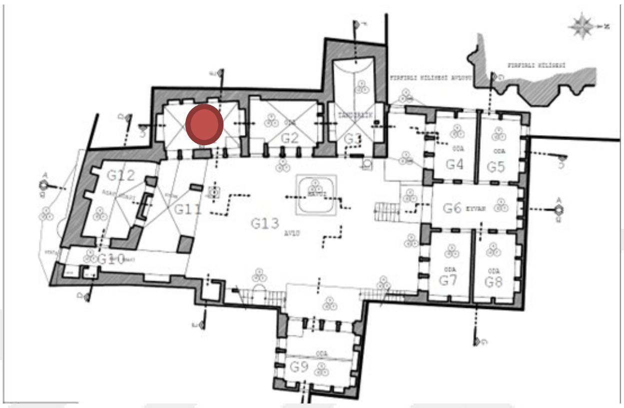


Figure 68: G1 Room location

Table 39: G1 Room daylight analysis

DAYLIGHT ANALYSIS RESULT OF SPACE G1						
	JAN.	FEB.	MARCH	APRIL	MAY	JUNE
	Overcast	Overcast	Overcast	Partly	Clearsky	Clearsky
08.00						
12.00						
15.00						
19.00	NO SUNLIGHT	NO SUNLIGHT	NO SUNLIGHT	NO SUNLIGHT		
	JULY	AUG.	SEP.	OCT.	NOV.	DEC.
	Clearsky	Clearsky	Clearsky	Partly	Overcast	Overcast
08.00						
12.00						
15.00						
19.00			NO SUNLIGHT	NO SUNLIGHT	NO SUNLIGHT	NO SUNLIGHT

The illuminance values decrease from red to blue in the table.

When the table of the first analysis for the G1 room is compared with the table of the analysis created after the improvement suggestions, it is observed that the situation where the daylight is not homogeneously distributed in the room during the winter months and the illuminnance value insufficiency is improved, and a more homogeneous distribution and illuminance values increase in the winter months, except for the analysis at 08:00 in January. The amount of daylight entering and the homogeneous distribution increased. In the summer months, the opposite situation occurs, and the illuminance value in front of the glass increases too much and the illuminance value in the back of the room decreases compared to the current situation.

5.3.2.3. G7 Room Daylight Analysis

In the first analysis, in the G7 room on the ground floor of the building, it was observed that the daylight distribution in the room was not homogeneous especially in the winter months and too much illuminance value in front of the glass in the summer months. In line with the suggestions developed in the room, 75 cm light shelves were applied to the three windows facing the south façade in the simulation. The reflectance of the light shelf is 80% and the height of the mezzanine is 30 cm. A 10% trend reflective ceiling appliqué is suggested, which decreases from the front of the glass to the back of the room. The plan of the room is as shown in Figure 69. The daylight analysis of the suggestions implemented in the simulation on the 15th of each month throughout the year with improvement suggestions is shown in Table 40.

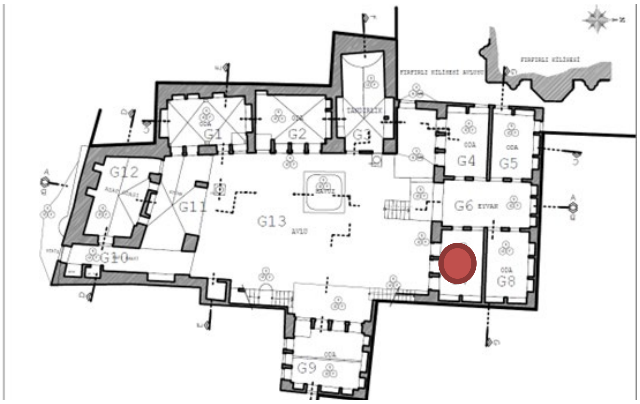
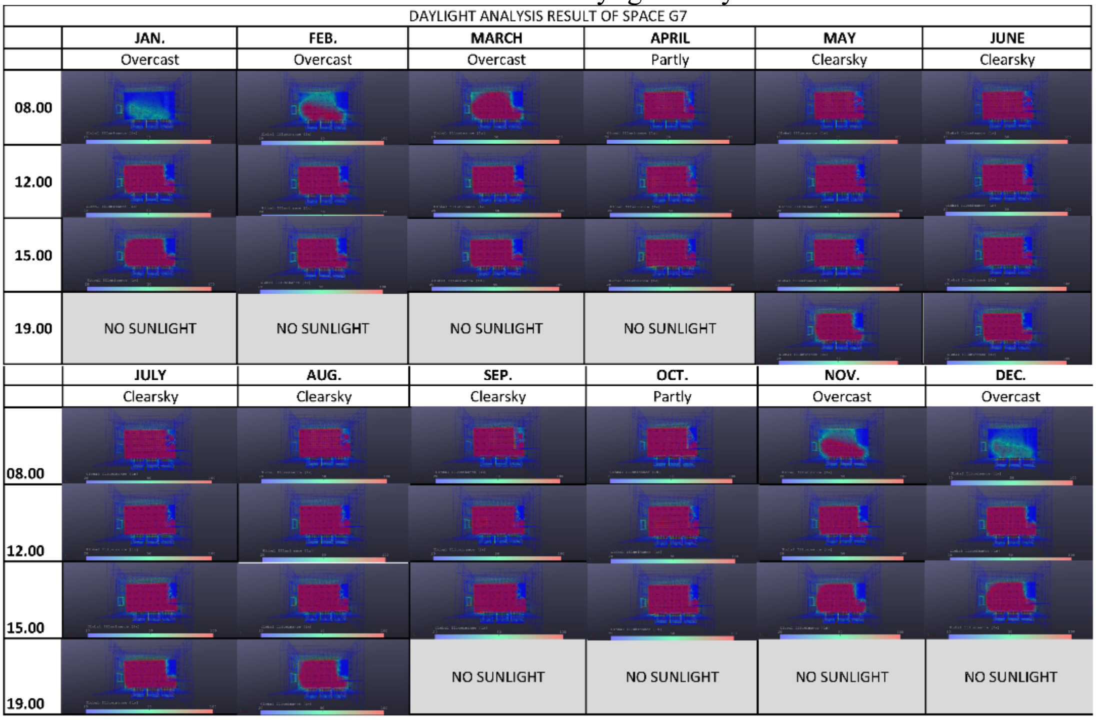


Figure 69: G7 Room location

Table 40: G7 Room daylight analysis



DAYLIGHT ANALYSIS RESULT OF SPACE G7						
	JAN.	FEB.	MARCH	APRIL	MAY	JUNE
	Overcast	Overcast	Overcast	Partly	Clearsky	Clearsky
08.00						
12.00						
15.00						
19.00	NO SUNLIGHT	NO SUNLIGHT	NO SUNLIGHT	NO SUNLIGHT		
	JULY	AUG.	SEP.	OCT.	NOV.	DEC.
	Clearsky	Clearsky	Clearsky	Partly	Overcast	Overcast
08.00						
12.00						
15.00						
19.00			NO SUNLIGHT	NO SUNLIGHT	NO SUNLIGHT	NO SUNLIGHT

The illuminance values decrease from red to blue in the table.

When the table of the first analysis for the G7 room was compared with the analysis table created after the improvement suggestions, the homogeneous distribution of daylight in the room increased in winter months, but the illuminance value decreased pointwise. The problem of excess illuminance value experienced in the summer months increased after the proposed improvement suggestions.

5.3.2.4. G9 Room Daylight Analysis

In the first analysis made in the G9 room on the ground floor of the building, it was determined that the daylight distribution in the room was not homogeneous, especially in winter, and the back of the room was almost 80% darker. As a suggestion for improvement, 90 cm light shelves were applied to the three windows facing the east facade. The reflectance of the light shelf is 80% and the height of the mezzanine is 36 cm. A 10% trend reflective ceiling sconce is recommended, which decreases from the front of the glass to the back of the room. The plan of the room is as shown in Figure 70. The daylight analysis of the suggestions implemented in the simulation on the 15th of each month throughout the year and the improvement suggestions are shown in Table 24.

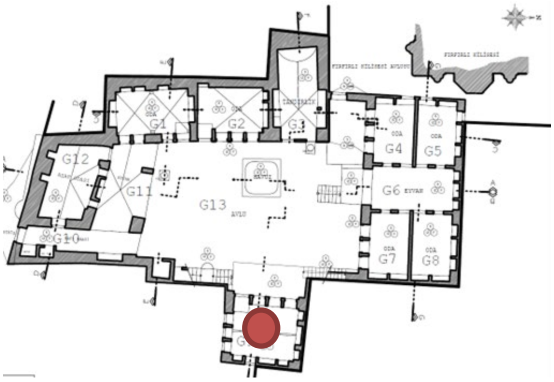


Figure 70: G9 Room location

Table 41: G9 Room daylight analysis

DAYLIGHT ANALYSIS RESULT OF SPACE G9						
	JAN.	FEB.	MARCH	APRIL	MAY	JUNE
	Overcast	Overcast	Overcast	Partly	Clearsky	Clearsky
08.00						
12.00						
15.00						
19.00	NO SUNLIGHT	NO SUNLIGHT	NO SUNLIGHT	NO SUNLIGHT		
	JULY	AUG.	SEP.	OCT.	NOV.	DEC.
	Clearsky	Clearsky	Clearsky	Partly	Overcast	Overcast
08.00						
12.00						
15.00						
19.00			NO SUNLIGHT	NO SUNLIGHT	NO SUNLIGHT	NO SUNLIGHT

The illuminance values decrease from red to blue in the table.

When the table of the first analysis for the G9 room is compared with the analysis table created after the improvement suggestions, the problem of not homogeneous distribution of daylight in the glass front and back of the room was solved to a significantly. Since there was no increase in the amount of daylight entering, illuminance values decreased on a point basis.

5.3.2.5. F1 Room Daylight Analysis

In the first analysis made in room F1 located on the first floor of the building, the problem of the inhomogeneity of daylight distribution from the front of the glass to the back of the room, which is common in other rooms, was determined as the decreasing daylight distribution in the left part of the room in this room. As a suggestion for improvement, 75 cm light shelves were applied to the three windows facing the north façade. The reflectance of the light shelf is 80% and the height of the mezzanine is 30 cm. In addition to the light shelf, it is aimed to increase the daylight distribution on the right and left wings by applying the reflective ceiling, which descends with a 10% trend from the middle point to the right and left wings. The plan of the room is as in Figure 71. The daylight analysis of the suggestions implemented in the simulation on the 15th of each month throughout the year and the improvement suggestions are shown in Table 42.

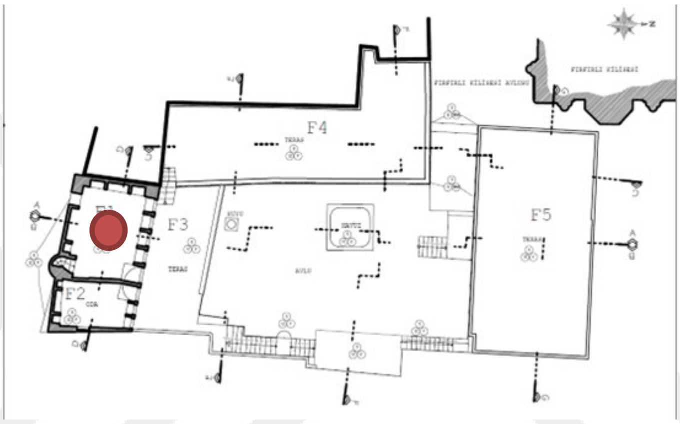
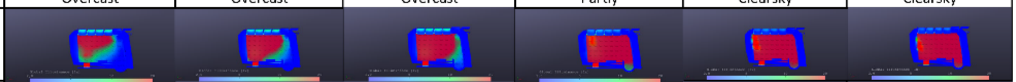
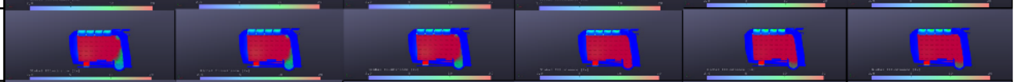
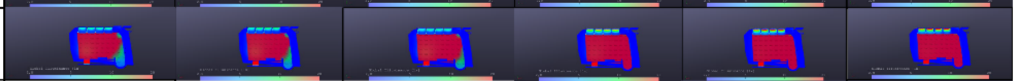
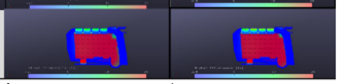
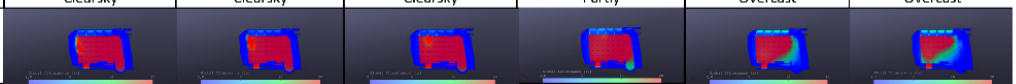
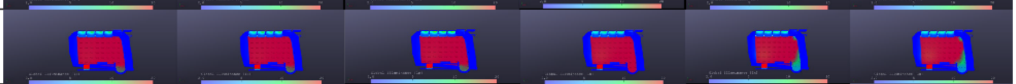
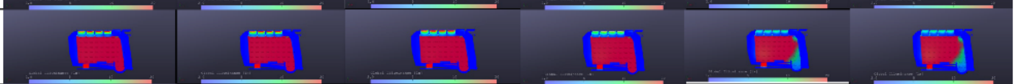
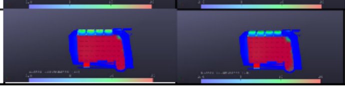


Figure 71: F1 Room location

Table 42: F1 Room daylight analysis

DAYLIGHT ANALYSIS RESULT OF SPACE F1						
	JAN.	FEB.	MARCH	APRIL	MAY	JUNE
	Overcast	Overcast	Overcast	Partly	Clearsky	Clearsky
08.00						
12.00						
15.00						
19.00	NO SUNLIGHT	NO SUNLIGHT	NO SUNLIGHT	NO SUNLIGHT		
	JULY	AUG.	SEP.	OCT.	NOV.	DEC.
	Clearsky	Clearsky	Clearsky	Partly	Overcast	Overcast
08.00						
12.00						
15.00						
19.00			NO SUNLIGHT	NO SUNLIGHT	NO SUNLIGHT	NO SUNLIGHT

The illuminance values decrease from red to blue in the table.

When the first analysis table for the F1 room was compared with the analysis table created after the improvement suggestions, the problem that the daylight did not reach the left part of the room and that the daylight was not homogeneously distributed was resolved. According to the simulation results in which improvement suggestions are applied, ideal illuminance levels can be reached mostly only with the use of daylight in summer months. In the winter months, the illuminance values obtained in the current situation are more homogeneously distributed throughout the room.

5.3.3. Daylight Analysis Results

Although the problems of uneven daylight distribution in the B5, G1 and F1 rooms changed noticeably after the improvement proposals, the current situation in the other rooms did not change significantly and caused other problems. The maximum and minimum illuminance values measured in the rooms are as seen in Table 43. The current situation in the rooms after daylight problems and improvement suggestions are as seen in Table 44.

Table 43: F1 Room daylight analysis

	MAXIMUM ILLUMINANCE			MINIMUM ILLUMINANCE		
	Lux	Time		Lux	Time	
		Month	Hour		Month	Hour
B5	74	April	09.00	0,01	December	16.00
G1	1028	June	12.00	2.7	January	08.00
G7	22800	June	08.00	6.9	January	08.00
G9	1421	April	12.00	0.4	January	08.00
F1	1021	August	15.00	1.9	January	08.00

Table 44: Daylight improvement results

	CURRENT PROBLEM	AFTER IMPROVEMENTS
B5	Lack of illuminance, lack of sunlight reaching the right and left wing of the room	The illuminance shortage continues. While the distribution of daylight to the right and left wings of the room increased in summer months, the distribution decreased more in winter.
G1	Illuminance value is sufficient in summer, insufficient in winter. Daylight distribution in the room decreases from the front of the window towards the back of the room.	Illuminance values increased. Except for January, the daylight distribution became more homogeneous.
G7	In winter, in the morning hours, in the absence of daylight distribution in the room, the back of the room is inefficient, while there is glare in the glass front of the room.	While the daylight distribution showed a positive improvement in the winter months, a decrease was observed in the point illuminance values. In the summer months, the excess of illuminance value in front of the glass increased.
G9	There is an 80% difference between the illuminance value in front of the glass in the room and the illuminance value in the back. Daylight distribution is insufficient and not homogeneously distributed.	While providing a more homogeneous daylight distribution, point illuminance insufficiency increased. Illuminance has not reached the ideal standard.
F1	Daylight does not reach the left part of the room.	Most of the year, the entire room reaches daylight more homogeneously.

CHAPTER VI
CONCLUSION

The scope of this endeavor entails adaptive reuse, retrofitting, and renovations aimed at achieving indoor user comfort and energy-efficient conversions within the context of building conversions. The specific focus is on Şanlıurfa Houses with hayat. The research conducted and recommendations put forth in this study align with the overarching goal of sustainability.

The work encompasses comprehensive investigations into parameters pertaining to indoor user comfort and energy efficiency, encompassing a range of factors. This includes examining strategies for providing interior user comfort while ensuring energy-efficient solutions. The research efforts are specifically tailored to the unique characteristics and requirements of Şanlıurfa Houses with hayat.

The study aims to contribute to the broader objective of sustainability by offering insightful suggestions and conducting thorough research within the designated framework.

Retrofitting allows the improvement of the building's interior quality parameters and the integration of energy-efficient systems into the building. In summary, adaptive reuse and retrofitting are methods that create more sustainable buildings in construction and use. By improving the indoor environmental quality contents of existing buildings in an energy-efficient way by using the retrofitting method, the building will both meet the user needs more efficiently and extend its useful life by reducing its usage costs. Both methods aim to prolong the life of the building and contribute significantly to sustainability in the architectural context. The combination of these two methods is important for prolonging the building's longevity.

Adaptive reuse and retrofitting management should be evaluated at the stage of restoration practices applied in historical buildings in order to extend the useful life of historical buildings that are part of the existing building stock.

In the case of restoration of buildings, it should be evaluated whether the function of the building is still suitable for the building at the time of restoration and, if necessary, adaptive reuse strategies should be applied and a functional change in the structure should be made. In this way, historical buildings that are approaching the end of their useful life will also be saved from being idle.

If the authencity of the building planned to be implemented with adaptive reuse and strengthening strategies in historical buildings is within the scope of the structure to be protected, the interventions to the structure should not cause permanent changes in the structure and should not damage the urban texture of the region where the building is located.

If the building is a registered structure, the projects prepared before these strategies are implemented according to the scope of the interventions must be approved by the Cultural Heritage Preservation Board of the region. If the building is one of the original structures of the current period, it should be advanced within the framework of the rules specified in the FSEK.

Indoor environmental quality, a focal point of the retrofitting method, encompasses a range of factors aimed at enhancing user comfort within a building. Thermal comfort and lighting comfort are two significant aspects that contribute extensively to energy consumption in modern buildings. Given their substantial energy consumption during building operation, addressing thermal comfort and lighting comfort holds significant importance in retrofitting projects. By improving these aspects, overall indoor environmental quality can be enhanced, leading to a more sustainable and comfortable built environment. Indoor lighting comfort indicator is selected as illuminance levels and glare. Also, air temperature is can be defined as indoor thermal comfort indicator. In order to reach comfort conditions efficiently, while considering energy conservation, the thermal transmittance coefficient, thermal capacity, and thermal conductivity of building elements have been addressed.

In the field study of this research, has been applied on-site measurement about indoor user comfort. These indicators that mentioned above used as parameters to evaluate indoor lighting comfort and thermal comfort during on site measurement. Based on the data obtained from on-site measurements, it was determined that the building requires continuously active systems to ensure indoor thermal ve lighting comfort In order to meet the values determined by the thermal comfort standard ASHRAE 55-2017 Thermal Environmental Conditions for Human Occupancy and the lighting comfort standard IES ANSI/IES RP-9-23 Recommended Practice:Lighting Hospitality Spaces an American National Standard, and TSE 17067 Conformity Assessment - Fundamentals of Product Certification and Guidelines For Product Certification Schemes.

After determine the necessity of active systems, energy consumption quantities and ratios for thermal and lighting comfort were identified on an annual basis through energy analyses applied to the building. The causes of heat gains and losses that contribute to thermal comfort energy consumption were determined. Daylight analyses were conducted to ensure energy-efficient provision of lighting comfort in the Nuran Elçi Mansion with REVIT software.

For the implementation of the analyses, the REVIT software was chosen due to its capability to perform the required analyses, user-friendliness, 3D modeling capabilities, and its ability to conduct energy and daylight analyses. The 3D model of the building was prepared using restitution and restoration projects obtained from the Şanlıurfa Regional Directorate for the Conservation of Cultural Heritage. The physical properties of the building elements, climatic data of the region where the building is located, and site-specific information were incorporated into the generated 3D model. The sky condition data required for daylight analyses was created by averaging the monthly sky condition data for a period of four years in Şanlıurfa. The obtained data was used for the simulation to generate annual energy consumption and daylight analysis for the building.

The result is that the building consumes a lot of energy due to the active systems used to provide user comfort. In order to reduce the determined energy consumption and increase the thermal comfort, insulation application on the walls and windows of the building and light shelf and reflective applique ceiling application to increase the lighting comfort in an energy efficient way have been proposed.

While determining the improvement suggestions, previously applied methods in the literature were used. Since the building is a historical and registered building, any intervention to the building is not allowed. While determining the improvement suggestions, it was aimed not to change the appearance of the building on the exterior and thus not to damage the urban texture. In the changes made in the interior, choices suitable for the texture of the building and methods that can be applied and removed that do not cause permanent changes in the building were preferred.

After the improvement suggestions were applied to the building on the 3D model, it was seen that the thermal losses and gains caused by the walls and windows in some of the rooms were reduced, but the improvement applications made in some rooms did not show the expected effect. Thanks to the improvement suggestions applied as a result of the energy analyzes made with the REVIT software. Considering the annual energy consumption, it was seen that the heating and cooling loads decrease.

As a result of the daylight analyzes applied to evaluate the improvement suggestions applied for the energy efficient improvement of lighting comfort, the problem of insufficient daylight distribution in the rooms has been solved, while the problem of excess illumination in some rooms has increased and an existing problem has increased even more. Since the light entering the spaces could not be increased in most rooms, no change in lighting energy was observed in annual energy loads.

It has been observed that positive results can be obtained after the energy and lighting analyzes made after the improvement proposals and the interventions to be applied to improve the thermal and lighting comfort in historical buildings with energy efficiency. During the analysis, the annual energy consumption of the building was reduced by 89.27 GJ. Within this reduction, the cooling energy consumption was decreased by 64.57 GJ, and the heating energy consumption was reduced by 14.90 GJ.

The findings indicate that improvement recommendations need to be tailored to address specific issues related to the facade, floor, and individual rooms within each building. It was observed that while certain rooms yielded positive results, others showed no significant impact or even presented additional challenges. Therefore, interventions should be developed by taking into account the unique characteristics and challenges of each building and its individual rooms. This approach ensures as target solutions can be implemented to address the specific problems encountered in each case. Before the improvement proposals that are planned to be applied to the buildings are made into a final project, it is important that the effect of the planned interventions can be seen with the energy and lighting analyzes to be made in the buildings.

In future studies, the data obtained in this study can be developed and the application costs of the interventions to be applied to improve the indoor environmental quality in historical buildings with energy efficiency, and the energy and materials consumed during the application, and the feasibility of the benefit obtained can be evaluated after the reduction of energy consumption obtained after the implementation of the improvement suggestions.

