GAZİ ÜNİVERSİTESİ

Gazi

1926

EVALUATION OF A LEED CERTIFIED BUILDING THROUGH ENVIRONMENTAL SUSTAINABILITY STRATEGIES FROM AN ETHICAL POINT OF VIEW

Mine SAĞLAMCI

IN PARTIAL FULFILLMENT OF THE REQUIREMENTS
FOR THE DEGREE OF MASTER OF SCIENCE
IN ARCHITECTURE DEPARTMENT

GAZİ UNIVERSITY
GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES

JANUARY 2024

ETHICAL STATEMENT

I hereby declare that in this thesis study I prepared in accordance with thesis writing rules of Gazi University Graduate School of Natural and Applied Sciences;

- All data, information and documents presented in this thesis have been obtained within the scope of academic rules and ethical conduct,
- All information, documents, assessments and results have been presented in accordance with scientific ethical conduct and moral rules,
- All material used in this thesis that are not original to this work have been fully cited and referenced,
- No change has been made in the data used,
- The work presented in this thesis is original,

or else, I admit all loss of rights to be incurred against me.

Mine SAĞLAMCI

09/01/2024

EVALUATION OF A LEED CERTIFIED BUILDING THROUGH ENVIRONMENTAL SUSTAINABILITY STRATEGIES FROM AN ETHICAL POINT OF VIEW

(M.Sc. Thesis)

Mine SAĞLAMCI

GAZİ UNIVERSITY

GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES

January 2024

ABSTRACT

In today's world, the ecological crisis is deepening, bringing forth significant environmental challenges accompanied by ethical predicaments. Sustainable architecture, which focuses on sustainability, must confront these issues and propose recommendations. The role of sustainable architecture is to consider space and building as a unified whole, aligned with local-contextual-environmental strategies. This study aims to explore the ethical dimension of architecture and how it can be integrated with sustainability, while guarding against the probability of greenwashing. To achieve this, Harries' theoretical framework is employed, building upon the "decorated shed" critique that distinguishes between decoration and ornamentation. According to Harries, decoration, which embodies ethos elements in architecture, has transitioned from meaningful elements to disconnected, arbitrary components since the 19th century. Harries elucidates this transformation with the concept of the "decorated shed," emphasizing architectural ethos. In Harries' view, architecture is a bearer of ethos, a realm of meaning. Ethos, which expresses the way people exist in the world, emerges as sustainability along with the environmental crisis. This study contends that this notion finds resonance in sustainable architecture and intersects in various ways. It explores the contextual-environmental strategies of local regions in Turkey based on climate, encompassing sustainability. Analyzing these strategies within regional contexts constitutes an ethical dimension of architecture. Spatial endeavors must consider multifaceted environmental processes. Accordingly, this study defines spatial-contextual local environmental strategies for sustainability, examining whether these strategies are upheld through a LEED Platinum certified building in the hot-humid climate zone. The analysis conducted through the lens of environmental design strategies has identified specific categories wherein the building exhibits shortcomings in passive design compliance. Furthermore, it has been observed that, even in areas deemed compatible, the level of compliance is suboptimal. As a result, when the ethical perspective mentioned in Harries' theoretical framework is considered within the context of sustainable architecture, it is suggested to be useful and thus can contribute to the state of sustainability.

Science Code	:	80107
Key Words:	:	Sustainability, greenwashing, ethics, environmental design strategies
Page Number	:	140
Supervisor	:	Prof. Dr. Aysu AKALIN

LEED SERTİFİKALI BİR YAPININ ÇEVRESEL SÜRDÜRÜLEBİLİRLİK STRATEJİLERİ KAPSAMINDA ETİK AÇIDAN DEĞERLENDİRİLMESİ
(Yüksek Lisans Tezi)

Mine SAĞLAMCI

GAZİ ÜNİVERSİTESİ
FEN BİLİMLERİ ENSTİTÜSÜ
Ocak 2024

ÖZET

Günümüzde ekolojik kriz gittikçe derinleşmekte, büyük çevresel problemlerle birlikte etik problemleri de beraberinde getirmektedir. Sürdürülebilirliği konu edinen mimarlığın bu problemlerle yüzleşerek birtakım önerilerde bulunması elzemdir. Sürdürülebilir mimarlığın görevi bu açıdan mekânı ve yapıyı yerel-bağlamsal-çevresel stratejilerle beraber bir bütün olarak düşünmektir. Bu çalışmada, yeşil aklama olasılığına karşı koruma sağlarken mimarlığın etik boyutunun ne anlam taşıdığı ve bunun sürdürülebilirlikle birlikte nasıl düşünülebileceği ele alınmak istenmiştir. Bunun için Harries'in geliştirdiği kuramsal şema izlenerek süsleme-dekorasyon ayrımında ortaya konan "decorated shed" eleştirisinden hareket edilmiştir. Harries'in düşüncesinde ethos öğeleri barındıran süsleme, 19. yüzyılla birlikte yerini birtakım bağlamdan kopuk, anlamsız öğelere bırakmaya başlamıştır. Harries bu değişimi "decorated shed" kavramıyla açıklayarak mimarlık ethos'unu vurgulamaktadır. Bu ethos mimarlıkta yapının çevreyle, kullanıcılarıyla kurduğu ilişkiye işaret etmektedir. Harries'te mimarlık bir ethos taşıyıcısı, bir anlam alanı olarak düşünülür. İnsanların dünyada var olma biçimini ifade eden ethos günümüzde çevre krizi ile birlikte sürdürülebilirlik olarak karşımıza çıkmaktadır. Bu düşüncenin sürdürülebilir mimarlıkta da karşılık bulduğunun, birtakım kesişme noktaları taşıdığının iddia edildiği bu çalışmada, sürdürülebilirliğin Türkiye'deki iklim bölgelerine göre yerel-bağlamsal çevresel stratejilerini ele almaya çalışmıştır. Bu stratejilerin bölgesel bağlamlara göre analiz edilmesi mimarlığın etik boyutudur. Yapılan mekânsal çalışmaların çok boyutlu çevresel süreçleri gözetmesi gerekmektedir. Bu açıdan, bu çalışmada sürdürülebilirliğin mekânsal-bağlamsal anlamda yerel çevresel stratejileri belirlenmiş ve bu stratejilerin gözetilip gözetilmediği sıcak-nemli bölgesinde LEED Platin sertifika sahibi bir yapı üzerinden ele alınmıştır. Çevresel tasarım stratejileri merceğinden yürütülen analiz, binanın pasif tasarım uyumunda eksiklikler sergilediği belirli kategoriler tespit edilmiştir. Ayrıca uyumlu görülen alanlarda dahi uyum düzeyinin optimalin altında olduğu gözlemlenmiştir. Sonuç olarak, Harries'in teorik çerçevesinde bahsi geçen etik anlayışının sürdürülebilir mimari bağlamında ele alındığında kullanışlı olabileceğine ve bu sayede sürdürülebilir olma durumuna katkı sağlayabileceğine işaret edilmektedir.

Bilim Kodu	:	80107
Anahtar Kelimeler	:	Sürdürülebilirlik, yeşil aklama, etik, çevresel tasarım stratejileri
Sayfa Adedi	:	140
Danışman	:	Prof. Dr. Aysu AKALIN

ACKNOWLEDGEMENT

I would like to express my sincere gratitude to my esteemed advisor Prof. Dr. Aysu AKALIN for her unwavering support, guidance, and mentorship throughout the course of my master's program. Her expertise, encouragement, and dedication have been instrumental in shaping my academic journey. Her commitment to excellence and passion for teaching have left an indelible mark on my educational experience, and for that, I extend my heartfelt thanks.

To my dear teacher Prof. Dr. Semra ARSLAN SELÇUK, whose support and interest I have always felt, who has always guided and contributed to my academic journey with her knowledge and experience,

To my dear mother Nurten SAĞLAMCI and my dear father Satılmış SAĞLAMCI, who supported me throughout my graduate education as well as in every step I took in my life, and from whose love I always draw strength,

To my dear brother Murat SAĞLAMCI and his dear wife Yasemin SAĞLAMCI who guided me throughout my education as well as at every stage of my life, my sister Ayşe KARA who has always been by my side with her moral support, and everyone who contributed to my thesis work,

To all faculty member at Hacettepe University, in particular, my dear teacher Dr. Özgür ÖZTÜRK for his valuable opinions and contribution, and my colleague Res. Asst. Kaya Emre GÖNENÇEN for his support throughout all stages of my thesis,

And, to all my friends, in particular, Hatice GÜLPINAR and Mustafa Burak ODA, who supported me through this process,

To my beloved Murat KARAM, who did not leave me alone with his patience, love, and support throughout my working process and relieved my burden as much as he could,

I offer my most sincere thanks..

TABLE OF CONTENTS

Page

Page

LIST OF TABLES

Table **Page**

Table **Page**

LIST OF FIGURES

Figure **Page**

SYMBOLS AND ABBREVIATIONS

In this study, the used symbols and abbreviations are explained below.

Symbols	Definition
cm	centimeter
km^2	square kilometers
kWh/m^2year	kilowatt hour / (square meters) year
m	meter
m^2	square meters

1. INTRODUCTION

From the dawn of civilization, mankind has relied on nature to provide essential resources for survival, while also recognizing its potential dangers. Over the course of history, there have been instances where nature has triggered catastrophic disasters, yet it is equally true that nature has played an indispensable role in supporting human existence. The relationship between nature and humanity has been a complex and ever-changing one throughout history. In ancient times, humans lived in harmony with nature, relying on it for survival and worshiping it as a divine force. However, with the rise of agriculture and urbanization, humans began to assert their dominance over nature, leading to a more exploitative relationship

Throughout the ages, as nature and human beings coexisted in an intricate framework, there was not a significant challenge in their reconciliation and shared existence. The necessary resources and needs for the survival of human beings were provided by nature, and according to this balance, humanity did not attempt to produce resources that nature did not offer yet. The climate and nature crisis has occurred because human beings are in search of more than their natural needs, the necessity of the unnecessary. This relationship of compromise and intricacy underwent a transformation in the 18th century with the effects of the Enlightenment and the Industrial Revolution. This transformation has also changed the coordination of nature with the gradual expansion of the areas where the human mind is capable or can be, and has made it one of the areas that can be controlled by the intervention of the mind.

Shelter opportunities have been at a critical point for people who have been trying to survive by living in harmony with nature since the beginning of history. Until the 19th century, when the pace of urbanization and industrialization accelerated to a great extent, humanity living in nature and producing housing units did not pose a major problem. However, with the influence of the Industrial Revolution and the Enlightenment in the 19th century, an anthropocentric age began to prevail. The rapidly increasing population and the resulting urbanization and industrialization speed have transformed the human figure in nature into a nature figure dominated by humanity. The ecological crisis humanity witnessed at the last stage of this process is a reaction of nature to this transformation.

During the Industrial Revolution, technology allowed humans to transform nature on a massive scale, leading to unprecedented levels of environmental destruction. This exploitation of nature continued well into the twentieth century, with deforestation, pollution, and climate change becoming increasingly severe problems. However, in recent decades, there has been a growing awareness of the need to protect nature and preserve its resources. This has led to the rise of the environmental movement, which seeks to promote sustainable practices and reduce the negative impact of human activities on the planet. Overall, the relationship between nature and humanity has been shaped by a complex interplay of cultural, societal, and technological factors. While there have been moments of exploitation and destruction, there is growing recognition of the need to protect and preserve nature resulting sustainability paradigm of today to occur.

Ecological crisis, the effect of which has been observed much more clearly since the last half of the 20th century, has had significant effects on humanity and continues to increase its impact. Signs of climate change include increased weather events such as droughts, floods, increased severe hurricanes, rising sea levels, and melting glaciers. While these effects cause deterioration in the ecosystem, they also pose a risk to all living species (Koçhan and Akın, 2022). At this point, sustainability concept has emerged and has become the paradigm of today. It is necessary to analyze its historical development of sustainability before giving its details in this thesis.

The birth of sustainability

The historical transformations of sustainability concept and its usage are important in the period extending to today's usage. The concept was first included in a text on the long-term protection of forests by Carl von Carlowitz, a forester, in 1712 and was chosen as a nomenclature in this direction. Although it was used in different ways from today's usage, it was not used frequently and started to be used again in the 1980s and started to be mentioned frequently. Prior to this, in the 1960s and 1970s, the environmental movement's mention of the concept in the infrastructure of the main problem of the period, at the point where sustainability was seen to be related to development, is the beginning of the widespread use that could be seen since the 1980s. After the 'sustainable development' mentioned by Norwegian Prime Minister Gro Brundtland in the ‘Our Common Future’ report in 1987, it is the subject of intense debate in various disciplines, with its use at the United Nations

Conference on Environment and Development (UNCED) held in Rio in 1992. The Brundtland Report, also known as "Our Common Future" was published in 1987 by the World Commission on Environment and Development (WCED). It presented a groundbreaking definition of sustainability and introduced the concept of sustainable development. The report emphasized the need to meet the needs of the present without compromising the ability of future generations to meet their own needs. Key points that the report includes could be pointed out as interconnectedness, poverty and environmental degradation, global cooperation, technology, and development. To be clearer, the report highlights the interdependence of environmental, social, and economic systems, connectivity with environmental degradation and poverty, a level of consciousness that needs to be awakened globally, and the role of technology to promote sustainable practices. According to the Brundtland Report (1987),

> The concept of sustainable development does imply limits - not absolute limits but limitations imposed by the present state of technology and social organization on environmental resources and by the ability of the biosphere to absorb the effects of human activities. But technology and social organization can be both managed and improved to make way for a new era of economic growth. (Brundtland, 1987).

The Brundtland Report's significance lies in its contribution to mainstream consciousness. It brought sustainability to the forefront of global discussions and motivated governments, organizations, and individuals to consider the long-term impact of their decisions. The report's emphasis on the interconnectedness of environmental, social, and economic aspects resonated with people, leading to a shift in mindset towards a more holistic approach to development.

The report also influenced the United Nations Conference on Environment and Development (UNCED) in 1992, where the concept of sustainable development was further solidified. It led to the adoption of Agenda 21, a comprehensive action plan for sustainable development, and the establishment of the Commission on Sustainable Development (CSD).

Since the publication of the Brundtland Report, sustainability has become a mainstream concern. The environmentalist perspectives embedded within the concept of sustainability, which have evolved in diverse contexts, now embody the principles underpinning the balanced coexistence of ecosystems and human generations. This entails aligning environmental, social, and economic priorities to ensure that today's resources are responsibly passed down to future generations (Utkutuğ, 2011). It has influenced policies, corporate practices, and individual choices. The report's legacy can be seen in the growing recognition of sustainability as a key driver for long-term prosperity, environmental protection, and social well-being. It continues to inspire efforts toward achieving a sustainable future for all.

When the great transformations and breakthroughs are examined throughout history, it can be detected the destruction caused by not approaching the problem in a simpler way. Instead of simplifying the many crises it caused and reaching the solution without a shortcut, humanity has moved away from the solution that should be focused on by magnifying the problem with various conflicts and oppositions and put the existence of the problem in place of the possibility of the solution. At this point, it should be said that sustainability, which is the popularized problem of the last period, should be handled with the simultaneous consideration of nature and humanity. Yalman (2019) argues that regarding nature as an external object would pose the risk of overreliance on technology to sustain it. Consequently, mankind is compelled to continually advance the technology to limit the harm inflicted upon the environment. Ultimately, the goal should be to promote the nature-human togetherness, not just the technical capability of humanity.

The concept of sustainability started to be mentioned a lot in the last half of the 20th century and has increased its importance. “Sustainability, which has existed in various disciplines, has also influenced architecture under the title of “green design” since the 1980s. From the 1990s on, the theory of “green building” has begun to grow beyond being a design idea and began to find the body also in architectural practice.” (Erden and Erkartal, 2019). With the developing technology and technical possibilities, the work of manipulating the order of nature and providing an artificial production has started. With the excuse that natural cycles such as water, energy and wind do not meet the needs, life cycles in nature have been forced to give their surplus with the possibilities of technique and technology. So the world has entered the age of the 'climate crisis', a realization that has dawned upon us after centuries of the Industrial Revolution. It is now understood that the artificial world humankind has constructed is intricately connected to the real, biological world. (Altomonte, 2008). There exists a necessity for a paradigmatic shift in the conceptualization of nature. It is imperative to move beyond perceiving nature as an unrelated mechanism to humans and instead strive for a more nuanced comprehension of its multifaceted scope. The dynamic relationship between humans and nature ought to be construed as an intricately integrated whole.

Problem statement / Description of the topic

Sustainability thinking always hides what needs to be sustained in its claim. Sustainable natural life is sometimes called, for example. However, it is nothing more than another name for allying with nature or overcoming it. Sustainability is not what comes to mind when the unsustainable are exhausted. It is the existing order that is maintained; it is not at all the specific cycle of nature. As can be seen in its various definitions, the concept has a multidimensional building that includes various vital factors, which is why it should be avoided to be perceived as just an ecological crisis. The current ecological crisis has emphasized the concept even more, due to the depletion of resources and rapid population growth. At this point in the historical process, the evaluation and perception of sustainable architecture as a response to the ecological crisis become crucial. The ecological crisis, which has become a reality of today, poses a threat to every living species on earth. For this reason, the concept of sustainability, which has been responded to in various ways in many disciplines, has still not been definitively resolved, and in this respect, it is the subject of various discussions on the theoretical and practical level.

This thesis study aims to examine the perception and reflections of the concept of sustainability, which is frequently mentioned in the field of architecture, especially with the effect of the increasing ecological crisis in recent years. The current ecological crisis has emphasized the concept even more, due to the depletion of resources and rapid population growth. In addition to these factors, the transformations in the nature-human relationship, especially since the 18th century, have also caused this crisis to increase its impact (Figure 1.1.). At this point in the historical process, the evaluation and perception of sustainable architecture as a response to the ecological crisis become crucial.

The ecological crisis, which has become a reality of today, poses a threat to every living species on earth. For this reason, the concept of sustainability, which has been responded to in various ways in many disciplines, has still not been definitively resolved, and in this respect, it is the subject of various discussions on the theoretical and practical level. In this thesis, sustainability is discussed at the architectural level and how it responds to architectural design-application studies is examined. Its impact on architectural projects, how it is perceived, and its possible consequences are discussed through a product.

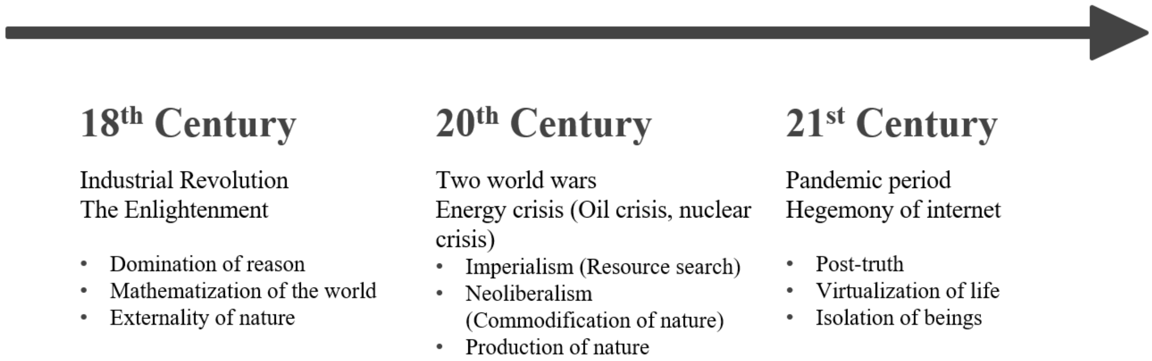


Figure 1.1. Ecological crisis process (by the author)

Aim and significance of the study

Karsten Harries' ethics concept in architecture emphasizes the ethical dimensions of design and advocates for a harmonious relationship between built environments and the natural world. His work contributes to the broader conversation on sustainability in architecture, urging designers to consider the ethical implications of their work and to strive for a balance that respects both human needs and the environment.

Considering that sustainability has three environmental, social, and economic dimensions, it is deduced how a project that is planned to be sustainable can be avoided from being just an example of greenwashing after analyzing the sustainable building over the determined strategies, to what extent this concept can be deepened in architecture. Environmental design strategies analysis can be used to identify greenwashing in architectural projects in Turkey by evaluating the extent to which the design strategies are met in the projects. The analysis can help identify any discrepancies between the project's sustainability claims and its actual ecological design performance. For instance, if a project claims to use sustainable materials but fails to meet the environmental design strategies for material selection, it may be considered as greenwashing. Similarly, if a project claims to reduce energy consumption but does not meet the environmental design strategies for energy efficiency, it may also be considered as greenwashing. Therefore, environmental design strategies analysis can help identify greenwashing practices in architectural projects in Turkey and promote sustainability in real depth in the built environment. The analysis can be conducted through a systematic evaluation of the project's design based on established environmental design strategies. The results of the analysis can be used to inform design decisions and promote sustainable practices in architectural projects in Turkey.

As Erden and Erkartal (2019) argue, Bowen and Correa provided a comprehensive explanation of greenwashing, describing it as the selective use of positive information while omitting any negative aspects to create an exaggeratedly positive environmental image. The main intention behind greenwashing is to enhance the actor's market image rather than genuinely promoting environmental interests. The utilization of resources, the disproportionate increase in the consumption of natural resources, and the pursuit of more than necessary, coupled with interventions in the organic order of nature, have been among the causes of climate change and, consequently, the environmental crisis humanity faces today. As Yalman (2019) mentioned, viewing sustainability as an extension of external nature entails several concepts, including the perception of nature as an external entity dependent on our technological progress. Consequently, technology is found to be continuously advanced to prevent environmental harm and ensure the survival of nature. The main intention is to perpetuate the individual's idea rather than to perpetuate nature.