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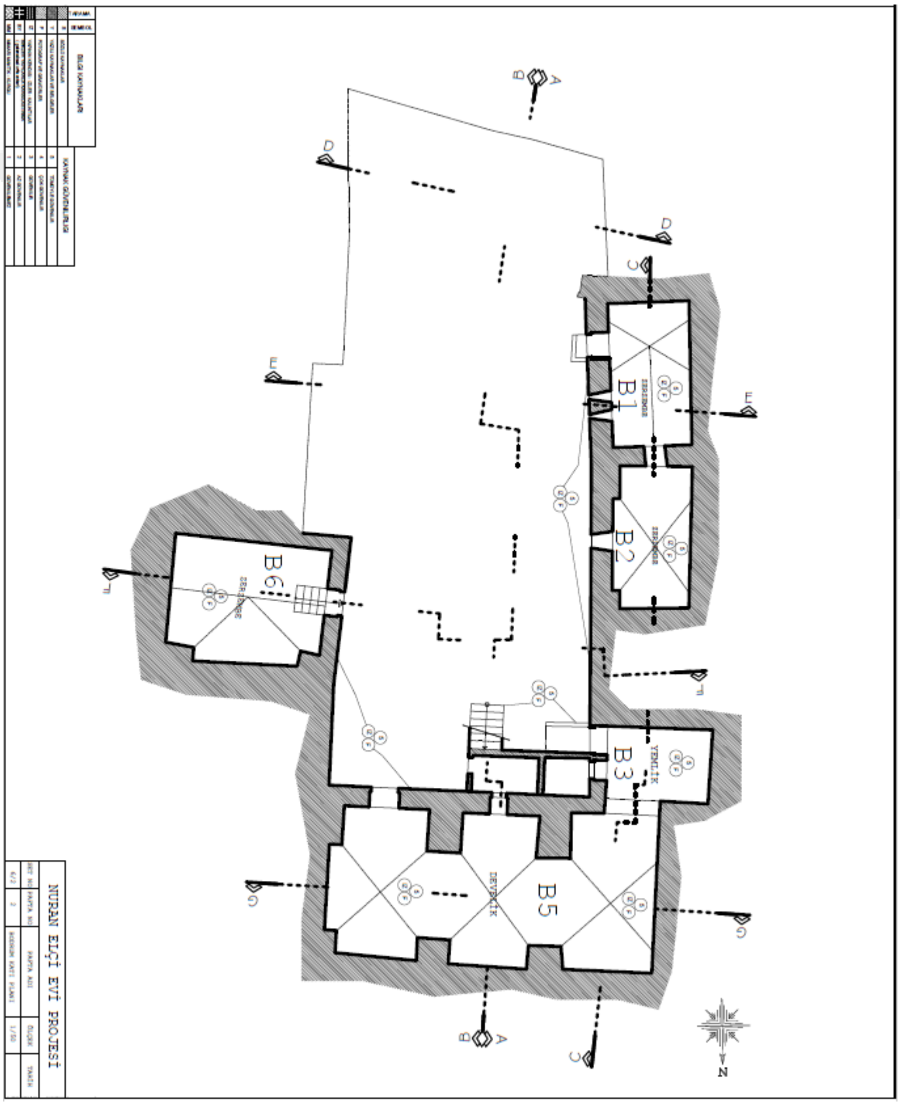
APPENDICES

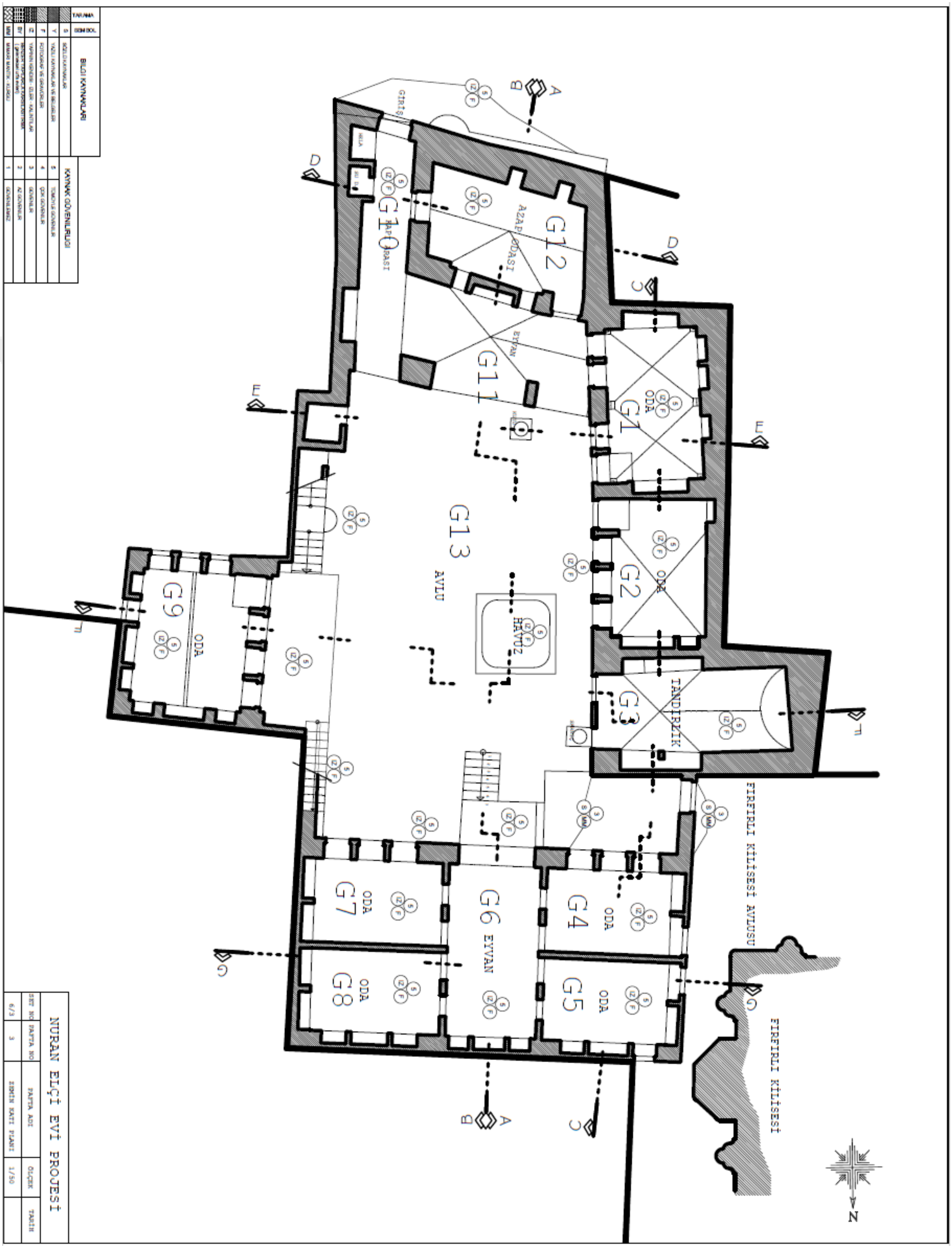
APPENDIX 1:

NURAN ELÇİ MANSION RESTITUTION PROJECT BASEMENT FLOOR PLAN DRAWING



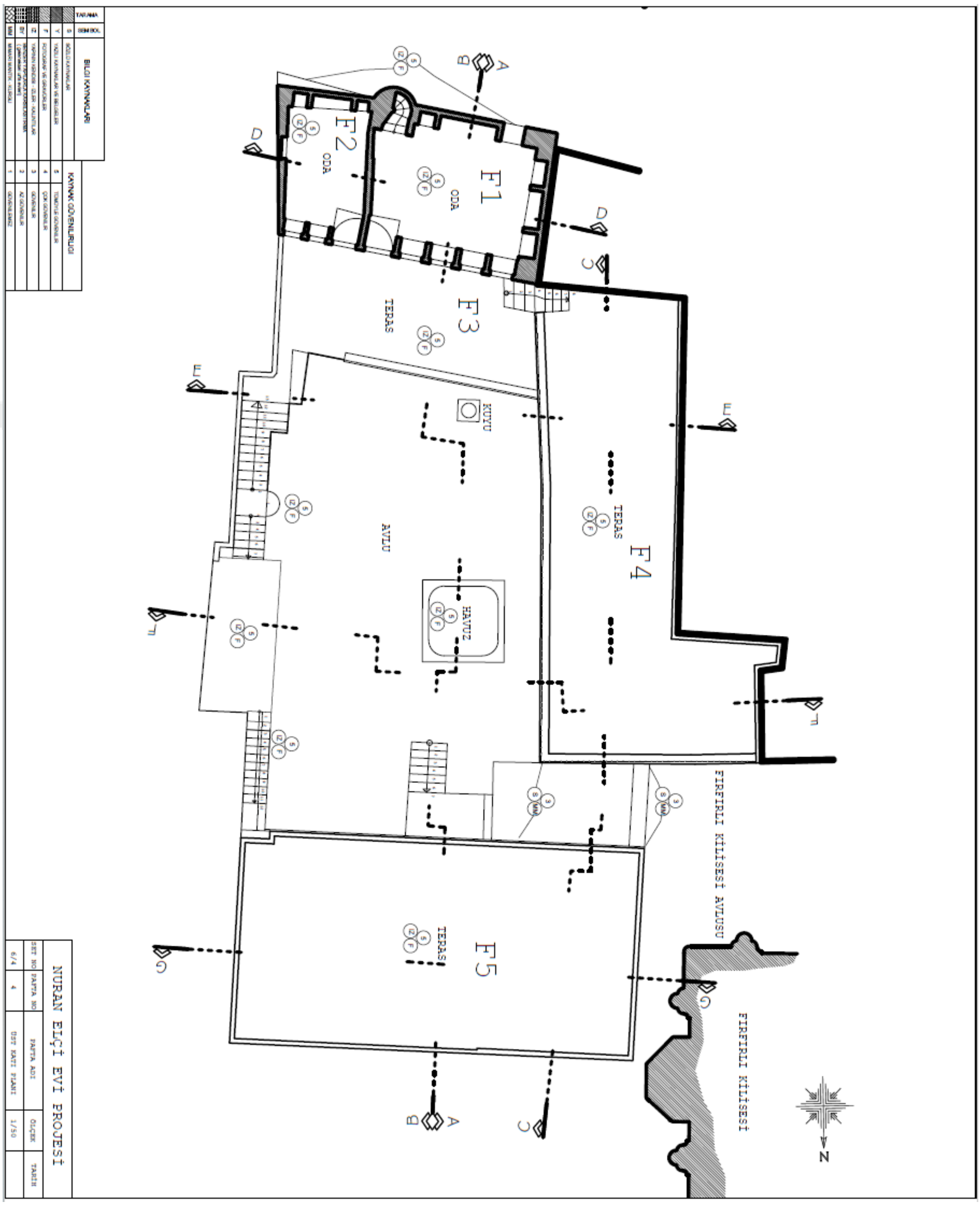
APPENDIX 2:

NURAN ELÇİ MANSION RESTITUTION PROJECT GROUND FLOOR PLAN DRAWING



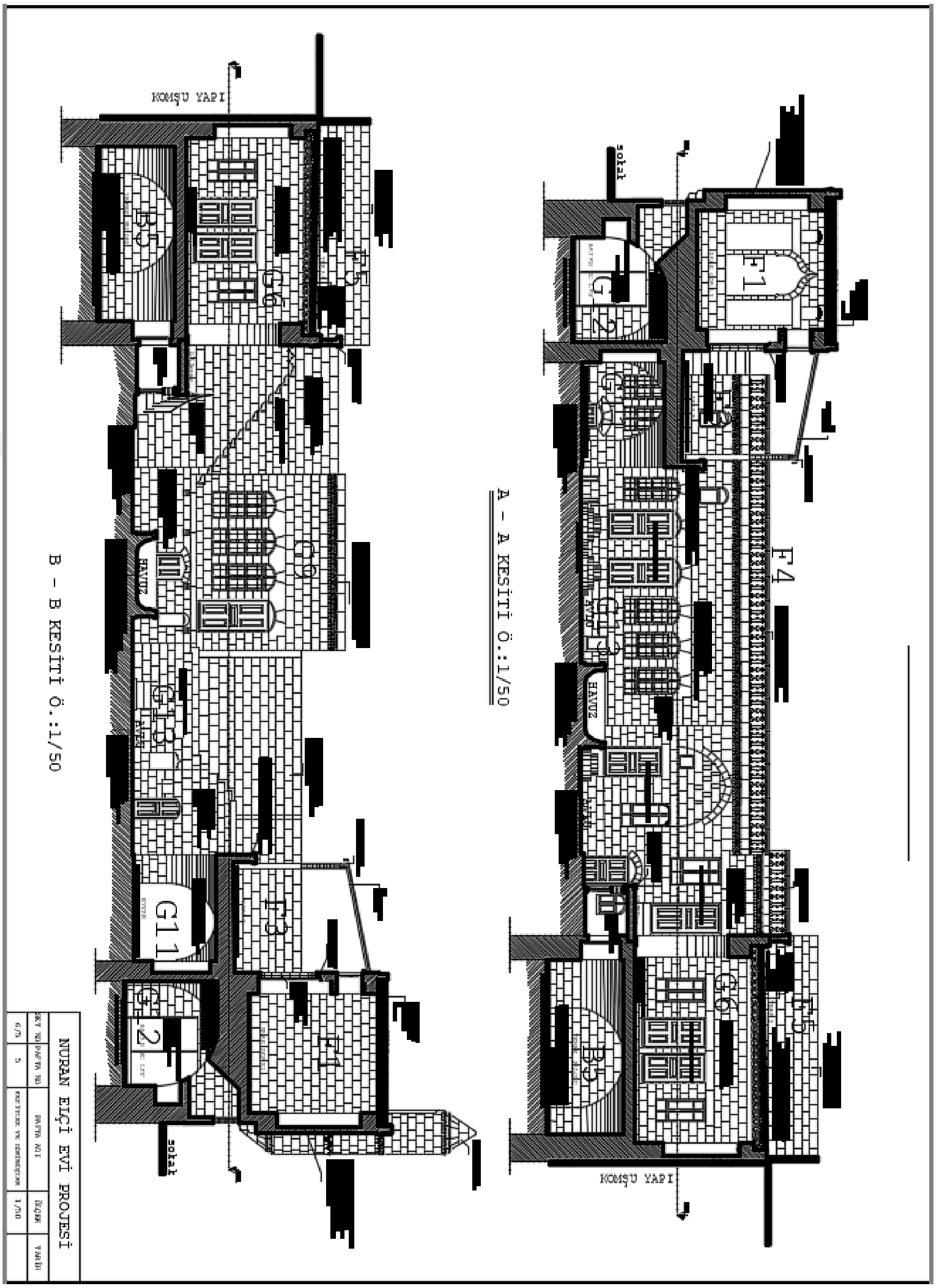
APPENDIX 3:

NURAN ELÇİ MANSION RESTITUTION PROJECT FIRST FLOOR PLAN DRAWING



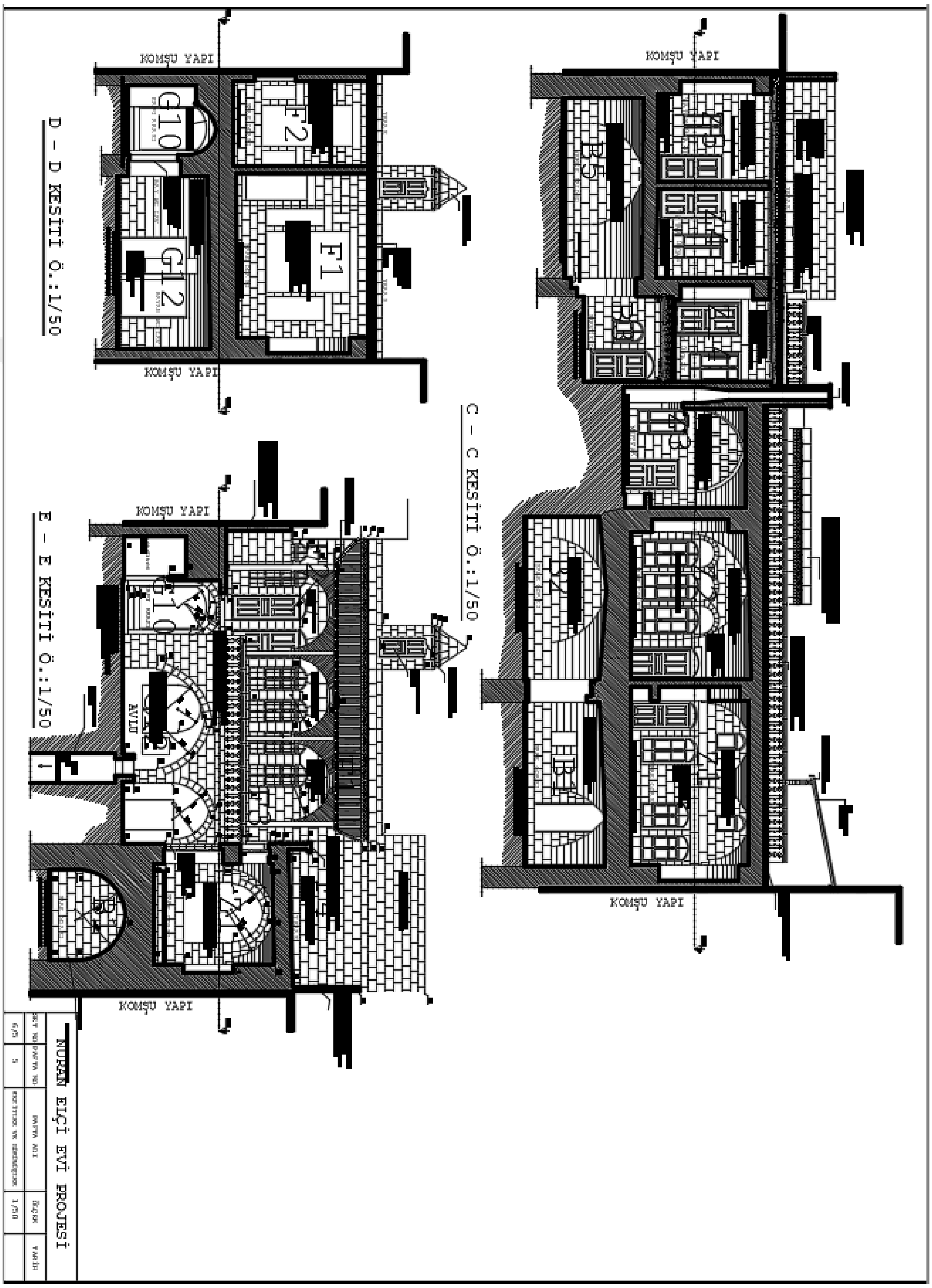
APPENDIX 4:

NURAN ELÇİ MANSION RESTITUTION PROJECT SECTIONS A-A AND B-B



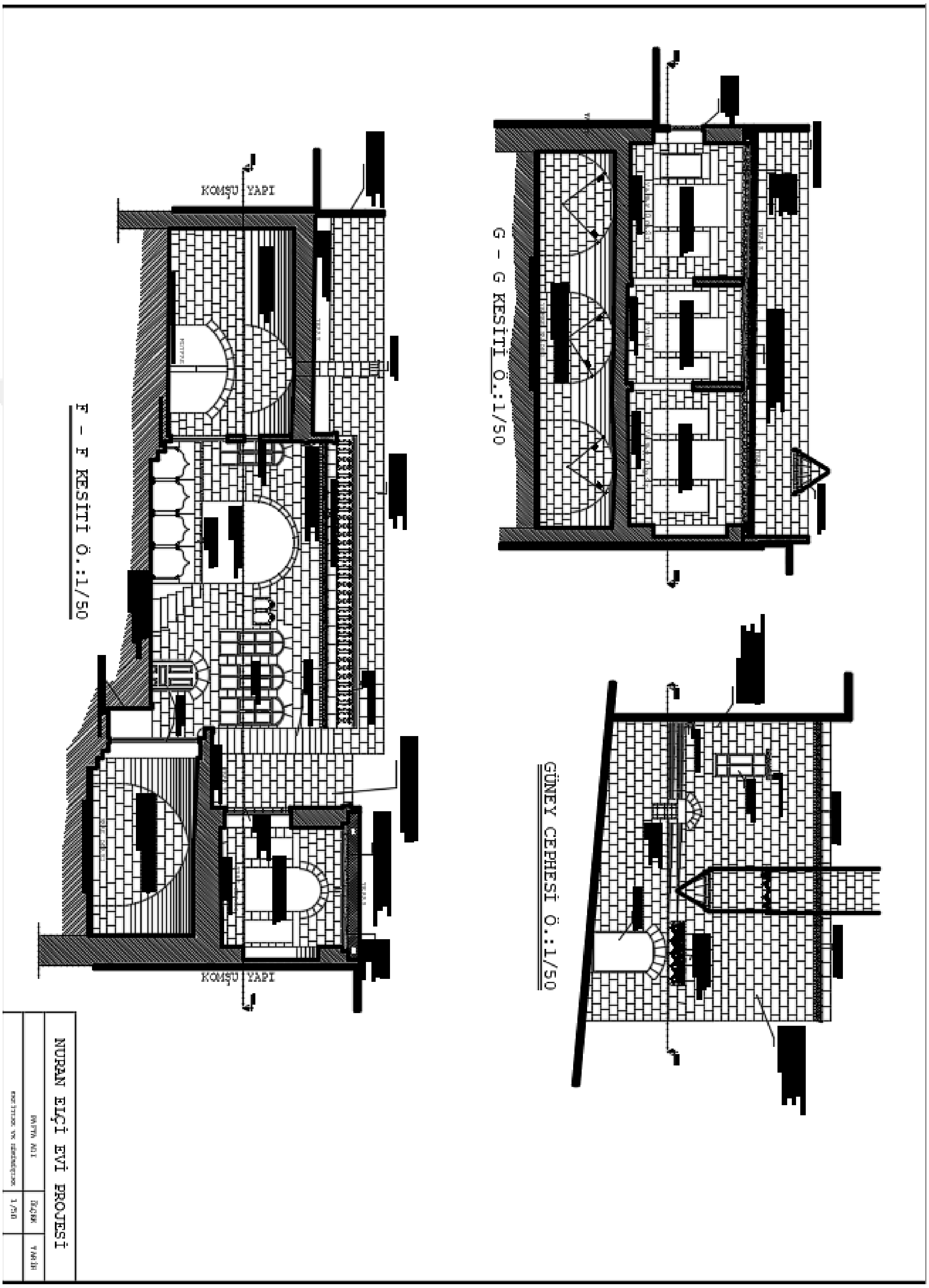
APPENDIX 5:

NURAN ELÇİ MANSION RESTITUTION PROJECT SECTIONS C-C, D-D, AND E-E



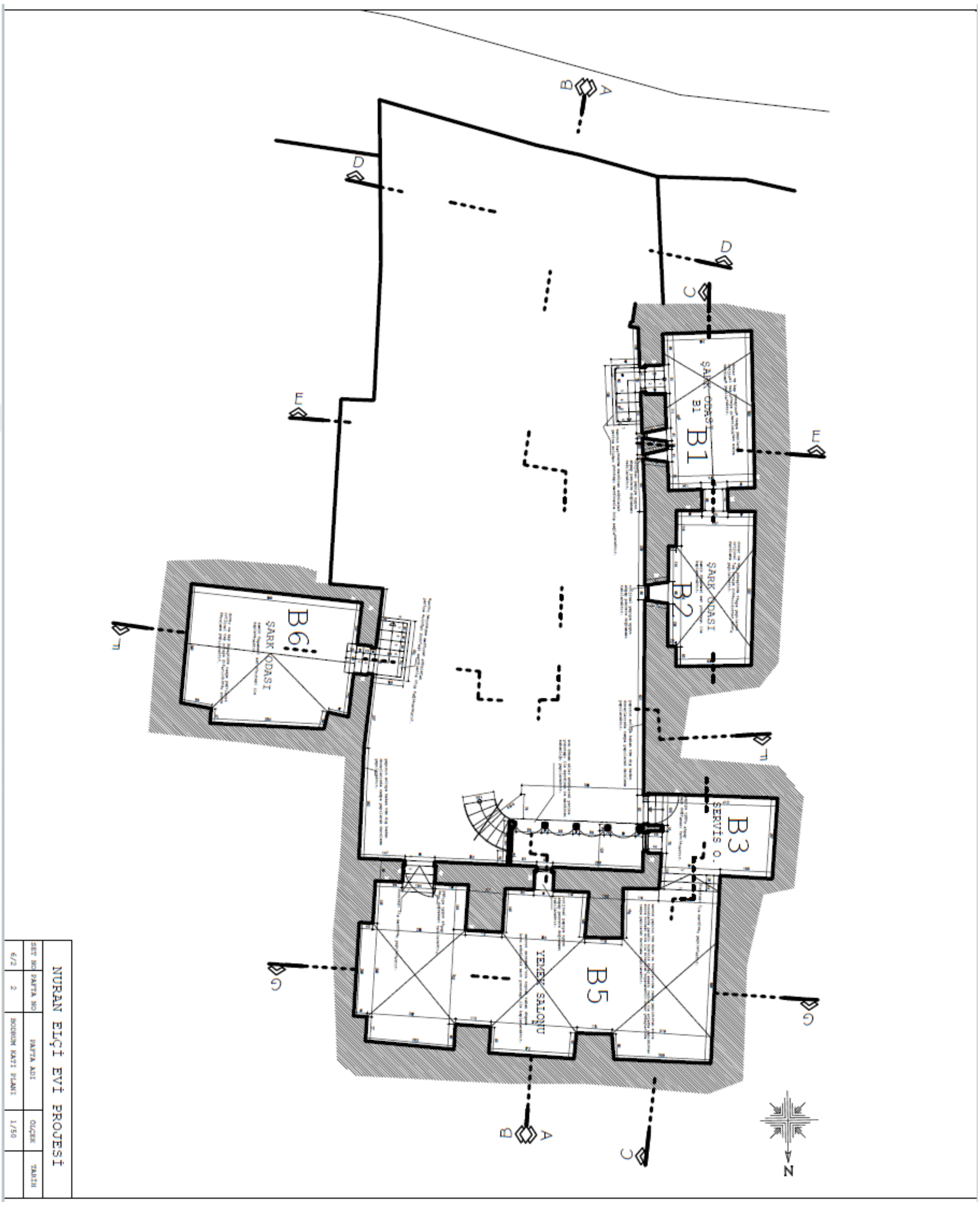
APPENDIX 6:

NURAN ELÇİ MANSION RESTITUTION PROJECT SECTIONS F-F, G-G, AND SOUTH FACADE



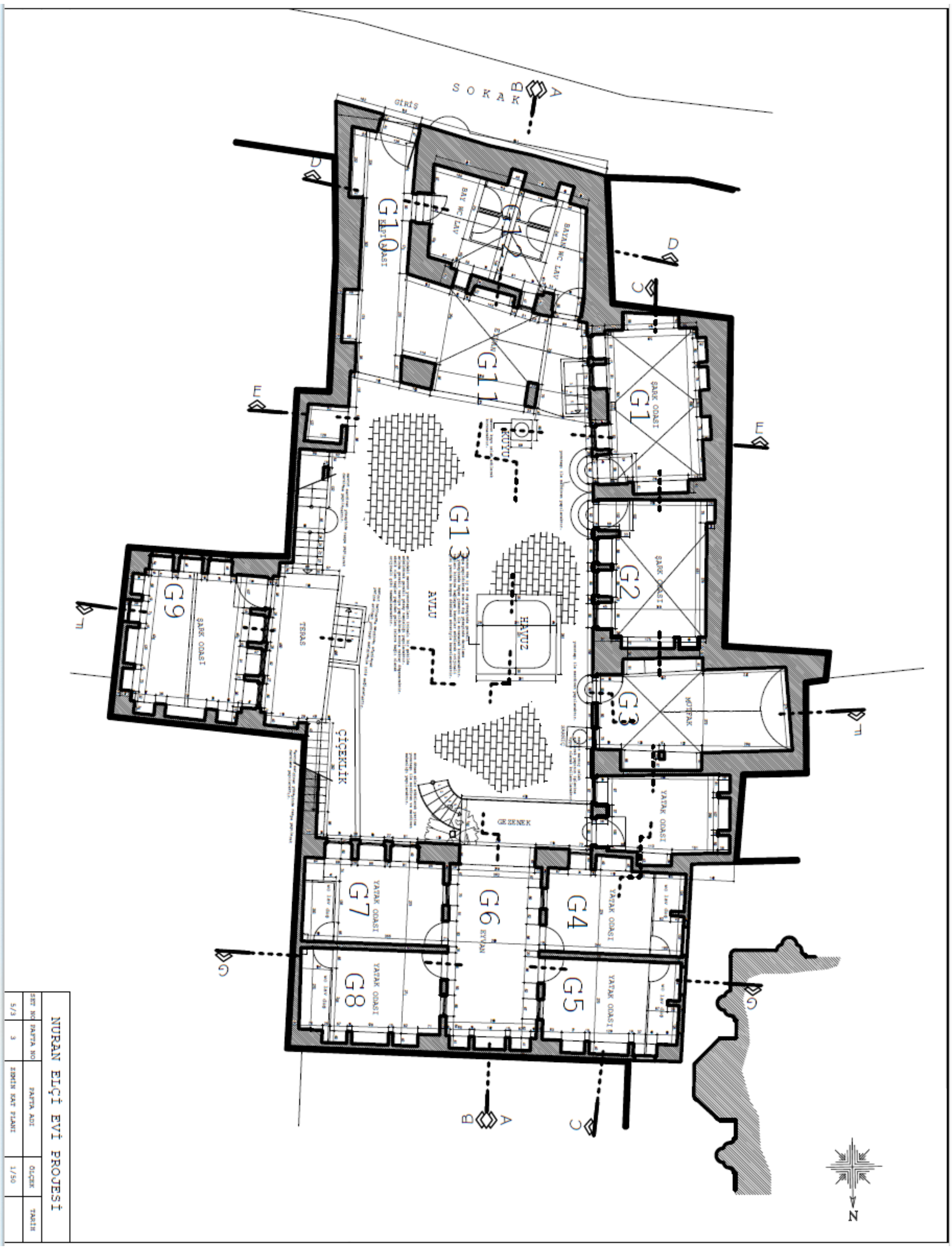
APPENDIX 7:

NURAN ELÇİ MANSION RESTORATION PROJECT BASEMENT FLOOR PLAN DRAWING



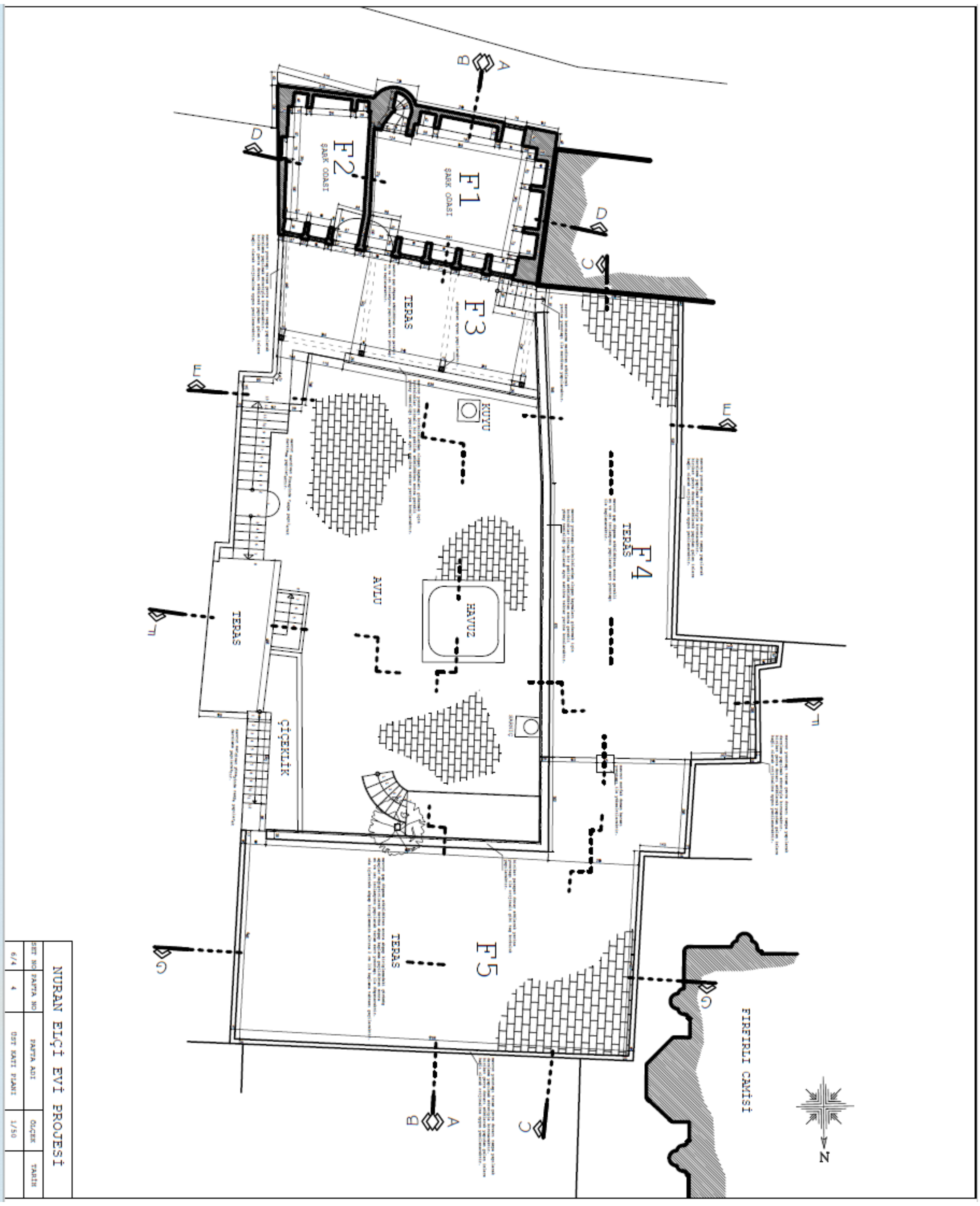
APPENDIX 8:

NURAN ELÇİ MANSION RESTORATION PROJECT GROUND FLOOR PLAN DRAWING



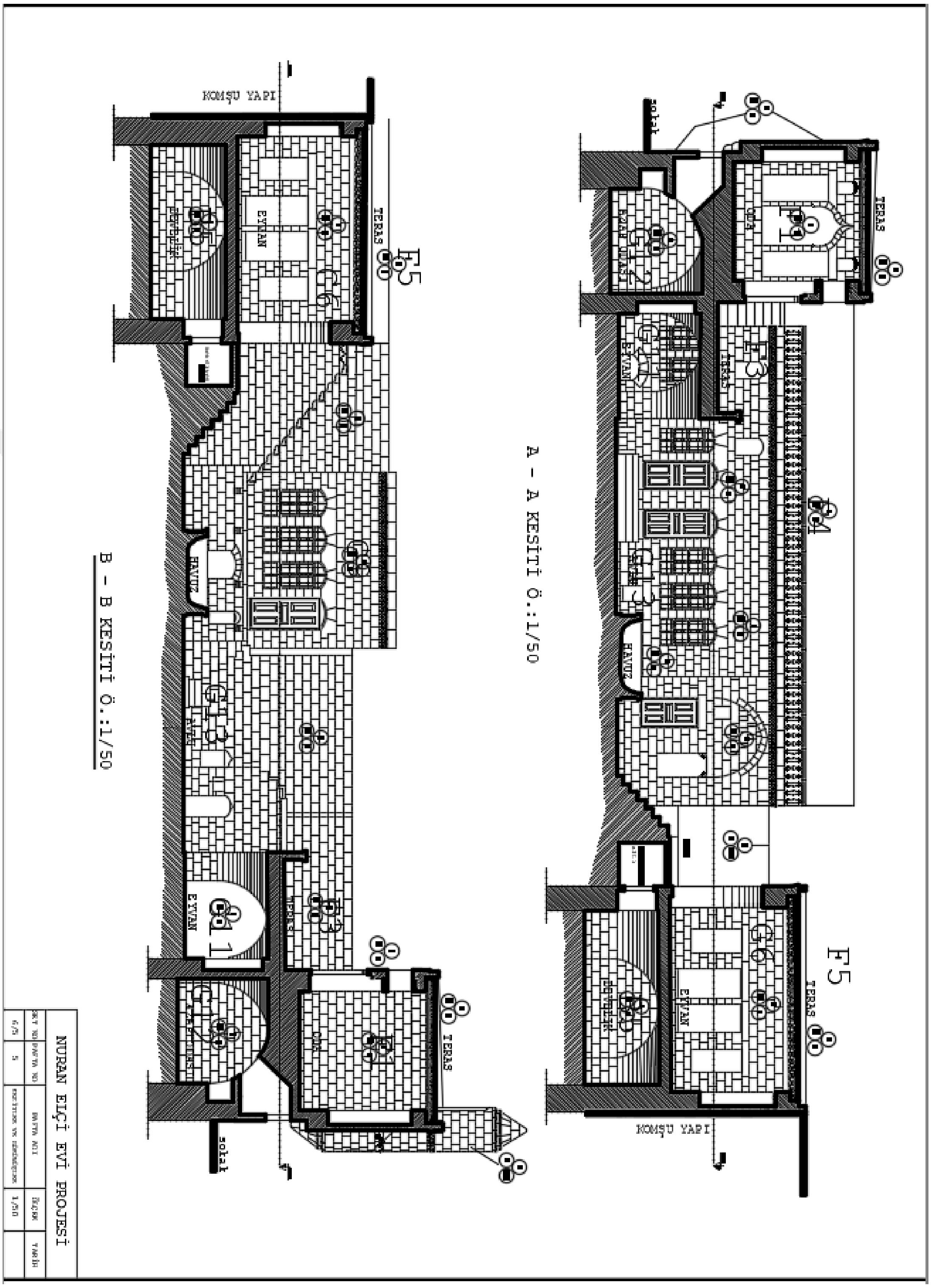
APPENDIX 9:

NURAN ELÇİ MANSION RESTORATION PROJECT FIRST FLOOR PLAN DRAWING



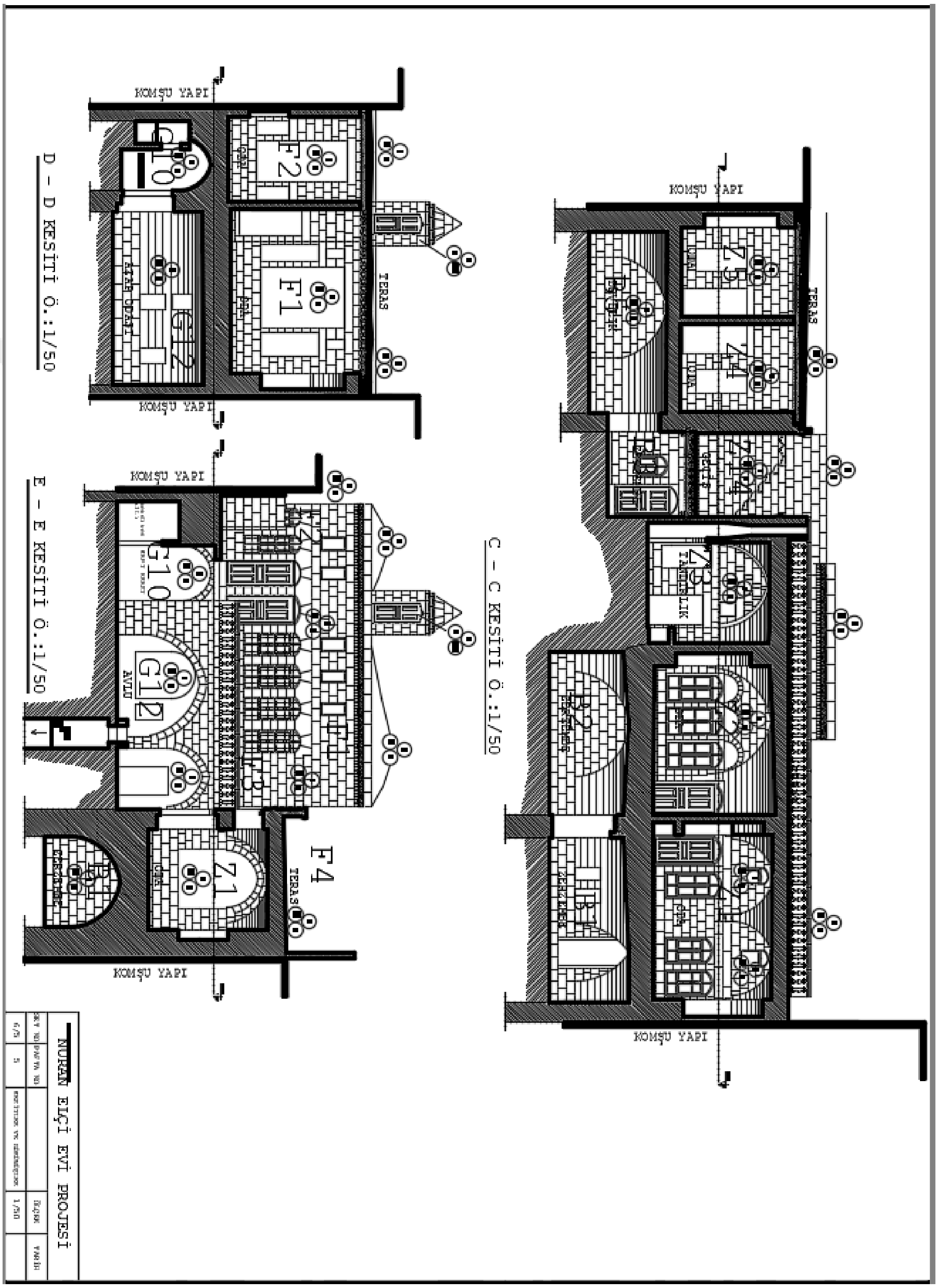
APPENDIX 10:

NURAN ELÇİ MANSION RESTORATION PROJECT SECTIONS A-A AND B-B



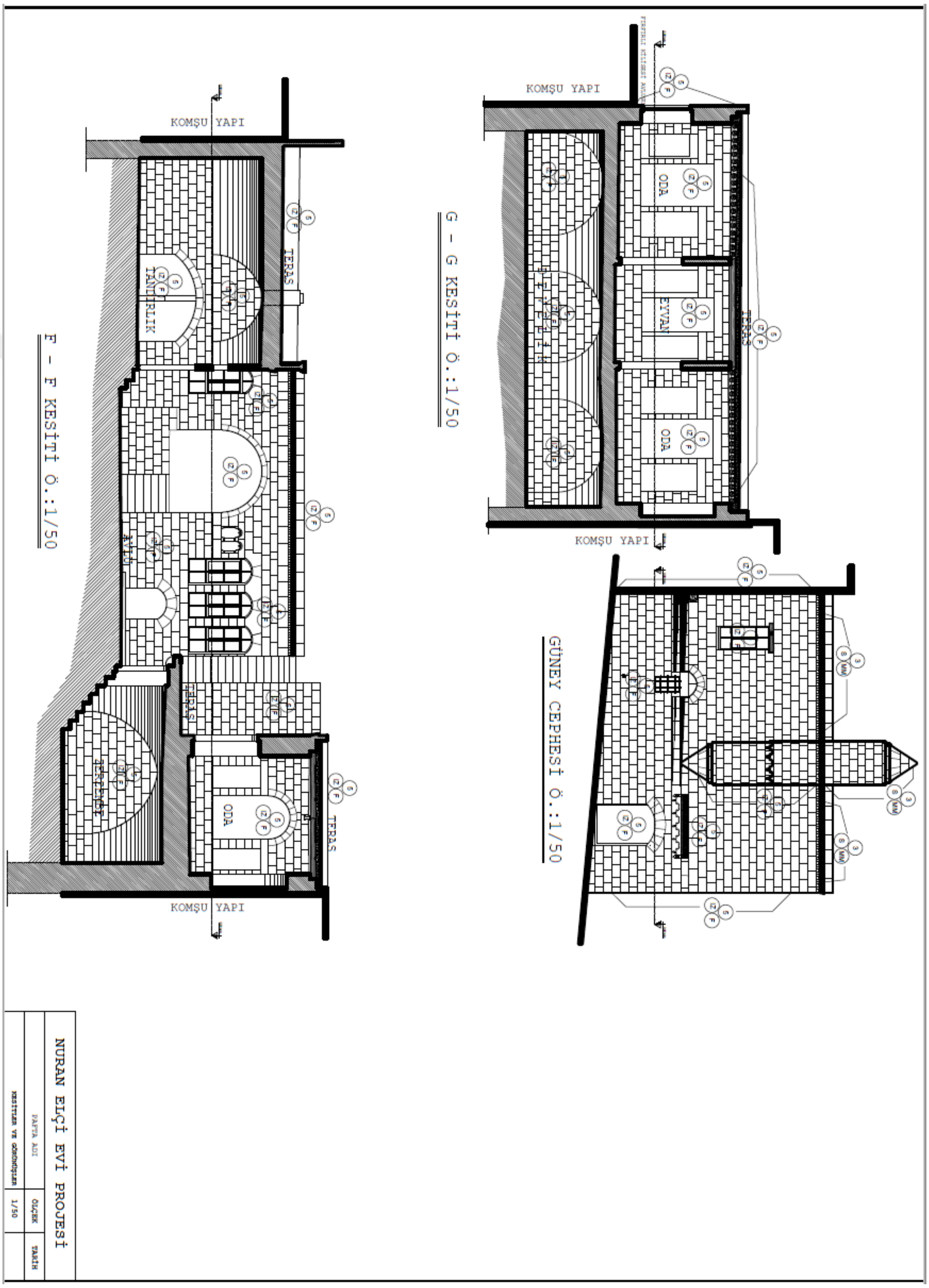
APPENDIX 11:

NURAN ELÇİ MANSION RESTORATION PROJECT SECTIONS C-C, D-D, AND E-E



APPENDIX 12:

NURAN ELÇİ MANSION RESTORATION PROJECT SECTIONS F-F, G-G, AND SOUTH FACADE



APPENDIX 13:

ON SITE MEASUREMENTS RESULTS DATE: 15.07.2022 TIME:10.00

NURAN ELÇİ MANSION INDOOR COMFORT PARAMETERS MEASUREMENT DATE : 15.07.2022 TIME: 10.00 COURTYARD TEMPERATURE: 34,1°C COURTYARD AIR FLOW:0,21 m/s											
FIELDS	TEMPERATURE		MOISTURE	SOUND	COURTYARD WALL SURFACE	EXTERIOR WALL SURFACE	NEIGBORING WALL 1 SURFACE	NEIGBORING WALL 2 SURFACE	FLOORING	LIGHTING	
SPACE 1	HİGH 1	32,9								AREA 1	55
										AREA2	317
										AREA 3	310
										AREA 4	64
	HİGH 2	33	22.1%	29,40	32,9	33,4	33,6	33,7		AREA 5	169
										AREA 6	188
										AREA 7	39
										AREA 8	117
	HİGH 3	33								AREA 9	371
	TEMPERATURE		MOISTURE	SOUND	COURTYARD WALL SURFACE	EXTERIOR WALL SURFACE	NEIGBORING WALL 1 SURFACE	NEIGBORING WALL 2 SURFACE	FLOORING	LIGHTING	
SPACE 2	HİGH 1	34,1								AREA 1	569
										AREA2	97
										AREA 3	52
										AREA 4	102
	HİGH 2	34,2	20,10%	30,90	32,8	32,6	32,9	32,9		AREA 5	62
										AREA 6	49
										AREA 7	71
										AREA 8	58
	HİGH 3	34,2								AREA 9	43
	TEMPERATURE		MOISTURE	SOUND	COURTYARD WALL SURFACE	EXTERIOR WALL SURFACE	NEIGBORING WALL 1 SURFACE	NEIGBORING WALL 2 SURFACE	FLOORING	LIGHTING	
SPACE 3	HİGH 1	32,9								AREA 1	281
										AREA2	211
										AREA 3	224
										AREA 4	45
	HİGH 2	33,1	22,10%	31,1	33,9	33,7	33,7	33,9		AREA 5	78
										AREA 6	79
										AREA 7	33
										AREA 8	51
	HİGH 3	33,1								AREA 9	62
	TEMPERATURE		MOISTURE	SOUND	COURTYARD WALL SURFACE	EXTERIOR WALL SURFACE	NEIGBORING WALL 1 SURFACE	NEIGBORING WALL 2 SURFACE	FLOORING	LIGHTING	
SPACE 4	HİGH 1	33,8								AREA 1	426
										AREA2	271
										AREA 3	173
										AREA 4	46
	HİGH 2	33,9	21,20%	30,1	33,8	33,6	33,8	32,8		AREA 5	51
										AREA 6	51
										AREA 7	43
										AREA 8	54
	HİGH 3	33,9								AREA 9	41
	TEMPERATURE		MOISTURE	SOUND	COURTYARD WALL SURFACE	EXTERIOR WALL SURFACE	NEIGBORING WALL 1 SURFACE	NEIGBORING WALL 2 SURFACE	FLOORING	LIGHTING	
SPACE 5	HİGH 1	32,7								AREA 1	21
										AREA2	18
										AREA 3	0
										AREA 4	1
	HİGH 2	32,7	35,20%	33,9	27,9	26,8	29,3	26,2		AREA 5	0
										AREA 6	0
										AREA 7	0
										AREA 8	0
	HİGH 3	32,8								AREA 9	0
	TEMPERATURE		MOISTURE	SOUND	COURTYARD WALL SURFACE	EXTERIOR WALL SURFACE	NEIGBORING WALL 1 SURFACE	NEIGBORING WALL 2 SURFACE	FLOORING	LIGHTING	
SPACE 6	HİGH 1	31,8								AREA 1	4
										AREA2	10
										AREA 3	4
										AREA 4	6
	HİGH 2	31,8	24,90%	32,8	29,6	29,8	29,4	29,8		AREA 5	2
										AREA 6	1
										AREA 7	1
										AREA 8	0
	HİGH 3	31,9								AREA 9	0

AREA 10	1	AREA 19	0
AREA 11	4	AREA 20	1
AREA 12	0	AREA 21	0
AREA 13	0	AREA 22	0
AREA 14	1	AREA 23	0
AREA 15	0	AREA 24	0
AREA 16	0	AREA 25	0
AREA 17	0	AREA 26	0
AREA 18	0	AREA 27	0

APPENDIX 14:

ON SITE MEASUREMENTS RESULTS DATE: 16.07.2022 TIME:10.00

NURAN ELÇİ MANSION INDOOR COMFORT PARAMETERS MEASUREMENT DATE : 16.07.2022 TIME: 10.00 COURTYARD TEMPERATURE: COURTYARD AIR FLOW:

FIELDS	TEMPERATURE		HUMIDITY	SOUND	COURTYARD WALL SURFACE	EXTERIOR WALL 1 SURFACE	NEIGHBORING WALL 1 SURFACE	NEIGHBORING WALL 2 SURFACE	FLOORING
SPACE 1	HİGH 1	32,9	21,90%	31,20	32,9	33,1	33,2	33,3	
	HİGH 2	33							
	HİGH 3	33							
SPACE 2	HİGH 1	31,9	20,00%	32,90	31,8	31,7	31,7	31,9	
	HİGH 2	32							
	HİGH 3	32							
SPACE 3	HİGH 1	32,8	21,90%	34	33,9	34,1	34	34,2	
	HİGH 2	32,8							
	HİGH 3	32,9							
SPACE 4	HİGH 1	33,8	20,90%	31,4	33,8	33,6	33,9	33,7	
	HİGH 2	33,9							
	HİGH 3	34							
SPACE 5	HİGH 1	32,1	34,90%	36,3	26,9	26,2	29,7	26,9	
	HİGH 2	32,1							
	HİGH 3	33,2							
SPACE 6	HİGH 1	31,8	23,50%	32,7	30,1	29,7	29,1	30	
	HİGH 2	31,8							
	HİGH 3	31,8							

LIGHTING	SPACE 1	SPACE 2	SPACE 3	SPACE 4	SPACE 5	SPACE 6
AREA 1	52	568	278	441	21	4
AREA2	319	91	211	269	18	9
AREA 3	310	50	242	170	0	2
AREA 4	49	98	45	46	1	4
AREA 5	170	63	79	54	0	1
AREA 6	189	41	78	57	0	1
AREA 7	44	74	34	46	0	1
AREA 8	110	58	54	54	0	0
AREA 9	341	40	65	47	0	0

SPACE 6 LIGHTING			
AREA 10	1	AREA 19	0
AREA 11	4	AREA 20	0
AREA 12	0	AREA 21	1
AREA 13	0	AREA 22	0
AREA 14	1	AREA 23	0
AREA 15	0	AREA 24	0
AREA 16	0	AREA 25	0
AREA 17	0	AREA 26	0
AREA 18	0	AREA 27	0

APPENDIX 15:

ON SITE MEASUREMENTS RESULTS DATE: 17.07.2022 TIME:10.00

NURAN ELÇİ MANSION INDOOR COMFORT PARAMETERS MEASUREMENT				DATE : 17.07.2022 TIME: 10.00		COURTYARD TEMPERATUREI: 35,1°C		COURTYARD AIR FLOW:0,42 m/s							
FIELDS	TEMPERATURE		HUMIDITY	SOUND	COURTYARD WALL SURFACE	EXTERIOR WALL SURFACE	NEIGHBORING WALL 1 SURFACE	NEIGHBORING WALL 2 SURFACE	FLOORING	LIGHTING					
	HİGH 1	32,8								AREA 1	60				
										AREA2	318				
										AREA 3	307				
										AREA 4	57				
SPACE 1	HİGH 2	32,9	22,10%	30,80	32,9	33,2	33,4	33,5	34,3	AREA 5	168				
										AREA 6	198				
										AREA 7	44				
	HİGH 3	32,9								AREA 8	114				
										AREA 9	372				
	TEMPERATURE		HUMIDITY	SOUND	COURTYARD WALL SURFACE	EXTERIOR WALL SURFACE	NEIGHBORING WALL 1 SURFACE	NEIGHBORING WALL 2 SURFACE	FLOORING	LIGHTING					
	HİGH 1	33,9								AREA 1	582				
										AREA2	98				
										AREA 3	52				
										AREA 4	112				
SPACE 2	HİGH 2	34,1	19,80%	32,4	32,8	32,6	32,9	32,9	34,7	AREA 5	71				
										AREA 6	49				
										AREA 7	79				
	HİGH 3	34,1								AREA 8	63				
										AREA 9	45				
	TEMPERATURE		HUMIDITY	SOUND	COURTYARD WALL SURFACE	EXTERIOR WALL SURFACE	NEIGHBORING WALL 1 SURFACE	NEIGHBORING WALL 2 SURFACE	FLOORING	LIGHTING					
	HİGH 1	33,1								AREA 1	256				
										AREA2	217				
										AREA 3	242				
										AREA 4	45				
SPACE 3	HİGH 2	33,2	21,80%	33,7	33,9	33,9	33,9	34,1	34,1	AREA 5	79				
										AREA 6	87				
										AREA 7	41				
	HİGH 3	33,2								AREA 8	57				
										AREA 9	61				
	TEMPERATURE		HUMIDITY	SOUND	COURTYARD WALL SURFACE	EXTERIOR WALL SURFACE	NEIGHBORING WALL 1 SURFACE	NEIGHBORING WALL 2 SURFACE	FLOORING	LIGHTING					
	HİGH 1	34,2								AREA 1	441				
										AREA2	282				
										AREA 3	175				
										AREA 4	53				
SPACE 4	HİGH 2	34,3	21,00%	29,9	33,8	33,6	33,9	33,6	34,9	AREA 5	58				
										AREA 6	56				
										AREA 7	47				
	HİGH 3	34,4								AREA 8	51				
										AREA 9	48				
	TEMPERATURE		HUMIDITY	SOUND	COURTYARD WALL SURFACE	EXTERIOR WALL SURFACE	NEIGHBORING WALL 1 SURFACE	NEIGHBORING WALL 2 SURFACE	FLOORING	LIGHTING					
	HİGH 1	32,9								AREA 1	16				
										AREA2	0				
										AREA 3	1				
										AREA 4	0				
SPACE 5	HİGH 2	33	35,30%	33,9	27,8	26,7	29,1	27,2	26,6	AREA 5	0				
										AREA 6	0				
										AREA 7	0				
	HİGH 3	33								AREA 8	0				
										AREA 9	0				
	TEMPERATURE		HUMIDITY	SOUND	COURTYARD WALL SURFACE	EXTERIOR WALL SURFACE	NEIGHBORING WALL 1 SURFACE	NEIGHBORING WALL 2 SURFACE	FLOORING	LIGHTING					
	HİGH 1	31,5								AREA 1	3	AREA 10	1	AREA 19	0
										AREA2	10	AREA 11	4	AREA 20	0
										AREA 3	4	AREA 12	1	AREA 21	1
										AREA 4	5	AREA 13	0	AREA 22	0
SPACE 6	HİGH 2	31,5	24,70%	32,8	30,1	29,8	29,5	29,8	29,5	AREA 5	1	AREA 14	1	AREA 23	0
										AREA 6	1	AREA 15	0	AREA 24	0
										AREA 7	1	AREA 16	0	AREA 25	0
	HİGH 3	31,7								AREA 8	0	AREA 17	0	AREA 26	0
										AREA 9	0	AREA 18	0	AREA 27	0

APPENDIX 16:

ON SITE MEASUREMENTS RESULTS DATE: 18.07.2022 TIME:10.00

NURAN ELÇİ MANSION INDOOR COMFORT PARAMETERS MEASUREMENT DATE : 18.07.2022 TIME: 10.00 COURTYARD TEMPERATURE:35,4°C COURTYARD AIR FLOW:0,34 m/s																
FIELDS	TEMPERATURE		HUMIDITY	SOUND	COURTYARD WALL SURFACE	EXTERIOR WALL SURFACE	NEIGHBORING WALL 1 SURFACE	NEIGHBORING WALL 2 SURFACE	FLOORING	LIGHTING						
SPACE 1	HİGH 1	34,1								AREA 1	57					
										AREA2	319					
										AREA 3	311					
										AREA 4	55					
	HİGH 2	34,1	21,10%	30,40	33,3	33,7	33,8	33,9	34,9	AREA 5	171					
										AREA 6	192					
										AREA 7	46					
	HİGH 3	34,1								AREA 8	113					
										AREA 9	365					
	TEMPERATURE		HUMIDITY	SOUND	COURTYARD WALL SURFACE	EXTERIOR WALL SURFACE	NEIGHBORING WALL 1 SURFACE	NEIGHBORING WALL 2 SURFACE	FLOORING	LIGHTING						
SPACE 2	HİGH 1	34,4								AREA 1	577					
										AREA2	92					
										AREA 3	50					
										AREA 4	103					
	HİGH 2	34,5	35,20%	31,7	33,5	33,3	33,3	33,6	34,8	AREA 5	67					
										AREA 6	48					
										AREA 7	77					
	HİGH 3	34,5								AREA 8	61					
										AREA 9	41					
	TEMPERATURE		HUMIDITY	SOUND	COURTYARD WALL SURFACE	EXTERIOR WALL SURFACE	NEIGHBORING WALL 1 SURFACE	NEIGHBORING WALL 2 SURFACE	FLOORING	LIGHTING						
SPACE 3	HİGH 1	33,7								AREA 1	283					
										AREA2	216					
										AREA 3	238					
										AREA 4	443					
	HİGH 2	33,7	24,80%	32,9	34,6	34,7	34,7	34,8	34,6	AREA 5	76					
										AREA 6	81					
										AREA 7	32					
	HİGH 3	33,9								AREA 8	52					
										AREA 9	59					
	TEMPERATURE		HUMIDITY	SOUND	COURTYARD WALL SURFACE	EXTERIOR WALL SURFACE	NEIGHBORING WALL 1 SURFACE	NEIGHBORING WALL 2 SURFACE	FLOORING	LIGHTING						
SPACE 4	HİGH 1	34,9								AREA 1	430					
										AREA2	278					
										AREA 3	171					
										AREA 4	45					
	HİGH 2	35	22,00%	30,2	34	33,9	34,1	33,9	35,3	AREA 5	52					
										AREA 6	54					
										AREA 7	42					
	HİGH 3	35								AREA 8	49					
										AREA 9	46					
	TEMPERATURE		HUMIDITY	SOUND	COURTYARD WALL SURFACE	EXTERIOR WALL SURFACE	NEIGHBORING WALL 1 SURFACE	NEIGHBORING WALL 2 SURFACE	FLOORING	LIGHTING						
SPACE 5	HİGH 1	33,2								AREA 1	24					
										AREA2	21					
										AREA 3	0					
										AREA 4	2					
	HİGH 2	33,3	20,00%	34,5	28,4	27,3	30	27,6	26,9	AREA 5	1					
										AREA 6	0					
										AREA 7	0					
	HİGH 3	33,3								AREA 8	0					
										AREA 9	0					
	TEMPERATURE		HUMIDITY	SOUND	COURTYARD WALL SURFACE	EXTERIOR WALL SURFACE	NEIGHBORING WALL 1 SURFACE	NEIGHBORING WALL 2 SURFACE	FLOORING	LIGHTING						
SPACE 6	HİGH 1	32,1								AREA 1	5	AREA 10	2	AREA 19	0	
										AREA2	11	AREA 11	5	AREA 20	1	
										AREA 3	4	AREA 12	1	AREA 21	2	
										AREA 4	6	AREA 13	1	AREA 22	0	
	HİGH 2	32,3	21,90%	33	30,3	30,1	29,8	30,3	29,6	AREA 5	2	AREA 14	2	AREA 23	0	
										AREA 6	1	AREA 15	0	AREA 24	0	
										AREA 7	1	AREA 16	0	AREA 25	0	
	HİGH 3	32,3								AREA 8	1	AREA 17	1	AREA 26	0	
										AREA 9	0	AREA 18	0	AREA 27	0	

APPENDIX 17:

ON SITE MEASUREMENTS RESULTS DATE: 15.07.2022 TIME:13.00

NURAN ELÇİ INDOOR COMFORT PARAMETERS MEASUREMENT DATE : 15.07.2022 TIME: 13.00 COURTYARD TEMPERATURE: 39,8 °C COURTYARD AIR FLOW:0,2 m/s											
FIELDS		TEMPERATURE	HUMIDITY	SOUND	COURTYARD WALL SURFACE	EXTERIOR WALL SURFACE	NEIGBORING WALL 1 SURFACE	NEIGBORING WALL 2 SURFACE	FLOORING	LIGHTING	
										AREA 1	24
	HİGH 1	37.5								AREA2	354
										AREA 3	442
										AREA 4	47
SPACE 1	HİGH 2	37.6	21,70%	33,40	35.4	36.4	35.6	35.3		AREA 5	214
										AREA 6	275
										AREA 7	34
	HİGH 3	37.8								AREA 8	224
										AREA 9	520
		TEMPERATURE	HUMIDITY	SOUND	COURTYARD WALL SURFACE	EXTERIOR WALL SURFACE	NEIGBORING WALL 1 SURFACE	NEIGBORING WALL 2 SURFACE	FLOORING	LIGHTING	
										AREA 1	223
	HİGH 1	37.2								AREA2	77
										AREA 3	24
										AREA 4	107
SPACE 2	HİGH 2	37.5	19,80%	37,1	33.9	33.5	33.3	34.2		AREA 5	26
										AREA 6	22
										AREA 7	39
	HİGH 3	37.8								AREA 8	17
										AREA 9	16
		TEMPERATURE	HUMIDITY	SOUND	COURTYARD WALL SURFACE	EXTERIOR WALL SURFACE	NEIGBORING WALL 1 SURFACE	NEIGBORING WALL 2 SURFACE	FLOORING	LIGHTING	
										AREA 1	696
	HİGH 1	37.7								AREA2	634
										AREA 3	796
										AREA 4	96
SPACE 3	HİGH 2	37.8	22,30%	32,7	35.9	36.1	35.5	35.6		AREA 5	157
										AREA 6	120
										AREA 7	40
	HİGH 3	37.8								AREA 8	68
										AREA 9	33
		TEMPERATURE	HUMIDITY	SOUND	COURTYARD WALL SURFACE	EXTERIOR WALL SURFACE	NEIGBORING WALL 1 SURFACE	NEIGBORING WALL 2 SURFACE	FLOORING	LIGHTING	
										AREA 1	132
	HİGH 1	37.3								AREA2	115
										AREA 3	131
										AREA 4	63
SPACE 4	HİGH 2	37.5	21,40%	30,9	35,3	35,2	34,4	34,5		AREA 5	48
										AREA 6	37
										AREA 7	52
	HİGH 3	37.7								AREA 8	58
										AREA 9	40
		TEMPERATURE	HUMIDITY	SOUND	COURTYARD WALL SURFACE	EXTERIOR WALL SURFACE	NEIGBORING WALL 1 SURFACE	NEIGBORING WALL 2 SURFACE	FLOORING	LIGHTING	
										AREA 1	3
	HİGH 1	28,4								AREA2	23
										AREA 3	19
										AREA 4	2
SPACE 5	HİGH 2	28,4	35,60%	37,3	31,3	28,7	30,2	28,9		AREA 5	6
										AREA 6	11
										AREA 7	2
	HİGH 3	28,6								AREA 8	6
										AREA 9	3
		TEMPERATURE	HUMIDITY	SOUND	COURTYARD WALL SURFACE	EXTERIOR WALL SURFACE	NEIGBORING WALL 1 SURFACE	NEIGBORING WALL 2 SURFACE	FLOORING	LIGHTING	
										AREA 1	5
	HİGH 1	30,1								AREA2	19
										AREA 3	4
										AREA 4	6
SPACE 6	HİGH 2	30,2	25,40%	36,6	31,6	30,1	30,6	30,4		AREA 5	21
										AREA 6	5
										AREA 7	2
	HİGH 3	30,2								AREA 8	5
										AREA 9	2

AREA 10	2	AREA 19	2
AREA 11	7	AREA 20	8
AREA 12	1	AREA 21	2
AREA 13	1	AREA 22	0
AREA 14	3	AREA 23	0
AREA 15	2	AREA 24	0
AREA 16	1	AREA 25	0
AREA 17	1	AREA 26	0
AREA 18	1	AREA 27	0

APPENDIX 18:

ON SITE MEASUREMENTS RESULTS DATE: 16.07.2022 TIME:13.00

NURAN ELÇİ MANSION INDOOR COMFORT PARAMETERS MEASUREMENT DATE : 16.07.2022 TIME: 13.00 COURTYARD TEMPERATURE:38,9 °C COURTYARD AIR FLOW:0,2m/s

FIELDS		TEMPERATURE	HUMIDITY	SOUND	COURTYARD WALL SURFACE	EXTERIOR WALL 1 SURFACE	NEIGHBORING WALL 1 SURFACE	NEIGHBORING WALL 2 SURFACE	FLOORING
SPACE 1	HİGH 1	36,2	22,50%	38,10	35,4	34,2	34,2	34,3	
	HİGH 2	36,3							
	HİGH 3	36,3							
		TEMPERATURE	HUMIDITY	SOUND	COURTYARD WALL SURFACE	EXTERIOR WALL 1 SURFACE	NEIGHBORING WALL 1 SURFACE	NEIGHBORING WALL 2 SURFACE	FLOORING
SPACE 2	HİGH 1	34,4	21,10%	41,2	32,9	33,2	33,2	33,2	
	HİGH 2	34,4							
	HİGH 3	34,6							
		TEMPERATURE	HUMIDITY	SOUND	COURTYARD WALL SURFACE	EXTERIOR WALL 1 SURFACE	NEIGHBORING WALL 1 SURFACE	NEIGHBORING WALL 2 SURFACE	FLOORING
SPACE 3	HİGH 1	37,5	23,80%	47,3	35,7	36,2	36,4	35,1	
	HİGH 2	37,5							
	HİGH 3	37,6							
		TEMPERATURE	HUMIDITY	SOUND	COURTYARD WALL SURFACE	EXTERIOR WALL 1 SURFACE	NEIGHBORING WALL 1 SURFACE	NEIGHBORING WALL 2 SURFACE	FLOORING
SPACE 4	HİGH 1	35,1	22,10%	36,1	32,2	33,1	34,9	34,1	
	HİGH 2	35,1							
	HİGH 3	35,2							
		TEMPERATURE	HUMIDITY	SOUND	COURTYARD WALL SURFACE	EXTERIOR WALL 1 SURFACE	NEIGHBORING WALL 1 SURFACE	NEIGHBORING WALL 2 SURFACE	FLOORING
SPACE 5	HİGH 1	30,1	20,30%	38,4	27,,9	29,4	31,4	28,1	
	HİGH 2	30,1							
	HİGH 3	30,2							
		TEMPERATURE	HUMIDITY	SOUND	COURTYARD WALL SURFACE	EXTERIOR WALL 1 SURFACE	NEIGHBORING WALL 1 SURFACE	NEIGHBORING WALL 2 SURFACE	FLOORING
SPACE 6	HİGH 1	32,2	23,20%	37,3	31,6	29,1	29,3	29,3	
	HİGH 2	32,4							
	HİGH 3	32,4							

LIGHTING

	SPACE 1	SPACE 2	SPACE 3	SPACE 4	SPACE 5	SPACE 6
AREA 1	35	225	712	135	4	5
AREA2	325	81	642	121	25	18
AREA 3	354	27	812	132	23	5
AREA 4	42	112	101	65	3	6
AREA 5	210	28	178	52	6	20
AREA 6	278	25	131	39	12	5
AREA 7	35	41	45	54	4	1
AREA 8	227	19	72	62	7	7
AREA 9	481	18	35	44	4	2

AREA 10	2	AREA 19	2
AREA 11	8	AREA 20	7
AREA 12	2	AREA 21	2
AREA 13	2	AREA 22	0
AREA 14	3	AREA 23	0
AREA 15	2	AREA 24	0
AREA 16	1	AREA 25	0
AREA 17	2	AREA 26	0
AREA 18	1	AREA 27	0

APPENDIX 19:

ON SITE MEASUREMENTS RESULTS DATE: 17.07.2022 TIME:13.00

NURAN ELÇİ MANSION INDOOR COMFORT PARAMETERS MEASUREMENT DATE : 17.07.2022 TIME: 13.00 COURTYARD TEMPERATURE: 40,4 °C COURTYARD AIR FLOW: 0,3 m/s

FIELDS	TEMPERATURE		HUMIDITY	SOUND	COURTYARD WALL SURFACE	EXTERIOR WALL SURFACE	NEIGHBORING WALL 1 SURFACE	NEIGHBORING WALL 2 SURFACE	FLOORING	LIGHTING	
SPACE 1	HİGH 1	37,6								AREA 1	27
										AREA2	365
										AREA 3	456
										AREA 4	56
	HİGH 2	37,6	22,20%	34,10	34,9	35,9	35,3	34,9		AREA 5	225
										AREA 6	284
										AREA 7	39
										AREA 8	233
	HİGH 3	37,7								AREA 9	560
	TEMPERATURE		HUMIDITY	SOUND	COURTYARD WALL SURFACE	EXTERIOR WALL SURFACE	NEIGHBORING WALL 1 SURFACE	NEIGHBORING WALL 2 SURFACE	FLOORING	LIGHTING	
SPACE 2	HİGH 1	37,3								AREA 1	225
										AREA2	79
										AREA 3	27
										AREA 4	114
	HİGH 2	37,5	20,10%	38,2	33,6	32,8	32,9	33,9		AREA 5	32
										AREA 6	24
										AREA 7	45
										AREA 8	19
	HİGH 3	37,5								AREA 9	19
	TEMPERATURE		HUMIDITY	SOUND	COURTYARD WALL SURFACE	EXTERIOR WALL SURFACE	NEIGHBORING WALL 1 SURFACE	NEIGHBORING WALL 2 SURFACE	FLOORING	LIGHTING	
SPACE 3	HİGH 1	37,8								AREA 1	720
										AREA2	654
										AREA 3	804
										AREA 4	114
	HİGH 2	37,9	22,80%	33,2	35,3	35,8	35,8	35,3		AREA 5	174
										AREA 6	134
										AREA 7	56
										AREA 8	74
	HİGH 3	37,9								AREA 9	38
	TEMPERATURE		HUMIDITY	SOUND	COURTYARD WALL SURFACE	EXTERIOR WALL SURFACE	NEIGHBORING WALL 1 SURFACE	NEIGHBORING WALL 2 SURFACE	FLOORING	LIGHTING	
SPACE 4	HİGH 1	37,5								AREA 1	137
										AREA2	121
										AREA 3	137
										AREA 4	72
	HİGH 2	37,6	21,80%	32,4	34,9	34,8	34,1	34,2		AREA 5	54
										AREA 6	45
										AREA 7	58
										AREA 8	67
	HİGH 3	37,6								AREA 9	47
	TEMPERATURE		HUMIDITY	SOUND	COURTYARD WALL SURFACE	EXTERIOR WALL SURFACE	NEIGHBORING WALL 1 SURFACE	NEIGHBORING WALL 2 SURFACE	FLOORING	LIGHTING	
SPACE 5	HİGH 1	29,2								AREA 1	5
										AREA2	28
										AREA 3	23
										AREA 4	4
	HİGH 2	29,2	36,40%	40,1	30,8	28,6	29,4	28,4		AREA 5	9
										AREA 6	17
										AREA 7	3
										AREA 8	8
	HİGH 3	29,3								AREA 9	4
	TEMPERATURE		HUMIDITY	SOUND	COURTYARD WALL SURFACE	EXTERIOR WALL SURFACE	NEIGHBORING WALL 1 SURFACE	NEIGHBORING WALL 2 SURFACE	FLOORING	LIGHTING	
SPACE 6	HİGH 1	30,3								AREA 1	6
										AREA2	21
										AREA 3	5
										AREA 4	7
	HİGH 2	30,4	26,10%	38,4	31,3	29,7	29,9	30,2		AREA 5	24
										AREA 6	8
										AREA 7	3
										AREA 8	7
	HİGH 3	30,4								AREA 9	3

AREA 10	3	AREA 19	3
AREA 11	9	AREA 20	9
AREA 12	3	AREA 21	2
AREA 13	2	AREA 22	0
AREA 14	5	AREA 23	0
AREA 15	2	AREA 24	0
AREA 16	1	AREA 25	0
AREA 17	1	AREA 26	0
AREA 18	1	AREA 27	0

APPENDIX 20:

ON SITE MEASUREMENTS RESULTS DATE: 18.07.2022 TIME:13.00

NURAN ELÇİ MANSION INDOOR COMFORT PARAMETERS MEASUREMENT DATE : 18.07.2022 TIME: 13.00 COURTYARD TEMPERATURE:42,4 °C COURTYARD AIR FLOW: 0,1 m/s

FIELDS		TEMPERATURE	HUMIDITY	SOUND	COURTYARD WALL SURFACE	EXTERIOR WALL SURFACE	NEIGHBORING WALL 1 SURFACE	NEIGHBORING WALL 2 SURFACE	FLOORING
SPACE 1	HİGH 1	38,1	22,40%	33,80	35,3	36,4	34,9	35	
	HİGH 2	38,1							
	HİGH 3	38,2							
SPACE 2	HİGH 1	37,6	20,40%	37,6	34,1	33,7	33,7	33,8	
	HİGH 2	37,6							
	HİGH 3	37,6							
SPACE 3	HİGH 1	38,4	22,90%	32,1	35,9	36,3	36,3	35,8	
	HİGH 2	38,6							
	HİGH 3	38,6							
SPACE 4	HİGH 1	37,9	21,90%	33,1	34,9	34,7	35,4	34,7	
	HİGH 2	37,9							
	HİGH 3	38,1							
SPACE 5	HİGH 1	30,2	36,80%	38,3	30,4	29,8	30,7	25,1	
	HİGH 2	30,4							
	HİGH 3	30,4							
SPACE 6	HİGH 1	31,1	26,30%	37,9	32,4	29,8	29,9	30,7	
	HİGH 2	31,3							
	HİGH 3	31,4							

LIGHTING

AREA	SPACE 1	SPACE 2	SPACE 3	SPACE 4	SPACE 5	SPACE 6
AREA 1	26	228	731	138	6	6
AREA2	334	89	657	124	31	20
AREA 3	442	29	812	141	25	4
AREA 4	53	117	109	78	4	6
AREA 5	221	38	185	61	10	25
AREA 6	267	26	132	48	21	8
AREA 7	38	49	57	62	3	4
AREA 8	229	24	78	74	9	7
AREA 9	545	23	42	51	4	3
AREA 10						4
AREA 11						9
AREA 12						3
AREA 13						2
AREA 14						4
AREA 15						3
AREA 16						1
AREA 17						2
AREA 18						1
AREA 19						2
AREA 20						11
AREA 21						2
AREA 22						0
AREA 23						0
AREA 24						0
AREA 25						0
AREA 26						0
AREA 27						0

APPENDIX 21:

ON SITE MEASUREMENTS RESULTS DATE: 15.07.2022 TIME:16.00

NURAN ELÇİ MANSION INDOOR COMFORT PARAMETERS MEASUREMENT DATE : 15.07.2022 TIME:16.00 COURTYARD TEMPERATURE: 43,4 °C COURTYARD AIR FLOW:0,3 m/s

FIELDS		TEMPERATURE	HUMIDITY	SOUND	COURTYARD WALL SURFACE	EXTERIOR WALL SURFACE	NEIGBORING WALL 1 SURFACE	NEIGBORING WALL 2 SURFACE	FLOORING
SPACE 1	HİGH 1	38,8	21,80%	38,40	35,7	36,3	34,9	34,8	
	HİGH 2	38,9							
	HİGH 3	38,9							
SPACE 2	HİGH 1	36,7	19,70%	40,3	33,9	34,1	34,9	33,8	
	HİGH 2	36,8							
	HİGH 3	36,,8							
SPACE 3	HİGH 1	38,2	22,40%	48,7	39,2	36,5	37,2	36,1	
	HİGH 2	38,3							
	HİGH 3	38,3							
SPACE 4	HİGH 1	37,8	21,50%	34,1	34,5	34,6	34,2	34,8	
	HİGH 2	37,9							
	HİGH 3	37,9							
SPACE 5	HİGH 1	32,5	36,10%	37,9	28,8	30,2	31,8	28,9	
	HİGH 2	32,5							
	HİGH 3	32,7							
SPACE 6	HİGH 1	32,9	27,10%	36,9	33,1	29,8	30,5	30,2	
	HİGH 2	33							
	HİGH 3	33							

LIGHTING

	SPACE 1	SPACE 2	SPACE 3	SPACE 4	SPACE 5
AREA 1	17	705	705	127	3
AREA2	288	21	21	102	13
AREA 3	285	16	16	98	9
AREA 4	30	216	216	48	0
AREA 5	189	18	18	31	3
AREA 6	239	17	17	40	5
AREA 7	24	92	92	30	0
AREA 8	124	41	41	30	3
AREA 9	442	12	12	25	0

SPACE 6 LIGHTING

AREA 1	2	AREA 10	3	AREA 19	1
AREA2	5	AREA 11	2	AREA 20	2
AREA 3	1	AREA 12	1	AREA 21	0
AREA 4	3	AREA 13	0	AREA 22	0
AREA 5	6	AREA 14	1	AREA 23	0
AREA 6	2	AREA 15	0	AREA 24	0
AREA 7	1	AREA 16	0	AREA 25	0
AREA 8	2	AREA 17	0	AREA 26	0
AREA 9	1	AREA 18	0	AREA 27	0

APPENDIX 22:

ON SITE MEASUREMENTS RESULTS DATE: 16.07.2022 TIME:16.00

NURAN ELÇİ MANSION INDOOR COMFORT PARAMETERS MEASUREMENT DATE : 16.07.2022 TIME: 16.00 COURTYARD TEMPERATURE: 41,6 °C AVLU HAVA AKIMI:0,4 m/s															
FIELDS	TEMPERATURE		HUMIDITY	SOUND	COURTYARD WALL SURFACE	EXTERIOR WALL 1 SURFACE	NEIGHBORING WALL 1 SURFACE	NEIGHBORING WALL 2 SURFACE	FLOORING	LIGHTING					
										AREA 1	19				
	HİGH 1	36,8								AREA2	296				
										AREA 3	294				
										AREA 4	36				
SPACE 1	HİGH 2	36,8	22,40%	40,10	35,9	34,5	34,4	34,7		AREA 5	197				
										AREA 6	248				
										AREA 7	28				
	HİGH 3	36,9								AREA 8	132				
										AREA 9	438				
	TEMPERATURE		HUMIDITY	SOUND	COURTYARD WALL SURFACE	EXTERIOR WALL 1 SURFACE	NEIGHBORING WALL 1 SURFACE	NEIGHBORING WALL 2 SURFACE	FLOORING	LIGHTING					
										AREA 1	704				
	HİGH 1	34,9								AREA2	29				
										AREA 3	23				
										AREA 4	235				
SPACE 2	HİGH 2	35,1	20,60%	42,6	32,1	33,8	33,8	33,8		AREA 5	25				
										AREA 6	23				
										AREA 7	104				
	HİGH 3	35,1								AREA 8	49				
										AREA 9	24				
	TEMPERATURE		HUMIDITY	SOUND	COURTYARD WALL SURFACE	EXTERIOR WALL 1 SURFACE	NEIGHBORING WALL 1 SURFACE	NEIGHBORING WALL 2 SURFACE	FLOORING	LIGHTING					
										AREA 1	305				
	HİGH 1	37,9								AREA2	659				
										AREA 3	682				
										AREA 4	128				
SPACE 3	HİGH 2	38,1	23,50%	48,4	35,9	36,6	36,7	35,8		AREA 5	201				
										AREA 6	219				
										AREA 7	74				
	HİGH 3	38,1								AREA 8	97				
										AREA 9	51				
	TEMPERATURE		HUMIDITY	SOUND	COURTYARD WALL SURFACE	EXTERIOR WALL 1 SURFACE	NEIGHBORING WALL 1 SURFACE	NEIGHBORING WALL 2 SURFACE	FLOORING	LIGHTING					
										AREA 1	127				
	HİGH 1	35,9								AREA2	104				
										AREA 3	98				
										AREA 4	55				
SPACE 4	HİGH 2	36,1	23,80%	37,1	34,3	33,9	35,5	34,5		AREA 5	35				
										AREA 6	42				
										AREA 7	39				
	HİGH 3	36,1								AREA 8	36				
										AREA 9	29				
	TEMPERATURE		HUMIDITY	SOUND	COURTYARD WALL SURFACE	EXTERIOR WALL 1 SURFACE	NEIGHBORING WALL 1 SURFACE	NEIGHBORING WALL 2 SURFACE	FLOORING	LIGHTING					
										AREA 1	6				
	HİGH 1	31,9								AREA2	18				
										AREA 3	12				
										AREA 4	0				
SPACE 5	HİGH 2	32	39,10%	39,5	28,7	29,7	31,5	28,4		AREA 5	4				
										AREA 6	8				
										AREA 7	0				
	HİGH 3	32,1								AREA 8	2				
										AREA 9	0				
	TEMPERATURE		HUMIDITY	SOUND	COURTYARD WALL SURFACE	EXTERIOR WALL 1 SURFACE	NEIGHBORING WALL 1 SURFACE	NEIGHBORING WALL 2 SURFACE	FLOORING	LIGHTING					
										AREA 1	2	AREA 10	5	AREA 19	3
	HİGH 1	31,4								AREA2	7	AREA 11	4	AREA 20	4
										AREA 3	1	AREA 12	1	AREA 21	0
										AREA 4	4	AREA 13	1	AREA 22	0
SPACE 6	HİGH 2	31,5	27,20%	37,8	32,7	29,6	29,9	29,5		AREA 5	7	AREA 14	2	AREA 23	0
										AREA 6	3	AREA 15	0	AREA 24	0
										AREA 7	2	AREA 16	0	AREA 25	0
	HİGH 3	31,5								AREA 8	4	AREA 17	0	AREA 26	0
										AREA 9	2	AREA 18	0	AREA 27	0

APPENDIX 23:

ON SITE MEASUREMENTS RESULTS DATE: 17.07.2022 TIME:16.00

NURAN ELÇİ MANSION INDOOR COMFORT PARAMETERS MEASUREMENT DATE : 17.07.2022 TIME: 16.00 COURTYARD TEMPERATURE: 44,7 °C COURTYARD AIR FLOW: 0,1 m/s											
FIELDS	TEMPERATURE		HUMIDITY	SOUND	COURTYARD WALL SURFACE	EXTERIOR WALL SURFACE	NEIGHBORING WALL 1 SURFACE	NEIGHBORING WALL 2 SURFACE	FLOORING		LIGHTING
SPACE 1	HİGH 1	38,7	22,10%	38,20	36,2	36,1	34,7	34,9		AREA 1	20
										AREA2	301
										AREA 3	296
	HİGH 2	38,7								AREA 4	35
										AREA 5	194
										AREA 6	245
	HİGH 3	38,8								AREA 7	26
										AREA 8	129
										AREA 9	447
	TEMPERATURE		HUMIDITY	SOUND	COURTYARD WALL SURFACE	EXTERIOR WALL SURFACE	NEIGHBORING WALL 1 SURFACE	NEIGHBORING WALL 2 SURFACE	FLOORING		LIGHTING
SPACE 2	HİGH 1	36,5	20,40%	40,1	33,9	33,9	34,1	33,9		AREA 1	708
										AREA2	28
										AREA 3	21
	HİGH 2	36,6								AREA 4	234
										AREA 5	24
										AREA 6	21
	HİGH 3	36,6								AREA 7	101
										AREA 8	47
										AREA 9	19
	TEMPERATURE		HUMIDITY	SOUND	COURTYARD WALL SURFACE	EXTERIOR WALL SURFACE	NEIGHBORING WALL 1 SURFACE	NEIGHBORING WALL 2 SURFACE	FLOORING		LIGHTING
SPACE 3	HİGH 1	38,5	23,20%	47,9	36,4	36,3	36,9	35,9		AREA 1	298
										AREA2	662
										AREA 3	678
	HİGH 2	38,6								AREA 4	127
										AREA 5	195
										AREA 6	221
	HİGH 3	38,6								AREA 7	76
										AREA 8	94
										AREA 9	48
	TEMPERATURE		HUMIDITY	SOUND	COURTYARD WALL SURFACE	EXTERIOR WALL SURFACE	NEIGHBORING WALL 1 SURFACE	NEIGHBORING WALL 2 SURFACE	FLOORING		LIGHTING
SPACE 4	HİGH 1	37,8	22,30%	35,2	34,7	34,3	36,1	34,6		AREA 1	129
										AREA2	106
										AREA 3	101
	HİGH 2	37,8								AREA 4	52
										AREA 5	33
										AREA 6	41
	HİGH 3	37,9								AREA 7	34
										AREA 8	32
										AREA 9	27
	TEMPERATURE		HUMIDITY	SOUND	COURTYARD WALL SURFACE	EXTERIOR WALL SURFACE	NEIGHBORING WALL 1 SURFACE	NEIGHBORING WALL 2 SURFACE	FLOORING		LIGHTING
SPACE 5	HİGH 1	32,4	37,80%	38,4	29,1	29,9	31,7	28,7		AREA 1	4
										AREA2	16
										AREA 3	10
	HİGH 2	32,4								AREA 4	0
										AREA 5	4
										AREA 6	7
	HİGH 3	32,6								AREA 7	0
										AREA 8	4
										AREA 9	1
	TEMPERATURE		HUMIDITY	SOUND	COURTYARD WALL SURFACE	EXTERIOR WALL SURFACE	NEIGHBORING WALL 1 SURFACE	NEIGHBORING WALL 2 SURFACE	FLOORING		LIGHTING
SPACE 6	HİGH 1	32,7	26,10%	37,5	32,9	29,7	30,3	29,9		AREA 1	3
										AREA2	6
										AREA 3	2
	HİGH 2	32,8								AREA 4	5
										AREA 5	7
										AREA 6	3
	HİGH 3	32,8								AREA 7	2
										AREA 8	4
										AREA 9	1

AREA 10	5	AREA 19	2
AREA 11	3	AREA 20	4
AREA 12	2	AREA 21	0
AREA 13	1	AREA 22	0
AREA 14	2	AREA 23	0
AREA 15	1	AREA 24	0
AREA 16	0	AREA 25	0
AREA 17	0	AREA 26	0
AREA 18	0	AREA 27	0

APPENDIX 24:

ON SITE MEASUREMENTS RESULTS DATE: 18.07.2022 TIME:16.00

NURAN ELÇİMANSION INDOOR COMFORT PARAMETERS MEASUREMENT DATE : 18.07.2022 TIME: 16.00 COURTYARD TEMPERATURE: 45,8 °C COURTYARD AIR FLOW: 0,1 m/s															
FIELDS	TEMPERATURE		HUMIDITY	SOUND	COURTYARD WALL SURFACE	EXTERIOR WALL SURFACE	NEIGHBORING WALL 1 SURFACE	NEIGHBORING WALL 2 SURFACE	FLOORING	LIGHTING					
SPACE 1	HİGH 1	39,2	22,20%	35,40	36,8	36,7	34,9	35,2		AREA 1	24				
										AREA2	305				
										AREA 3	301				
	HİGH 2	39,4								AREA 4	34				
										AREA 5	197				
										AREA 6	241				
	HİGH 3	39,4								AREA 7	24				
										AREA 8	131				
										AREA 9	451				
	TEMPERATURE		HUMIDITY	SOUND	COURTYARD WALL SURFACE	EXTERIOR WALL SURFACE	NEIGHBORING WALL 1 SURFACE	NEIGHBORING WALL 2 SURFACE	FLOORING	LIGHTING					
SPACE 2	HİGH 1	37,1	20,50%	39,6	34,3	34,5	34,5	33,9		AREA 1	712				
										AREA2	27				
										AREA 3	20				
	HİGH 2	37,1								AREA 4	241				
										AREA 5	23				
										AREA 6	22				
	HİGH 3	37,3								AREA 7	104				
										AREA 8	52				
										AREA 9	22				
	TEMPERATURE		HUMIDITY	SOUND	COURTYARD WALL SURFACE	EXTERIOR WALL SURFACE	NEIGHBORING WALL 1 SURFACE	NEIGHBORING WALL 2 SURFACE	FLOORING	LIGHTING					
SPACE 3	HİGH 1	38,9	23,70%	45,8	37,1	37,1	37,1	36,2		AREA 1	304				
										AREA2	671				
										AREA 3	684				
	HİGH 2	40,1								AREA 4	128				
										AREA 5	201				
										AREA 6	224				
	HİGH 3	40,1								AREA 7	81				
										AREA 8	98				
										AREA 9	54				
	TEMPERATURE		HUMIDITY	SOUND	COURTYARD WALL SURFACE	EXTERIOR WALL SURFACE	NEIGHBORING WALL 1 SURFACE	NEIGHBORING WALL 2 SURFACE	FLOORING	LIGHTING					
SPACE 4	HİGH 1	38,1	22,50%	34,2	34,8	34,6	36,6	35,1		AREA 1	128				
										AREA2	111				
										AREA 3	105				
	HİGH 2	38,1								AREA 4	54				
										AREA 5	36				
										AREA 6	45				
	HİGH 3	38,3								AREA 7	38				
										AREA 8	32				
										AREA 9	29				
	TEMPERATURE		HUMIDITY	SOUND	COURTYARD WALL SURFACE	EXTERIOR WALL SURFACE	NEIGHBORING WALL 1 SURFACE	NEIGHBORING WALL 2 SURFACE	FLOORING	LIGHTING					
SPACE 5	HİGH 1	32,7	37,90%	36,3	29,4	30,2	32,1	29,2		AREA 1	4				
										AREA2	18				
										AREA 3	9				
	HİGH 2	32,8								AREA 4	0				
										AREA 5	5				
										AREA 6	8				
	HİGH 3	32,8								AREA 7	0				
										AREA 8	4				
										AREA 9	2				
	TEMPERATURE		HUMIDITY	SOUND	COURTYARD WALL SURFACE	EXTERIOR WALL SURFACE	NEIGHBORING WALL 1 SURFACE	NEIGHBORING WALL 2 SURFACE	FLOORING	LIGHTING					
SPACE 6	HİGH 1	32,9	26,30%	37,3	33,5	30,1	30,6	33,3		AREA 1	2	AREA 10	6	AREA 19	3
										AREA2	7	AREA 11	3	AREA 20	5
										AREA 3	1	AREA 12	2	AREA 21	0
	HİGH 2	33,1								AREA 4	6	AREA 13	2	AREA 22	0
										AREA 5	7	AREA 14	2	AREA 23	0
										AREA 6	4	AREA 15	1	AREA 24	0
	HİGH 3	33,1								AREA 7	2	AREA 16	0	AREA 25	0
										AREA 8	4	AREA 17	0	AREA 26	0
										AREA 9	2	AREA 18	0	AREA 27	0

APPENDIX 25:

ON SITE MEASUREMENTS RESULTS DATE: 15.07.2022 TIME:19.00

NURAN ELÇİ MANSION INDOOR COMFORT PARAMETERS MEASUREMENT DATE : 15.07.2022 TIME: 19.00 COURTYARD TEMPERATURE: 34,6°C COURTYARD AIR FLOW: 0,3 m/s

FIELDS	TEMPERATURE		HUMIDITY	SOUND	COURTYARD WALL SURFACE	EXTERIOR WALL SURFACE	NEIGBORING WALL 1 SURFACE	NEIGBORING WALL 2 SURFACE	FLOORING	LIGHTING	
										AREA 1	0
	HİGH 1	35,9								AREA2	18
										AREA 3	17
										AREA 4	0
SPACE 1	HİGH 2	36	21,90%	31,40	35,3	36,1	34,3	34,1		AREA 5	7
										AREA 6	4
										AREA 7	0
	HİGH 3	36								AREA 8	4
										AREA 9	6
	TEMPERATURE		HUMIDITY	SOUND	COURTYARD WALL SURFACE	EXTERIOR WALL SURFACE	NEIGBORING WALL 1 SURFACE	NEIGBORING WALL 2 SURFACE	FLOORING	LIGHTING	
										AREA 1	19
	HİGH 1	34,2								AREA2	7
										AREA 3	2
										AREA 4	2
SPACE 2	HİGH 2	34,2	20,20%	34,5	33,1	32,9	32,9	33,1		AREA 5	2
										AREA 6	0
										AREA 7	0
	HİGH 3	34,3								AREA 8	0
										AREA 9	0
	TEMPERATURE		HUMIDITY	SOUND	COURTYARD WALL SURFACE	EXTERIOR WALL SURFACE	NEIGBORING WALL 1 SURFACE	NEIGBORING WALL 2 SURFACE	FLOORING	LIGHTING	
										AREA 1	7
	HİGH 1	37,1								AREA2	7
										AREA 3	5
										AREA 4	0
SPACE 3	HİGH 2	37,1	22,40%	36,7	36,8	35,8	36,1	35,8		AREA 5	0
										AREA 6	0
										AREA 7	0
	HİGH 3	37,2								AREA 8	0
										AREA 9	0
	TEMPERATURE		HUMIDITY	SOUND	COURTYARD WALL SURFACE	EXTERIOR WALL SURFACE	NEIGBORING WALL 1 SURFACE	NEIGBORING WALL 2 SURFACE	FLOORING	LIGHTING	
										AREA 1	0
	HİGH 1	37,8								AREA2	0
										AREA 3	0
										AREA 4	0
SPACE 4	HİGH 2	37,8	21,00%	33,1	34,3	34,2	34,2	34,9		AREA 5	0
										AREA 6	1
										AREA 7	0
	HİGH 3	37,9								AREA 8	0
										AREA 9	0
	TEMPERATURE		HUMIDITY	SOUND	COURTYARD WALL SURFACE	EXTERIOR WALL SURFACE	NEIGBORING WALL 1 SURFACE	NEIGBORING WALL 2 SURFACE	FLOORING	LIGHTING	
										AREA 1	0
	HİGH 1	32,9								AREA2	1
										AREA 3	0
										AREA 4	0
SPACE 5	HİGH 2	33	35,30%	38,9	28,2	27,5	27,8	29,1		AREA 5	0
										AREA 6	0
										AREA 7	0
	HİGH 3	33								AREA 8	0
										AREA 9	0
	TEMPERATURE		HUMIDITY	SOUND	COURTYARD WALL SURFACE	EXTERIOR WALL SURFACE	NEIGBORING WALL 1 SURFACE	NEIGBORING WALL 2 SURFACE	FLOORING	LIGHTING	
										AREA 1	0
	HİGH 1	33								AREA2	0
										AREA 3	0
										AREA 4	0
SPACE 6	HİGH 2	33	25,10%	39,1	30,2	30,9	30,9	30,7		AREA 5	0
										AREA 6	0
										AREA 7	0
	HİGH 3	33,1								AREA 8	0
										AREA 9	0

AREA 10	0	AREA 19	0
AREA 11	0	AREA 20	0
AREA 12	0	AREA 21	0
AREA 13	0	AREA 22	0
AREA 14	0	AREA 23	0
AREA 15	0	AREA 24	0
AREA 16	0	AREA 25	0
AREA 17	0	AREA 26	0
AREA 18	0	AREA 27	0

APPENDIX 26:

ON SITE MEASUREMENTS RESULTS DATE: 16.07.2022 TIME:19.00

NURAN ELÇİ MANSION INDOOR COMFORT PARAMETERS MEASUREMENT DATE: 16.07.2022 TIME: 19.00 COURTYARD TEMPERATURE: 34,4 °C COURTYARD AIR FLOW:0,2 m/s														
FIELDS	TEMPERATURE		HUMIDITY	SOUND	COURTYARD WALL SURFACE	EXTERIOR WALL 1 SURFACE	NEIGHBORING WALL 1 SURFACE	NEIGHBORING WALL 2 SURFACE	FLOORING	LIGHTING				
										AREA 1	0			
	HİGH 1	35,6								AREA2	14			
										AREA 3	17			
										AREA 4	0			
SPACE 1	HİGH 2	35,6	22,50%		35,2	35,8	34,1	33,9		AREA 5	7			
										AREA 6	4			
										AREA 7	0			
	HİGH 3	35,7								AREA 8	3			
										AREA 9	5			
	TEMPERATURE		HUMIDITY	SOUND	COURTYARD WALL SURFACE	EXTERIOR WALL 1 SURFACE	NEIGHBORING WALL 1 SURFACE	NEIGHBORING WALL 2 SURFACE	FLOORING	LIGHTING				
										AREA 1	18			
	HİGH 1	34								AREA2	7			
										AREA 3	2			
										AREA 4	2			
SPACE 2	HİGH 2	34,1	20,50%		33,1	32,8	332,7	32,9		AREA 5	1			
										AREA 6	0			
										AREA 7	0			
	HİGH 3	34,1								AREA 8	0			
										AREA 9	0			
	TEMPERATURE		HUMIDITY	SOUND	COURTYARD WALL SURFACE	EXTERIOR WALL 1 SURFACE	NEIGHBORING WALL 1 SURFACE	NEIGHBORING WALL 2 SURFACE	FLOORING	LIGHTING				
										AREA 1	7			
	HİGH 1	36,8								AREA2	6			
										AREA 3	5			
										AREA 4	0			
SPACE 3	HİGH 2	36,8	22,30%		36,5	36,5	35,4	35,8		AREA 5	0			
										AREA 6	0			
										AREA 7	0			
	HİGH 3	36,9								AREA 8	0			
										AREA 9	0			
	TEMPERATURE		HUMIDITY	SOUND	COURTYARD WALL SURFACE	EXTERIOR WALL 1 SURFACE	NEIGHBORING WALL 1 SURFACE	NEIGHBORING WALL 2 SURFACE	FLOORING	LIGHTING				
										AREA 1	0			
	HİGH 1	37,5								AREA2	0			
										AREA 3	0			
										AREA 4	0			
SPACE 4	HİGH 2	37,5	21,40%		33,9	33,9	33,7	34,5		AREA 5	0			
										AREA 6	0			
										AREA 7	0			
	HİGH 3	37,6								AREA 8	0			
										AREA 9	0			
	TEMPERATURE		HUMIDITY	SOUND	COURTYARD WALL SURFACE	EXTERIOR WALL 1 SURFACE	NEIGHBORING WALL 1 SURFACE	NEIGHBORING WALL 2 SURFACE	FLOORING	LIGHTING				
										AREA 1	0			
	HİGH 1	32,7								AREA2	0			
										AREA 3	0			
										AREA 4	0			
SPACE 5	HİGH 2	32,7	35,70%		27,9	27,2	27,4	28,7		AREA 5	0			
										AREA 6	0			
										AREA 7	0			
	HİGH 3	32,8								AREA 8	0			
										AREA 9	0			
	TEMPERATURE		HUMIDITY	SOUND	COURTYARD WALL SURFACE	EXTERIOR WALL 1 SURFACE	NEIGHBORING WALL 1 SURFACE	NEIGHBORING WALL 2 SURFACE	FLOORING	LIGHTING				
										AREA 1	0	AREA 10	0	AREA 19	0
	HİGH 1	32,6								AREA2	0	AREA 11	0	AREA 20	0
										AREA 3	0	AREA 12	0	AREA 21	0
										AREA 4	0	AREA 13	0	AREA 22	0
SPACE 6	HİGH 2	32,7	25,20%		29,9	30,5	30,6	30,1		AREA 5	0	AREA 14	0	AREA 23	0
										AREA 6	0	AREA 15	0	AREA 24	0
										AREA 7	0	AREA 16	0	AREA 25	0
	HİGH 3	32,8								AREA 8	0	AREA 17	0	AREA 26	0
										AREA 9	0	AREA 18	0	AREA 27	0

APPENDIX 27:

ON SITE MEASUREMENTS RESULTS DATE: 17.07.2022 TIME:19.00

NURAN ELÇİ MANSION INDOOR COMFORT PARAMETERS MEASUREMENT DATE: 17.07.2022 TIME: 19.00 COURTYARD TEMPERATURE: 34,4 °C COURTYARD AIR FLOW:0,2 m/s

FIELDS	TEMPERATURE		HUMIDITY	SOUND	COURTYARD WALL SURFACE	EXTERIOR WALL SURFACE	NEIGHBORING WALL 1 SURFACE	NEIGHBORING WALL 2 SURFACE	FLOORING
SPACE 1	HİGH 1	35,8	22,40%	31,60	33,1	35,8	33,9	33,9	34,2
	HİGH 2	35,8							
	HİGH 3	35,8							
SPACE 2	HİGH 1	34	20,30%	33,9	32,8	32,5	32,6	32,7	33,1
	HİGH 2	34							
	HİGH 3	34,2							
SPACE 3	HİGH 1	36,8	22,30%	35,9	36,5	35,6	35,8	35,5	35,8
	HİGH 2	36,8							
	HİGH 3	36,9							
SPACE 4	HİGH 1	37,5	21,40%	32,8	33,8	34,1	34	34,7	34,1
	HİGH 2	37,5							
	HİGH 3	37,6							
SPACE 5	HİGH 1	32,7	35,60%	38,6	27,9	27,2	27,5	28,8	27,9
	HİGH 2	32,8							
	HİGH 3	32,8							
SPACE 6	HİGH 1	32,8	25,30%	38,8	29,9	30,3	30,4	30,4	30,1
	HİGH 2	32,8							
	HİGH 3	32,9							

LIGHTING	SPACE 1	SPACE 2	SPACE 3	SPACE 4	SPACE 5	SPACE 6
AREA 1	0	17	7	0	0	0
AREA2	11	6	6	0	0	0
AREA 3	15	1	5	0	0	0
AREA 4	0	1	0	0	0	0
AREA 5	5	0	0	0	0	0
AREA 6	3	0	0	0	0	0
AREA 7	0	0	0	0	0	0
AREA 8	2	0	0	0	0	0
AREA 9	4	0	0	0	0	0

SPACE 6 LIGHTING			
AREA 10	0	AREA 19	0
AREA 11	0	AREA 20	0
AREA 12	0	AREA 21	0
AREA 13	0	AREA 22	0
AREA 14	0	AREA 23	0
AREA 15	0	AREA 24	0
AREA 16	0	AREA 25	0
AREA 17	0	AREA 26	0
AREA 18	0	AREA 27	0

APPENDIX 28:

ON SITE MEASUREMENTS RESULTS DATE: 18.07.2022 TIME:19.00

NURAN ELÇİMANSION INDOOR COMFORT PARAMETERS MEASUREMENT DATE : 18.07.2022 TIME: 19.00 COURTYARD TEMPERATURE: 34,9 °C COURTYARD AIR FLOW:0,2 m/s															
FIELDS		TEMPERATURE	HUMIDITY	SOUND	COURTYARD WALL SURFACE	EXTERIOR WALL SURFACE	NEIGHBORING WALL 1 SURFACE	NEIGHBORING WALL 2 SURFACE	FLOORING	LIGHTING					
SPACE 1	HİGH 1	36,5	21,80%	31,60	35,8	36,3	34,8	34,4	34,4	AREA 1	1				
										AREA2	17				
										AREA 3	17				
	HİGH 2	36,6								AREA 4	0				
										AREA 5	8				
										AREA 6	4				
	HİGH 3	36,7								AREA 7	0				
										AREA 8	4				
										AREA 9	7				
		TEMPERATURE	HUMIDITY	SOUND	COURTYARD WALL SURFACE	EXTERIOR WALL SURFACE	NEIGHBORING WALL 1 SURFACE	NEIGHBORING WALL 2 SURFACE	FLOORING	LIGHTING					
SPACE 2	HİGH 1	34,9	20,40%	34,7	33,5	33,4	33,4	33,3	33,3	AREA 1	19				
										AREA2	9				
										AREA 3	2				
	HİGH 2	34,9								AREA 4	3				
										AREA 5	2				
										AREA 6	0				
	HİGH 3	35,1								AREA 7	1				
										AREA 8	0				
										AREA 9	0				
		TEMPERATURE	HUMIDITY	SOUND	COURTYARD WALL SURFACE	EXTERIOR WALL SURFACE	NEIGHBORING WALL 1 SURFACE	NEIGHBORING WALL 2 SURFACE	FLOORING	LIGHTING					
SPACE 3	HİGH 1	37,7	22,40%	37,1	36,9	36,2	36,4	36	36	AREA 1	8				
										AREA2	7				
										AREA 3	5				
	HİGH 2	37,8								AREA 4	0				
										AREA 5	0				
										AREA 6	1				
	HİGH 3	37,8								AREA 7	0				
										AREA 8	0				
										AREA 9	0				
		TEMPERATURE	HUMIDITY	SOUND	COURTYARD WALL SURFACE	EXTERIOR WALL SURFACE	NEIGHBORING WALL 1 SURFACE	NEIGHBORING WALL 2 SURFACE	FLOORING	LIGHTING					
SPACE 4	HİGH 1	38,1	21,00%	32,3	34,834,9	34,9	34,9	35,4	34,3	AREA 1	0				
										AREA2	0				
										AREA 3	0				
	HİGH 2	38,2								AREA 4	0				
										AREA 5	0				
										AREA 6	0				
	HİGH 3	38,2								AREA 7	0				
										AREA 8	0				
										AREA 9	0				
		TEMPERATURE	HUMIDITY	SOUND	COURTYARD WALL SURFACE	EXTERIOR WALL SURFACE	NEIGHBORING WALL 1 SURFACE	NEIGHBORING WALL 2 SURFACE	FLOORING	LIGHTING					
SPACE 5	HİGH 1	36,8	24,80%	37,6	30,7	31,1	32,2	30,9	30,3	AREA 1	0				
										AREA2	0				
										AREA 3	0				
	HİGH 2	36,9								AREA 4	0				
										AREA 5	0				
										AREA 6	0				
	HİGH 3	36,9								AREA 7	0				
										AREA 8	0				
										AREA 9	0				
		TEMPERATURE	HUMIDITY	SOUND	COURTYARD WALL SURFACE	EXTERIOR WALL SURFACE	NEIGHBORING WALL 1 SURFACE	NEIGHBORING WALL 2 SURFACE	FLOORING	LIGHTING					
SPACE 6	HİGH 1	33,2	34,90%	39,5	28,5	27,9	28,4	29,6	28,2	AREA 1	0	AREA 10	0	AREA 19	0
										AREA2	1	AREA 11	0	AREA 20	0
										AREA 3	1	AREA 12	0	AREA 21	0
	HİGH 2	33,3								AREA 4	0	AREA 13	0	AREA 22	0
										AREA 5	0	AREA 14	0	AREA 23	0
										AREA 6	0	AREA 15	0	AREA 24	0
	HİGH 3	33,3								AREA 7	0	AREA 16	0	AREA 25	0
										AREA 8	0	AREA 17	0	AREA 26	0
										AREA 9	0	AREA 18	0	AREA 27	0

APPENDIX 29:

CURRENT ENERGY ANALYSIS ANUAL OVERVIEW

Detailed Report

Program Version:**EnergyPlus, Version 9.1.0-fafb9d5652, YMD=2023.04.13 17:10**

Tabular Output Report in Format: **HTML**

Building: **Project Name**

Environment: **RUN PERIOD 1 ** Sanliurfa SU TUR TurTMY WMO#=172700**

Simulation Timestamp: **2023-04-13 17:10:54**

Report: **Annual Building Utility Performance Summary**

For: **Entire Facility** Table of Contents

Timestamp: **2023-04-13 17:10:54**

Values gathered over 8760.00 hours

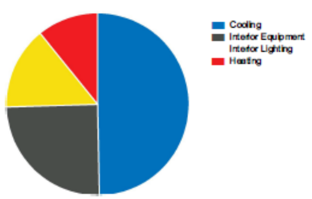
Comfort and Setpoint Not Met Summary

	Facility [Hours]
Time Setpoint Not Met During Occupied Heating	0.00
Time Setpoint Not Met During Occupied Cooling	0.00
Time Not Comfortable Based on Simple ASHRAE 55-2004	4136.50

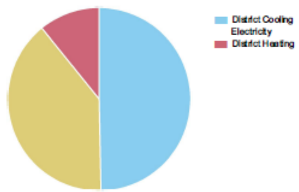
	Total Energy [GJ]	Energy Per Total Building Area [MJ/m2]	Energy Per Conditioned Building Area [MJ/m2]
Total Site Energy	306.20	1453.87	1651.59
Net Site Energy	306.20	1453.87	1651.59

Annual Overview

End Use - view table



Energy Use - view table



End Uses

	Electricity [GJ]	District Cooling [GJ]	District Heating [GJ]
Heating		0.00	69.05
Cooling		177.95	0.00
Interior Lighting	27.78	0.00	0.00
Exterior Lighting	0.00	0.00	0.00
Interior Equipment	31.44	0.00	0.00
Total End Uses	59.[illegible]	177.95	69.05

Note: District heat appears to be the principal heating source based on energ

	Value
Program Version and Build	EnergyPlus, Version 9.1.0-fafb9d5652, YMD=2023.04.13 21:23
RunPeriod	RUN PERIOD 1
Weather File	Sanliurfa SU TUR TurTMY WMO#=172700
Latitude [deg]	37.13
Longitude [deg]	38.77
Elevation [m]	549.00
Time Zone	2.00
North Axis Angle [deg]	0.00
Rotation for Appendix G [deg]	0.00
Hours Simulated [hrs]	8760.00

APPENDIX 30:

CURRENT ENERGY ANALYSIS B1 ROOM COOLING COMPONENTS

Zone Load Summary | System Load Summary | Design Psychrometrics | Revit Units

b1 Room | Cooling | Heating

Conditions at Time of Peak

Time at Peak: **7/21 17:15:00**

Outside

DB: **41.2 C**
HR: **0.0075 kg/kg**
WB: **21.1 C**

Zone

DB: **21.7 C**
HR: **0.0086 kg/kg**
RH: **53.1 %**

Engineering Checks

Capacity per Floor Area
49.79 W/m²

Floor Area per Capacity
20.0849 m2/kW

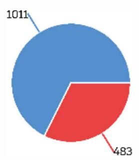
Outdoor Air Percentage
0.00 %

Airflow per Floor Area
5.418719 l/s-m2

Airflow per Capacity
108.834384 l/s-kW

Number of People
0.3

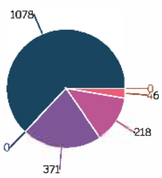
Peak Loads [W]



Cooling

Heating

Cooling Load Components [W]



Conduction

Solar

Equipment

Lights

People

Outdoor Air

Other

		Instant Sensible [W]	Delayed Sensible [W]	Latent [W]	Total [W]	Percent of Total [%]
Envelope						
Roof		-	64	-	64	6.3
Other - Roof		-	0	-	0	0.0
Ceiling		-	0	-	0	0.0
Glass - Conduction		0	-	-	0	0.0
Glass - Solar		-	0	-	0	0.0
Door		-	34	-	34	3.4
Wall		-	628	-	628	62.1
Below-grade Wall		-	0	-	0	0.0
Partition		-	0	-	0	0.0
Other - Wall		-	0	-	0	0.0
Exterior Floor		-	0	-	0	0.0
Interior Floor		-	0	-	0	0.0
Slab		-	-352	-	-352	-34.8
Other - Floor		-	0	-	0	0.0
Infiltration		0	-	0	0	0.0
	Subtotal	**0**	**375**	**0**	**375**	**37.1**
Internal Gains						
People		18	8	20	46	4.6
Lights		218	0	-	218	21.6
Return Air - Lights		0	-	-	0	0.0
Equipment		371	0	0	371	36.7
	Subtotal	**608**	**8**	**20**	**636**	**62.9**
Systems						
Zone Ventilation		0	-	0	0	0.0
Transfer Air		0	-	0	0	0.0
DOAS Direct to Zone		0	-	0	0	0.0
Return Air - Other		0	-	-	0	0.0
Power Generation Equipment		0	0	-	0	0.0
Refrigeration		0	-	0	0	0.0
Water Use Equipment		0	-	0	0	0.0
HVAC Equipment Loss		0	0	-	0	0.0
	Subtotal	**0**	**0**	**0**	**0**	**0.0**
Total						
Sizing Factor Adjustment		0	-	-	0	0.0
Time Delay Correction		-	-0	-	-0	-0.0
	Grand Total	**608**	**383**	**20**	**1,011**	**100.0**

APPENDIX 31:

CURRENT ENERGY ANALYSIS B1 ROOM HEATING COMPONENTS

Zone Load Summary | System Load Summary | Design Psychrometrics | Revit Units

b1 Room | Cooling | Heating

Conditions at Time of Peak

Time at Peak: **1/21 01:45:00**

Outside

DB: **-1.0 C**
HR: **0.0037 kg/kg**
WB: **-1.0 C**

Zone

DB: **20.6 C**
HR: **0.0050 kg/kg**
RH: **33.4 %**

Engineering Checks

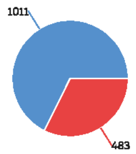
Capacity per Floor Area
-23.77 W/m²

Outdoor Air Percentage
0.00 %

Airflow per Floor Area
0.985222 l/s-m2

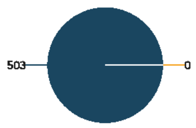
Number of People
0.3

Peak Loads [W]



Cooling
Heating

Heating Load Components [W]



Conduction
Solar
Equipment
Lights
People
Outdoor Air
Other

	Instant Sensible [W]	Delayed Sensible [W]	Latent [W]	Total [W]	Percent of Total [%]
Envelope					
Roof	-	-100	-	-100	20.7
Other - Roof	-	0	-	0	0.0
Ceiling	-	0	-	0	0.0
Glass - Conduction	0	-	-	0	0.0
Glass - Solar	-	0	-	0	0.0
Door	-	-31	-	-31	6.5
Wall	-	-362	-	-362	75.0
Below-grade Wall	-	0	-	0	0.0
Partition	-	0	-	0	0.0
Other - Wall	-	0	-	0	0.0
Exterior Floor	-	0	-	0	0.0
Interior Floor	-	0	-	0	0.0
Slab	-	10	-	10	-2.1
Other - Floor	-	0	-	0	0.0
Infiltration	0	-	0	0	0.0
Subtotal	**0**	**-483**	**0**	**-483**	**100.0**
Internal Gains					
People	0	0	0	0	0.0
Lights	0	0	-	0	0.0
Return Air - Lights	0	-	-	0	0.0
Equipment	0	0	0	0	0.0
Subtotal	**0**	**0**	**0**	**0**	**0.0**
Systems					
Zone Ventilation	0	-	0	0	0.0
Transfer Air	0	-	0	0	0.0
DOAS Direct to Zone	0	-	0	0	0.0
Return Air - Other	0	-	-	0	0.0
Power Generation Equipment	0	0	-	0	0.0
Refrigeration	0	-	0	0	0.0
Water Use Equipment	0	-	0	0	0.0
HVAC Equipment Loss	0	0	-	0	0.0
Subtotal	**0**	**0**	**0**	**0**	**0.0**
Total					
Sizing Factor Adjustment	0	-	-	0	0.0
Time Delay Correction	-	0	-	0	0.0
Grand Total	**0**	**-483**	**0**	**-483**	**100.0**

APPENDIX 32:

CURRENT ENERGY ANALYSIS B5 ROOM COOLING COMPONENTS

Zone Load Summary | System Load Summary | Design Psychrometrics | Revit Units

b5 Room | Cooling | Heating

Conditions at Time of Peak

Time at Peak: **10/21 13:30:00**

Outside
DB: **33.0 C**
HR: **0.0087 kg/kg**
WB: **19.5 C**

Zone
DB: **21.7 C**
HR: **0.0086 kg/kg**
RH: **53.2 %**

Engineering Checks

Capacity per Floor Area
42.79 W/m²

Floor Area per Capacity
23.3698 m2/kW

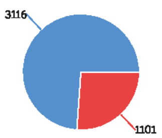
Outdoor Air Percentage
0.00 %

Airflow per Floor Area
4.669688 l/s-m2

Airflow per Capacity
109.129659 l/s-kW

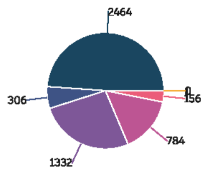
Number of People
1.4

Peak Loads [W]



Cooling
Heating

Cooling Load Components [W]



Conduction
Solar
Equipment
Lights
People
Outdoor Air
Other

	Instant Sensible [W]	Delayed Sensible [W]	Latent [W]	Total [W]	Percent of Total [%]
Envelope					
Roof	-	2	-	2	0.0
Other - Roof	-	0	-	0	0.0
Ceiling	-	0	-	0	0.0
Glass - Conduction	175	-	-	175	5.6
Glass - Solar	-	306	-	306	9.8
Door	-	169	-	169	5.4
Wall	-	1,156	-	1,156	37.1
Below-grade Wall	-	0	-	0	0.0
Partition	-	0	-	0	0.0
Other - Wall	-	0	-	0	0.0
Exterior Floor	-	0	-	0	0.0
Interior Floor	-	0	-	0	0.0
Slab	-	-963	-	-963	-30.9
Other - Floor	-	0	-	0	0.0
Infiltration	0	-	0	0	0.0
Subtotal	**175**	**670**	**0**	**844**	**27.1**
Internal Gains					
People	71	4	81	156	5.0
Lights	784	0	-	784	25.2
Return Air - Lights	0	-	-	0	0.0
Equipment	1,332	0	0	1,332	42.8
Subtotal	**2,187**	**4**	**81**	**2,272**	**72.9**
Systems					
Zone Ventilation	0	-	0	0	0.0
Transfer Air	0	-	0	0	0.0
DOAS Direct to Zone	0	-	0	0	0.0
Return Air - Other	0	-	-	0	0.0
Power Generation Equipment	0	0	-	0	0.0
Refrigeration	0	-	0	0	0.0
Water Use Equipment	0	-	0	0	0.0
HVAC Equipment Loss	0	0	-	0	0.0
Subtotal	**0**	**0**	**0**	**0**	**0.0**
Total					
Sizing Factor Adjustment	0	-	-	0	0.0
Time Delay Correction	-	-1	-	-1	-0.0
Grand Total	**2,362**	**672**	**81**	**3,116**	**100.0**

APPENDIX 33:

CURRENT ENERGY ANALYSIS B5 ROOM HEATING COMPONENTS

Zone Load Summary | System Load Summary | Design Psychrometrics | Revit Units

b5 Room | Cooling | Heating

Conditions at Time of Peak

Time at Peak: 1/21 16:00:00

Outside
DB: -1.0 C
HR: 0.0037 kg/kg
WB: -1.0 C

Zone
DB: 20.6 C
HR: 0.0050 kg/kg
RH: 33.4 %

Engineering Checks

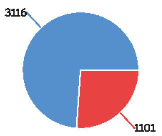
Capacity per Floor Area
-15.12 W/m²

Outdoor Air Percentage
0.00 %

Airflow per Floor Area
0.686719 l/s-m2

Number of People
1.4

Peak Loads [W]



Cooling
Heating

Heating Load Components [W]

Conduction
Solar
Equipment
Lights
People
Outdoor Air
Other

	Instant Sensible [W]	Delayed Sensible [W]	Latent [W]	Total [W]	Percent of Total [%]
Envelope					
Roof	-	-19	-	-19	1.7
Other - Roof	-	0	-	0	0.0
Ceiling	-	0	-	0	0.0
Glass - Conduction	-124	-	-	-124	11.2
Glass - Solar	-	0	-	0	0.0
Door	-	-62	-	-62	5.6
Wall	-	-973	-	-973	88.4
Below-grade Wall	-	0	-	0	0.0
Partition	-	0	-	0	0.0
Other - Wall	-	0	-	0	0.0
Exterior Floor	-	0	-	0	0.0
Interior Floor	-	0	-	0	0.0
Slab	-	77	-	77	-7.0
Other - Floor	-	0	-	0	0.0
Infiltration	0	-	0	0	0.0
Subtotal	**-124**	**-977**	**0**	**-1,101**	**100.0**
Internal Gains					
People	0	0	0	0	0.0
Lights	0	0	-	0	0.0
Return Air - Lights	0	-	-	0	0.0
Equipment	0	0	0	0	0.0
Subtotal	**0**	**0**	**0**	**0**	**0.0**
Systems					
Zone Ventilation	0	-	0	0	0.0
Transfer Air	0	-	0	0	0.0
DOAS Direct to Zone	0	-	0	0	0.0
Return Air - Other	0	-	-	0	0.0
Power Generation Equipment	0	0	-	0	0.0
Refrigeration	0	-	0	0	0.0
Water Use Equipment	0	-	0	0	0.0
HVAC Equipment Loss	0	0	-	0	0.0
Subtotal	**0**	**0**	**0**	**0**	**0.0**
Total					
Sizing Factor Adjustment	0	-	-	0	0.0
Time Delay Correction	-	0	-	0	0.0
Grand Total	**-124**	**-977**	**0**	**-1,101**	**100.0**

APPENDICES 34:

CURRENT ENERGY ANALYSIS G1 ROOM COOLING COMPONENTS

Zone Load Summary | System Load Summary | Design Psychrometrics | Revit Units

g1 Room | Cooling | Heating

Conditions at Time of Peak

Time at Peak: 7/21 17:30:00

Outside
DB: 40.9 C
HR: 0.0075 kg/kg
WB: 21.1 C

Zone
DB: 21.7 C
HR: 0.0085 kg/kg
RH: 53.0 %

Engineering Checks

Capacity per Floor Area
84.90 W/m²

Floor Area per Capacity
11.7784 m2/kW

Outdoor Air Percentage
0.00 %

Airflow per Floor Area
9.615385 l/s-m2

Airflow per Capacity
113.253490 l/s-kW

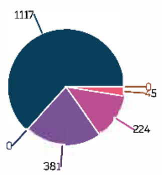
Number of People
0.4

	Instant Sensible [W]	Delayed Sensible [W]	Latent [W]	Total [W]	Percent of Total [%]
Envelope					
Roof	-	106	-	106	6.0
Other - Roof	-	0	-	0	0.0
Ceiling	-	0	-	0	0.0
Glass - Conduction	30	-	-	30	0.0
Glass - Solar	-	49	-	0	0.0
Door	-	65	-	65	3.7
Wall	-	816	-	816	49.0
Below-grade Wall	-	0	-	0	0.0
Partition	-	0	-	0	0.0
Other - Wall	-	0	-	0	0.0
Exterior Floor	-	81	-	81	4.6
Interior Floor	-	0	-	0	0.0
Slab	-	0	-	0	0.0
Other - Floor	-	0	-	0	0.0
Infiltration	0	-	0	0	0.0
Subtotal	**30**	**1,117**	**0**	**1,147**	**63.2**
Internal Gains					
People	19	3	22	45	2.5
Lights	224	0	-	224	12.7
Return Air - Lights	0	-	-	0	0.0
Equipment	381	0	0	381	21.6
Subtotal	**624**	**3**	**22**	**649**	**36.8**
Systems					
Zone Ventilation	0	-	0	0	0.0
Transfer Air	0	-	0	0	0.0
DOAS Direct to Zone	0	-	0	0	0.0
Return Air - Other	0	-	-	0	0.0
Power Generation Equipment	0	0	-	0	0.0
Refrigeration	0	-	0	0	0.0
Water Use Equipment	0	-	0	0	0.0
HVAC Equipment Loss	0	0	-	0	0.0
Subtotal	**0**	**0**	**0**	**0**	**0.0**
Total					
Sizing Factor Adjustment	0	-	-	0	0.0
Time Delay Correction	-	-0	-	-0	-0.0
Grand Total	**624**	**1,120**	**22**	**1,766**	**100.0**

Peak Loads [W]

Cooling
Heating

Cooling Load Components [W]



Conduction
Solar
Equipment
Lights
People
Outdoor Air
Other

APPENDIX 35:

CURRENT ENERGY ANALYSIS G1 ROOM HEATING COMPONENTS

Zone Load Summary | System Load Summary | Design Psychrometrics   Revit Units

g1 Room   Cooling | Heating

Conditions at Time of Peak

Time at Peak: 1/21 14:15:00

Outside
DB: -1.0 C
HR: 0.0037 kg/kg
WB: -1.0 C

Zone
DB: 20.6 C
HR: 0.0050 kg/kg
RH: 33.4 %

Engineering Checks

Capacity per Floor Area
-40.75 W/m²

Outdoor Air Percentage
0.00 %

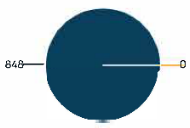
Airflow per Floor Area
1.923077 l/s-m2

Number of People
0.4

Peak Loads [W]

Cooling
Heating

Heating Load Components [W]



Conduction
Solar
Equipment
Lights
People
Outdoor Air
Other

	Instant Sensible [W]	Delayed Sensible [W]	Latent [W]	Total [W]	Percent of Total [%]
Envelope					
Roof	-	-127	-	-127	15.0
Other - Roof	-	0	-	0	0.0
Ceiling	-	0	-	0	0.0
Glass - Conduction	34	-	-	34	0.0
Glass - Solar	-	0	-	0	0.0
Door	-	-64	-	-64	7.6
Wall	-	-566	-	-566	66.7
Below-grade Wall	-	0	-	0	0.0
Partition	-	0	-	0	0.0
Other - Wall	-	0	-	0	0.0
Exterior Floor	-	-91	-	-91	10.7
Interior Floor	-	0	-	0	0.0
Slab	-	0	-	0	0.0
Other - Floor	-	0	-	0	0.0
Infiltration	0	-	0	0	0.0
Subtotal	**0**	**-848**	**0**	**-814**	**100.0**
Internal Gains					
People	0	0	0	0	0.0
Lights	0	0	-	0	0.0
Return Air - Lights	0	-	-	0	0.0
Equipment	0	0	0	0	0.0
Subtotal	**0**	**0**	**0**	**0**	**0.0**
Systems					
Zone Ventilation	0	-	0	0	0.0
Transfer Air	0	-	0	0	0.0
DOAS Direct to Zone	0	-	0	0	0.0
Return Air - Other	0	-	-	0	0.0
Power Generation Equipment	0	0	-	0	0.0
Refrigeration	0	-	0	0	0.0
Water Use Equipment	0	-	0	0	0.0
HVAC Equipment Loss	0	0	-	0	0.0
Subtotal	**0**	**0**	**0**	**0**	**0.0**
Total					
Sizing Factor Adjustment	0	-	-	0	0.0
Time Delay Correction	-	0	-	0	0.0
Grand Total	**0**	**-848**	**0**	**-848**	**100.0**

APPENDIX 36:

CURRENT ENERGY ANALYSIS G7 ROOM COOLING COMPONENTS

Zone Load Summary | System Load Summary | Design Psychrometrics | Revit Units

g7 Room | Cooling | Heating

Conditions at Time of Peak

Time at Peak: 9/21 15:15:00

Outside
DB: 38.7 C
HR: 0.0096 kg/kg
WB: 21.9 C

Zone
DB: 21.7 C
HR: 0.0086 kg/kg
RH: 53.2 %

Engineering Checks

Capacity per Floor Area
62.51 W/m²

Floor Area per Capacity
15.9975 m2/kW

Outdoor Air Percentage
0.00 %

Airflow per Floor Area
6.525285 l/s-m2

Airflow per Capacity
104.388220 l/s-kW

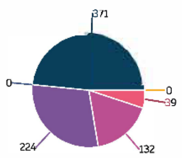
Number of People
0.3

	Instant Sensible [W]	Delayed Sensible [W]	Latent [W]	Total [W]	Percent of Total [%]
Envelope					
Roof	-	0	-	0	0.0
Other - Roof	-	0	-	0	0.0
Ceiling	-	0	-	0	0.0
Glass - Conduction	103	-	-	103	0.0
Glass - Solar	-	545	-	545	0.0
Door	-	0	-	0	0.0
Wall	-	352	-	352	46.0
Below-grade Wall	-	0	-	0	0.0
Partition	-	0	-	0	0.0
Other - Wall	-	0	-	0	0.0
Exterior Floor	-	18	-	18	2.4
Interior Floor	-	0	-	0	0.0
Slab	-	0	-	0	0.0
Other - Floor	-	0	-	0	0.0
Infiltration	0	-	0	0	0.0
Subtotal	**103**	**916**	**0**	**1,019**	**48.4**
Internal Gains					
People	16	6	18	39	5.1
Lights	132	0	-	132	17.2
Return Air - Lights	0	-	-	0	0.0
Equipment	224	0	0	224	29.3
Subtotal	**372**	**6**	**18**	**396**	**51.6**
Systems					
Zone Ventilation	0	-	0	0	0.0
Transfer Air	0	-	0	0	0.0
DOAS Direct to Zone	0	-	0	0	0.0
Return Air - Other	0	-	-	0	0.0
Power Generation Equipment	0	0	-	0	0.0
Refrigeration	0	-	0	0	0.0
Water Use Equipment	0	-	0	0	0.0
HVAC Equipment Loss	0	0	-	0	0.0
Subtotal	**0**	**0**	**0**	**0**	**0.0**
Total					
Sizing Factor Adjustment	0	-	-	0	0.0
Time Delay Correction	-	-0	-	-0	-0.0
Grand Total	**372**	**376**	**18**	**766**	**100.0**