Research problems and hypotheses

In this study, it was found correct for a building to comply with the conditions and requirements of the region in which it is located, in order to strengthen the ethical dimension of architecture. In this respect, it has been analyzed that a building that has been certified for sustainability does not become any building on anywhere other than its technical equipment and that it maintains its self-sufficiency in the scenario of technical difficulties with the contribution of environmental design strategies that contribute passive design. This study accepts that the selected case building is a successful example because it has a LEED certificate. However, it argues that the buildings that are entitled to receive these certificates, which are evaluated based on overarching rules around the world, should be analyzed not only with their technical equipment, but also with their suitability in context by participating in the evaluation from an ethical perspective. For this reason, it becomes important to evaluate the selected building based on the region and climatic conditions where it is located. The hypotheses of this analysis and evaluation are as follows:

- Considering that the ethical dimension of architecture is provided by the communication it establishes with the society in which it is located and the individuals of that society, it is thought that designing a building that is considered sustainable in a way that is disconnected from the characteristics of the region and society in which it is located would break this communication.
- It has been considered that in order to ensure the ethical function of architecture, importance should be given to environmental design strategies in line with passive design as well as the sustainability success achieved with technical equipment.
- This thesis aims to analyze an example of LEED Platinum certified projects and Building A which is built as a result of architectural design competition under the title of environmental sustainability is analysed specifially. Since Building A has a LEED certificate, it is emphasized that it is sustainable and it is considered sufficient in this sense. In this respect, it is assumed that it has common sustainability qualities with other successful buildings in the LEED certificate which is one of the best-known signifiers of sustainability in architecture.

Scope and limitations of the study

The scope of the study is to analyze in detail a building thought to be sustainable in terms of environmental sustainability. Based on the expansion of the ethical dimension of architecture, it can be claimed that a building continues its communication as a result of the interaction of the society and its context. For this reason, the analysis is limited to environmental design strategies in line with passive design, as the suitability of a sustainable building to its context is also critical.

The reason why the building was chosen in Turkey is due to the necessity of contextual physical environment, built environment and climate data in order to make an assessment in terms of environmental sustainability. LEED certification, which is a strong premise of sustainability, would be used as a tool in the selection of the building to be analyzed and the building to be evaluated within the scope of the analysis would be determined.

Considering Turkey's energy demand in this context and its self-sufficiency rate in meeting this demand, it can be observed that the alignment of a building with the region's climatic conditions holds critical importance.[1] Therefore, thoughtful consideration of the characteristics of the region where the building is designed and constructed contributes to reducing the energy requirements of the building while enhancing user comfort conditions. Adapting architectural designs to suit the climate holds paramount importance for ensuring sustainability, potentially leading to substantial energy savings for heating and cooling, all the while upholding occupants' thermal well-being (Albatayneh, Alterman, Page and Moghtaderi, 2018).

To test the level of environmental sustainability, Building A in hot-humid climate region, is selected. The main reasons why this building is chosen for analysis is that it is a LEED Platinum certified office building. Besides that, it is built as a result of an architectural design competition and it emphasizes sustainability, which is the focal point, as in the name of the building. The fact that it was the most successful design selected as a result of an architectural design competition and that it is a certified building in terms of sustainability indicates why it was chosen as the subject of analysis. Additionally, the importance of office buildings in terms of sustainability and energy efficiency compared to other building types has been determined through the studies and reports of the Ministry of Environment, Urbanization and Climate Change as shown in Chapter 3. When other certified buildings are examined, it is observed that the emphasis on sustainability is not made to this extent. As a result, Building A is seen as the most appropriate example for the sustainable building design that is intended to be analyzed within the scope of this thesis. It can be observed that the building is located on a site within a hot and humid climatic zone. Since the hot-humid climate zone is the selected region for the building, the data collected for the hot-humid climate region will be evaluated. When starting from the definition of the ethical function of architecture, it was deemed necessary to examine the technical and technological advances, as well as its location and its harmony with the hot-humid climate region.

The optimum conditions of environmental design strategies determined for the hot-humid climate region is compiled from the literature and compared with the conditions of the building. At the same time, analysis and simulations carried out with various programs and

[1] Over the past 15 years, Turkey has exhibited the most significant surge in energy demand within the Organization for Economic Co-operation and Development (OECD) nations. Given that only 26% of the total demand can be satisfied by domestic resources, energy-related challenges have gained heightened prominence. Consequently, enhancing energy efficiency has emerged as a focal objective within Turkey's strategic approach to energy (MFA, 2018).

the results are evaluated. The main motivation of these analyzes is to question the self-sufficiency of a building that has been deemed successful in terms of technical advancements and earned a certificate, thanks to the harmony it provides with its context in a scenario where there is no technical support.

Data collection method and tool

To analyze the passive design compliance of the building two different analysis are carried out. Firstly, an analysis according to the strategies obtained from literature as environmental design criteris is examined. Environmental design strategies inferred from the local studies is utilized to to check the building’s suitability for passive design that have been studied. Furthermore, alongside the environmental design strategies, a comprehensive analysis is conducted with the support of simulation programs like LadyBug, Climate Consultant, and DesignBuilder. This analysis specifically focuses on evaluating the passive design compatibility used in the building according to both local studies and simulation programs. The results derived from this simulation analysis enable a thorough assessment of the building's adherence to passive design. By delving into the specifics of various zones within the building, the study aims to provide a nuanced understanding of how well the building aligns with sustainable and environmentally conscious design strategies.

Following this in-depth analysis, the discussion would revolve around whether the building's placement, leveraging the available technological capabilities, could indeed yield significant differences. Architecturally, the extent to which it seamlessly integrates with the regional conditions, even in the absence of technological advancements, holds significant importance. Recognizing that buildings, when designed to harmonize with their context, need not be entirely reliant on technical solutions to address challenges, underscores the critical need to examine the ethical facets of sustainable architecture.

Within the scope of this thesis, which is organized in two stages as theoretical and experimental, the subject is covered under five main headings.

In the first part of the thesis, the subject is defined; literature research, the purpose of the research, the research question and hypothesis and the importance of the research is explained.

In the second part of the thesis, the notion of sustainability and ethos concept are explained through the ecological crisis, which is one of the most prominent issues of today. It has been argued that the necessity of addressing the controversial issues related to sustainability through the ethical function of the concept would contribute to the development in this field in architecture. The dangers inherent in scenarios where ethical value could be compromised have been examined.

In the third part of the thesis, material and method is explained through detailed drawings and descriptions of Building A, which is LEED Platinum certified building. Afterwards research problems and sub-hypothesis are introduced together with data collection method and tool, and sample.

In the fourth part of the thesis, the findings are evaluated according to environmental design strategies compiled from literature which are analyzed by the support of simulation programs, and the ethical function of sustainable architecture is discussed in terms of Building A.

In the fifth part of the thesis, as a result of the evaluations made, the research questions are answered and suggestions for future studies are presented, and the study is completed.

Chapter	Research Questions/Content	Method
1 Introduction	The subject, research objectives, research importance, research questions and hypothesis Data collection method and tool	Literature Review
2 Theoretical Background	What ethical dilemmas does architecture face when considering the environmental performance of its sustainable designs, and how can they responsibly solve these challenges? What types of inherent risks are entailed within the ethical reflection of sustainability within the realm of architecture? **ETHICAL ASPECT OF SUSTAINABLE BUILDING ANALYSIS**	Literature Review
3 Material and Method	Examination of building types that are important in the context of sustainability. Case study selection and introduction of analysis method which is based on environmental design strategies and simulation. **CASE STUDY (BUILDING A) SELECTION PROCESS AND REASONS**	Presenting informations about the material and method
4 Findings and Evaluations	Analysis of Building A based on the determined environmental strategies and simulations. How does the alignment of sustainability with local factors inform the ethics of sustainable architecture at Building A? **PASSIVE DESIGN COMPLIANCE** **ENVIRONMENTAL DESIGN STRATEGIES ANALYSIS**: -Compilation of strategies by literature; - Requirements of the strategies according to Turkey's climate zones; -Evaluation of strategies and the case building **SIMULATION ANALYSIS**: -Modeling the case building; -Utilizing analysis and simulation programs like LadyBug, Climate Consultant, and DesignBuilder; -Evaluation of simulation run by various programs	Analysis and evaluation of the obtained data
5 Conclusion	The answers to the research questions are given. As a result of the evaluations, it is stated that the hypothesis is confirmed. Recommendations for future research are presented.	Evaluation of results and recommendat ions

Figure 1.2. Thesis flow-chart

2. LITERATURE REVIEW AND THEORETICAL BACKGROUND

Today, the ecological crisis continues to deepen, presenting not only with significant environmental challenges but also ethical quandaries. Central to this dilemma is the manner in which humanity interacts with the environment, often driven by a predominant 'technological' mindset. The belief that global catastrophe can be averted solely through technological innovation raises fundamental questions about the nature of the crisis itself. In the contemporary era, there is a concerted effort to alleviate the severe symptoms of this crisis, with the effectiveness of these measures remaining a subject of ongoing debate. In the realm of architecture, which plays a pivotal role in the quest for sustainability, these challenges demand thorough consideration and the formulation of innovative solutions. However, it remains open to debate whether these solutions are purely technical in nature. The examination of the ethical dimension of architecture and its integration with sustainability is deemed necessary at this juncture.

At this point, it has been determined that sustainable architecture should be evaluated in the context of shallow and deep understandings of ecology over Karsten Harries' understanding of ethics. To this end, Harries' theoretical framework, commencing with an examination of his critique of the ornament-decoration distinction in architecture is employed. Harries argues that ornament, once imbued with elements of ethos, has gradually been replaced by disconnected and meaningless elements since the 19th century. This transformation, as elucidated by the concept of the 'decorated shed', underscores the ethos inherent in architecture, signifying its role in establishing a profound relationship between the built environment, its surroundings, and its inhabitants. In Harries' vision, architecture assumes the role of an ethos carrier, functioning as a realm of profound meaning. This ethos, which embodies humanity's way of existing in the world, now finds its expression in the form of sustainable architecture as humanity grapples with the environmental crisis. Today, environmental elements in the contemporary ethos defined by Harries' ornament-decoration distinction, often reduced to mere decoration, would be examined through architectural examples commonly labeled as sustainable solely through technical solutions. An analogy could be drawn between Harries' ornamentation-decoration framework and the relationship between sustainability and 'greenwashing' in the context of architecture. Arne Naess' conceptual distinction between shallow and deep ecology could also be included in this analogy.

2.1. Ornament - Decoration

All situations, which find their counterparts in life, serve the ethical function of architecture. It is necessary to understand the concept of ethics correctly and to be aware of its scope. Harries (2000) points out:

> By a person's ethos we mean his or her character, nature, or disposition. Similarly, we speak of a community's ethos, referring to the spirit that presides over its activities. 'Ethos' here names the way human beings exist in the world: their way of dwelling. By the ethical function of architecture, I mean its task to help articulate a common ethos. (Harries, 2000: 4)

The fact that ethics is a reflection of the vital also finds its counterpart in architecture, which leads to the idea that an architect does more than build. The criticism of modernism here is that it tries to standardize the ethical dimension of architecture, and this actually comes to the end of destroying its ethical dimension. The fact that architecture, as an art, tries to create a universal style together with modernism, is no longer reflecting the state of the society, but reaching the level of making it conform to the rules of modernism reveals the danger of making the society uniform. As a result, architecture loses its ethical dimension which includes praxis perspective and related to whole and turns into an aesthetic activity which includes formalist perspective and related to fragment. However, it should not be forgotten that architecture includes both aesthetical and ethical approach.

At last, it could be concluded that every human being is a member of a society and every society could be evaluated with architecture. The issue of architecture and the issue of community are fundamentally intertwined and cannot be completely separated (Harries, 2000: 12). It indicates that architects do not just build aesthetic objects; they do something more. Yet, it must be well understood what is more. To get the right answer, right questions must be asked. As Harries (2000) states:

> "Our dwelling is always a dwelling with others. The problem of architecture is therefore inevitably also the problem of community, which is only the other side of the problem of

> the individual. The ethical function of architecture cannot finally be divorced from the political." (Harries, 2000: 13)

At this point, some kind of communication way with the human and the society to fulfill its main task which is interpretation. There is an opportunity of architecture to express the society, history, and the individual in that society, not only for that period, but even after centuries by continuing its existence for many years. While it is not possible to assert a direct causation between architecture and societal change, architecture does possess the ability to transform its own essence, thereby proposing alternative modes of creation. By constructing our edifices and urban environments in alignment with our ideals, a lifestyle that resonates with our identity could be cultivated. Constructing improved and habitable cities holds the potential to actively foster the development of a more enhanced social existence (URL-1). In this respect, the value of the ethical function of architecture and how it is positioned in the ethical sense can be observed. The moral argument presented here focuses on buildings, particularly on areas where meticulous aesthetic consideration in design is evidently lacking. Two primary approaches can be employed to assess a building in relation to ethical argument. These two approaches include examining individual parts and details for meticulous consideration and evaluating the building as a whole in relation to its context in the landscape or townscape (Fox, 2012: 203). As it could be concluded, a work of art will not imitate its period, but will reflect its spirit in the best way possible. A whole, built from the materials used, the ornaments made, and chosen forms, actually reflects the spirit of the period. The work of art therefore does not consist of imitation, because as it occurs it does not appear as "imitation" but as the truth of the period which means ethical state.

Harries delves into the philosophical significance of ornament and decoration in the context of architecture. Decoration is a pleasing arrangement of real things that does not have a permanent connection with its carrier, serving to enhance the aesthetic appeal and ambiance of a space temporarily. The eclectic decoration from the 19th century onwards is decadent because it involves adding an aesthetic element to a building that could function perfectly well even without this embellishment (Harries, 2000: 55). As a consequence of the weak relationship formed with buildings to which decoration is added, decorated sheds point to the fundamental departure of this concept from ornamentation. Seeking to address architecture's struggle with losing its communicative essence by replacing aesthetic decoration with signs is not a solution to the language challenge encountered by architecture.

The buildings, often obscured or overshadowed by these signs, do not undergo a transformation into true architecture as a result (Harries, 2000: 81). The ubiquity of decoration added to buildings jeopardizes the relationship they establish with society and their surroundings, necessitating buildings to be defined by signs to convey their meaning. This, in turn, contributes to the proliferation of the aforementioned decorated sheds.

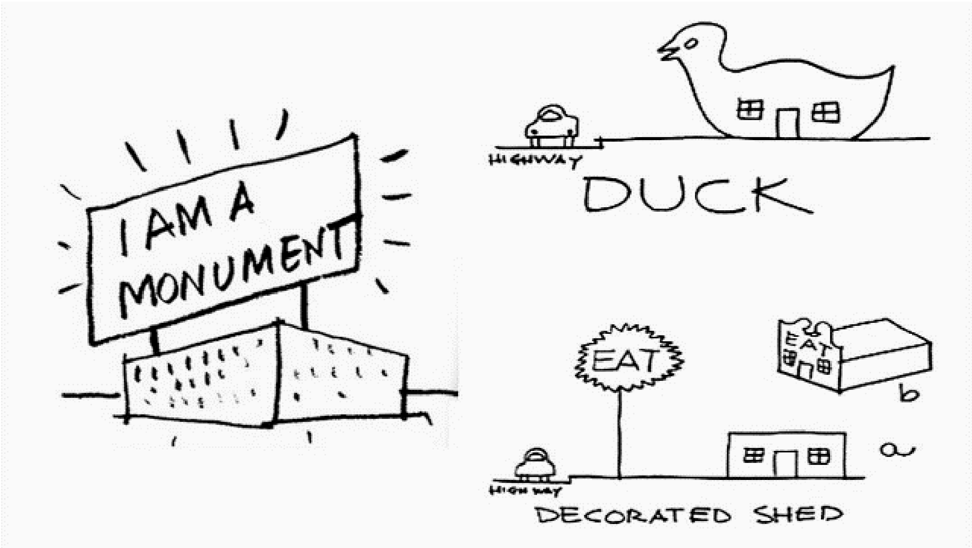


Figure 2.1. Decorated shed (Harries, 2000)

Ornamentation, on the other hand serves as a means of humanizing the built environment, allowing individuals to establish a meaningful connection with their surroundings. Integral to the constructed environment, it constitutes a documented history that mirrors the historical evolution of humanity, fostering a strong connection with its host and enhancing the visual and cultural composition of a structure. The visual harmony of notable historical styles serves to visually express the unity arising from a shared way of life and common values. Both style and ornament are imbued with ethical significance (Harries, 2000: 59). He challenges the conventional view of ornamentation as mere embellishment, arguing that it carries profound existential and ethical implications.

In recent years, the discourse on sustainability and ecology has gained increasing prominence in the fields of architecture and design. Karsten Harries' framework offers valuable insights into the intersection of environmental consciousness and architecture, emphasizing the intrinsic relationship between built environments and the natural world. He contends that sustainable design is not merely a technical endeavor but a philosophical and ethical commitment to harmonizing human habitation with the ecological balance.

Harries' exploration of sustainability transcends conventional environmentalism, encompassing a holistic perspective that acknowledges the interconnectedness of human existence with the broader ecosystem. His framework underscores the imperative of reimagining architectural practices in ways that honor ecological integrity, promote resource efficiency, and mitigate the impact of human interventions on the environment.

2.2. Sustainability - Greenwashing

In the contemporary discourse, the oft-cited concept of sustainability is posited as today's ethical paradigm. The matter of nature's values is fundamentally an ethical concern, influencing our perceptions of what is good, just, and worthy. It shapes an ethical framework that prioritizes a broad range of human needs, encompassing physical, emotional, intellectual, and spiritual aspects rooted in our biology. A balance is sought between a utilitarian perspective, which may prove inadequate, and an environmental ethic detached from human interests, which could be misguided and irrelevant (Kellert, 2012). While holding significant value, this concept has entered a realm of controversy marked by inherent contradictions. A point of contention within these discussions revolves around the perceived risk of sustainability metamorphosing into the phenomenon of greenwashing.

Behind the green rhetoric, various initiatives attempt to conceal the ecological crisis, with its environmental, social, and economic dimensions, under the prevailing concept of "sustainability." Therefore, it is necessary to first critically examine sustainability, but this goes beyond Ghisleni's definitions of "greenwashing." Greenwashing is a term used in response to the failure of the widely accepted definition of "sustainability," but it is essential to reevaluate and enrich the concept and dynamics of sustainability on a broader ecological scale. The question raised here is whether the currently accepted definition of "sustainability" is valid, and as a result, whether greenwashing is a consequence of the actual failure to implement sustainability or an inherent contradiction within the commonly used concept of "sustainability" (URL-2). Therefore, "greenwashing" can be described as a crisis derived from the idea of concealing the ecological crisis.

In recent years, the emergence of green skyscrapers has been witnessed, primarily driven by the growing awareness that buildings contribute more carbon dioxide emissions than any other single source. A more effective approach may involve shifting emphasis away from mutable sustainable and technological determinism's impact on building design. Instead, attention should be directed towards the architectural process, reaffirming its essential nature—to materialize unity, generative principles, formative elements, corporeal aspects, and regenerative strategies. Unfortunately, the term "architecture" often requires the qualifier "green" to convey sustainable responsibility, even though green intentions should inherently be part of it. However, given current economic pressures and low development standards, mainstream architecture tends to be generally unsustainable (Tabb and Deviren, 2017: 179). However, this surge in environmentally conscious construction has also been accompanied by a troubling increase in 'greenwashing'—a phenomenon where companies falsely claim to be environmentally friendly in order to capitalize on the market's growing interest in sustainability. Observing the relationship between sustainability and greenwashing through various architectural examples is important in order to clarify this relationship.

One striking example of this intersection between green building trends and deceptive marketing practices is the Antilia Tower in Mumbai, designed by Perkins+Will. This building has become a focal point of controversy due to allegations of greenwashing. During the design phase of Antilia Tower, the three-dimensional renderings presented an image of a sustainable project, complete with lush green walls, ivy-clad facades, and verdant green roofs. Designers promoted the tower as a solution to combat Mumbai's urban heat island effect through its extensive vegetative cover (URL-3). However, when the project was completed in 2010 and real-life photographs surfaced, it became evident that the promised 'green' features, including the living walls and green roofs, were conspicuously absent. Furthermore, the fact that Perkins+Will no longer featured the project on their website lent credence to these criticisms. The disconnect between the alluring images used for promotion and the actual implementation of green and sustainable features in the final product raises questions about the integrity of the design process, including the selection and execution of green elements.

Figure 2.2. Antilia Tower a) visualization b) real image

The initial instance of a 'Vertical Forest' (known as Bosco Verticale) was unveiled in October 2014 within Milan's Porta Nuova Isola district. This marked the commencement of a broader redevelopment initiative spearheaded by Hines Italia. Milan's Vertical Forest comprises two towers, standing at heights of 80 and 112 meters, accommodating 480 large and medium-sized trees, 300 smaller trees, 11,000 perennial plants, and 5,000 shrubs. In essence, this urban area, spanning 1,500 square meters, mirrors the presence of a vast forest and undergrowth, equivalent to an expanse of 20,000 square meters (URL-4).