Peak Loads [W]

Cooling
Heating

Cooling Load Components [W]



Conduction
Solar
Equipment
Lights
People
Outdoor Air
Other

APPENDIX 37:

CURRENT ENERGY ANALYSIS G7 ROOM HEATING COMPONENTS

Zone Load Summary | System Load Summary | Design Psychrometrics | Revit Units

g7 Room | Cooling | Heating

Conditions at Time of Peak

Time at Peak: **1/21 14:15:00**

Outside

DB: **-1.0 C**
HR: **0.0037 kg/kg**
WB: **-1.0 C**

Zone

DB: **20.6 C**
HR: **0.0050 kg/kg**
RH: **33.4 %**

Engineering Checks

Capacity per Floor Area
-22.15 W/m²

Outdoor Air Percentage
0.00 %

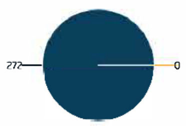
Airflow per Floor Area
0.815661 l/s-m2

Number of People
0.3

Peak Loads [W]

Cooling
Heating

Heating Load Components [W]



Conduction
Solar
Equipment
Lights
People
Outdoor Air
Other

	Instant Sensible [W]	Delayed Sensible [W]	Latent [W]	Total [W]	Percent of Total [%]
Envelope					
Roof	-	0	-	0	0.0
Other - Roof	-	0	-	0	0.0
Ceiling	-	0	-	0	0.0
Glass - Conduction	-34	-	-	-34	0.0
Glass - Solar	-	0	-	0	0.0
Door	-	0	-	0	0.0
Wall	-	-218	-	-218	80.2
Below-grade Wall	-	0	-	0	0.0
Partition	-	0	-	0	0.0
Other - Wall	-	0	-	0	0.0
Exterior Floor	-	-54	-	-54	19.8
Interior Floor	-	0	-	0	0.0
Slab	-	0	-	0	0.0
Other - Floor	-	0	-	0	0.0
Infiltration	0	-	0	0	0.0
Subtotal	**0**	**-272**	**0**	**-306**	**100.0**
Internal Gains					
People	0	0	0	0	0.0
Lights	0	0	-	0	0.0
Return Air - Lights	0	-	-	0	0.0
Equipment	0	0	0	0	0.0
Subtotal	**0**	**0**	**0**	**0**	**0.0**
Systems					
Zone Ventilation	0	-	0	0	0.0
Transfer Air	0	-	0	0	0.0
DOAS Direct to Zone	0	-	0	0	0.0
Return Air - Other	0	-	-	0	0.0
Power Generation Equipment	0	0	-	0	0.0
Refrigeration	0	-	0	0	0.0
Water Use Equipment	0	-	0	0	0.0
HVAC Equipment Loss	0	0	-	0	0.0
Subtotal	**0**	**0**	**0**	**0**	**0.0**
Total					
Sizing Factor Adjustment	0	-	-	0	0.0
Time Delay Correction	-	0	-	0	0.0
Grand Total	**0**	**-272**	**0**	**-272**	**100.0**

APPENDIX 38:

CURRENT ENERGY ANALYSIS G9 ROOM COOLING COMPONENTS

Zone Load Summary | System Load Summary | Design Psychrometrics | Revit Units

g9 Room | Cooling | Heating

Conditions at Time of Peak

Time at Peak: **7/21 09:00:00**

Outside
DB: **36.2 C**
HR: **0.0075 kg/kg**
WB: **19.6 C**

Zone
DB: **21.7 C**
HR: **0.0085 kg/kg**
RH: **52.9 %**

Engineering Checks

Capacity per Floor Area
134.37 W/m²

Floor Area per Capacity
7.4419 m2/kW

Outdoor Air Percentage
0.00 %

Airflow per Floor Area
15.248401 l/s-m2

Airflow per Capacity
113.477047 l/s-kW

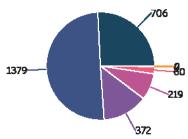
Number of People
0.4

	Instant Sensible [W]	Delayed Sensible [W]	Latent [W]	Total [W]	Percent of Total [%]
Envelope					
Roof	-	0	-	0	0.0
Other - Roof	-	0	-	0	0.0
Ceiling	-	0	-	0	0.0
Glass - Conduction	304	-	-	304	11.1
Glass - Solar	-	1,379	-	1,379	50.5
Door	-	34	-	34	1.2
Wall	-	352	-	352	12.9
Below-grade Wall	-	0	-	0	0.0
Partition	-	0	-	0	0.0
Other - Wall	-	0	-	0	0.0
Exterior Floor	-	16	-	16	0.6
Interior Floor	-	0	-	0	0.0
Slab	-	0	-	0	0.0
Other - Floor	-	0	-	0	0.0
Infiltration	0	-	0	0	0.0
Subtotal	**304**	**1,781**	**0**	**2,085**	**76.3**
Internal Gains					
People	21	15	24	60	2.2
Lights	219	0	-	219	8.0
Return Air - Lights	0	-	-	0	0.0
Equipment	372	0	0	372	13.6
Subtotal	**612**	**15**	**24**	**651**	**23.8**
Systems					
Zone Ventilation	0	-	0	0	0.0
Transfer Air	0	-	0	0	0.0
DOAS Direct to Zone	0	-	0	0	0.0
Return Air - Other	0	-	-	0	0.0
Power Generation Equipment	0	0	-	0	0.0
Refrigeration	0	-	0	0	0.0
Water Use Equipment	0	-	0	0	0.0
HVAC Equipment Loss	0	0	-	0	0.0
Subtotal	**0**	**0**	**0**	**0**	**0.0**
Total					
Sizing Factor Adjustment	0	-	-	0	0.0
Time Delay Correction	-	-4	-	-4	-0.1
Grand Total	**916**	**1,792**	**24**	**2,732**	**100.0**

Peak Loads [W]

Cooling
Heating

Cooling Load Components [W]



Conduction
Solar
Equipment
Lights
People
Outdoor Air
Other

APPENDIX 39:

CURRENT ENERGY ANALYSIS G9 ROOM HEATING COMPONENTS

Zone Load Summary | System Load Summary | Design Psychrometrics | Revit Units

g9 Room | Cooling | Heating

Conditions at Time of Peak

Time at Peak: 1/21 14:00:00

Outside
DB: -1.0 C
HR: 0.0037 kg/kg
WB: -1.0 C

Zone
DB: 20.6 C
HR: 0.0050 kg/kg
RH: 33.4 %

Engineering Checks

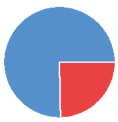
Capacity per Floor Area
-44.08 W/m²

Outdoor Air Percentage
0.00 %

Airflow per Floor Area
1.967536 l/s-m2

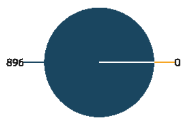
Number of People
0.4

Peak Loads [W]



Cooling
Heating

Heating Load Components [W]



Conduction
Solar
Equipment
Lights
People
Outdoor Air
Other

	Instant Sensible [W]	Delayed Sensible [W]	Latent [W]	Total [W]	Percent of Total [%]
Envelope					
Roof	-	0	-	0	0.0
Other - Roof	-	0	-	0	0.0
Ceiling	-	0	-	0	0.0
Glass - Conduction	-272	-	-	-272	30.3
Glass - Solar	-	0	-	0	0.0
Door	-	-81	-	-81	9.1
Wall	-	-459	-	-459	51.2
Below-grade Wall	-	0	-	0	0.0
Partition	-	0	-	0	0.0
Other - Wall	-	0	-	0	0.0
Exterior Floor	-	-84	-	-84	9.4
Interior Floor	-	0	-	0	0.0
Slab	-	0	-	0	0.0
Other - Floor	-	0	-	0	0.0
Infiltration	0	-	0	0	0.0
Subtotal	**-272**	**-625**	**0**	**-896**	**100.0**
Internal Gains					
People	0	0	0	0	0.0
Lights	0	0	-	0	0.0
Return Air - Lights	0	-	-	0	0.0
Equipment	0	0	0	0	0.0
Subtotal	**0**	**0**	**0**	**0**	**0.0**
Systems					
Zone Ventilation	0	-	0	0	0.0
Transfer Air	0	-	0	0	0.0
DOAS Direct to Zone	0	-	0	0	0.0
Return Air - Other	0	-	-	0	0.0
Power Generation Equipment	0	0	-	0	0.0
Refrigeration	0	-	0	0	0.0
Water Use Equipment	0	-	0	0	0.0
HVAC Equipment Loss	0	0	-	0	0.0
Subtotal	**0**	**0**	**0**	**0**	**0.0**
Total					
Sizing Factor Adjustment	0	-	-	0	0.0
Time Delay Correction	-	0	-	0	0.0
Grand Total	**-272**	**-625**	**0**	**-896**	**100.0**

APPENDIX 40:

CURRENT ENERGY ANALYSIS F1 ROOM COOLING COMPONENTS

Zone Load Summary | System Load Summary | Design Psychrometrics — Revit Units

f1 Room — Cooling | Heating

Conditions at Time of Peak

Time at Peak: 7/21 17:30:00

Outside
DB: 40.9 C
HR: 0.0075 kg/kg
WB: 21.1 C

Zone
DB: 21.7 C
HR: 0.0086 kg/kg
RH: 53.0 %

Engineering Checks

Capacity per Floor Area
82.04 W/m²

Floor Area per Capacity
12.1895 m2/kW

Outdoor Air Percentage
0.00 %

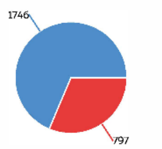
Airflow per Floor Area
8.928571 l/s-m2

Airflow per Capacity
108.834497 l/s-kW

Number of People
0.5

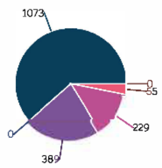
	Instant Sensible [W]	Delayed Sensible [W]	Latent [W]	Total [W]	Percent of Total [%]
Envelope					
Roof	-	0	-	0	0.0
Other - Roof	-	0	-	0	0.0
Ceiling	-	0	-	0	0.0
Glass - Conduction	75	-	-	0	0.0
Glass - Solar	-	254	-	0	0.0
Door	-	73	-	73	4.2
Wall	-	665	-	920	52.7
Below-grade Wall	-	0	-	0	0.0
Partition	-	0	-	0	0.0
Other - Wall	-	0	-	0	0.0
Exterior Floor	-	81	-	81	4.6
Interior Floor	-	0	-	0	0.0
Slab	-	0	-	0	0.0
Other - Floor	-	0	-	0	0.0
Infiltration	0	-	0	0	0.0
Subtotal	**75**	**1,073**	**0**	**1,148**	**61.5**
Internal Gains					
People	24	3	27	55	3.1
Lights	229	0	-	229	13.1
Return Air - Lights	0	-	-	0	0.0
Equipment	389	0	0	389	22.3
Subtotal	**643**	**3**	**27**	**673**	**38.6**
Systems					
Zone Ventilation	0	-	0	0	0.0
Transfer Air	0	-	0	0	0.0
DOAS Direct to Zone	0	-	0	0	0.0
Return Air - Other	0	-	-	0	0.0
Power Generation Equipment	0	0	-	0	0.0
Refrigeration	0	-	0	0	0.0
Water Use Equipment	0	-	0	0	0.0
HVAC Equipment Loss	0	0	-	0	0.0
Subtotal	**0**	**0**	**0**	**0**	**0.0**
Total					
Sizing Factor Adjustment	0	-	-	0	0.0
Time Delay Correction	-	-0	-	-0	-0.0
Grand Total	**643**	**1,076**	**27**	**1,746**	**100.0**

Peak Loads [W]



Cooling
Heating

Cooling Load Components [W]



Conduction
Solar
Equipment
Lights
People
Outdoor Air
Other

APPENDIX 41:

CURRENT ENERGY ANALYSIS F1 ROOM HEATING COMPONENTS

Zone Load Summary | System Load Summary | Design Psychrometrics | Revit Units

f1 Room | Cooling | Heating

Conditions at Time of Peak

Time at Peak: **1/21 07:00:00**

Outside

DB: **-1.0 C**
HR: **0.0037 kg/kg**
WB: **-1.0 C**

Zone

DB: **20.6 C**
HR: **0.0050 kg/kg**
RH: **33.4 %**

Engineering Checks

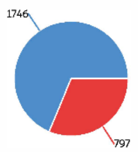
Capacity per Floor Area
-37.44 W/m²

Outdoor Air Percentage
0.00 %

Airflow per Floor Area
1.879699 l/s-m2

Number of People
0.5

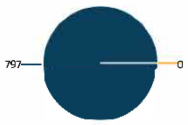
Peak Loads [W]



Cooling

Heating

Heating Load Components [W]



Conduction
Solar
Equipment
Lights
People
Outdoor Air
Other

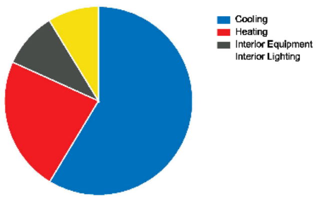
	Instant Sensible [W]	Delayed Sensible [W]	Latent [W]	Total [W]	Percent of Total [%]
Envelope					
Roof	-	0	-	0	0.0
Other - Roof	-	0	-	0	0.0
Ceiling	-	0	-	0	0.0
Glass - Conduction	52	-	-	52	0.0
Glass - Solar	-	0	-	0	0.0
Door	-	-71	-	-71	8.9
Wall	-	-634	-	-634	79.5
Below-grade Wall	-	0	-	0	0.0
Partition	-	0	-	0	0.0
Other - Wall	-	0	-	0	0.0
Exterior Floor	-	-92	-	-92	11.6
Interior Floor	-	0	-	0	0.0
Slab	-	0	-	0	0.0
Other - Floor	-	0	-	0	0.0
Infiltration	0	-	0	0	0.0
Subtotal	**52**	**-797**	**0**	**-745**	**100.0**
Internal Gains					
People	0	0	0	0	0.0
Lights	0	0	-	0	0.0
Return Air - Lights	0	-	-	0	0.0
Equipment	0	0	0	0	0.0
Subtotal	**0**	**0**	**0**	**0**	**0.0**
Systems					
Zone Ventilation	0	-	0	0	0.0
Transfer Air	0	-	0	0	0.0
DOAS Direct to Zone	0	-	0	0	0.0
Return Air - Other	0	-	-	0	0.0
Power Generation Equipment	0	0	-	0	0.0
Refrigeration	0	-	0	0	0.0
Water Use Equipment	0	-	0	0	0.0
HVAC Equipment Loss	0	0	-	0	0.0
Subtotal	**0**	**0**	**0**	**0**	**0.0**
Total					
Sizing Factor Adjustment	0	-	-	0	0.0
Time Delay Correction	-	0	-	0	0.0
Grand Total	**0**	**-797**	**0**	**-797**	**100.0**

APPENDIX 42:

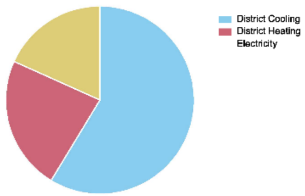
IMPROVED ENERGY ANALYSIS ANUAL OVERVIEW

Annual Overview

End Use - view table



Energy Use - view table



EUI - Electricity - view table

End Uses

	Electricity [GJ]	District Cooling [GJ]	District Heating [GJ]
Heating	0.00	0.00	44.15
Cooling	0.00	113.38	0.00
Interior Lighting	27.76	0.00	0.00
Exterior Lighting	0.00	0.00	0.00
Interior Equipment	31,44	0.00	0.00
Total End Uses	59,40	113,38	44,15

Note: District heat appears to be the principal heating source based on energy usage.

	Value
Program Version and Build	EnergyPlus, Version 9.1.0-fafb9d5652, YMD=2023.05.07 15:38
RunPeriod	RUN PERIOD 1
Weather File	Sanliurfa SU TUR TurTMY WMO#=172700
Latitude [deg]	37.13
Longitude [deg]	38.77
Elevation [m]	549.00
Time Zone	2.00
North Axis Angle [deg]	0.00
Rotation for Appendix G [deg]	0.00
Hours Simulated [hrs]	8760.00

Detailed Report

Program Version:**EnergyPlus, Version 9.1.0-fafb9d5652, YMD=2023.05.07 15:38**

Tabular Output Report in Format: **HTML**

Building: **Project Name**

Environment: **RUN PERIOD 1 ** Sanliurfa SU TUR TurTMY WMO#=172700**

Simulation Timestamp: **2023-05-07 15:38:28**

Report: **Annual Building Utility Performance Summary**

For: **Entire Facility**

Timestamp: **2023-05-07 15:38:28**

Values gathered over 8760.00 hours

Comfort and Setpoint Not Met Summary

	Facility [Hours]
Time Setpoint Not Met During Occupied Heating	0.00
Time Setpoint Not Met During Occupied Cooling	0.00
Time Not Comfortable Based on Simple ASHRAE 55-2004	6031.00

	Total Energy [GJ]	Energy Per Total Building Area [MJ/m2]	Energy Per Conditioned Building Area [MJ/m2]
Total Site Energy	216.93	1127.99	1298.10
Net Site Energy	216.93	1127.99	1298.10

APPENDIX 43:

IMPROVED ENERGY ANALYSIS B1 ROOM COOLING COMPONENTS

Zone Load Summary | b1 4 | COOLING

CONDITIONS AT TIME OF PEAK

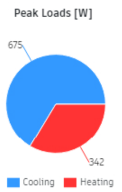
Time at Peak: 7/21 16:15:00

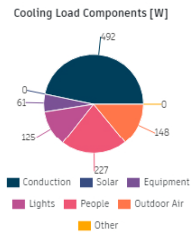
Outside
DB: **42.3 C**
HR: **0.0075 kg/kg**
WB: **21.5 C**

Zone
DB: **21.7 C**
HR: **0.0088 kg/kg**
RH: **54.5 %**

ENGINEERING CHECKS

Capacity per Floor Area: **64.30 W/m2**
Floor Area per Capacity: **15.5509 m2/kW**
Outdoor Air Percentage: **11.31 %**
Airflow per Floor Area: **6.666667 l/s-m2**
Airflow per Capacity: **103.672986 l/s-kW**
Number of People: **2.0**





	Instant Sensible [W]	Delayed Sensible [W]	Latent [W]	Total [W]	Percent of Total [%]
Envelope					
Roof	-	0	-	0	0.0
Other - Roof	-	0	-	0	0.0
Ceiling	-	59	-	59	8.8
Glass - Conduction	0	-	-	0	0.0
Glass - Solar	-	0	-	0	0.0
Door	-	0	-	0	0.0
Wall	-	204	-	204	30.2
Below-grade Wall	-	-45	-	-45	-6.6
Partition	-	-11	-	-11	-1.6
Other - Wall	-	0	-	0	0.0
Exterior Floor	-	0	-	0	0.0
Interior Floor	-	0	-	0	0.0
Slab	-	-133	-	-133	-19.7
Other - Floor	-	0	-	0	0.0
Infiltration	47	-	-7	39	5.8
Subtotal	**47**	**75**	**-7**	**114**	**16.9**
Internal Gains					
People	103	33	91	227	33.6
Lights	125	0	-	125	18.6
Return Air - Lights	0	-	-	0	0.0
Equipment	61	0	0	61	9.0
Subtotal	**289**	**33**	**91**	**413**	**61.2**
Systems					
Zone Ventilation	175	-	-27	148	21.9
Transfer Air	0	-	0	0	0.0
DOAS Direct to Zone	0	-	0	0	0.0
Return Air - Other	0	-	-	0	0.0
Power Generation Equipment	0	0	-	0	0.0
Refrigeration	0	-	0	0	0.0
Water Use Equipment	0	-	0	0	0.0
HVAC Equipment Loss	0	0	-	0	0.0
Subtotal	**175**	**0**	**-27**	**148**	**21.9**
Total					
Sizing Factor Adjustment	0	-	-	0	0.0
Time Delay Correction	-	-0	-	-0	-0.0
Grand Total	**511**	**108**	**57**	**675**	**100.0**

APPENDIX 44:

IMPROVED ENERGY ANALYSIS B1 ROOM HEATING COMPONENTS

Zone Load Summary

b1 4 HEATING

CONDITIONS AT TIME OF PEAK

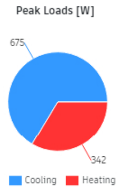
Time at Peak: 1/2: 24:00:00

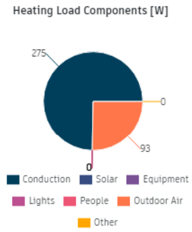
Outside
DB: -1.0 C
HR: 0.0037 kg/kg
WB: -1.0 C

Zone
DB: 20.6 C
HR: 0.0046 kg/kg
RH: 31.0 %

ENGINEERING CHECKS

Capacity per Floor Area: -32.56 W/m2
Floor Area per Capacity: null m2/kW
Outdoor Air Percentage: 11.31 %
Airflow per Floor Area: 0.952381 l/s-m2
Airflow per Capacity: null l/s-kW
Number of People: 2.0





	Instant Sensible [W]	Delayed Sensible [W]	Latent [W]	Total [W]	Percent of Total [%]
Envelope					
Roof	-	0	-	0	0.0
Other - Roof	-	0	-	0	0.0
Ceiling	-	-30	-	-30	8.7
Glass - Conduction	0	-	-	0	0.0
Glass - Solar	-	0	-	0	0.0
Door	-	0	-	0	0.0
Wall	-	-103	-	-103	30.0
Below-grade Wall	-	13	-	13	-3.9
Partition	-	-41	-	-41	11.8
Other - Wall	-	0	-	0	0.0
Exterior Floor	-	0	-	0	0.0
Interior Floor	-	0	-	0	0.0
Slab	-	-27	-	-27	8.0
Other - Floor	-	0	-	0	0.0
Infiltration	-56	-	-6	-61	18.0
Subtotal	**-56**	**-187**	**-6**	**-248**	**72.7**
Internal Gains					
People	0	0	0	0	0.0
Lights	0	0	-	0	0.0
Return Air - Lights	0	-	-	0	0.0
Equipment	0	0	0	0	0.0
Subtotal	**0**	**0**	**0**	**0**	**0.0**
Systems					
Zone Ventilation	-84	-	-9	-93	27.3
Transfer Air	0	-	0	0	0.0
DOAS Direct to Zone	0	-	0	0	0.0
Return Air - Other	0	-	-	0	0.0
Power Generation Equipment	0	0	-	0	0.0
Refrigeration	0	-	0	0	0.0
Water Use Equipment	0	-	0	0	0.0
HVAC Equipment Loss	0	0	-	0	0.0
Subtotal	**-84**	**0**	**-9**	**-93**	**27.3**
Total					
Sizing Factor Adjustment	0	-	-	0	0.0
Time Delay Correction	-	-0	-	-0	0.1
Grand Total	**-140**	**-187**	**-15**	**-342**	**100.0**

APPENDIX 45:

IMPROVED ENERGY ANALYSIS B5 ROOM COOLING COMPONENTS

Zone Load Summary

b5 5 COOLING

CONDITIONS AT TIME OF PEAK

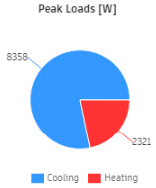
Time at Peak: 7/21 15:15:00

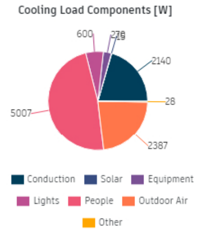
Outside
DB: **43.1 C**
HR: **0.0075 kg/kg**
WB: **21.7 C**

Zone
DB: **23.9 C**
HR: **0.0095 kg/kg**
RH: **51.7 %**

ENGINEERING CHECKS

Capacity per Floor Area: **179.95 W/m2**
Floor Area per Capacity: **5.5573 m2/kW**
Outdoor Air Percentage: **27.36 %**
Airflow per Floor Area: **12.486545 l/s-m2**
Airflow per Capacity: **69.390856 l/s-kW**
Number of People: **33.0**





	Instant Sensible [W]	Delayed Sensible [W]	Latent [W]	Total [W]	Percent of Total [%]
Envelope					
Roof	-	101	-	101	1.2
Other - Roof	-	0	-	0	0.0
Ceiling	-	220	-	220	2.6
Glass - Conduction	21	-	-	21	0.2
Glass - Solar	-	15	-	15	0.2
Door	-	0	-	0	0.0
Wall	-	632	-	632	7.6
Below-grade Wall	-	-114	-	-114	-1.4
Partition	-	-20	-	-20	-0.2
Other - Wall	-	0	-	0	0.0
Exterior Floor	-	0	-	0	0.0
Interior Floor	-	0	-	0	0.0
Slab	-	-882	-	-882	-10.6
Other - Floor	-	0	-	0	0.0
Infiltration	203	-	-54	149	1.8
Subtotal	**224**	**-48**	**-54**	**123**	**1.5**
Internal Gains					
People	1,862	485	2,660	5,007	59.9
Lights	600	0	-	600	7.2
Return Air - Lights	0	-	-	0	0.0
Equipment	270	0	0	270	3.2
Subtotal	**2,732**	**485**	**2,660**	**5,877**	**70.3**
Systems					
Zone Ventilation	3,249	-	-862	2,387	28.6
Transfer Air	0	-	0	0	0.0
DOAS Direct to Zone	0	-	0	0	0.0
Return Air - Other	0	-	-	0	0.0
Power Generation Equipment	0	0	-	0	0.0
Refrigeration	0	-	0	0	0.0
Water Use Equipment	0	-	0	0	0.0
HVAC Equipment Loss	0	0	-	0	0.0
Subtotal	**3,249**	**0**	**-862**	**2,387**	**28.6**
Total					
Sizing Factor Adjustment	0	-	-	0	0.0
Time Delay Correction	-	-28	-	-28	-0.3
Grand Total	**6,205**	**410**	**1,744**	**8,358**	**100.0**

APPENDIX 46:

IMPROVED ENERGY ANALYSIS B5 ROOM HEATING COMPONENTS

Zone Load Summary

b5 5 HEATING

CONDITIONS AT TIME OF PEAK

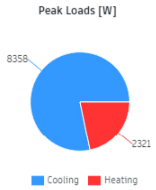
Time at Peak: 1/21 24:00:00

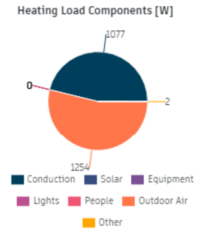
Outside
DB: -1.0 C
HR: 0.0037 kg/kg
WB: -1.0 C

Zone
DB: 21.1 C
HR: 0.0045 kg/kg
RH: 29.3 %

ENGINEERING CHECKS

Capacity per Floor Area: -49.97 W/m2
Floor Area per Capacity: null m2/kW
Outdoor Air Percentage: 27.36 %
Airflow per Floor Area: 2.152853 l/s-m2
Airflow per Capacity: null l/s-kW
Number of People: 33.0





	Instant Sensible [W]	Delayed Sensible [W]	Latent [W]	Total [W]	Percent of Total [%]
Envelope					
Roof	-	-80	-	-80	3.5
Other - Roof	-	0	-	0	0.0
Ceiling	-	-85	-	-85	3.6
Glass - Conduction	-18	-	-	-18	0.8
Glass - Solar	-	0	-	0	0.0
Door	-	0	-	0	0.0
Wall	-	-498	-	-498	21.4
Below-grade Wall	-	6	-	6	-0.2
Partition	-	-7	-	-7	0.3
Other - Wall	-	0	-	0	0.0
Exterior Floor	-	0	-	0	0.0
Interior Floor	-	0	-	0	0.0
Slab	-	-90	-	-90	3.9
Other - Floor	-	0	-	0	0.0
Infiltration	-269	-	-25	-294	12.7
Subtotal	**-288**	**-753**	**-25**	**-1,066**	**45.9**
Internal Gains					
People	0	0	0	0	0.0
Lights	0	0	-	0	0.0
Return Air - Lights	0	-	-	0	0.0
Equipment	0	0	0	0	0.0
Subtotal	**0**	**0**	**0**	**0**	**0.0**
Systems					
Zone Ventilation	-1,147	-	-106	-1,254	54.0
Transfer Air	0	-	0	0	0.0
DOAS Direct to Zone	0	-	0	0	0.0
Return Air - Other	0	-	-	0	0.0
Power Generation Equipment	0	0	-	0	0.0
Refrigeration	0	-	0	0	0.0
Water Use Equipment	0	-	0	0	0.0
HVAC Equipment Loss	0	0	-	0	0.0
Subtotal	**-1,147**	**0**	**-106**	**-1,254**	**54.0**
Total					
Sizing Factor Adjustment	0	-	-	0	0.0
Time Delay Correction	-	-2	-	-2	0.1
Grand Total	**-1,435**	**-755**	**-131**	**-2,321**	**100.0**

APPENDIX 47:

IMPROVED ENERGY ANALYSIS G1 ROOM COOLING COMPONENTS

Zone Load Summary | g1 1 | COOLING

CONDITIONS AT TIME OF PEAK

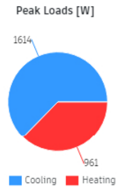
Time at Peak: 7/21 16:45:00

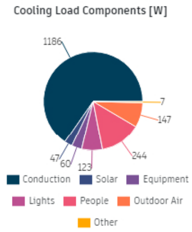
Outside
DB: **41.8 C**
HR: **0.0075 kg/kg**
WB: **21.3 C**

Zone
DB: **21.7 C**
HR: **0.0086 kg/kg**
RH: **53.2 %**

ENGINEERING CHECKS

Capacity per Floor Area: **78.67 W/m2**
Floor Area per Capacity: **12.7114 m2/kW**
Outdoor Air Percentage: **4.40 %**
Airflow per Floor Area: **8.771930 l/s-m2**
Airflow per Capacity: **111.503438 l/s-kW**
Number of People: **2.0**





	Instant Sensible [W]	Delayed Sensible [W]	Latent [W]	Total [W]	Percent of Total [%]
Envelope					
Roof	-	58	-	58	3.6
Other - Roof	-	0	-	0	0.0
Ceiling	-	0	-	0	0.0
Glass - Conduction	30	-	-	30	1.8
Glass - Solar	-	47	-	47	2.9
Door	-	66	-	66	4.1
Wall	-	755	-	755	46.8
Below-grade Wall	-	0	-	0	0.0
Partition	-	-24	-	-24	-1.5
Other - Wall	-	0	-	0	0.0
Exterior Floor	-	0	-	0	0.0
Interior Floor	-	-69	-	-69	-4.3
Slab	-	0	-	0	0.0
Other - Floor	-	0	-	0	0.0
Infiltration	212	-	-28	184	11.4
Subtotal	**242**	**833**	**-28**	**1,047**	**64.9**
Internal Gains					
People	103	51	91	244	15.1
Lights	123	0	-	123	7.6
Return Air - Lights	0	-	-	0	0.0
Equipment	60	0	0	60	3.7
Subtotal	**285**	**51**	**91**	**426**	**26.4**
Systems					
Zone Ventilation	170	-	-22	147	9.1
Transfer Air	0	-	0	0	0.0
DOAS Direct to Zone	0	-	0	0	0.0
Return Air - Other	0	-	-	0	0.0
Power Generation Equipment	0	0	-	0	0.0
Refrigeration	0	-	0	0	0.0
Water Use Equipment	0	-	0	0	0.0
HVAC Equipment Loss	0	0	-	0	0.0
Subtotal	**170**	**0**	**-22**	**147**	**9.1**
Total					
Sizing Factor Adjustment	0	-	-	0	0.0
Time Delay Correction	-	-7	-	-7	-0.4
Grand Total	**696**	**877**	**41**	**1,614**	**100.0**

APPENDIX 48:

IMPROVED ENERGY ANALYSIS G1 ROOM HEATING COMPONENTS

Zone Load Summary | g1 1 | HEATING

CONDITIONS AT TIME OF PEAK

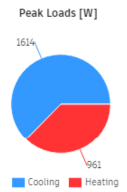
Time at Peak: 1/21 24:00:00

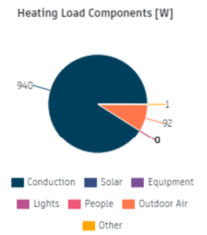
Outside
DB: **-1.0 C**
HR: **0.0037 kg/kg**
WB: **-1.0 C**

Zone
DB: **20.6 C**
HR: **0.0047 kg/kg**
RH: **31.2 %**

ENGINEERING CHECKS

Capacity per Floor Area: **-46.82 W/m2**
Floor Area per Capacity: **null m2/kW**
Outdoor Air Percentage: **4.40 %**
Airflow per Floor Area: **1.949318 l/s-m2**
Airflow per Capacity: **null l/s-kW**
Number of People: **2.0**





	Instant Sensible [W]	Delayed Sensible [W]	Latent [W]	Total [W]	Percent of Total [%]
Envelope					
Roof	-	-73	-	-73	7.6
Other - Roof	-	0	-	0	0.0
Ceiling	-	0	-	0	0.0
Glass - Conduction	-34	-	-	-34	3.5
Glass - Solar	-	0	-	0	0.0
Door	-	-65	-	-65	6.8
Wall	-	-445	-	-445	46.3
Below-grade Wall	-	0	-	0	0.0
Partition	-	6	-	6	-0.6
Other - Wall	-	0	-	0	0.0
Exterior Floor	-	0	-	0	0.0
Interior Floor	-	30	-	30	-3.1
Slab	-	0	-	0	0.0
Other - Floor	-	0	-	0	0.0
Infiltration	-259	-	-29	-288	29.9
Subtotal	**-293**	**-547**	**-29**	**-869**	**90.4**
Internal Gains					
People	0	0	0	0	0.0
Lights	0	0	-	0	0.0
Return Air - Lights	0	-	-	0	0.0
Equipment	0	0	0	0	0.0
Subtotal	**0**	**0**	**0**	**0**	**0.0**
Systems					
Zone Ventilation	-82	-	-9	-92	9.5
Transfer Air	0	-	0	0	0.0
DOAS Direct to Zone	0	-	0	0	0.0
Return Air - Other	0	-	-	0	0.0
Power Generation Equipment	0	0	-	0	0.0
Refrigeration	0	-	0	0	0.0
Water Use Equipment	0	-	0	0	0.0
HVAC Equipment Loss	0	0	-	0	0.0
Subtotal	**-82**	**0**	**-9**	**-92**	**9.5**
Total					
Sizing Factor Adjustment	0	-	-	0	0.0
Time Delay Correction	-	-1	-	-1	0.1
Grand Total	**-375**	**-548**	**-38**	**-961**	**100.0**

APPENDIX 49:

IMPROVED ENERGY ANALYSIS G7 ROOM COOLING COMPONENTS

Zone Load Summary

g7 COOLING

CONDITIONS AT TIME OF PEAK

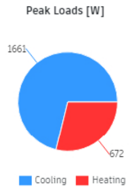
Time at Peak: 7/21 16:30:00

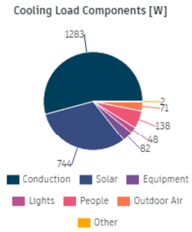
Outside
DB: **42.0 C**
HR: **0.0075 kg/kg**
WB: **21.4 C**

Zone
DB: **21.7 C**
HR: **0.0086 kg/kg**
RH: **53.1 %**

ENGINEERING CHECKS

Capacity per Floor Area: **184.53 W/m2**
Floor Area per Capacity: **5.4192 m2/kW**
Outdoor Air Percentage: **2.02 %**
Airflow per Floor Area: **20.000000 l/s-m2**
Airflow per Capacity: **108.384766 l/s-kW**
Number of People: **1.0**





	Instant Sensible [W]	Delayed Sensible [W]	Latent [W]	Total [W]	Percent of Total [%]
Envelope					
Roof	-	28	-	28	1.7
Other - Roof	-	0	-	0	0.0
Ceiling	-	0	-	0	0.0
Glass - Conduction	54	-	-	54	6.2
Glass - Solar	-	144	-	144	44.8
Door	-	101	-	101	6.1
Wall	-	273	-	273	35.2
Below-grade Wall	-	0	-	0	0.0
Partition	-	-41	-	-41	-2.5
Other - Wall	-	0	-	0	0.0
Exterior Floor	-	0	-	0	0.0
Interior Floor	-	0	-	-0	-18.7
Slab	-	0	-	0	0.0
Other - Floor	-	0	-	0	0.0
Infiltration	133	-	-17	116	7.0
Subtotal	**236**	**505**	**-17**	**724**	**79.7**
Internal Gains					
People	51	28	59	138	8.3
Lights	48	0	-	48	2.9
Return Air - Lights	0	-	-	0	0.0
Equipment	82	0	0	82	5.0
Subtotal	**182**	**28**	**59**	**268**	**16.2**
Systems					
Zone Ventilation	81	-	-10	71	4.3
Transfer Air	0	-	0	0	0.0
DOAS Direct to Zone	0	-	0	0	0.0
Return Air - Other	0	-	-	0	0.0
Power Generation Equipment	0	0	-	0	0.0
Refrigeration	0	-	0	0	0.0
Water Use Equipment	0	-	0	0	0.0
HVAC Equipment Loss	0	0	-	0	0.0
Subtotal	**81**	**0**	**-10**	**71**	**4.3**
Total					
Sizing Factor Adjustment	0	-	-	0	0.0
Time Delay Correction	-	-2	-	-2	-0.1
Grand Total	**499**	**1,130**	**31**	**1,661**	**100.0**

APPENDIX 50:

IMPROVED ENERGY ANALYSIS G7 ROOM HEATING COMPONENTS

Zone Load Summary

g7 HEATING

CONDITIONS AT TIME OF PEAK

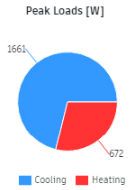
Time at Peak: 1/21 24:00:00

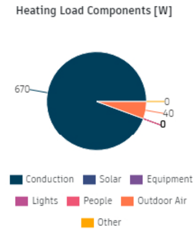
Outside
DB: **-1.0 C**
HR: **0.0037 kg/kg**
WB: **-1.0 C**

Zone
DB: **20.6 C**
HR: **0.0047 kg/kg**
RH: **31.6 %**

ENGINEERING CHECKS

Capacity per Floor Area: **-74.65 W/m2**
Floor Area per Capacity: **null m2/kW**
Outdoor Air Percentage: **2.02 %**
Airflow per Floor Area: **3.333333 l/s-m2**
Airflow per Capacity: **null l/s-kW**
Number of People: **1.0**





	Instant Sensible [W]	Delayed Sensible [W]	Latent [W]	Total [W]	Percent of Total [%]
Envelope					
Roof	-	-46	-	-46	6.9
Other - Roof	-	0	-	0	0.0
Ceiling	-	0	-	0	0.0
Glass - Conduction	-50	-	-	-50	7.4
Glass - Solar	-	0	-	0	0.0
Door	-	-37	-	-37	5.4
Wall	-	-118	-	-118	50.5
Below-grade Wall	-	0	-		0.0
Partition	-	4	-	0	-0.6
Other - Wall	-	0	-	4	0.0
Exterior Floor	-	0	-	0	0.0
Interior Floor	-	15	-	0	-2.3
Slab	-	0	-	15	0.0
Other - Floor	-	0	-	0	0.0
Infiltration	-161	-	-19	-179	26.7
Subtotal	**-210**	**-182**	**-19**	**-411**	**93.9**
Internal Gains					
People	0	0	0	0	0.0
Lights	0	0	-	0	0.0
Return Air - Lights	0	-	-	0	0.0
Equipment	0	0	0	0	0.0
Subtotal	**0**	**0**	**0**	**0**	**0.0**
Systems					
Zone Ventilation	-36	-	-4	-40	6.0
Transfer Air	0	-	0	0	0.0
DOAS Direct to Zone	0	-	0	0	0.0
Return Air - Other	0	-	-	0	0.0
Power Generation Equipment	0	0	-	0	0.0
Refrigeration	0	-	0	0	0.0
Water Use Equipment	0	-	0	0	0.0
HVAC Equipment Loss	0	0	-	0	0.0
Subtotal	**-36**	**0**	**-4**	**-40**	**6.0**
Total					
Sizing Factor Adjustment	0	-	-	0	0.0
Time Delay Correction	-	-0	-	-0	0.0
Grand Total	**-246**	**-403**	**-23**	**-672**	**100.0**

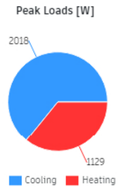
APPENDIX 51:

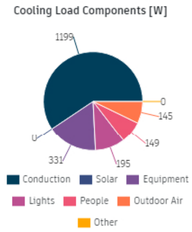
IMPROVED ENERGY ANALYSIS G9 ROOM COOLING COMPONENTS

Zone Load Summary

g9 COOLING

CONDITIONS AT TIME OF PEAK	ENGINEERING CHECKS
Time at Peak: 7/21 17:15:00	Capacity per Floor Area: **111.63 W/m2**
Outside	Floor Area per Capacity: **8.9580 m2/kW**
DB: **41.2 C**	Outdoor Air Percentage: **3.46 %**
HR: **0.0075 kg/kg**	Airflow per Floor Area: **12.721239 l/s-m2**
WB: **21.1 C**	Airflow per Capacity: **113.957291 l/s-kW**
Zone	Number of People: **1.0**
DB: **21.7 C**	
HR: **0.0085 kg/kg**	
RH: **52.8 %**	





	Instant Sensible [W]	Delayed Sensible [W]	Latent [W]	Total [W]	Percent of Total [%]
Envelope					
Roof	-	54	-	54	2.7
Other - Roof	-	0	-	0	0.0
Ceiling	-	0	-	0	0.0
Glass - Conduction	273	-	-	273	0.0
Glass - Solar	-	744	-	744	0.0
Door	-	243	-	243	12.1
Wall	-	349	-	662	32.8
Below-grade Wall	-	0	-	0	0.0
Partition	-	0	-	0	0.0
Other - Wall	-	0	-	0	0.0
Exterior Floor	-	59	-	59	2.9
Interior Floor	-	0	-	0	0.0
Slab	-	0	-	0	0.0
Other - Floor	-	0	-	0	0.0
Infiltration	207	-	-26	181	9.0
Subtotal	**480**	**1,449**	**-26**	**1,903**	**59.4**
Internal Gains					
People	51	39	59	149	7.4
Lights	195	0	-	195	9.6
Return Air - Lights	0	-	-	0	0.0
Equipment	331	0	0	331	16.4
Subtotal	**577**	**39**	**59**	**674**	**33.4**
Systems					
Zone Ventilation	166	-	-21	145	7.2
Transfer Air	0	-	0	0	0.0
DOAS Direct to Zone	0	-	0	0	0.0
Return Air - Other	0	-	-	0	0.0
Power Generation Equipment	0	0	-	0	0.0
Refrigeration	0	-	0	0	0.0
Water Use Equipment	0	-	0	0	0.0
HVAC Equipment Loss	0	0	-	0	0.0
Subtotal	**166**	**0**	**-21**	**145**	**7.2**
Total					
Sizing Factor Adjustment	0	-	-	0	0.0
Time Delay Correction	-	-0	-	-0	-0.0
Grand Total	**950**	**1,057**	**11**	**2,018**	**100.0**

APPENDICX 52:

IMPROVED ENERGY ANALYSIS G9 ROOM HEATING COMPONENTS

Zone Load Summary

g9 HEATING

CONDITIONS AT TIME OF PEAK

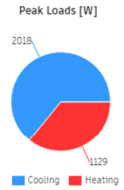
Time at Peak: 1/21 21:30:00

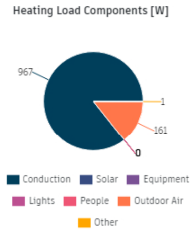
Outside
DB: **-1.0 C**
HR: **0.0037 kg/kg**
WB: **-1.0 C**

Zone
DB: **20.6 C**
HR: **0.0047 kg/kg**
RH: **31.2 %**

ENGINEERING CHECKS

Capacity per Floor Area: **-62.44 W/m2**
Floor Area per Capacity: **null m2/kW**
Outdoor Air Percentage: **3.46 %**
Airflow per Floor Area: **2.765487 l/s-m2**
Airflow per Capacity: **null l/s-kW**
Number of People: **1.0**





	Instant Sensible [W]	Delayed Sensible [W]	Latent [W]	Total [W]	Percent of Total [%]
Envelope					
Roof	-	-75	-	-75	6.7
Other - Roof	-	0	-	0	0.0
Ceiling	-	0	-	0	0.0
Glass - Conduction	-273	-	-	-273	0.0
Glass - Solar	-	0	-	0	0.0
Door	-	-84	-	-84	7.5
Wall	-	-341		-341	39.0
Below-grade Wall	-	0	-	0	0.0
Partition	-	0	-	0	0.0
Other - Wall	-	0	-	0	0.0
Exterior Floor	-	-78	-	-78	6.9
Interior Floor	-	0	-	0	0.0
Slab	-	0	-	0	0.0
Other - Floor	-	0	-	0	0.0
Infiltration	-260	-	-29	-288	25.5
Subtotal	**-533**	**-578**	**-29**	**-1140**	**85.7**
Internal Gains					
People	0	0	0	0	0.0
Lights	0	0	-	0	0.0
Return Air - Lights	0	-	-	0	0.0
Equipment	0	0	0	0	0.0
Subtotal	**0**	**0**	**0**	**0**	**0.0**
Systems					
Zone Ventilation	-145	-	-16	-161	14.3
Transfer Air	0	-	0	0	0.0
DOAS Direct to Zone	0	-	0	0	0.0
Return Air - Other	0	-	-	0	0.0
Power Generation Equipment	0	0	-	0	0.0
Refrigeration	0	-	0	0	0.0
Water Use Equipment	0	-	0	0	0.0
HVAC Equipment Loss	0	0	-	0	0.0
Subtotal	**-145**	**0**	**-16**	**-161**	**14.3**
Total					
Sizing Factor Adjustment	0	-	-	0	0.0
Time Delay Correction	-	-1	-	-1	0.1
Grand Total	**-405**	**-679**	**-45**	**-1,129**	**100.0**

APPENDIX 54:

IMPROVED ENERGY ANALYSIS F1 ROOM COOLING COMPONENTS

Zone Load Summary f1 6 COOLING

CONDITIONS AT TIME OF PEAK

Time at Peak: 8/21 15:15:00

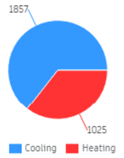
Outside
DB: 41.7 C
HR: 0.0097 kg/kg
WB: 22.8 C

Zone
DB: 21.7 C
HR: 0.0087 kg/kg
RH: 54.2 %

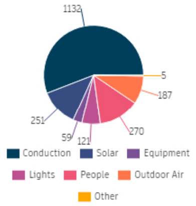
ENGINEERING CHECKS

Capacity per Floor Area: 91.56 W/m2
Floor Area per Capacity: 10.9215 m2/kW
Outdoor Air Percentage: 4.01 %
Airflow per Floor Area: 9.368836 l/s-m2
Airflow per Capacity: 102.321624 l/s-kW
Number of People: 2.0

Peak Loads [W]



Cooling Load Components [W]



	Instant Sensible [W]	Delayed Sensible [W]	Latent [W]	Total [W]	Percent of Total [%]
Envelope					
Roof	-	51	-	51	2.8
Other - Roof	-	0	-	0	0.0
Ceiling	-	0	-	0	0.0
Glass - Conduction	75	-	-	75	4.0
Glass - Solar	-	251	-	251	13.5
Door	-	69	-	69	3.7
Wall	-	621	-	621	33.5
Below-grade Wall	-	0	-	0	0.0
Partition	-	-20	-	-20	-1.1
Other - Wall	-	0	-	0	0.0
Exterior Floor	-	0	-	0	0.0
Interior Floor	-	-59	-	-59	-3.2
Slab	-	0	-	0	0.0
Other - Floor	-	0	-	0	0.0
Infiltration	211	-	26	237	12.8
Subtotal	**286**	**913**	**26**	**1,225**	**66.0**
Internal Gains					
People	103	76	91	270	14.5
Lights	121	0	-	121	6.5
Return Air - Lights	0	-	-	0	0.0
Equipment	59	0	0	59	3.2
Subtotal	**283**	**76**	**91**	**450**	**24.2**
Systems					
Zone Ventilation	166	-	20	187	10.1
Transfer Air	0	-	0	0	0.0
DOAS Direct to Zone	0	-	0	0	0.0
Return Air - Other	0	-	-	0	0.0
Power Generation Equipment	0	0	-	0	0.0
Refrigeration	0	-	0	0	0.0
Water Use Equipment	0	-	0	0	0.0
HVAC Equipment Loss	0	0	-	0	0.0
Subtotal	**166**	**0**	**20**	**187**	**10.1**
Total					
Sizing Factor Adjustment	0	-	-	0	0.0
Time Delay Correction	-	-5	-	-5	-0.3
Grand Total	**736**	**985**	**137**	**1,857**	**100.0**

APPENDIX 55:

IMPROVED ENERGY ANALYSIS F1 ROOM HEATING COMPONENTS

Zone Load Summary | f1 6 | HEATING

CONDITIONS AT TIME OF PEAK

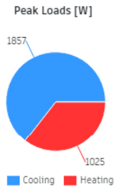
Time at Peak: 1/2[illegible] 24:00:00

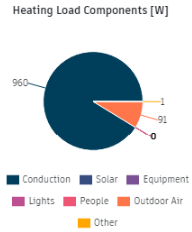
Outside
DB: **-1.0 C**
HR: **0.0037 kg/kg**
WB: **-1.0 C**

Zone
DB: **20.6 C**
HR: **0.0047 kg/kg**
RH: **31.3 %**

ENGINEERING CHECKS

Capacity per Floor Area: **-50.54 W/m2**
Floor Area per Capacity: **null m2/kW**
Outdoor Air Percentage: **4.01 %**
Airflow per Floor Area: **1.972387 l/s-m2**
Airflow per Capacity: **null l/s-kW**
Number of People: **2.0**





	Instant Sensible [W]	Delayed Sensible [W]	Latent [W]	Total [W]	Percent of Total [%]
Envelope					
Roof	-	-91	-	-91	8.8
Other - Roof	-	0	-	0	0.0
Ceiling	-	0	-	0	0.0
Glass - Conduction	-52	-	-	-52	5.1
Glass - Solar	-	0	-	0	0.0
Door	-	-70	-	-70	6.8
Wall	-	-441	-	-441	43.0
Below-grade Wall	-	0	-	0	0.0
Partition	-	-2	-	-2	0.2
Other - Wall	-	0	-	0	0.0
Exterior Floor	-	0	-	0	0.0
Interior Floor	-	13	-	13	-1.3
Slab	-	0	-	0	0.0
Other - Floor	-	0	-	0	0.0
Infiltration	-261	-	-29	-291	28.4
Subtotal	**-314**	**-590**	**-29**	**-934**	**91.1**
Internal Gains					
People	0	0	0	0	0.0
Lights	0	0	-	0	0.0
Return Air - Lights	0	-	-	0	0.0
Equipment	0	0	0	0	0.0
Subtotal	**0**	**0**	**0**	**0**	**0.0**
Systems					
Zone Ventilation	-82	-	-9	-91	8.8
Transfer Air	0	-	0	0	0.0
DOAS Direct to Zone	0	-	0	0	0.0
Return Air - Other	0	-	-	0	0.0
Power Generation Equipment	0	0	-	0	0.0
Refrigeration	0	-	0	0	0.0
Water Use Equipment	0	-	0	0	0.0
HVAC Equipment Loss	0	0	-	0	0.0
Subtotal	**-82**	**0**	**-9**	**-91**	**8.8**
Total					
Sizing Factor Adjustment	0	-	-	0	0.0
Time Delay Correction	-	-1	-	-1	0.1
Grand Total	**-395**	**-591**	**-39**	**-1,025**	**100.0**