One of the main disadvantages is that it requires irrigation and maintenance, which can be expensive and time-consuming. Additionally, the building imposes loads on the structure, and there is a chance of leakage if not installed properly. The building still requires massive amounts of cooling and heating electricity and still uses millions of gallons of water each day without an efficient recyclable water system and a poor rain collection system. The vertical garden also requires a much larger volume of growing media, which can be a challenge in terms of engineering and construction. Furthermore, the trees and plants require sophisticated irrigation and drainage systems. Architects adopted a customized framework and scaffolding layout to accommodate the unique needs of a vertical forest. Concrete balconies, boasting a substantial thickness of 28 centimeters, extended irregularly by 3.35 meters to offer adequate space for vegetation. These balconies were further fortified with steel to bear the additional weight imposed by the lush greenery. Following the completion of the building's superstructure, the architects employed innovative solutions such as steel safety cages to protect the largest and most vulnerable trees. Other plants found their home in containers of varying sizes, strategically positioned throughout the building. It is essential to acknowledge that green buildings like Bosco Verticale are obliged to consider a range of factors beyond aesthetics and sustainability. These encompass waterproofing and drainage measures to safeguard against water infiltration, compliance with national building codes related to fire safety, and the ongoing commitment to maintenance in accordance with regulations governing plant size, moisture levels, and the implementation of fire prevention and evacuation systems (URL-5). This structure accommodated upwards of 900 trees and over 2000 plants, distributed on balconies across various sides of the building. These green elements introduced additional weight to the projecting balconies. The objective of this project was to simulate the increased load on the balconies and compare the tensile stress and deflection between a conventional reinforced concrete slab and a pre-stressed concrete slab (Sun et al., 2016). The carbon emission caused by the amount of concrete and steel used to meet this load capacity is higher than the positive effect of natural ventilation and microclimate provided by the plants used on the facade of the building. At this point, the misconception that sustainability is achieved merely by adorning buildings referred to as sustainable with green elements should be supported by detailed analyses and improvements.

Figure 2.3. Bosco Verticale a) balconies b) perspective view

One Central Park is a residential and commercial complex located in Sydney, Australia. It is known for its innovative and striking design, particularly its extensive vertical gardens. The building consists of two high-rise towers and includes apartments, retail spaces, and a green roof. The building is adorned with lush vertical gardens on its façade, which are not only aesthetically pleasing but also contribute to improved air quality and insulation. These gardens are a prominent and unique aspect of the building's design. One Central Park is designed with sustainability in mind. It incorporates various eco-friendly features such as rainwater harvesting, energy-efficient lighting, and natural ventilation to reduce its environmental impact. The complex boasts a green roof with a heliostat system that directs sunlight down into the public space below, enhancing natural light in the area. In addition to residential units, the building includes retail spaces, making it a mixed-use development that contributes to the vibrancy of the surrounding area (URL-6). Overall, One Central Park is recognized for its integration of greenery into urban architecture and its commitment to sustainable design strategies.

One Central Park is explained as a best practice urban infill development in Sydney, Australia, that showcases how the flows of water and energy are organized to provide enhanced sustainability, liveability, and resilience for the local and neighboring communities. The development takes a precinct approach to utility and mobility services, and demonstrates the opportunities to drive deeper socio/environmental benefits by enabling prosumer services through low-cost access to utility services and circular resource flows (McLean and Roggema, 2019). However, it faced some criticism for greenwashing, particularly regarding its actual energy efficiency and the extent to which it achieved its sustainable design goals.

Figure 2.4. One Central Park a) visualization b) real view

Hollowed-out Mountain for Hyde Park which is designed to redefine the connection between Oxford Street and Hyde Park, connects to one of Europe’s busiest shopping streets. MVRDV's concept brings forth a park-like environment featuring lush greenery, offering an elevated perspective of Oxford Street and the park with a 25-meter-tall viewing point. This project is designed to be explored through a continuous pathway, allowing visitors to enjoy various perspectives of the arch along the way (URL-7). MVRDV architects had a clear goal for this attraction. They aimed to show how nature can help cities facing climate change and, in the immediate future, revitalize Oxford Street after the pandemic caused fewer people to visit the area. However, this is exactly why the outcome of the proposed project became the focus of criticism. After the £2 million attraction opened to the public, it faced criticism, with some people describing Marble Arch Mound as a 'waste pile' and noting that it does not resemble the lush landscape depicted in the initial renderings.

Figure 2.5. Hollowed-out Mountain for Hyde Park a) render view b) real view

2.2.1. Sustainability of what?

In the United Nations' 1987 report "Our Common Future," the definition of "sustainable development" reveals that the concept of sustainability is observed to contain various uncertainties. Demos (2023), in his article "Sustainability Policy: Contemporary Art and Ecology," points to this ambiguity notes the problematic nature of approaching environmental issues from an economic perspective. According to him, such an approach largely serves the development of companies operating under the banner of "green capitalism" and is shaped according to the needs of these companies. Reducing the concept of sustainability with a reductionist approach solely to environmental movements is incorrect. Questions should be raised about whether these environmental movements under the patronage of large companies and the state deepen or reinforce social inequalities, strengthen authoritarian regimes, or serve the interests of multinational corporations in their urgent fight against climate change. Indeed, a new power technique called "environmental discipline" has been developed. According to Demos, environmental discipline refers to the practices of national, non-governmental, and international institutions that regulate the health of our natural environment, defining sustainable development in favor of financial interests. Therefore, this new eco-power implements greenwashing strategies with manipulative initiatives related to public environmental health, all the while saying nothing about the real solution to the ecological crisis, environmental justice, or the transformation of capitalist commodification practices. Thus, the question of "what is sustainable" becomes crucial. Environmental ethics argue for replacing the utilitarian exploitation of nature for our purposes with a perspective that sees nature as an end in itself, possessing its own imperatives that could not be ignored. However, it is challenging to neatly encapsulate environmental thinking in such a straightforward manner (Hagan, 2007: 65). The fundamental problem is the encoding of nature as an exploitable and economic domain. As long as this perspective remains unchanged, the manipulative aspect of greenwashing strategies will not be revealed.

Capitalist exploitation is now an acknowledged reality. However, the origin of this exploitation, the real source of this crisis, is still highly debated. Some use concepts like the Anthropocene, while others use the term Capitalocene to try to shed light on this process. Is there anyone in these perspectives who would pave the way for "greenwashing," providing strategic opportunities for it? In this regard, the examination of the concept of the "Anthropocene" is particularly important. According to Çaylı (2023: 21-22), the term "Anthropocene" has been used in a way that disconnects it from the historical context it signifies. While the term initially refers to the transformative impact of humans on the planet, it actually indicates a process that emerged through the mutual influence of industrialization and colonialism. However, later on, it became attributed not to a certain group or community but to all of humanity. Therefore, the term has been abstracted from its original dimensions and reduced to the level of "humankind." "Anthropocene" is now being used as a reference to the innocence of something as vague and ambiguous as "humankind." This term has actually become the fundamental basis for greenwashing strategies. In this ecological crisis that implies the guilt of every individual, each person also has significant responsibilities. Practices such as saving, avoiding overconsumption, shifting toward "eco-friendly" consumption, etc., are subjected to eco-power. As a good example, in an online magazine titled "Plastic & Packaging Technology," a green-packaged product is accompanied by the following words: "Packaging has an important mission to fulfill: besides preserving the freshness, quality, and aroma of the product it encloses, it also has to protect the environment and consequently the future. The point of environmental pollution reached worldwide is encouraging consumers to become aware of this issue and to prefer brands that use sustainable packaging" (URL-8). What is implied by consumers becoming aware is to "choose brands that use sustainable packaging." Thus, the ecological crisis is distorted in this way: eco-power is applied to people's consumer identities and perceptions. Therefore, sustainability seems to be nothing more than the economy itself on a large scale.

2.2.2. What is “nature”?

How does a particular understanding of "nature" lead to the failure of sustainability and, consequently, green rhetoric? To understand this issue, what is meant by the concept of nature needs to be examined. To grasp how nature has become a target of economic development as an area of exploitation, the nature-culture distinction must be explored. Nature is designed not only as a realm for consumption but also as a sacred space. After the ecological crisis emerged due to what "humankind" has done, it is perceived as nature's revenge, and all of humanity is held responsible for it (Çaylı, 2023: 76). Such conceptions of "nature" are quite problematic because they hinder the resolution of the current crisis, blocking processes that stand in its way.

Slavoj Zizek (2022: 59), who closely examines these conceptions of "nature," says the following:

> "The radicality of the ecological crisis is not emphasized enough. The crisis is not radical just because of the actual danger it poses, i.e., simply because human survival is at stake. Our most unquestioned assumptions, our horizons of meaning, our everyday understanding of 'nature' as a regular, rhythmic process are all called into question." (Zizek, 2022: 59)

Zizek (2022: 59-60) points out the significance of questioning our understanding of nature and goes even further. He constructs a matrix based on these conceptions and examines the logic of exhibiting three types of ecological stances. The first logic features someone who understands the importance and seriousness of the ecological crisis but does not include it in their symbolic universe because they do not truly believe in the crisis. Such a person is reluctant to take the ecological crisis seriously because they believe it will not be a serious problem for them. Second is the logic that can also be described as obsessive environmentalism. In this logic, a person acts as if disaster will strike if they stop their obsessive environmental activities, constantly active to prevent the crisis. An example of this could be someone who is constantly striving for sustainability, managing waste, and obsessively cleaning up trash. Thirdly, there is the idea of divine retribution stemming from the ruthless exploitation of nature. For these individuals, to escape moral corruption, people must return to a way of life "integrated" with nature and live a peaceful life. According to Zizek, all these approaches are problematic because they attribute meaning to a crisis they do not possess. Instead of following this principle of "attributing meaning," the "reality" needs to be confronted head-on, and the imposition of mythological meanings on the crisis should be avoided. Thus, Zizek suggests avoiding three types of approaches: pragmatic, neurotic, romantic, or theological. In these three types of approaches, it is mainly the neurotic and romantic-theological approaches that come into contact with greenwashing. As long as individual responses to the crisis are based on these two approaches, eco-power will be in action for "greenwashing."

There are movements that start with an environmental motto but do not respond adequately to the crisis or fail to fully understand it. The problematic aspect of these movements is that they maintain the nature-culture distinction. The fundamental problem with this dualism is the externalization of nature and its positioning as an ontological "pure" realm. This move aligns with Zizek's romantic-theological approach in his matrix. This ontological framing encodes nature as a sacred area that is independent of "social, political, and technological" processes and, as a result, legitimizes the exploitation of nature and the destructive efforts of capitalism over nature (Demos, 2023). In other words, the problem examined under the theme of "fragile ecologies" in Demos' article is not that these movements are opposed to capitalist industry's exploitation of nature; rather, these movements, albeit unintentionally, undermine this struggle. This issue stems from the fact that the ontological understanding of "nature" as an external element actually reproduces capitalist objectification. As a result of these movements, it becomes challenging to understand environmental damage from a wide perspective of technological, social, and economic dimensions. So, why is this fragile approach, despite emerging as an ecological resistance to the exploitation of nature, drifting in the opposite direction of what it desires? While these movements claim to criticize capitalist exploitation of nature, they unintentionally obscure the actual problems. Practices that "proffer temporary solutions to natural destruction without making connections between technological, social, and economic systems that construct the environment" (Demos, 2023) have a naive approach to ecological crisis. The crucial point here is that responses to the ecological crisis, as well as the proposed solutions, must be well thought out and deeply capture the problem.

As it can be seen, when talking about "the environment," "ecological balance," and "sustainability," it is clear that the issue is not just about displaying a reductionist ecological approach within the context of an externalized design of nature. At this point, the concept of "political ecology" becomes a significant turning point. Stephanie Smith (cited in Demos, 2023) points to the difference between "sustainable development" and "development of sustainment": In the first, the existing order and capitalist relationship forms are not changed, but production methods are made environmentally friendly; while in the second, there is a necessity for an effective definition of sustainability that puts social and environmental justice equally at its core. This kind of distinction can also be seen in the conceptual division between shallow ecology and deep ecology, as explored by Arne Naess. According to Naess (2023: 67-74), the shallow ecology movement is concerned with the health and welfare of people in developed countries only, dealing with pollution and resource depletion. Deep ecology, on the other hand, has a much broader scope, not stopping at being "green." It emphasizes replacing an anthropocentric approach with a relational and holistic ecological consciousness. Additionally, it highlights the importance of "biospheric egalitarianism," underlining the equality of all life forms and expressions. The deep ecology movement rejects the classic design of nature that works with phenomena such as elimination, survival, and competition, advocating instead for principles like complex relationships, solidarity, and shared living. In the deep ecology approach, the fight against pollution and resource depletion differs significantly from the shallow ecology approach. For example, the widespread use of pollution prevention measures may have the potential to create an economic imbalance. Meeting vital human needs could become increasingly difficult. Deep ecology does not accept such an approach that exacerbates class differences. For the deep ecology movement to succeed, local autonomy and self-governance are also necessary, and hierarchical rigidity and intensity should be reduced. In general, what is common in all these new ecological approaches is the effort to expand the meaning of "ecology." When terms like "ecology" and "nature" are used in the classical sense, they generate specific imaginations. For example, when the term "nature" is used, an image is conjured of an Amazon-like place, untouched by human hands, with a unique structure, where animals live, and plants grow. Unfortunately, such imaginations do not accurately represent reality and pave the way for a negative understanding of nature. In this regard, Genosko (2023: 88) quotes Guattari: "We need to stop identifying ecology with an image of a small minority that loves nature or with qualified experts." This quote actually highlights a crucial point. The concept of ecology as an "environmental world" and greenery is problematic as it creates problematic social imaginings. Therefore, the issue has a philosophical underpinning.

2.3. Deep Ecology - Shallow Ecology

"It is possible to find an example of ecological criticism in the works of the prominent 20th-century philosopher Heidegger. Although Heidegger's central concern is modernity and technology, his critiques of these issues have paved the way for contemporary ecological calls. Patricia A. Johnson (2013: 129) mentions that some people perceive an ecological orientation in Heidegger. For them, the lesson to be drawn from Heidegger is to embrace a simple way of life, to allow beings to reveal themselves as they are, and to refrain from dominating things.

Heidegger shares many points with the concept of 'deep ecology,' but he also differentiates himself. To explain this, the concept of deep ecology needs to be elaborated. According to Zimmermann (2011: 414-415), deep ecologists have a fundamental concern: attributing numerous environmental problems solely to industrialization and confronting the crisis with an attitude of challenging the industry will not serve any purpose. Deep ecologists believe that the root problem is the anthropocentric/human-centered principles of Western culture. The sources of this are Christianity and Greek philosophy. The doctrines of philosophers like Francis Bacon and Descartes, who advocated 'dominating nature,' correspond to the ultimate dimensions of this understanding. It is crucial to note that deep ecologists do not have a vague and wholesale notion of 'humankind.' They view it as a product of the Western ontological understanding and emphasize the nature-culture distinction. According to

Zimmermann (2011: 416), deep ecologists summarize where they find the real solution: 'Humanity can potentially escape environmental catastrophe only by transcending anthropocentric tendencies and embracing biocentric egalitarianism.' Therefore, the path to overcoming anthropocentrism is not to integrate humanity with natural bonds but to realize that humanity is not autonomous and central, but in service of the whole of existence. Heidegger's opposition to anthropocentric humanism, his call to 'let things be,' his doctrine of 'poetic dwelling on Earth,' and his resistance to the technological domination of nature all find many similarities with deep ecologists. However, according to Zimmermann (2011: 417), Heidegger's philosophy contains a different type of anthropocentrism, which sets him apart from deep ecologists. This means that the way to transcend anthropocentrism is not to 'integrate humanity with natural bonds,' but to understand that humanity is not autonomous and central but in service of the whole of existence. Heidegger's philosophy is against all kinds of naturalism.

Heidegger's critique, which can be interpreted ecologically, is rooted in his criticism of modernity. In his text 'The Question Concerning Technology,' Heidegger seeks to reveal the essence of technology and the way modern thought has led human life into a certain place. The problem here is the reduction of life to a single dimension and the danger of transforming the world's existence into a form of control. Heidegger's rejection of subject-based philosophy arises from the fear of the world being entirely humanized, designed to secure humanity. Heidegger (1998: 55) believes that this path passes through modern technology: 'The challenge that prevails in modern technology, unveiling-hiding, is an unreasonable challenge that imposes on nature an unreasonable demand, that it supplies energy that can be unlocked and stored.' In this sense, Heidegger indicates that modern technology narrows nature down to an 'energy' field. People, plants, animals, and all the dynamics that make up nature are seen as 'energy' sources. Heidegger calls this 'Ge-stell,' which is often translated as 'enframing.' For example, when he uses the example of the Rhine River, Heidegger (1998: 57-58) states that the Rhine River enters the resource area of the hydroelectric power plant, which is an apparatus of modern technology. The Rhine River has become a space for a series of technical possibilities. The water still flows, but it is not enough; it has become an object designed for people who come there for holidays. The points Heidegger highlights are essential for understanding the technological domination of nature. Moreover, Zizek (2005: 18) draws a connection between Heidegger's thought and the ecological crisis. In light of this association, an implicit assumption is made that the resolution hinges on subsequent technological advancements and innovations by delineating the crisis as a consequence of extensive exploitation of nature. This perspective anticipates the emergence of a novel 'green' technology purported to be more efficient and globally impactful in managing natural processes and human resources. Any ecological initiative or design seeking to modify technology for the betterment of the natural environment is rendered futile, as it fundamentally emanates from the root cause of the issue. The crucial point here is the ongoing technological quest in the present day. The urgency of the ecological crisis is, in fact, the urgency of thinking rather than acting. The ecological crisis points to a 'mental' crisis rather than a technical problem. As Demos (2023) also mentioned, one of the danger signs is to reduce the complexity of representation by underestimating intellectual criticism and aesthetic subtlety in order to emphasize the undeniable urgency of climate change.

It is evident that constant confrontations with crises and manipulations may be rooted in this perspective. The transformation of sustainable behaviors into 'green' rhetoric should not be surprising at all. Green rhetoric demonstrates that the relationship with beings has not changed, implying that the crisis has not been truly taken seriously.

The 'Our Common Future' report, which is related to development goals, was criticized by Demos for serving economic growth and the interests of specific companies. This is because the understanding of nature remains unchanged or has even reached its extreme. Indeed, the development of the concept of sustainability shows that nature cannot be fully controlled, and the depletion of resources will lead to a crisis. Heidegger foresaw something that had not yet emerged because there was no solid ground for sustainability during his time. The need for 'sustainability' paradoxically increased significantly, particularly with the rise of neoliberalism.

Adorno and Horkheimer (2014: 20) begin their critique of modernity with the dominance of instrumental reason, stating, 'What humanity sought to learn from nature was how to use nature entirely to master nature and, through it, other human beings.' Neil Smith criticizes the representatives of the Frankfurt School in this context and suggests that 'nature production' might be a more suitable term than 'nature domination.' According to Smith (2023: 138), this school's fundamental thought can be interpreted as 'dominating nature as an inevitable dimension of the human-nature relationship.' Smith argues that this school's opposition to nature domination is not a dialectical necessity but a 'choice.' The problematic aspect of these ideas is that they do not leave room for any other political alternatives apart from two: a 'nature-against-society' policy and accepting a gentle domination.

Here, there is no need to delve into a political direction, and since the core issue is the critique of sustainability, it is necessary to focus on the important criticisms by Neil Smith. In this regard, a specific examination of Smith's political economy-based criticisms is required. The ongoing exploitation of nature is examined as a factor of 'green capitalism,' particularly when it comes to the commodification and marketization of nature. Neil Smith, in his article 'Nature as Accumulation Strategy,' addresses the problems of the commodification and marketization of nature. According to Neil Smith (2023: 127), 'Green capitalism' goes far beyond the mere alleviation of capitalist exploitation; it is a deep strategic ecological commodification process developed by capital for the stable, intense, and continuous exploitation of nature. It is essential to note that this ecological commodification is not coincidental, nor is it a mere consequence of well-intentioned environmental laws. This approach is crucial in making the commodity markets and the banking sector work. As Smith (2023: 131) expressed, the development of ecological commodity markets is neither coincidental nor simply an unintended consequence of well-meaning environmental regulations. As Morgan M. Robertson has observed, the commodification and integration of such markets into the realm of banking are crucial to create new and stable opportunities for capitalist activities.

As seen, environmental movements, legal efforts, and protocols are not made solely for the betterment of nature. Due to neoliberalism's private market economy, it is distant from social planning, and, for this reason, it would process any part valued by society into a commodity. In this era where everything is buyable and sellable, even the smallest element is processed into something useful for the market. The steady exploitation of biodiversity to carbon emissions, everything is turned into a useful asset for the market. This approach makes nature an energy and capital field. Therefore, it is crucial to protect it. The qualified exploitation of nature leads to its 'sustainability.' Sustainability implies that nature cannot be consumed as a regular area; it must be 'sustainable' for the market. This issue is primarily related to the rise of neoliberalism. Smith (2023: 127-128) provides an example of wetlands. According to Smith, after understanding the socio-economic value of wetlands, the George W.H. Bush administration introduced a series of laws to protect these environments. Although Bush embraced an 'environmentalist' principle, he also introduced wetland credits, which is an example of ecological commodification. This attitude is significant because it parallels Heidegger's ideas. Nature's sustainability in this sense is essentially the market's sustainability. Nature becomes an energy and capital field, and this is why it needs to be protected. Furthermore, as mentioned earlier, being 'ecological' is not merely about being 'environmental.' Ecology has three dimensions: environmental, social, and mental. Neil Smith (2023: 132) argues that the sustainable environmentalism of 'green capitalism' overlooks important aspects beyond the environmental one. Thus, 'green capitalism' is not just about greenwashing environmental concerns; it is about making nature's exploitation continuous and stable. It does not address the 'social' aspects that remain beyond environmental ones. The main point here is that 'social' remains beyond the scope of 'green capitalism.' It is essential to remember that being 'ecological' does not equate to being 'environmental' only.

2.4. Section Evaluation

In conclusion, this work delves into the dimensions of the greenwashing developed under the guise of sustainability. It examines the processes that lead sustainability towards "greenwashing" and aims to demonstrate that the problem is deeply entwined with the concept of "nature." The relationship between the concept of nature and economic domination is explored, tracing the path to the ecological commodification of nature. Based on all these discussions, it is essential to recognize that this limited and deceptive pseudo-ecological approach points to a process in which everything valued in society becomes commodifiable and marketable. Looking at these interpretations, greenwashing can also be seen as an exploitation of societal sensitivity for the benefit of the market. However, beyond this, green capitalism renders nature useful for endless exploitation. Deceptions like greenwashing fall short of conveying the enormity of the issue; in fact, "nature" is being produced for capital. In light of these considerations, this study, undertaken to shed light on these matters, has significant implications for architecture as well. From an architectural perspective, approaches that assess sustainability within the green capitalist paradigm, driving it towards greenwashing, neglecting social and large-scale economic dynamics, focusing on singular rather than holistic working domains, and working in isolation from context should undergo critical scrutiny.

3. MATERIAL AND METHOD

3.1. Case Study Selection

Considering the energy consumption rate of buildings in the world and in Turkey, it has been determined that buildings have a significant impact in the context of measures to be taken against the environmental crisis. Within total energy usage, buildings account for the most substantial portion, comprising around 34% in Turkey and 40% globally. This emphasizes the significance of prioritizing energy efficiency initiatives targeted at buildings (URL-9). In this direction, a guide for developments specific to public buildings in Turkey has been prepared in 2020 by the Ministry of Environment, Urbanization and Climate Change. In the process of creating Guide To Energy Efficient Renovation of Public Buildings (Kamu Binalarinin Enerji Verimli Yenilemesine Yönelik Rehber) by conducting energy simulations in actual buildings, representative "specific energy consumption" figures were established for the regions of Antalya, Istanbul, Ankara, and Erzurum (chosen to typify the climatic zones outlined in the "TS825 Standard for Thermal Insulation Regulations in Building"), as well as for various architectural categories. The resultant reference values from these computations are provided in Table 3.1.

Table 3.1. Total specific energy consumption of different building types (kWh/m²year) (URL-9)

Building Category	Scenario	Building Shell Thermal Properties	Climate Zones: Antalya	İstanbul	Ankara	Erzurum	Notes
Gym	I	Non-isolated case	327	365	458	384	Single-storey, 600 m^2 gym building.
	II	Case conforming to TS825	271	307	386	312	
	III	High performance	232	272	300	240	
Apartment (Dwelling)	I	Non-isolated case	102	174	270	422	5 floors, 16 flats, 1000 m^2 residential block.
	II	Case conforming to TS825	74	108	145	192	
	III	High performance	54	85	116	155	
Office Building	I	Non-isolated case	203	265	354	468	3 floors, 23000 m^2, office building.
	II	Case conforming to TS825	163	194	234	278	
	III	High performance	114	133	154	171	

Table 3.1. (continued) Total specific energy consumption of different building types (kWh/m²year) (URL-9)

Primary school	I	Non-isolated case	72	148	225	317	Typical primary school with 4 floors and 3700 m^2.
	II	Case conforming to TS825	53	84	108	138	
	III	High performance	38	49	57	71	
Faculty Building	I	Non-isolated case	118	176	242	326	19200 m^2 faculty building with 3 floors, office spaces and classrooms.
	II	Case conforming to TS825	96	126	161	202	
	III	High performance	67	78	90	120	
Hospital Building	I	Non-isolated case	313	371	481	608	5-storey, 100000 m^2 full-fledged hospital building.
	II	Case conforming to TS825	284	321	405	497	
	III	High performance	255	270	337	412	
Swimming pool and social facility complex	I	Non-isolated case	320	403	523	519	2-storey 5800 m^2 building with swimming pools and social areas.
	II	Case conforming to TS825	265	303	335	342	
	III	High performance	237	260	281	271	

Table 3.1 shows that energy consumption amounts for different building types vary in different climate regions along with observed changes in building envelope usage. The shifts in usage are analyzed to identify which climate region and building type would experience more significant reductions in energy consumption. According to this analysis, the highest potential for energy savings seems to be achievable in a cold climate region within an office building. Additionally, in temperate-humid and temperate-dry climate zones, it is noticeable that the energy use of a swimming pool and social facility complex can have a substantial impact on reducing energy consumption of the building envelope. However, it has been determined that an office building located in hot-humid, mild-humid, and mild-dry climate regions also has a notable influence, ranking second in terms of impact after swimming pool and social facility complexes. In conclusion, across all simulated climate regions, office buildings are generally inferred to have the most significant potential impact, and the possibilities of reducing energy consumption in relation to changes in building envelope usage are illustrated in Table 3.2. The most substantial changes in energy consumption for each climate region are indicated, marked by the first and second largest percentage changes.

Table 3.2. Reduction of energy consumption by using the building envelope at high performance in various climatic zones

Building Category	Climate Zones				Notes
	Antalya (Hot-Humid)	İstanbul (Temperate-Humid)	Ankara (Temperate-Dry)	Erzurum (Cold)	
Gym	95	93	158	144	Single-storey, 600 m^2 gym building.
Apartment (Dwelling)	48	89	154	267	5 floors, 16 flats, 1000 m^2 residential block.
Office Building	89	132	200	297	3 floors, 23000 m^2, office building.
Primary school	34	99	168	246	Typical primary school with 4 floors and 3700 m^2.
Faculty Building	51	98	152	206	19200 m^2 faculty building with 3 floors, office spaces and classrooms.
Hospital Building	58	101	144	196	5-storey, 100000 m^2 full-fledged hospital building.
Swimming pool and social facility complex	83	143	242	248	2-storey 5800 m^2 building with swimming pools and social areas.
The largest energy usage change (dark grey: Gym–Antalya 95, Office–Erzurum 297, Swimming pool–İstanbul 143, Swimming pool–Ankara 242)			Second largest energy usage change (light grey: Apartment–Erzurum 267, Office–Antalya 89, Office–İstanbul 132, Office–Ankara 200)		

The Table 3.3. presents the “total specific energy consumption” figures, which were computed by the Ministry of Environment, Urbanization and Climate Change using invoices from certain buildings that underwent thorough energy assessments. These consumption values are compared with the data provided in Table 3.2. to assess the presence of energy efficiency possibilities. Notes in the table elaborate on the evaluations made based on the comparison, indicating whether energy efficiency potential exists or not. Buildings with high energy efficiency potential are marked in Table 3.3. It has been determined that the majority of the buildings with high potential in this direction are office buildings. Even though the other types of buildings, for which detailed energy studies have been made, are suitable for development in terms of being energy efficient, it can be claimed that those with high potential are at a more critical point and have priority.

Table 3.3. Energy efficiency potential of studied buildings (URL-9)

Type of Building	Location of the Building	Area of the Building (m^2)	Year of Building	Total Specific Energy Consumption from invoices (kWh/m^2year)			Notes
				Electricity	Natural gas	Total	
Office building	Ankara	142000	2015	64	78	142	Consumption is normal, energy efficiency increase potential is low
Office building	Ankara	7500	1998	83	153	236	Consumption is high, energy efficiency increase potential is high
Office building	Ankara	28000	1981	74	142	216	Consumption is high, energy efficiency increase potential is high. Also there is no ventilation.
Hospital	Trabzon	18000	2000	110	193	303	Consumption is acceptable, but there is potential for energy efficiency improvement.
University buildings	Ankara	70000	2016	174	200	374	Consumption is high, energy efficiency increase potential is high
Health clinic	Urla	460	1985	40	55	95	There is only heating and lighting. There is potential for energy efficiency improvement.
Office building	İstanbul	16000		69	65	134	Consumption is normal but no ventilation.
Sports center complex	İstanbul	23200		90	140	230	Consumption is normal, energy efficiency increase potential is low
Sports center complex	İstanbul	14000	2007	127	304	431	Consumption is high, energy efficiency increase potential is high
Office building	İstanbul	24000	2000	190	117	307	Consumption is high, energy efficiency increase potential is high
Dormitory building	Ankara	8000	1989	131	209	340	There is only heating and lighting. Energy efficiency increase potential is high

Table 3.3. (continued) Energy efficiency potential of studied buildings (URL-9)

High school building	Samsun	12700	1973	15	63	78	There is only heating and lighting. There is potential for energy efficiency improvement.
High school building	Bolu	10500	1964	13	102	115	There is only heating and lighting. There is potential for energy efficiency improvement.
Primary school	Ankara	4000	1995	15	54	69	There is only heating and lighting. Energy efficiency increase potential is low
Museum building	İstanbul	7000	1983	44	39	83	There is only heating and lighting. Energy efficiency increase potential is low
Library building	KKTC	3500	2005	71	0	71	There is only heating and lighting. Energy efficiency increase potential is low
Office building	Ankara	10000	2014	85	55	140	Consumption is normal, energy efficiency increase potential is low
Office building	Ankara	32000	2015	184	172	356	Consumption is high, energy efficiency increase potential is high
Office building	Ankara	20500	2010	158	92	250	Consumption is high, there is potential for energy efficiency improvement.
High energy efficiency potential							

Significant human engagement within office premises during work operations leads to considerable energy usage. As a result, the assessment of office buildings through the lens of sustainable architecture gains significance due to its relevance to implementing this concept effectively. When the buildings that have been studied in Turkey are examined, it can be deduced that the energy efficiency of office buildings would have a significant contribution in the context of sustainable architecture. Considering large number of people and their long-term use, it could be said that the application of sustainable architectural strategies in office buildings can provide improvements in both energy use and indoor comfort. In addition to obtaining an efficient working environment in offices where people spend a significant part of day, energy use can be reduced which promotes sustainability.

LEED: Building Design and Construction (BD+C) and Office Buildings

In order to test the environmental design strategies developed within the context of the climate regions existing in Turkey for structures claimed to be environmentally sustainable, it has been deemed necessary to focus on office buildings as a sample selection. To constitute the sample set for this office structure, buildings that have been awarded the highest level of the globally recognized LEED (Leadership in Energy and Environmental Design) certification, namely LEED Platinum, were identified. This selection aims to evaluate the environmental design strategies within the context of Turkey's climatic regions.

In Turkey, 73 buildings that are currently eligible for LEED Platinum have been identified as of December 2023. It was observed that these 73 buildings were taken in different LEED categories like building design and construction, interior design and construction, building operations and maintenance, etc. (Figure 3.1.).

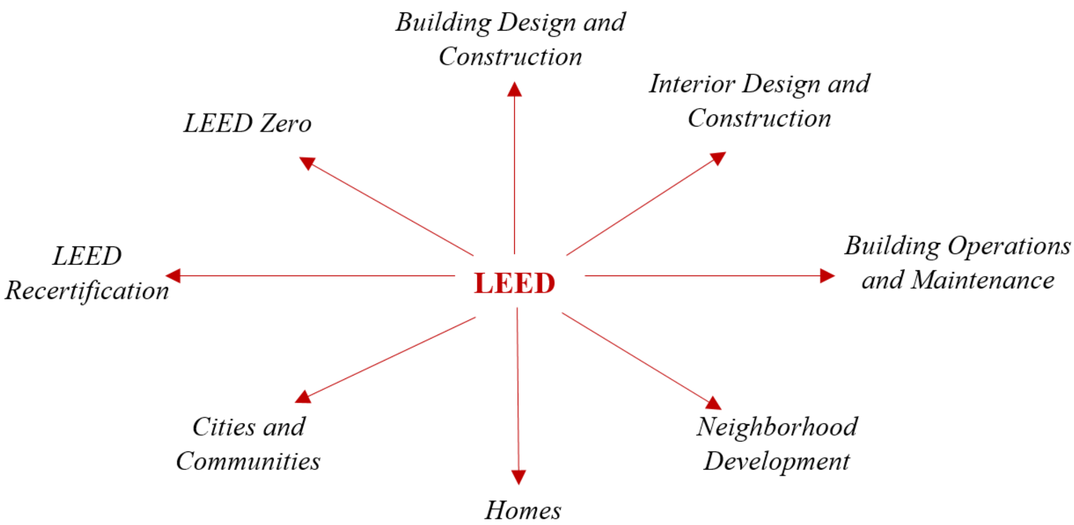


Figure 3.1. LEED for various building types and building phases (URL-10)

Considering that a larger impact can be made on a building designed from the very beginning of the architectural design process, among these categories, platinum certificate winners were determined in the category of Building Design and Construction (BD+C). In this case, it is observed that 53 of 73 buildings with platinum certificates are evaluated within Building Design and Construction. Within the subheadings of Building Design and Construction category, including new construction and major renovation, core and shell development, data centers, healthcare, hospitality, retail, schools, warehouses, and distribution centers, it was deduced that the most suitable choice is "New Construction and Major Renovation." This inference was made based on the objective of analyzing office buildings. Following this deduction, it has been observed that out of 53 certified buildings within the context of building design and construction, 24 of them are categorized under “New Construction and Major Renovation."

Turkey's climatic regions and office buildings

Distinct climatic zones necessitate distinct design methodologies, demanding a precise comprehension of climatic parameters such as solar radiation, precipitation, wind patterns, and humidity. Various climate types are observed in Turkey. These climate types are classified as hot-humid, hot-dry, temperate-humid, temperate-dry and cold (Figure 3.2.).

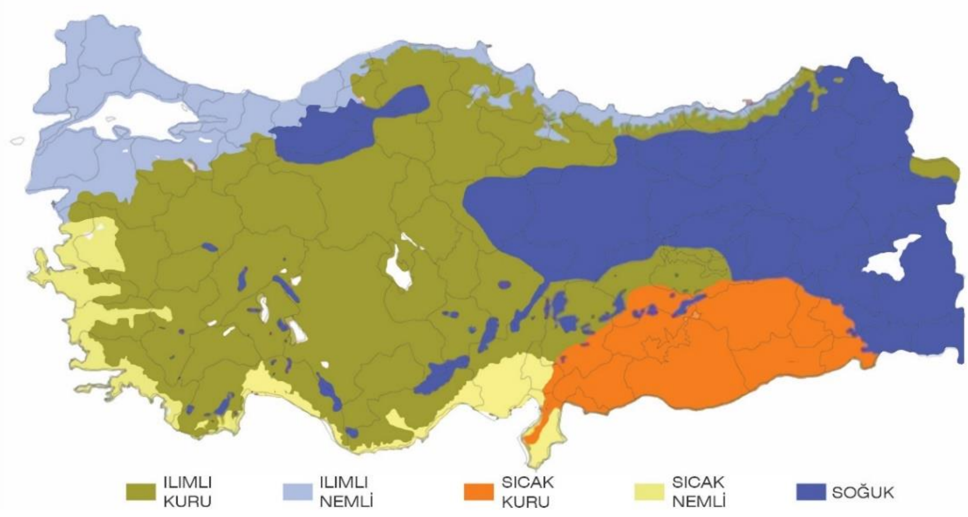


Figure 3.2. Climate zones in Turkey (Zeren, 1978)

According to Göksu (1999), the characteristics of the five climate zones marked on the map are as follows:

- Cold Climate Zone: The region experiences a minimum average temperature of approximately -20ºC. During summer, precipitation comes in the form of rain, while in winter, it falls as snow. Snowfall typically commences in October and continues until mid-May. In contrast, summers are brief and mild, with low rainfall and relative humidity. The harsh climatic conditions are further intensified by the impact of strong winds.

- Temperate-Humid Climate Zone: It is characterized by a small temperature difference between summer and winter months, providing conditions closest to human comfort. However, variations in temperature can occur depending on factors like altitude and proximity to the sea. Precipitation is spread across the seasons, typically concentrated in January, February, and June. The hottest periods usually fall in July, August, and September. The key characteristic of this climate is its abundance of precipitation and high humidity levels.
- Temperate-Dry Climate Zone: In moderately dry climatic regions, there is a significant temperature contrast between daytime and nighttime. The average outdoor temperature fluctuates between +30ºC and -5ºC. This temperature variation is primarily influenced by the presence of mountains, which hinder the cooling effect of the sea during summer and the warming effect during winter, rather than the altitude itself. Consequently, summer nights are refreshingly cool with temperatures averaging between 27-37ºC, while winters see milder temperatures ranging from 8-15ºC.
- Hot-Dry Climate Zone: It experiences scorching and arid summers, with average high temperatures reaching approximately 40 ºC. Winters, on the other hand, are cold. The yearly average temperature settles at 16.4 °C, and the relative humidity hovers around 53.6%. This climate exhibits a considerable disparity in radiation and temperature between summer and winter, as well as between day and night. Summers witness limited precipitation, resulting in low cloud cover and humidity levels. Additionally, the region experiences dry and powerful winds during certain periods of the year.
- Hot-Humid Climate Zone: It is characterized by significant attributes such as abundant rainfall, high humidity, and elevated temperatures. There is a minor contrast in temperature between summer and winter months. During winter, the region experiences considerable rainfall. Additionally, prevailing winds or air currents between the sea and land, particularly over mountainous terrains, contribute to the desirable characteristics of this climate zone.

When these 24 buildings are classified according to Turkish climate regions, it is deduced that 11 are located in the temperate-humid climate region, 9 in the temperate-dry climate region, 2 in the hot-humid climate region, 1 in the hot-dry climate region, and 1 in the cold climate region (Figure 3.3.).

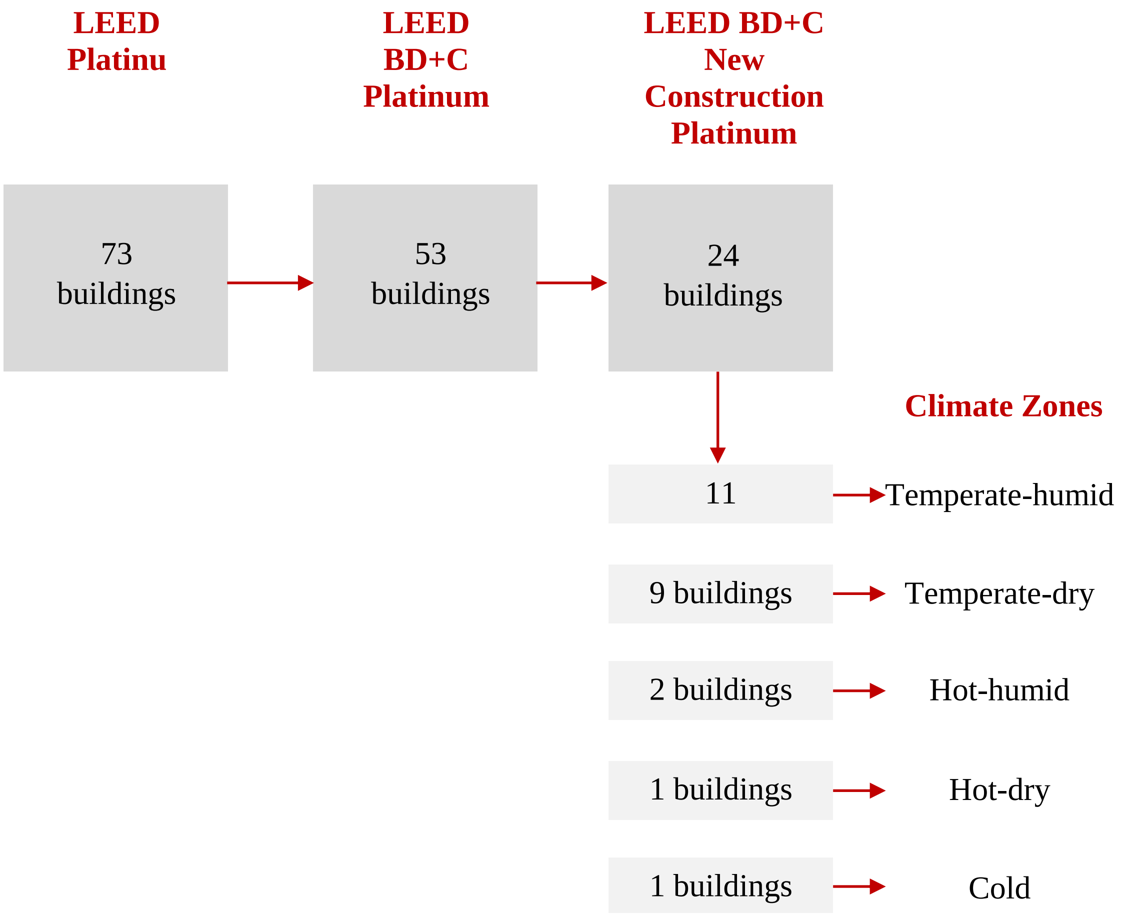


Figure 3.3. Categorization of buildings with LEED Platinum certificate

Considering LEED Platinum certified new constructions according to climate zones, it can be said that in comparison to temperate climate conditions, hot-humid, hot-dry, and cold climate conditions exhibit more extreme ranges of minimum and maximum temperatures, hence posing challenging conditions. Due to these conditions, factors like heating-cooling loads and indoor comfort conditions of buildings in these climate types are significantly affected. Therefore, it can be argued that compliance alignment with environmental design strategies in line with passive design are more critical for buildings in these regions. A total of 4 buildings are identified in these climate zones. These buildings are listed in Table 3.4.

Table 3.4. Four buildings with LEED Platinum certificate in hot and cold climate zones

Building name	Climate zone	Area of the building
Building A	Hot-humid	1948 m^2
Building B	Hot-humid	440 m^2
Building C	Hot-dry	311.6 m^2
Building D	Cold	3970 m^2

In Table 3.4., it has been observed that among the 4 LEED Platinum certified structures, Building B and Building C buildings are relatively smaller in terms of area, with office use being less prominent. Therefore, Building A building stands out for analysis due to their larger areas that accommodate office functions for a significant number of users. Consequently, Building A, being better suited for examining compliance with passive design, has been selected.

The work aims to analyze the Building A, located in hot-humid climate zone of Turkey, from a passive design perspective. The analysis focuses on evaluating the building’s performance against the bioclimatic conditions of hot-humid climate, and has highlighted the significance of assessing the project’s success in achieving LEED Platinum certification, especially in its climate-sensitive design. The analysis also aims to prioritize identifying any shortcomings or inadequacies in the passive design compliance. The work aims to emphasize the importance of identifying both appropriate and inappropriate aspects of the project about passive design based on the local climatic conditions.

3.2. Case Study (Building A)

In the year 2017, a competition by invitation was arranged for the creation of Building A in hot-humid climate zone of Turkey. The purpose of the building was to accommodate an archive, a museum (exhibition space), and administrative offices. As per the guidelines specified in the program, the archive segment was designed, the museum was intended to showcase visually significant materials, including historical equipment, and the offices were meant to serve the needs of pertinent maintenance divisions. The chosen project resulting from the competition, deemed to have merit, was to be built following international standards for energy-efficient and environmentally friendly construction.

An aluminum perforated shell surrounding the building is used adjacent to the walls in the north and west directions, and at a greater distance in the south and east directions. crucial in creating inner gardens and green spaces. This shell serves as a sunbreaker during the day to ensure a comfortable working environment in the office spaces. It contributes to facade lighting by transmitting interior illumination to the outside during the night.

The design incorporates green courtyards within the building, fostering air circulation and providing resting and fresh air areas for office staff. The green roof area on the building's interior is transformed into a versatile space with seating areas for various events and celebrations. At the core of the interior, there are inner gardens and side gardens adjacent to the building's perimeter. These gardens are purposefully designed to provide natural light, illumination, and a comfortable working environment. Additionally, pools are integrated into these gardens, offering areas of relaxation and respite for office employees.

Examining the interior spaces of the building on the ground floor plan, there is a conference hall, an exhibition and museum area, and office spaces. The design of the reception, office, and museum area follows an open plan approach, where interconnected spaces seamlessly flow into each other, forming an outward-facing steel structure. In this specific part of the building, the spaces are designed with glass facades that allow the interior to be showcased. In contrast, the archive section is constructed as a self-contained reinforced concrete structure, characterized by a closed appearance. The museum is exclusively outward-facing in its design, while the office spaces are sometimes self-contained and at other times designed with an open layout. These spaces, along with the archive section that is fully self-contained, come together to create a unified entity within a single structure. The foyer area acts as a transitional space shared by both open and enclosed functions.

In the first floor plan, there are office spaces, a meeting room, a kitchen, and a versatile rooftop garden. This rooftop garden is designed to serve as a relaxation area for upper-floor offices and can also function as a multipurpose meeting space for various celebrations and events as needed. The presence of photovoltaic panels on the roof plays a significant role in meeting the building's energy requirements. The building, which accommodates a range of functions, is constructed with an entirely white, partially permeable, and dynamically designed exterior shell. The dynamic characteristics of this shell, which can move away from and toward the building as well as ascend and descend, result in the creation of gardens and communal spaces in the cross-sectional area where the facade and shell intersect.

The archive, designed as a self-contained space, is constructed with reinforced concrete. The offices are designed to showcase the internal steel structure with transparent glass facades, creating a dynamic interplay of light and space. The museum serves as a meeting point and foyer, seamlessly connecting the archive and office spaces. This design choice promotes the flow of movement within the Building, enhancing connectivity and functionality.

3.2.1. Zoning and activities

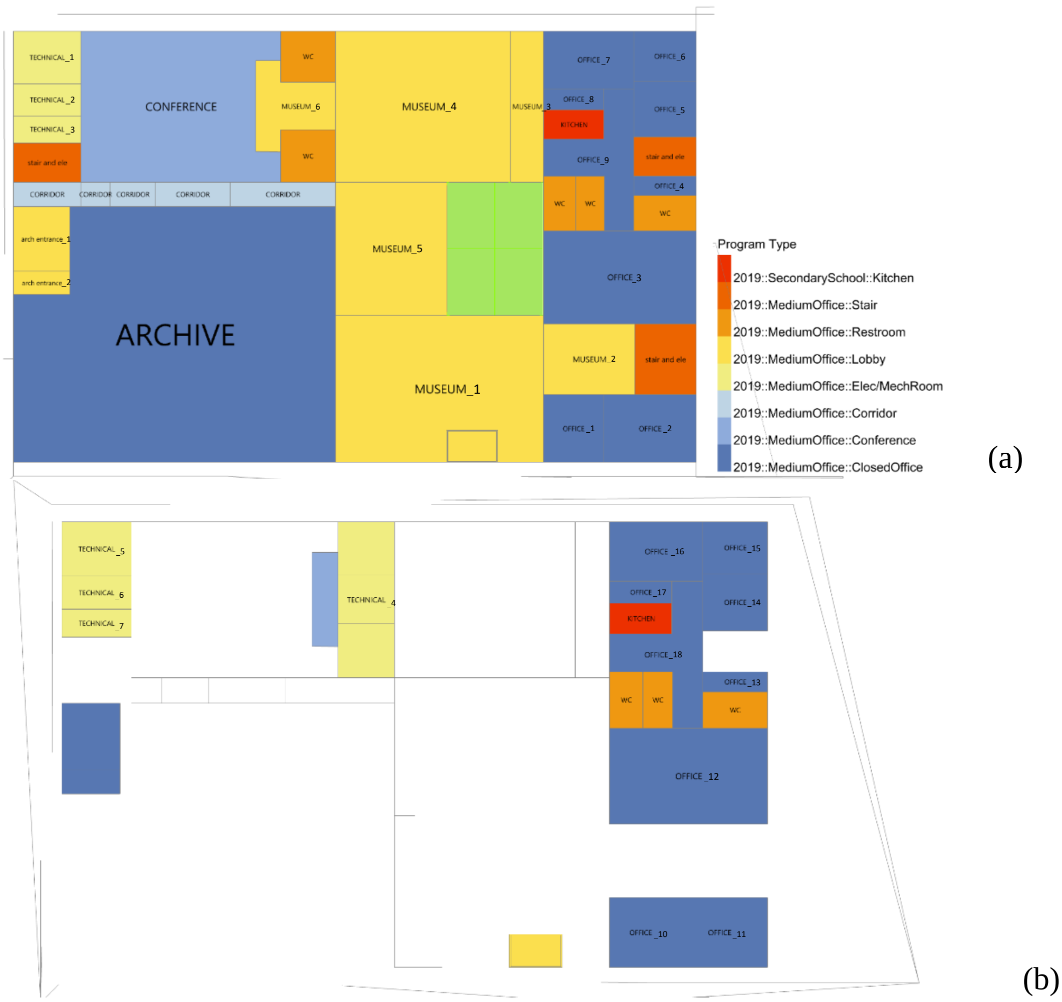


Figure 3.4. Thermal zones of the building a) ground floor plan b) first floor plan

Figure 3.4. shows that a model is created by modeling thermal zones based on their activity. In this project, the construction details for the glazing system stand out as a pivotal component. While other constructions rely on the ASHRAE 90.1 2019 library, it is essential to note that the green roof has been excluded from this particular analysis.

The glazing system is characterized by silver-colored Insulating Glass (6 mm TRC Tentesol / TRC Tentesol T + 6 mm TRC Ecotherm Low-E coated). This system exhibits a solar permeability of 46% and boasts a U (Thermal et al.) of 1.1 W/m²K. These attributes make it an ideal choice for effectively controlling heat and sunlight, contributing significantly to the project's energy efficiency and thermal performance. For the primary construction elements, specific details are outlined in Table 3.5.

Table 3.5. Main building components

Component	Detail
Window	U- 1,1 W/m^{2}K, SHGC- 0,46, Visible transmittance- 0,7
Roof (green)	Concrete Slab, U- 0,63 W/m^{2}K
Roof	Concrete Slab, U- 0,8 W/m^{2}K
External Wall	Concrete block + R8, U- 0,76 W/m^{2}K
Internal Wall	Gypsum board + air gap, U- 2,1 W/m^{2}K
Floor	Concrete Slab, U- 1,15 W/m^{2}K

While the green roof is not explicitly addressed in this analysis, the construction details presented here offer a comprehensive view of the materials and their respective attributes that contribute to the project's overall energy efficiency and thermal comfort. These choices have been carefully considered to align with the specific needs and climatic conditions of hot-humid climate zone.

The HVAC (Heating, Ventilation, and Air Conditioning) system in the Building A is designed to emphasize energy efficiency and environmental sustainability. The system is based on a heat pump configuration that utilizes water as a heat source or sink, offering heating and cooling capabilities for the building. This design choice significantly enhances efficiency while minimizing electricity consumption and emissions compared to conventional boiler and chiller systems.

The selected HVAC template from the Ladybug Tools library features a DOAS (Dedicated Outdoor Air System) with water-source heat pumps, a fluid cooler, and a boiler. This configuration allows for the efficient exchange of thermal energy between the building and the environment, ensuring comfortable indoor conditions throughout the year.

It is important to note that the control system in the model has not been considered in this analysis because the analysis is based on passive design. Nevertheless, it is worth mentioning that the building is equipped with a smart control system. This system is designed to continually monitor and adapt various environmental parameters in individual rooms, including temperature, humidity, lighting, and ventilation. These adjustments are made in response to occupancy, weather conditions, and user preferences.

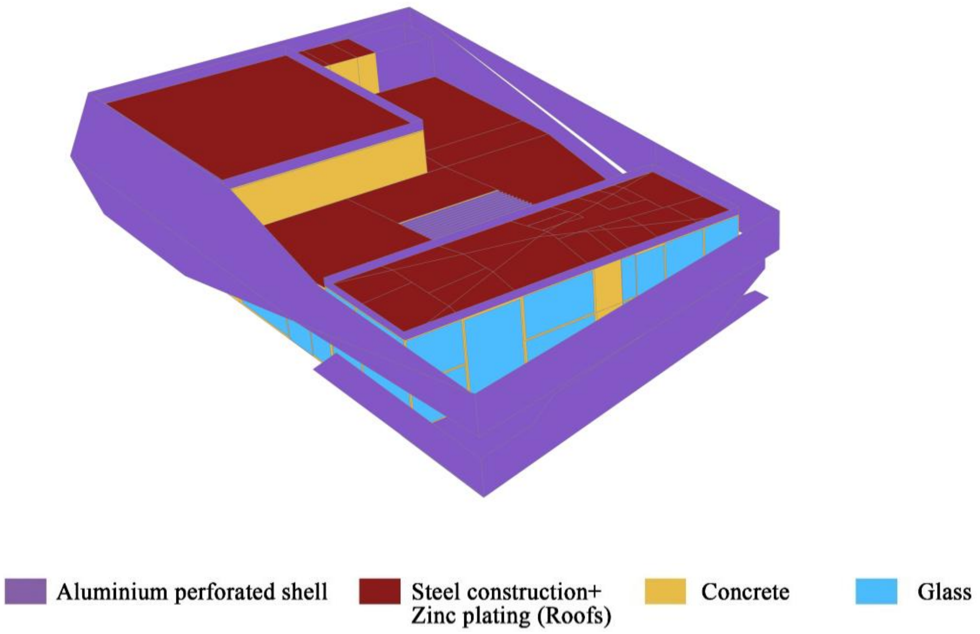


Figure 3.5. Thermal model of the building view (by author using Ladybug)

3.2.2. Thermal zone

As the materials of the building components are set, the next step is to set the thermal properties of each room. In thermal analysis, this is called the "thermal zone". A "zone" is an area of a building where the temperature is controlled by a single thermostat in the design of heating, ventilation, and air conditioning (HVAC) systems. This is not the same as a single space or room. For example, a small house in which thermal demand is relatively constant throughout might be controlled by a single thermostat, and so be considered a single zone. There may be multiple zones in a more complex, larger building with significant differences in thermal demand.

The various zones within the building can be grouped into several categories, each characterized by similar functions and programs—the value of each program extracted from ASHRAE 90.1 2019.

1. Public Areas and Lobbies (e.g., museum) serve as the public-facing spaces of the building, including lobbies and entrances. They are designed for welcoming visitors and may include exhibition areas or gathering spaces.
2. Technical and Equipment Rooms (e.g., technical rooms) house electrical and mechanical equipment, making them critical for the building's infrastructure and operations.
3. Conference Rooms and Meeting Spaces (e.g., conference) are intended for meetings, presentations, and collaborative activities, often featuring audio-visual equipment and seating arrangements suitable for group discussions.
4. Archive and Closed Offices (e.g., archive and office rooms) are primarily for individual or group office spaces. Archives are for storing documents or records and may require specific environmental conditions.
5. Restrooms provide restroom facilities for building occupants and visitors.
6. Corridors provide circulation and access to various zones within the building.
7. Kitchen is equipped for food preparation and cooking activities, typically in cafeterias or kitchenettes.
8. Stairwells and Elevator Areas are designed for vertical circulation within the building, primarily accommodating stairs and elevators.

By grouping the zones based on their functions and programs, managing and controlling the building's environmental conditions and energy usage becomes more convenient, as similar zones often have analogous heating, cooling, and ventilation requirements.

3.2.3. Building assessment

Building A, a prestigious LEED Platinum certified building, represents an exemplar of sustainable architecture, emphasizing the integration of passive design to enhance energy efficiency and environmental consciousness. These strategies encompass an array of elements, including natural ventilation, daylighting, green roofing, and solar panel installations.

One of the noteworthy features of this building is its aluminum perforated shell enveloping the entire structure. This architectural innovation creates intermediary spaces that bridge the realms of the interior and the exterior. The shell, as a dynamic shading device, serves a dual purpose - blocking direct sunlight to mitigate heat gain, while facilitating the influx of natural light and fresh air into the building.

Additionally, Building A boasts an inner courtyard that seamlessly links the office and exhibition areas. This green courtyard also functions as an integral component of the natural ventilation system. By fostering air pressure differentials, the courtyard enhances air circulation within the building.

However, despite the remarkable achievements of passive design, there are challenges and potential deficiencies that warrant attention:

Figure 3.6. Building elements related to sustainability

1. Aluminum Perforated Shell: The aluminum perforated shell's effectiveness in preventing overheating or glare may be compromised, particularly during the scorching summer months when outdoor temperatures and solar radiation peak. Unintended reflections or shadows created by the shell could impact visual comfort and interior quality.
2. Natural Ventilation: The natural ventilation system, while commendable, may face limitations in certain seasons or adverse weather conditions. For instance, during the winter, when outdoor temperatures are low and winds are strong, the system's efficacy might diminish. Furthermore, introducing noise, dust, or pollutants from the external environment raises concerns.

3. Green Roof: The green roof's sustained performance and longevity require regular maintenance and irrigation efforts. This additional upkeep may also place an increased structural load on the building and elevate its water consumption, potentially affecting overall sustainability.
4. Photovoltaic Panels: While incorporating solar panels aligns with renewable energy goals, their capacity to generate electricity might fall short of the building's energy demands, especially on cloudy or rainy days. The high initial costs and potential environmental impacts of solar panel installation merit careful consideration.

Although the LEED Platinum certification currently highlights the Building A's competence in various sustainable areas, it should be questioned whether the building is suitable for its context without technically advanced equipment. A comprehensive evaluation of these passive design efforts and their potential deficiencies through simulation and performance analysis is vital to ascertain the building's alignment with sustainability objectives. In this context, detailed simulations can offer insights into the real-world performance of these strategies, enabling the identification of areas for improvement and optimization.

3.3. The Method Used in the Work

In the next chapter the building is subject to examination within the ethical framework of sustainable architecture. Climate analyses for the building's location, specifically for hot-humid climate zone are conducted through the integration of literature-derived information and simulation analyses. Strategies tailored for the hot-humid climate region are identified based on literature-derived insights, and the building's adherence to these strategies is evaluated. These strategies encompass diverse facets, including the building's location, orientation, relationship with the immediate surrounding, form, envelope, spatial organization, openings, solar and ventilation control, material selection, and color usage. Subsequently, they are compared with climate-appropriate recommendations. Climate data for simulation analysis is sourced from applications like Climate Consultant, CBE Clima Tool, and LadyBug. Appendix-1, 2, 3, 4, 5 provide outdoor temperature analysis, monthly heating and cooling degree days, relative humidity analysis, and wind analysis. The simulations, incorporating these analyses, employ passive design applications to evaluate the building's performance, encompassing glare, annual daylight, heat island, Computational Fluid Dynamics (CFD), and indoor thermal comfort analyses. Both assessments consider the hot-humid climate, local climatic conditions, and the building's responsiveness to these factors. This comprehensive analysis is substantiated with literature-derived insights and computer programs.

3.4. Section Evaluation

In the process of selecting a case study, the studies and analyses conducted by the Ministry of Environment, Urbanization, and Climate Change have been utilized. Based on these studies, it is inferred that office buildings have a higher energy efficiency potential compared to other building typologies. Accordingly, in Turkey, office buildings that have earned the highest level of the globally recognized and symbol of sustainability, LEED Platinum certification, have been identified.

In Turkey, it has been observed that there are 73 office buildings that have earned LEED Platinum. Subsequently, various categories of LEED were examined, and among them, the Building Design and Construction (BD+C) category was deemed more suitable architecturally. In this category, 53 office buildings were identified as Platinum certified.

Among these, it has been determined that 24 of them fall under the Building Design and Construction (LEED BD+C) project type, New Construction, and Major Renovation category. Examining these 24 buildings across diverse climate zones reveals pronounced challenges in hot-humid, hot-dry, and cold conditions compared to temperate climates. These regions experience extreme temperature variations, significantly affecting factors like heating-cooling loads and indoor comfort conditions. Emphasizing environmental design strategies with passive design compliance is crucial for buildings in these climates, with four identified within these climate zones. Building A, located in the hot-humid climate region, has been selected as a case study due to its larger size compared to other examples in the field, carrying a high energy efficiency potential.

In the next section, particular emphasis is placed on the context for preserving interaction and communication in the discourse on the ethical dimension of sustainable architecture. Accordingly, the focus is on foregrounding the contextual aspects and on environmental design strategies that contribute passive design. This analysis is considered essential for scenarios wherein a building can maintain its self-sufficiency even in the absence of intensive technical support.

4. ANALYSIS AND EVALUATION

To analyze the passive design compliance of the building two different analysis are carried out. Firstly, an analysis according to the strategies obtained from literature as environmental design criteris is examined. Environmental design strategies inferred from the local studies is utilized to check the building's suitability for passive design that have been studied. Furthermore, alongside the environmental design strategies, a comprehensive analysis is conducted with the support of simulation programs like LadyBug, Climate Consultant, and DesignBuilder. This analysis specifically focuses on evaluating the passive design compatibility used in the building according to both local studies and simulation programs.

Analyzing certain issues to predict the positive or negative effects that a building could have on its environment throughout its life cycle is essential. From the moment the building is designed, the entire life cycle must be taken into account and all possible factors must be addressed within this life cycle. At the beginning of the process, sustainable design requirements should be questioned, and then the relevant design should be tested with the necessary modeling and simulations, and improvements should be made in accordance with the53dentifyed deficiencies by making predictions for the future. The key essence for genuine architectural sustainability lies in designing buildings that respect and minimally disturb the Earth's systems. Sustainable buildings are those that maximize the efficient utilization of material resources and energy throughout their entire life cycle, while also minimizing waste. Any unavoidable waste should be handled through reuse, recycling, or environmentally responsible disposal. This comprehensive approach to sustainability means addressing the challenge in a holistic manner, rather than simply adding "green" features to otherwise environmentally harmful building types (Macdonald, 2018). This design process should be continued by considering the output obtained holistically and ensuring healthy and efficient communication with the people who will play a role throughout the life cycle of the building.

It can be observed that the integrated design approach would be more useful than the traditional design approach to handle the construction process holistically and direct it correctly when the differences between the two understandings are examined. The comparison of traditional and integrated design approach is shown in the Table 4.1.

Table 4.1. Traditional and integrated design approaches (URL-11)

Traditional Design Approach	Integrated Design Approach
The design process is linear.	The energy requirement of the building, environmental effects, use of natural resources and user relations are considered as a whole.
Team members are involved in the process when necessary.	Team members are completely in the process.
More decisions are made with fewer people.	Decisions are made with teams.
Cost is a priority.	In the life cycle, costs and benefits take precedence.
Each system is examined individually.	For a complete optimization, importance is given to the relations of the systems with each other.
There is less time, energy and cooperation in the early stage. Most of the time, business is conducted without communication with other business groups.	The interdisciplinary cooperation starts at the first step and the initial process of the project is long. In the process, the team receives information from each other, and the work is carried out.

Although there are many detailed parameters that need to be foreseen in the sustainable design process, these parameters can be grouped under the three main pillars of sustainability, namely, social, economic, and environmental sustainability. All three pillars of sustainability should be handled holistically by applying the integrated design approach in sustainable architecture as well (Figure 4.1.).

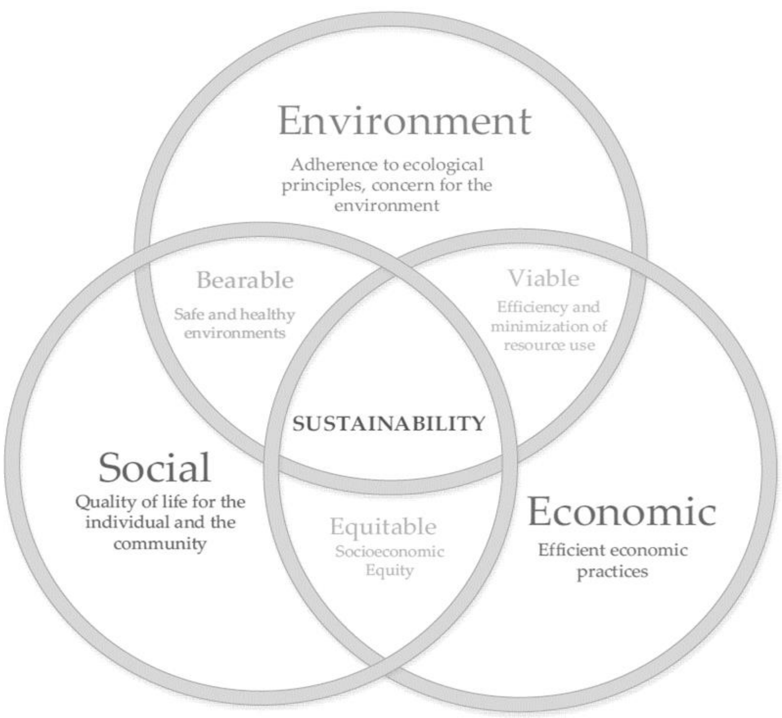


Figure 4.1. Three pillars of sustainability (Paredes and Herrera, 2020)

Social sustainability means designing and creating built environments that promote the well-being, inclusivity, and equitable access of communities, while fostering a sense of belonging and cultural identity. The current perspective suggests that the sustainability discourse has transitioned beyond focusing solely on ecological and environmental aspects and now encompasses social and economic dimensions. Consequently, the concept of "social sustainability" has emerged as an independent theme in this discussion (Turkington and Sangster, 2006: 184). It involves considering the social, cultural, and human aspects of the built environment and addressing the needs and aspirations of individuals and communities as a whole. Construction is a social process, and therefore, the social aspects of sustainability need to be given attention. They acknowledge that construction activities have significant impacts on society, and it is important to take into consideration the social implications during the design, planning, and production stages of construction projects (Zuo, Jin and Flynn, 2012). The social aspect of sustainability refers to the active support of current and future generations in creating healthy and livable communities. Socially sustainable communities are characterized by equity, diversity, interconnectedness, quality of life, democracy, governance, and maturity. These dimensions contribute to creating communities that are equitable, diverse, connected, democratic, and provide a good quality of life (Sijakovic and Peric, 2021).

Economic sustainability refers to designing, constructing, and operating buildings and urban environments in a way that maximizes their long-term economic viability and minimizes negative impacts on financial resources. It involves considering both the short-term costs and the long-term economic benefits associated with the built environment. It is very important to prioritize the costs associated with the construction of buildings. Environmentally sustainable buildings can undermine economic sustainability strategies if they do not consider cost-effectiveness. "Plus-energy houses", which most of the building owners cannot afford, should not be counted as examples of environmental sustainability (Maywald and Riesser, 2016). In scenarios where economic sustainability is ignored, social and environmental sustainability may also be damaged in the long or even short term. Building sustainable buildings at costs that the majority of the society cannot afford appeals to a certain segment of the society, and as long as it remains economically unaffordable for the rest, it will be inevitable for the building that claims to be sustainable to become a commodity. Considering the economic perspective, which is an important part of the sustainability process, due to the reasons mentioned above, and ensuring its economic sustainability plays a critical role. Therefore, it is important for sustainable architectural buildings to meet certain criteria in terms of economy for the entire period from the beginning of the design process to the end of the life of the building.

Environmental sustainability

This thesis aims to examine the example of Building A under the title of environmental sustainability. The primary focus of the analysis will be environmental sustainability. There are various reasons for this focus, including the significant share of the building sector in energy consumption, the undeniable and ongoing interaction of spaces with climate and the natural environment, and the fact that well-designed sustainability in spaces also supports the social and economic dimensions of sustainability. As Ministry of Energy and Natural Resources has reported (2017), the building sector has experienced swift growth in recent times. The sector's ultimate energy usage, which stood at 19,5 megatoe (Mtoe) in 2000, surged by 66%, reaching 32,4 Mtoe by 2015. With an average yearly energy demand rise of 4,4%, the building sector's contribution to total final energy consumption rose to 32,8%, surpassing even the industrial sector in Turkey (Figure 4.2.).

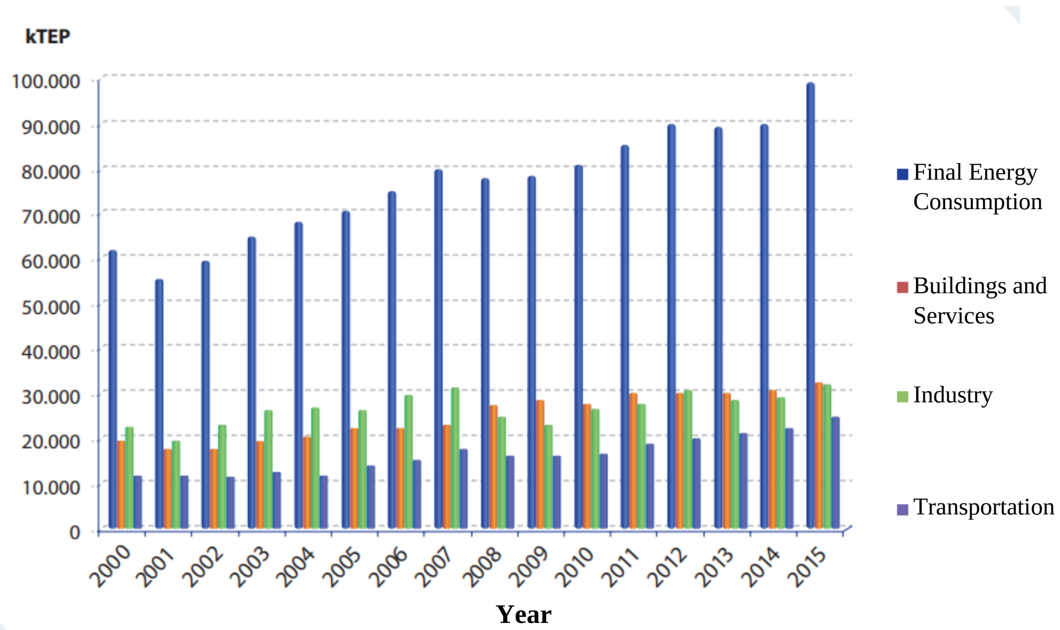


Figure 4.2. Change of sectoral energy consumption by years

Considering energy consumption rates, it can be seen that buildings designed appropriately in terms of architecture can contribute to environmental sustainability and be effective. For this reason, the effects of the environmental crisis can be reduced with building design suitable for environmental factors. Environmental design strategies in architecture refer to the strategies and considerations that aim to create environmentally sustainable and ecologically responsible buildings. These strategies take into account the impact of buildings on natural resources, ecosystems, and human health, and seek to minimize negative environmental effects while maximizing positive ones.

The aim of the environmentally sensitive design process is to examine the relationship of a building with its environment and the use of resources throughout its life cycle. According to Yeang (2006), the effects of the built environment on the natural environment through production and interaction; inputs and outputs, transport, etc. Problems related to activities are resolved and a perfect and symbiotic integration is achieved in harmony with the natural environment (Yeang, 2006: 29). Ecological design in architecture is the product of a process that should be evaluated based on the built environment. Environmental design strategies should be considered in this context and the inputs of the design process should be directed in this way. Broadly and inclusively defined, sustainable architecture refers to an architectural approach that responds to and engages with both environmental and local factors. It seeks to harness the ecological capacities of its surroundings to establish favorable environmental conditions. This entails achieving an ecological equilibrium, minimizing ecological harm, while also demonstrating resilience, adjustability, and persistence in the face of shifts and requirements. Notably, sustainable architecture is characterized by its unique incorporation of local characteristics (Williams, 2007).

The climate compatibility of the places where people interact is of great importance in order to strengthen the sustainability claim. The adaptive model of thermal comfort holds significant promise for both energy conservation in buildings and enabling buildings to adjust to the impacts of climate change (Kwok and Rajkovich, 2010). Building buildings that can withstand challenges, conserve resources, and respond effectively to evolving needs and environmental conditions is a notion that strengthens resilience, sustainability, flexibility, and adaptability. Strategies to add adaptive capacity to passive and low-energy buildings are significant on the aspect of reducing the energy use of the building (Table 4.2.).

Table 4.2. Strategies to add adaptive capacity to passive and low-energy buildings (Kwok and Rajkovich, 2010)

Approach	Strategies
site analysis	orientation for solar access
building form	open, closed form; compact, dense versus open, loose construction
envelope optimization	insulation
daylighting, shading	toplighting, sidelighting, light shelves, overhangs, vertical fins
passive solar heating	direct gain, isolated gain, indirect gain, thermal mass
passive cooling	cross ventilation, stack ventilation, night ventilation of thermal mass, evaporative cooling, courtyards, earth contact, earth tubes, transitional spaces
facilities management and education	relaxed clothing standards, shifted work hours to avoid mid-day heat, seasonal set points higher in summer, lower in the winter
low-energy “active” systems	fans, heat recovery ventilators, evaporative chillers

4.1. Environmental Design Strategies

There are various topics to be considered while making an environmental design. These are issues that need to be addressed according to the context of the building and contribute to the sustainability of the building by ensuring that the nature and the built environment is in harmony. As commonly understood, a substantial amount of energy is used in the construction and operation of buildings, with approximately 65% of the total energy consumption occurring during their lifespan (Yeang, 2012). For this reason, in order to keep the energy use and need that will occur during the usage process at the optimum level, the building should be designed in a way that references the conditions of the geography where it is located. Determining certain environmental strategies and considering them by including them in the design process has the opportunity to contribute in this respect. As the literature is examined, various kinds of categorization of environmental design strategies could be found as shown in the Table 4.3.

Table 4.3. Environmental design strategies at literature

Watsons and Labs (1992)	Givoni (1998)	Gökşen, Güner and Koçhan (2017)	Umaroğulları and Motor (2019)
Layout planning concepts (windbreaks, plants, and water)	The building’s layout (shape)	Sustainable thinking and design principles	Location of the building

Table 4.3. (continued) Environmental design strategies at literature

Building mass and space organization concepts (Inside-outside rooms, settlement in the earth’s crust)	The building’s orientation	Economical architectural artificial environment design	Orientation of the building
Concepts related to the building envelope (Solar walls and windows, heat cover+insulation)	Orientation and shading conditions of the windows	Building envelope	Form of the building
Concepts for building openings (Solar shading, natural ventilation)	Orientation and colors of the walls	Building geometry	Building shell
	The size and location of the windows from the ventilation aspect	Space organization	The relationship of the building with its immediate surroundings and the layout
	The effect of the ventilation conditions of a building on its indoor temperatures	Building material selection	
	Building materials	Air conditioning systems	
	Site landscaping	Waste management	

As seen in the table, environmental design strategies have been compiled under various headings. Although various strategies have been put forward, these strategies are basically created by categorizing and elaborating five titles in various ways. Below are the key principles, strategies, and technologies related to the five primary elements of green building design: Sustainable Site Design, Water Conservation and Quality, Energy and Environment, Indoor Environmental Quality, and Conservation of Materials and Resources. These guidelines align with the use of the USGBC LEED green Building Rating System. However, the emphasis is on overarching principles and strategies, rather than prescribing particular solutions or technologies. It acknowledges that such solutions are often tailored to specific sites and would naturally differ from one project to another (Ragheb, A., El-Shimy and Ragheb, G., 2016). Today, it is observable that environmental sustainability is assessed and attempted to be implemented in architecture under these fundamental headings.

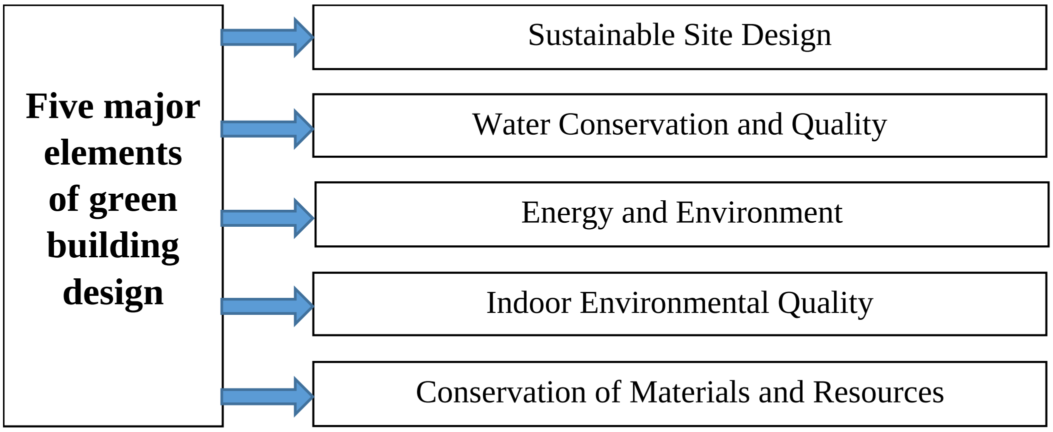


Figure 4.3. Elements of green building design (Ragheb, 2016)

As can be seen, different classifications and categories have been used in the literature for ecological design. Although the major elements come to the fore in the table in a fundamental sense, it should be taken into account that the consumption of natural resources and the damage to the environment can be kept at a reasonable level with the design of a sustainable building in accordance with its context. For this reason, it has been concluded that the strategies obtained in Table 4.3. and Figure 4.3. should be synthesized and sustainable architecture appropriate to the context should comply with the detailed categories. In order to reach this synthesis, Figure 4.4. is created with the simultaneous evaluation of Table 4.3. and Figure 4.3.

Environmental design strategies in the literature in green building design are synthesized in Figure 4.4. Accordingly, Sustainable Site Design strategies in architecture and planning are important as they play a role in the energy use of the building and the use of ecological resources. The correct evaluation of these headings is necessary in order to keep the heat loss or gain of the building in balance, to use the natural ventilation potential, and to evaluate the natural lighting potential, etc. For the design of the building in harmony with the contexts of the region, and to reduce the resource use, parameters for Indoor Environmental Quality, and Conservation of Materials and Resources are also included in the analyses.

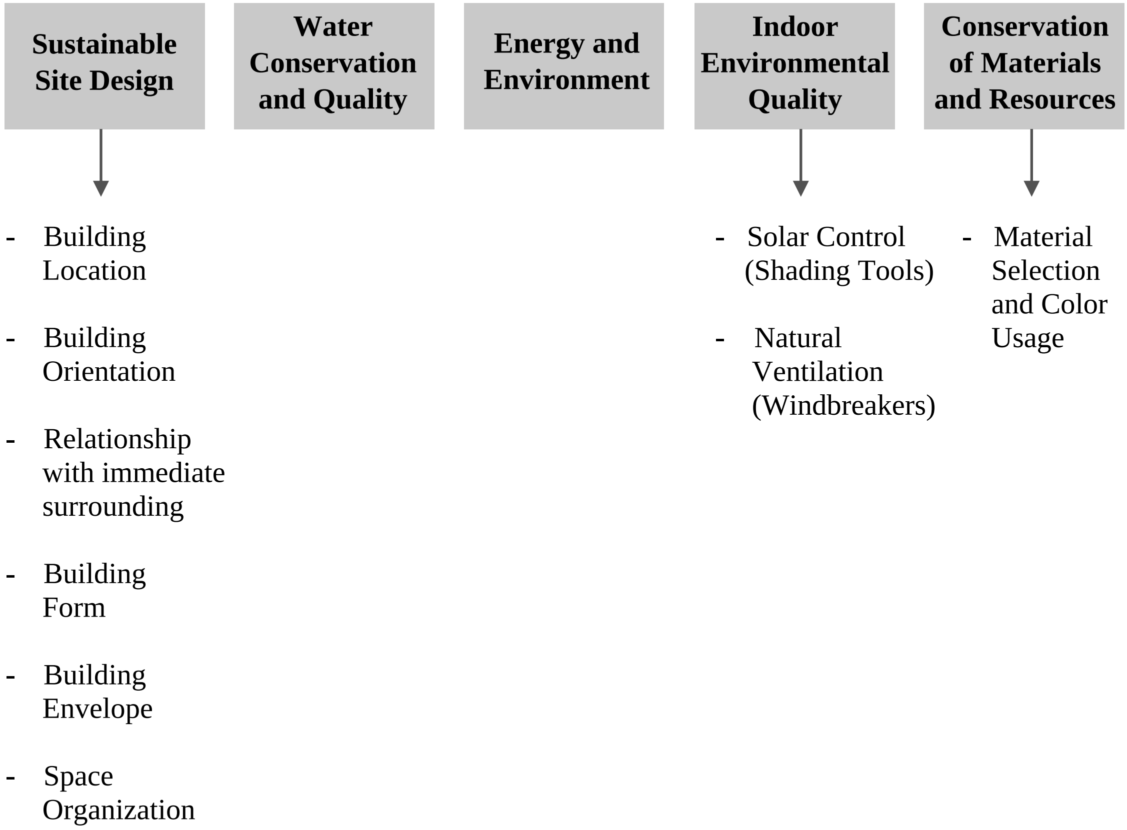


Figure 4.4. Environmental design strategies synthesized (adopted from Ragheb, 2016 by the author)

In order to reduce the energy requirement of a sustainable building and avoid increasing the cost, environmental design strategies should be considered together with the climate characteristics at the local scale.

While designing a sustainable building, mechanical systems created with technical solutions contribute to the structure. However, the suitability of the building, which is supported and developed with mechanical and technical solutions, to the context that architecture has prioritized for centuries, that is, its suitability for climatic and other environmental factors should not be ignored. As a result of problems related to operation and automation that arise during the installation of mechanical systems, the energy efficiency of these systems has either been compromised, leading to a reduction in efficiency, or they have failed to function altogether. For this reason, the physical environmental factors in the area where the building is located were taken into consideration while evaluating the environmental design strategies.

Besides the environmental design strategies, the study employs simulation analyses through tools such as LadyBug, Climate Consultant, and DesignBuilder to comprehensively evaluate the environmental aspects of the selected building. This approach aims to supplement the analysis of environmental design strategies gathered from the literature and offers an in-depth examination of the analysis outputs. The chosen programs play a pivotal role in identifying areas within the building where potential issues or challenges may arise. Additionally, they incorporate climate data specific to hot-humid climate zone, providing a contextualized understanding of the building's environmental performance.

4.1.1. Building location

The location of the building is one of the main inputs that affect the ecological design process, but it is also a remarkable element in context. Considering the solar radiation and air currents that constitute the natural data, it is necessary to choose the appropriate place in the topographic order according to the climate. In addition, in the settlement of the buildings on the land, it is desirable to position them in accordance with the existing slope without disturbing the landform, without the need for excavation or filling (Tönük, 2001).

Examples of strategies that should be evaluated for the location of the building are the amount of sunlight exposure, wind direction, and slope. According to Rapoport (1969), the main factors to be considered in climatic data are radiation (as a heating factor, requiring utilization or protection), temperature (requiring exploitation or protection), humidity (desired or undesirable), and wind (requiring exploitation or protection) can be sorted. If the wind is to be used in the location, it is necessary to consider the settlement on the hills, and under the slopes when it is to be avoided.

In addition, the topography should be evaluated in accordance with the level of sunlight utilization in the region. It is essential to determine which of the heating or cooling options is a priority in the current location and to take the necessary design decisions as a result.

The location of the building, which is of critical importance for the determination of these conditions, is one of the strategies that should be considered on behalf of the ecological design process. Resident energy refers to the energy available within a specific area. Since natural energies and resources unique to each region, location, and site context differ, it is essential to assess the climate-specific conditions of the site when adopting a sustainable-design approach. When designing for human habitation, most climates provide comfortable conditions at certain times of the day and year. However, the specific periods of climatic comfort depend on the geographical location and prevailing climate of that area (Williams, 2007). In this context, it is an issue that needs to be analyzed and resolved at the first stage of the ecological design process.

In temperate climates, making the most of the sun and wind while also protecting from them is crucial. Therefore, settlements should be located below the slopes in temperate dry climates, and in temperate humid climates, the upper parts of the slopes are more suitable (Figure 4.5.) (Zeren, 1978). In hot and humid climate regions, settling on valley ridges is appropriate to benefit from the cooling effect of the wind. In hot and dry climate regions, valleys are preferred to shield from the heating effect of the sun and the wind's carrying of dust and sand. In cold climate regions, it is essential to position settlements on the south-facing surfaces of the slopes and in the lower parts of the thermal zone to optimize sun exposure and protect from the adverse effects of the wind (Koçlar Oral, 2010).

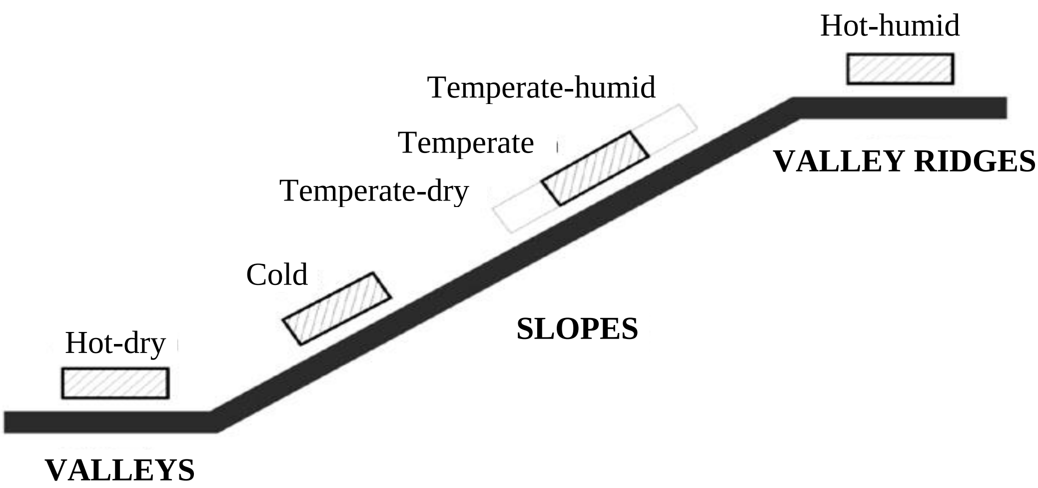
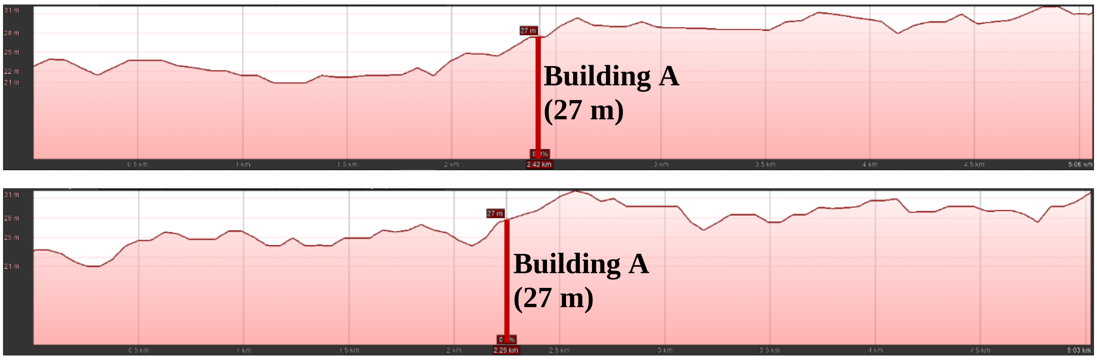


Figure 4.5. Appropriate topographic locations according to climatic characteristics (Zeren, 1978)

Case study (Building A)

The conditions of the land where Building A is located have been evaluated. It has been observed that the site where the structure is positioned is not on the high parts of the south-facing slopes with cool winds (hills) as required for hot-humid climate zones. As a result, it has been determined that the location of the structure does not contribute to the cooling load, which plays a critical role in this climate zone. In terms of its positioning, the building does not comply with environmental design strategies. In Figure 4.6., in which 5-meter height profiles are seen on the north-south and east-west axes of the land where the building is located, it is stated that the building is located at an altitude of 27 m, which can be described as the upper parts of the slopes. The upper parts of the slopes are good location preference for temperate-humid climate zone the high part of the hills are appropriate for hot-humid climate zone.



(a)

(b)

Figure 4.6. Site elevation profile a) north-south axis b) east-west axis

The active energy source utilized in the structure is solar energy. Approximately 147 solar panels with a total capacity of about 47 kWh have been installed on the roof of the building, aiming for an efficiency of around 50%. Furthermore, the PV panels used in the structure have contributed to a reduction of approximately 46,564 kg of CO_2 emissions over the course of a year. This aspect underscores the aim to mitigate the structure's impact on the atmosphere. It is worth noting that the building is situated at a considerable distance from the city center, necessitating the use of public transportation or personal vehicles for access. As a consequence, the carbon emissions mitigated by the panels are partially offset by the increased emissions resulting from transportation to the building due to its remote location.

4.1.2. Building orientation

The orientation of the building is a factor that needs to be considered in how much sunlight can be utilized or avoided. The direction of the building should be designed according to the answer to this, considering whether heat loss or gain is necessary for the area. The choice of orientation should result from a harmonious fusion of the interconnections between solar exposure, airflow, thermal interaction, visual aspects, natural surroundings, and moisture levels, particularly influenced by the vicinity of a water body (Golany, 1996). This decision process is used to correctly assess the prevailing wind and daylight. So, based on the requirements of the climate zone in which the building is situated, it is essential to orient the buildings in a manner that allows them to take advantage of sunlight and wind when required, while also providing protection when needed. The amount of heat gained by indoor volumes from solar radiation is a function of the direction the building envelope faces (Manioğlu and Yılmaz, 2011). Additionally, the arrangement of spaces should adhere to the guiding principles set forth for optimal design (Yılmaz, 2005). The direction of the building changes the heat loss and gains as well as the potential to benefit from daylight. For this reason, the angle of the building direction with the south should be calculated according to the sunshine status of the region.

Factors that play a major role in the energy consumption of the building can be listed as latitude, slope, location, and orientation. These factors are effective in the heat (heating-cooling) balance of the building depending on the seasons and the amount of radiation, and by optimizing these conditions, indoor comfort, and low energy use could be achieved. The orientation of the building impacts both its potential for utilizing sunlight and its heat loss and gain. Consequently, it is crucial to calculate the angle between the building's orientation and the region's sun exposure. The building's orientation is determined based on two main factors: optimizing solar gains during winter while minimizing them in summer, and taking advantage of the prevailing wind patterns to facilitate natural ventilation (Umaroğulları and Motor, 2019). It could be seen that there are various orientation ranges as optimum, good and valid as seen on Table 4.4.

Table 4.4. Optimum direction, good and valid orientation ranges according to climatic zones (Zeren, 1987; Orhon, Küçükdoğu and Ok, 1988)

Climate Zone	Building Orientation				
	Optimum sun orientation	Good orientation ranges	Valid orientation ranges	Orientation direction with respect to the sun	Protection from/utilizing the wind
Cold	Wide surface, 22º southeast from the south	20º southwest to 45º southeast	31º southwest to 86º southeast	East-west axis	Closed to the wind, on the northeast-southwest axis

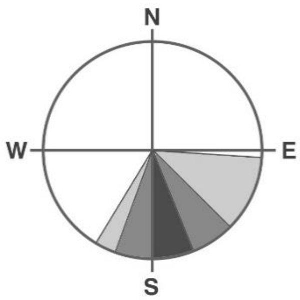
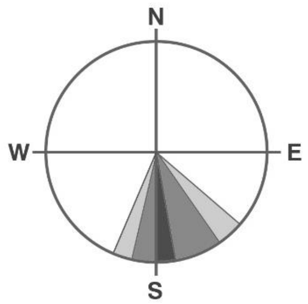
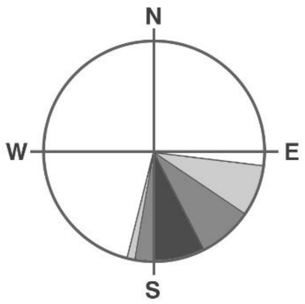
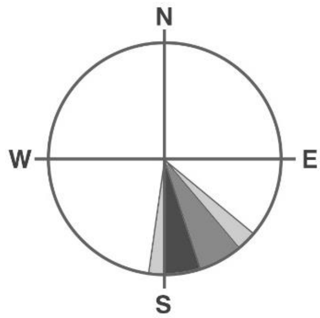
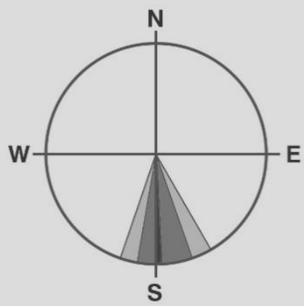
Table 4.4. (continued) Optimum direction, good and valid orientation ranges according to climatic zones (Zeren, 1987; Orhon, Küçükdoğu and Ok, 1988)

Temperate-Humid	Wide surface, 10º southeast from the south	13º southwest to 35º southeast	23º southwest to 49º southeast	East-west axis	Giving a wide surface to the wind
Temperate-Dry	Wide surface, 27º southeast from the south	10º southwest to 56º southeast	14º southwest to 83º southeast	East-west axis	No wide opening against the wind
Hot-Humid	Wide surface, 3º southeast or north from south	10º southwest to 19º southeast	19º southwest to 30º southeast	East-west axis	Open to the wind, raised above the ground
Hot-Dry	Wide surface, 18º southeast from the south	0º south to 40º southeast	8º southwest to 50º southeast	Southwest-northeast axis	The openings are in the direction of the courtyard, the courtyard is in the north direction

In cold climates, the building should be oriented to maximize solar gain during the winter months. The building's long axis should be oriented towards the south, and the glazing should be located on the south-facing façade to maximize solar gain. The east and west-facing façades should have minimal glazing to reduce heat loss. The optimum orientation angle is between 22º southeast from the south. The building should also consider wind protection, with the building's narrow surface facing the prevailing wind direction (Dursun and Yavaş, 2015). Another climate zone which is the temperate-humid climate zone necessitates buildings oriented to minimize solar gain during the summer months. The building's long axis should be oriented towards the east and west, and the glazing should be located on the north and south-facing façades to minimize solar gain (Yılmaz, 2008). The east and west-facing façades should have minimal glazing to reduce heat gain. The optimum orientation angle is between 10º southeast from the south. In temperate-dry climates, the optimum orientation according to the sun in temperate-dry climate zone is 27º southeast from the south which is specified to maximize solar gain during the winter months and minimize solar gain during the summer months. Building's long axis should be oriented towards the east and west. The glazing should be located on the north and south-facing façades (Ateek, 2020). Due to the harsh climatic conditions, the orientation in these regions should be determined carefully. Depending on the orientation of the building, the intensity of solar radiation on the outer surface of the shell elements surrounding the building, therefore, the amount of heat passing through the unit area of the shell varies (Koca, 2006). Building orientation in hot-humid climate zones in Turkey should focus on maximizing solar gain during the winter, promoting natural ventilation, and providing protection from excessive summer radiation. As a result, it could be observed that optimum, good and valid orientation ranges for hot-humid climate zone are the narrowest range compared to other climate zones (Table 4.5.).

Since the orientation of the building is extra important with humidity and excessive solar radiation in hot-humid climate type, this range is also quite narrow in order to take precautions against the aforementioned situations. For hot-humid climate, the optimum orientation angle is between 3º southeast or north from south. The optimum orientation according to the sun in temperate-dry climate zone is 27º southeast from the south.

Table 4.5. Orientation range for different climates in Turkey

COLD		TEMPERATE-HUMID	
TEMPERATE-DRY		HOT-DRY	
HOT-HUMID			
Optimum Orientation	Good Orientation	Valid Orientation	

Selecting the optimum orientation also involves utilizing heat gain and illumination effectively, while safeguarding against drawbacks like too much heat and intense brightness. This is particularly vital in buildings like office buildings, where occupant contentment considerably impacts efficiency. The positioning of glass surfaces holds great significance in such cases. Despite the challenges posed by excessive heat and glare, the design of shading elements becomes indispensable. Thus, during the initial design phase, it is crucial to make well-informed design choices and take precautions by simultaneously considering the climate, orientation, and building purpose.

Case study (Building A)

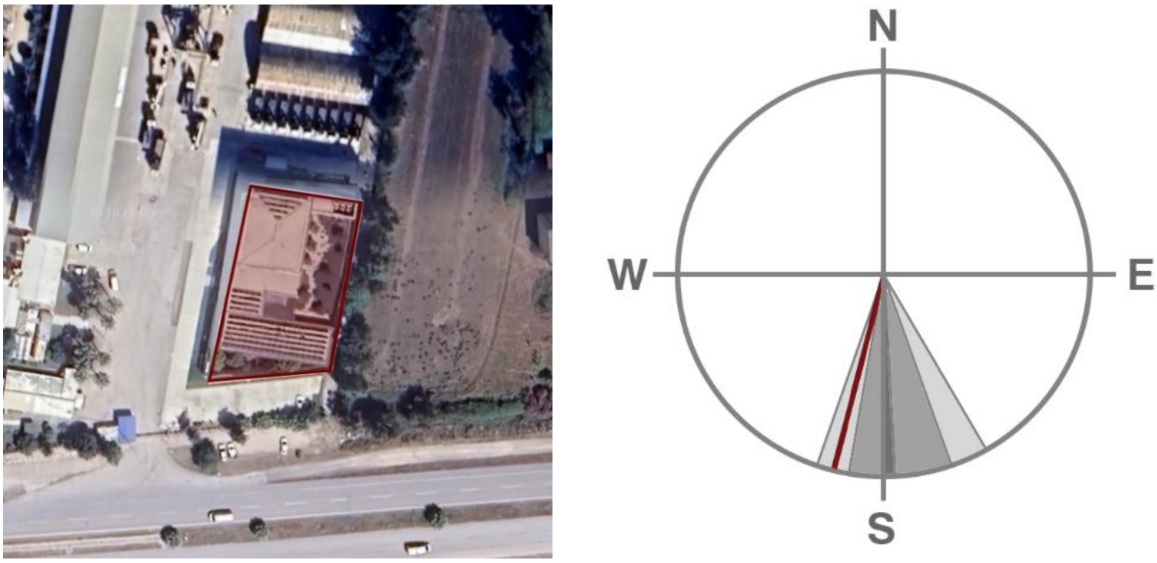


Figure 4.7. Orientation of Building A

The building is oriented along the north-south axis at an angle of 12º towards the southwest direction (Figure 4.7.). Office sections, which are used at regular intervals, are concentrated in the southern part of the structure, while functions such as archives and conference rooms, used during specific time periods, are positioned in the northern region. However, this orientation does not align with the optimal orientation angle defined for hot-humid climate regions. Positioning functions with lower frequency of use, such as archives, conference halls and electrical rooms, in the north direction, and positioning office areas with high frequency of use in the south region causes an increase in the cooling need in hot-humid climate regions for a building that is not oriented in the optimum range.

The building's orientation angle falls within a range considered to be valid, albeit not within the optimal orientation range, similar to an office-intensive building. Consequently, while the north-south orientation of the building is considered favorable, the increase in cooling demand due to the concentration of cooling needs in the southern region, where the office spaces are concentrated, becomes a consideration.

Although the building is not oriented at the optimal orientation angle defined for hot-humid climate regions, it still falls within a valid orientation range of 19º southwest to 30º southeast. Even though the optimal orientation range has not been achieved, being within a good orientation range could have positively impacted the building's energy requirements.

4.1.3. Relationship with immediate surrounding

The streets, green spaces and various other facilities around the buildings are important on both an urban and architectural scale. It should be considered that the settlement pattern of the buildings, their scales and their relations with each other, streets, green areas such as parks directly affect the microclimate (Kun, 2005). For example, airflow and sunlight conditions in urban and rural areas can be examined. Considering these examples, it can be said that structuring in accordance with the environmental design strategies in the urban design process is critical in the formation of microclimate and thus in the process of the buildings being ecological.

Situations such as the orientation and width of the streets at the urban scale, the creation of green areas with flora suitable for the climate of the region, the arrangement of the parcels in a way to direct the wind and sun according to the conditions of the region, and the appropriate design of the building stock should be considered. The height and spacing of the buildings are not only factors affecting them, but also important variables for the levels of natural lighting, natural ventilation and heat gain as a result of daylight and wind factors of other surrounding buildings. This interactive relationship needs to be taken into consideration with the effect of the change in the angle of incidence of the sun in the summer and winter months, as well as the effect on the area where the building is located (Figure 4.8.). The gaps left between the buildings and the heights of the neighboring buildings are concrete elements at the point of transmission or interruption of daylight.

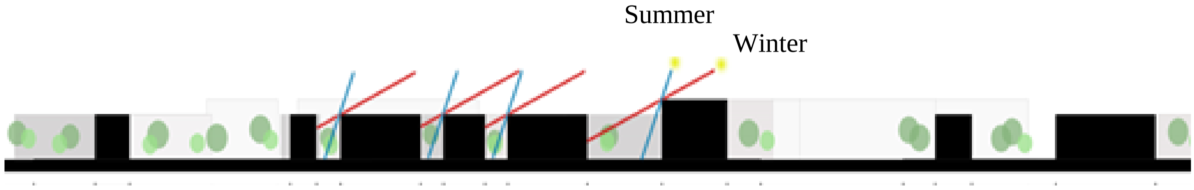


Figure 4.8. Building heights and spacing - sunlight relation scheme

The heights and distances of buildings are significant concerning their ability to block sunlight and wind for surrounding spaces. The heights and distances of buildings hinder the access of sunlight to the shaded areas and also influence the wind speed reduction. Buildings could serve as shields against solar radiation and wind for one another, the extent of which depends on their proximity, height, and relative positioning. As a result, the degree of exposure or protection from solar heating is influenced by the size of the gaps between buildings (Demircan and Gültekin, 2017). In these conditions, considering the heating or cooling needs of the region's climate is essential. When viewed at an urban scale, the utilization or avoidance rates of sunlight and wind play a decisive role in the comfort of the urban area's building stock, streets, and open spaces. In regions characterized by hot climates and elevated temperatures necessitating shielding from solar radiation, it is crucial to strategically design buildings to cast shadows on one another and mitigate prolonged sunray reflection throughout the day (Zorer, 1992). Designs should allow for the utilization of sunlight or wind without obstructing them, thus keeping the energy requirements of the building at an optimal level.

The spacing between buildings should be calculated in accordance with the comfort conditions of the climate in which the building is situated. In cold climate regions, larger interspaces might be employed to contribute to heating loads, whereas in temperate-humid and temperate-dry zones, shorter distances between structures can be realized compared to cold climate areas. However, especially in hot-humid climates where the cooling effect of wind is sought more than daylight heat gain due to high humidity levels, the predominant wind direction should be prioritized to facilitate airflow. In densely populated urban districts, the orientation of buildings can be optimized to reduce solar exposure, while the arrangement of narrow streets and pathways creates shaded outdoor spaces to mitigate excessive solar radiation (Du, 2019). From this point of view, it can be said that the spacing and heights of buildings in the hot-humid climate zone can be handled with this understanding. In contrast, in hot-dry climates where humidity's impact is less, closer placement of taller buildings might be favored in hot-humid climates, while some flexibility can be exercised in hot-dry climates regarding this aspect. The fundamental approaches to passive cooling encompass narrow pathways for shading and ventilation, utilizing the ground and alley walls as heat absorbers, and promoting night time ventilation (Chen and Zhong, 2011).

In the context of Turkey, the optimum values for building spacing and heights for the five observed climate types in Turkey are indicated in the Table 4.6.

Table 4.6. Suitable values of distances between buildings that can be selected according to climatic zones (Orhon et al., 1988)

Climate Zone	According to the wind (In the direction of the prevalent wind)	According to the sun (North-south direction)
Cold	Z – 5 H	1 ½ - 2 ½ H
Temperate-Humid	H – 5 H	2 – 3 H
Temperate-Dry	H – 5 H	2 – 3 H
Hot-Humid	5- 7 H < DX	1 ½ - 2 ½ H
Hot-Dry	1 ½ - 2 H	1 ½ - 2 ½ H
H= Height of obstacle building		

<u>Case study (Building A)</u>

Changes in height can influence wind patterns and sunlight exposure data. The adjacent buildings around Building A are characterized by their low height and low density. These nearby buildings do not hinder the building in relation to aspects like natural illumination, air circulation, wind effects, and scenic views.

In hot-humid climate zone, especially where high humidity prevails, the focus shifts from daylight heat gain to seeking the cooling effects of wind. In such contexts, prioritizing the dominant wind direction becomes crucial to facilitate airflow. Surrounding buildings could be utilized to minimize exposure to direct sunlight, while arranging narrow streets and pathways can create shaded outdoor spaces to mitigate excessive solar radiation. As location of Building A is analyzed, it is found that the nearest surrounding buildings are located 40 m to the west, 25 m to the north, 51 m to the east and 101 m to the south (Figure 4.9.).

Figure 4.9. Map showing the surrounding of Building A

The building spacing that should be according to the wind and the sun in hot-humid climatic regions are shown in the Table. The height of the building is 8 m. In this case, it is determined that the ideal spacing of the building in the north-south direction with respect to the sun should be 12 m-20 m. On the other hand, it has been calculated that the ideal range to be found in the south and northwest directions, which are the prevailing wind directions, is 40 m-56 m. As a result, it is stated that the ideal building spacing specified for the hot-humid climate region should be 12 m-20 m in the north and south direction according to the sun, 40 m-56 m in the south and northwest direction according to the prevalent wind which is from southwest and northeast this building (Table 4.7.).

Table 4.7. Building spacing for Building A

Climate Zone	According to the wind (In the direction of the prevalent wind)	According to the sun (North-south direction)
Hot-Humid	23 m – 93 m	25 m – 101 m

The required intervals of the structure were determined and compared with the existing intervals. As a result of this comparison, it has been determined that the distances of the building from its surroundings are not in the optimum range specified according to the sun and wind. The high distance to the surrounding structures results in the shading and wind effect required in the hot-humid climatic region not contributing to the airflow support conditions. In case of high exposure to sunlight, energy use increases simultaneously with the increase in the cooling required in the building.

It is seen that the lack of compliance with the ideally determined building spacings in the hot-humid climate region results in the absence of any obstacle protecting the building against sunlight. Since there is no other building to act as a blocking system in the immediate vicinity of the building, the heat gain of a building, especially in a hot-humid climate region, becomes more than desired. In addition, due to the wide streets and spacings in the south and northwest directions, which are the prevailing wind directions, the air flow does not gain speed and cannot contribute to the cooling and ventilation.

Lack of adequate green measures around a building results in over-exposure of the building to the sun. In scenarios where surrounding buildings fail to provide sufficient shading, incorporating green elements can prove beneficial. Implementing green textures, such as trees and plants, strategically around the building can contribute to effective sun protection and enhance overall environmental sustainability. This approach not only mitigates solar heat gain but also introduces aesthetic and ecological benefits to the built environment.

While the aluminum perforated shell surrounding the building plays a role in mitigating excessive sunlight exposure, its consistent presence on every façade, especially the fully concrete portions of west and north facades, can lead to thermal imbalances. This situation may create heat disparities, particularly on the the fully concrete portions of western and northern sides. However, the glass-covered section on the western side and the southern orientation provide shading benefits.

4.1.4. Building form

The form of the building is decisive in terms of the relationship that the building will establish with the physical environmental conditions. The building form includes titles such as geometric shape, volume-surface area relationship, and juxtaposition of volumes. Even if the volumes are equal in the geometric shape difference, a change is observed in the heat loss and gain. On the other hand, it is known that in scenarios where the volume-surface area relationship differs, the heat loss of the volumes whose outer surface area decreases proportionally decreases. As depicted in Figure 4.10. showing heat losses in buildings with identical volumes but varying mass ratios, taller structures exhibit greater heat losses. The graph indicates that the optimal configuration approaches a ratio of 1:4 between height and depth (Dörter, 1994).

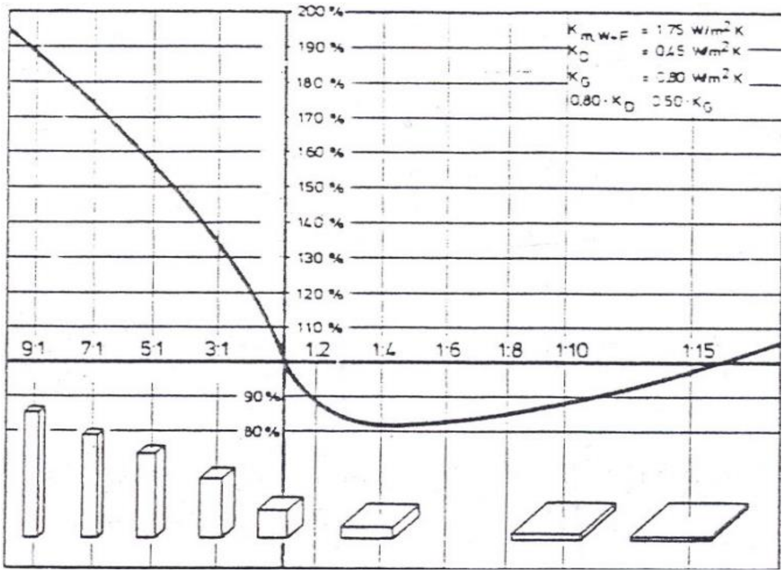


Figure 4.10. Building form – heat loss relationship (Dörter, 1994)

In addition, due to the fact that the surface area can be changed by combining the volumes in different ways, the level of interaction with the physical environmental conditions changes, and a change is observed in the heating or cooling requirement of the building. Table 4.8. is the expression of the aforementioned volume relations for a building.

Table 4.8. Optimum and maximum building rates according to climatic zones (Olgyay, 1963)

Climate Zone	Building Form	
	Optimum Ratio	The Highest Ratio
Cold	1:1,1	1:1,3
Temperate-Humid	1:1,6	1:2,4
Temperate-Dry	1:1,1	1:1,3
Hot-Humid	1:1,7	1:3
Hot-Dry	1:1,3	1:1,6

If it is necessary to visualize the building forms suitable for climatic regions, they can be embodied as seen in Figure 4.11.

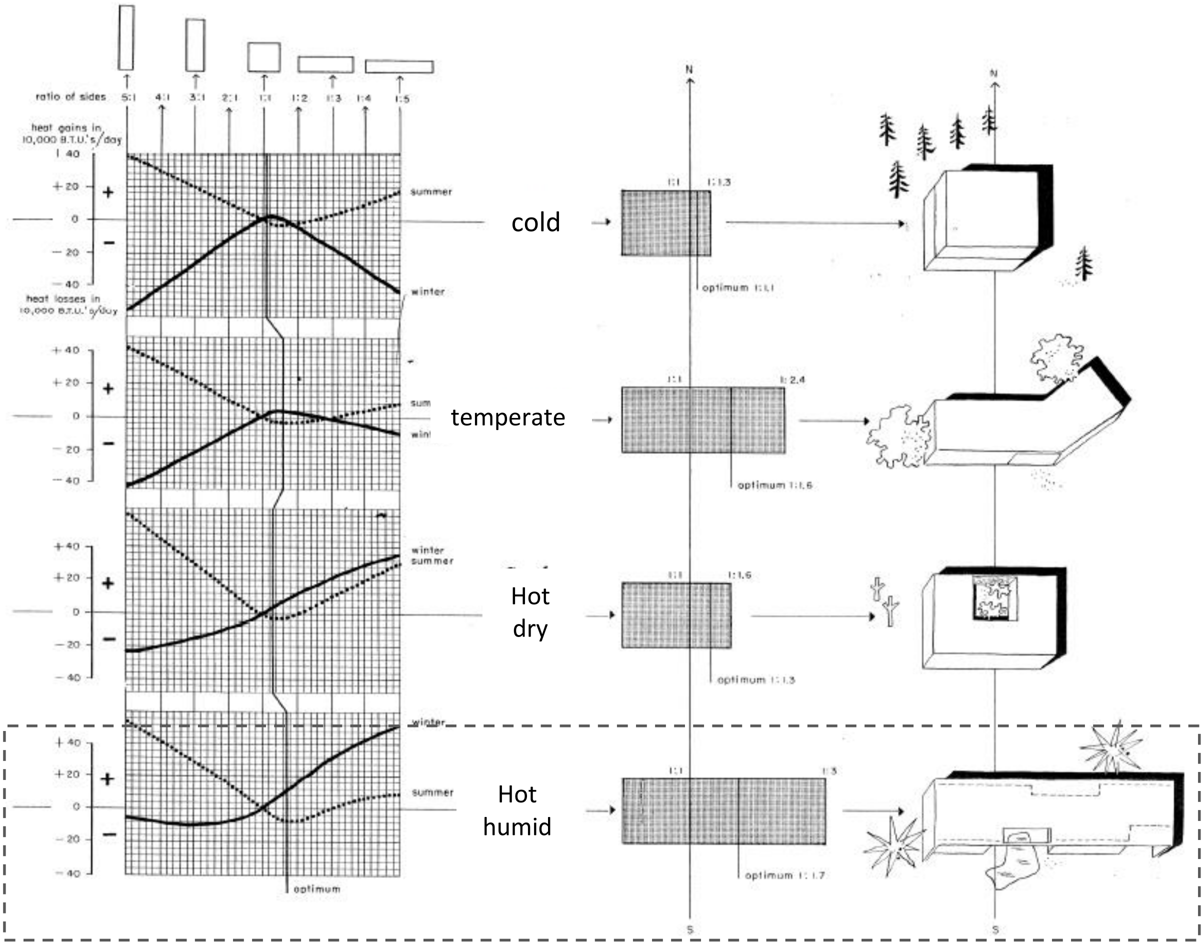


Figure 4.11. Optimum building forms according to climatic zones (Olgyay, 1963)

Case study (Building A)

Table 4.9. Building ratio of Building A

Climate Zone	Building Ratio
Hot-Humid	1:1,55

For optimum effect, freestanding building forms raised above the ground. narrow tall should be designed at a ratio of 1:1,7 (up to 1:3) in the hot-humid climate zone. It has been determined that the ratio of the eastern façade to the building is 1:1,55 (Table 4.9.), while the ratio compared to the western façade is 1:1,83 by analyzing the form of the building. The ratio of 1:1,83 seen on the western façade of the building is being disregarded. The reason for this is due to the fact that this ratio is achieved in conjunction with the aluminum perforated shell surrounding the structure. In other words, the proportional volume of the building's mass has been considered as 1:1,55 in the overall form.

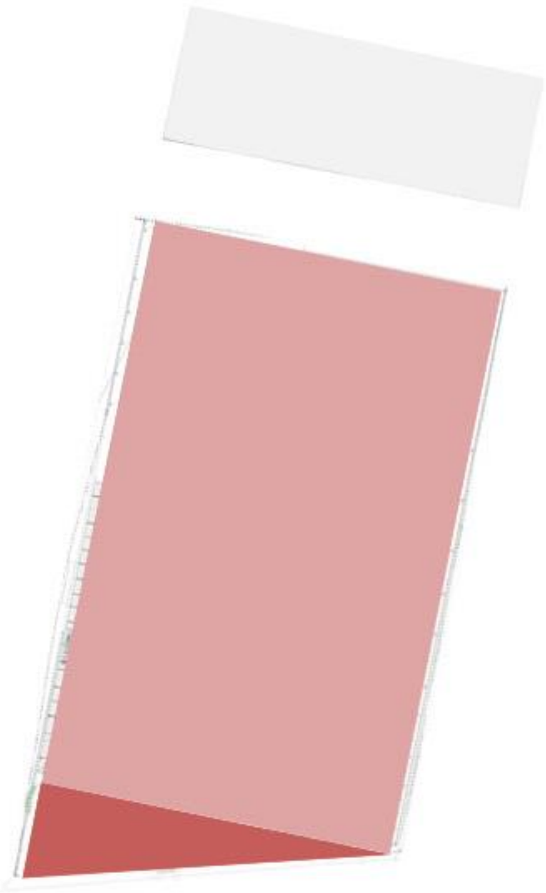


Figure 4.12. Mass of Building A without aluminum shell

Although these ratios are not optimal, they do not exceed the highest ratio limit, and the building form is deemed appropriate in terms of proportion. However, due to the design of the building being elevated from the ground, it is preferable in the hot-humid climate region as it reduces the impact of heat, which is amplified by humidity. In this regard, it can be said that the building's defense against the temperature amplified by humidity is diminished.

4.1.5. Space organization

The environmentally and energy-conscious approach within the context of ecological designs elucidates the utilization of methods for creating zoning/buffer zones through the strategic grouping of spaces with diverse indoor comfort conditions in spatial organization. This involves the deliberate separation of spaces requiring warmth from those that may experience cooler temperatures. In the architectural design of buildings featuring colder zones, the incorporation of designated cold spaces serves to obstruct the ingress of chilly external air. These cold spaces strategically envelop areas intended to maintain consistent warmth, effectively creating a buffer zone. Examples of cold spaces encompass garages, basements, corridors, windbreaks, and winter gardens oriented towards the south (Deviren, 2006). In the cold, temperate-humid, and temperate-dry climate regions, which are the priority for heating in Turkey, the spaces (living areas) with high heating requirements should be in the center of the building in the north-south direction, in the south and west orientation, and the service spaces should be in the north orientation to create a buffer area against the cold. In vertical placement, the volumes with close heat requirements should be placed on top of each other and energy conservation should be observed between floors.

Since compact building solutions with courtyards provide optimum effect in hot-dry climate regions where the temperature difference between day and night is high, an organization that includes temperature zoning around the courtyard should be carried out in the organization of the space. In cold, temperate-humid, and temperate-dry climate regions prioritizing heating in Turkey, it is recommended to position high heating-demand spaces (such as living areas) at the center of the building along the north-south axis, facing south and west for solar gain, while service spaces should be oriented towards the north to act as a buffer against the cold. In hot-humid regions prioritizing cooling, increased ventilation options should be considered to mitigate humidity, and temperature zoning may not be necessary in the plan layout. Shading should be provided for indoor spaces, and natural ventilation should be ensured. When arranging the layout, living areas ought to be situated to capture the east and west airflow (Kısa Ovalı, 2019). For hot-dry climates with significant day-night temperature differences, compact building designs with courtyards are most effective, and temperature zoning should be incorporated around the courtyard in the spatial layout (Kısa Ovalı, 2009). To conclude, it could be suggested that space organization must be done for cold, temperate-humid, temperate-dry and hot-dry climate zones while it could be done for hot-humid climate zone.

Depth of space

Another aspect of space organization which is the depth of space must be utilized to ensure the comfort level in the building. When the space depth is designed in the right ratio depending on the building form, space zoning solutions and related energy loads such as heating, ventilation, and lighting can be kept at an appropriate level. The interaction of the climatic conditions in the region with the interior space would play a decisive role. A room's exterior wall width determines heat exchange and daylight, while depth affects daylight penetration. A wide, shallow room has good daylight but high heat gain/loss. A narrow, deep room has less daylight and lower heat transfer (Susorova, Tabibzadeh, Rahman, Clack and Elnimeiri, 2013). As the depth of the space differs, the rate of daylight utilization and the distribution of heat in the interior are affected. Reducing the depth of the structure leads to an increase in the heating load. This suggests that during winter, the building experiences significant heat loss that surpasses the insufficient solar heat gain, resulting in discomfort (Muhaisen and Gadi, 2006). Therefore, it could be conceivable that it is critical to determine the depths of space suitable for the requirements of various climatic regions in Turkey and to make the design based on this.

In cold, temperate-humid, and temperate-dry climate zones, having an optimal space depth is suitable, while in cold and temperate-dry climate zones, the depth should exceed the width. In the temperate-humid climate zone, a narrower width compared to the depth is preferred. In a hot-humid climate zone, a wider width than the depth, as mentioned for the previous climate zones, leads to a suitable minimum space depth. Conversely, in a hot-dry climate zone, having a considerably narrower width than the depth results in the opposite situation, making a maximum space depth suitable for the region. The depth of space and its symbolic representation in accordance with the climatic regions in Turkey, are as seen in Table 4.10.

Table 4.10. Optimum depth of space for the climate zones of Turkey (Kısa Ovalı, 2009)

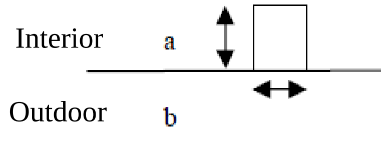
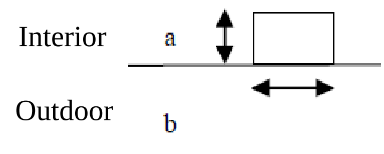
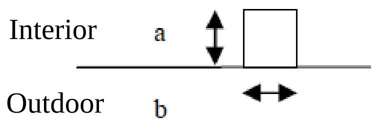
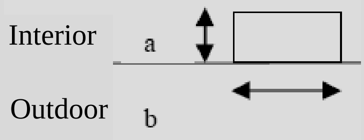
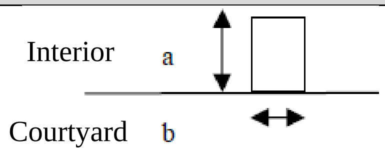
Climate Zone	Depth Of Space	Visualized Expression
Cold	Depth optimum, width-height close, a >b	
Temperate-Humid	Depth optimum, width-height close, a <b	

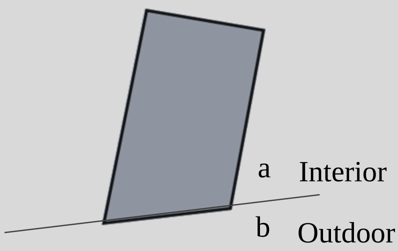
Table 4.10. (continued) Optimum depth of space for the climate zones of Turkey (Kısa Ovalı, 2009)

Temperate-Dry	Depth optimum, width-height close, a >b	
Hot-Humid	Depth minimum, height is longer, a< b	
Hot-Dry	Depth maximum, width is longer, a >b	
	a = depth	b = width

<u>Case study (Building A)</u>

The thermal dynamics and daylighting of a room are intricately shaped by the width of its exterior wall and the extent of its depth. The breadth of the exterior wall plays a pivotal role in regulating heat exchange and the ingress of natural daylight. Simultaneously, the depth of the room influences the extent to which daylight permeates the space. A building endowed with a wide exterior wall and a relatively shallow depth is characterized by abundant natural daylight; it also demonstrates heightened susceptibility to pronounced heat gain or loss. In contrast, a room with a narrower width and greater depth experiences diminished daylight penetration and exhibits relatively lower tendencies for heat transfer. Space depth should be minimum and the height should be longer than the depth in hot-humid climate zone.

Table 4.11. Space depth of Building A

Climate Zone	Depth Of Space	Visualized Expression
Hot-Humid	Depth maximum, width is longer, a> b	
	a = depth	b = width

Upon examination of the architectural configuration of Building A, it becomes apparent that the room depth is notably substantial. However, this depth does not align with the advisable minimum criteria for optimal design in hot and humid climatic conditions (Table 4.11.). In contexts characterized by such climates, the room depth should ideally be less than its width. In this particular instance, the situation presents itself in a rather contrary manner.

Space zoning is done in a hot-humid climate type, although it is less necessary compared to other climate types, but with its correct application, it can improve indoor conditions. As shown in Chapter 3.2.1., thermal zones of the building based on their activity arranged in such a way that areas with similar functions and frequency of use are located side by side and transition area with common use is formed between them. As a result, space zoning, which is of lesser significance in this climate type, has been attempted in this building.

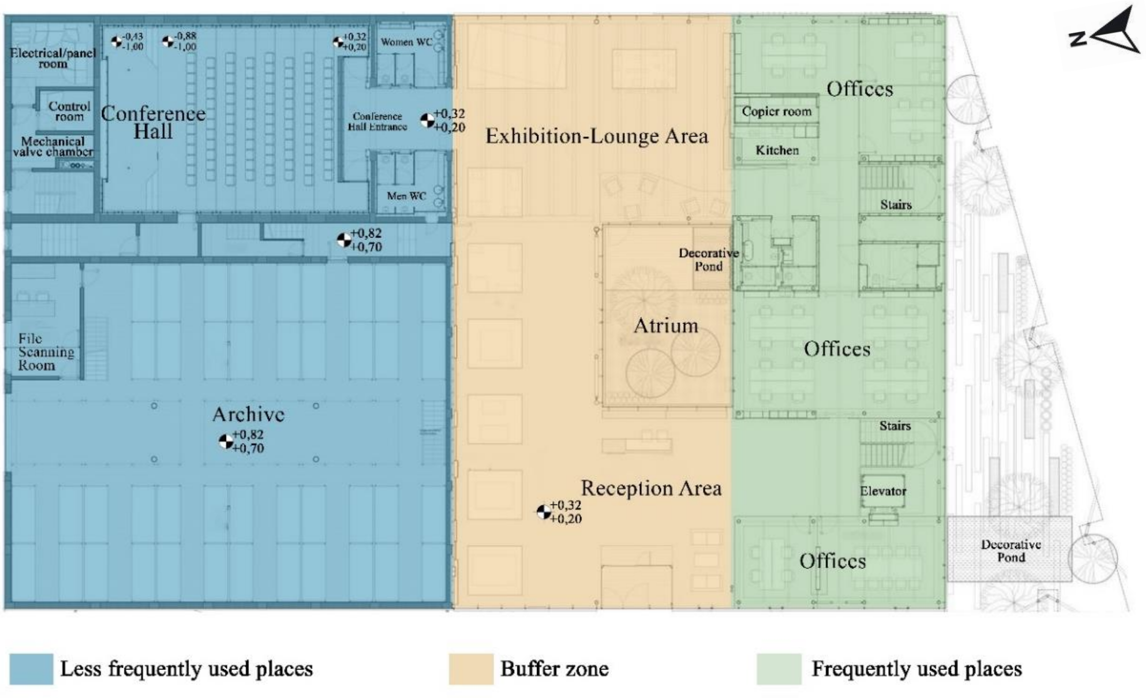


Figure 4.13. Space zoning on Building A

Upon analyzing the architectural layout of the building, it becomes evident that the allocated spaces align effectively with the principles of space zoning. The region that bridges the archive and conference hall sections, enveloped by reinforced concrete walls, and the office area, which integrates a steel shell onto a glass facade, has been designated as an exhibition space. This transitional zone functions as a connective conduit between discrete areas, each distinguished by usage frequency and their orientation towards specific facades (Figure 4.13.). This design approach indicates an endeavor to address space zoning for this building, a consideration of relatively lesser significance within this particular climatic context compared to the other climate zones.

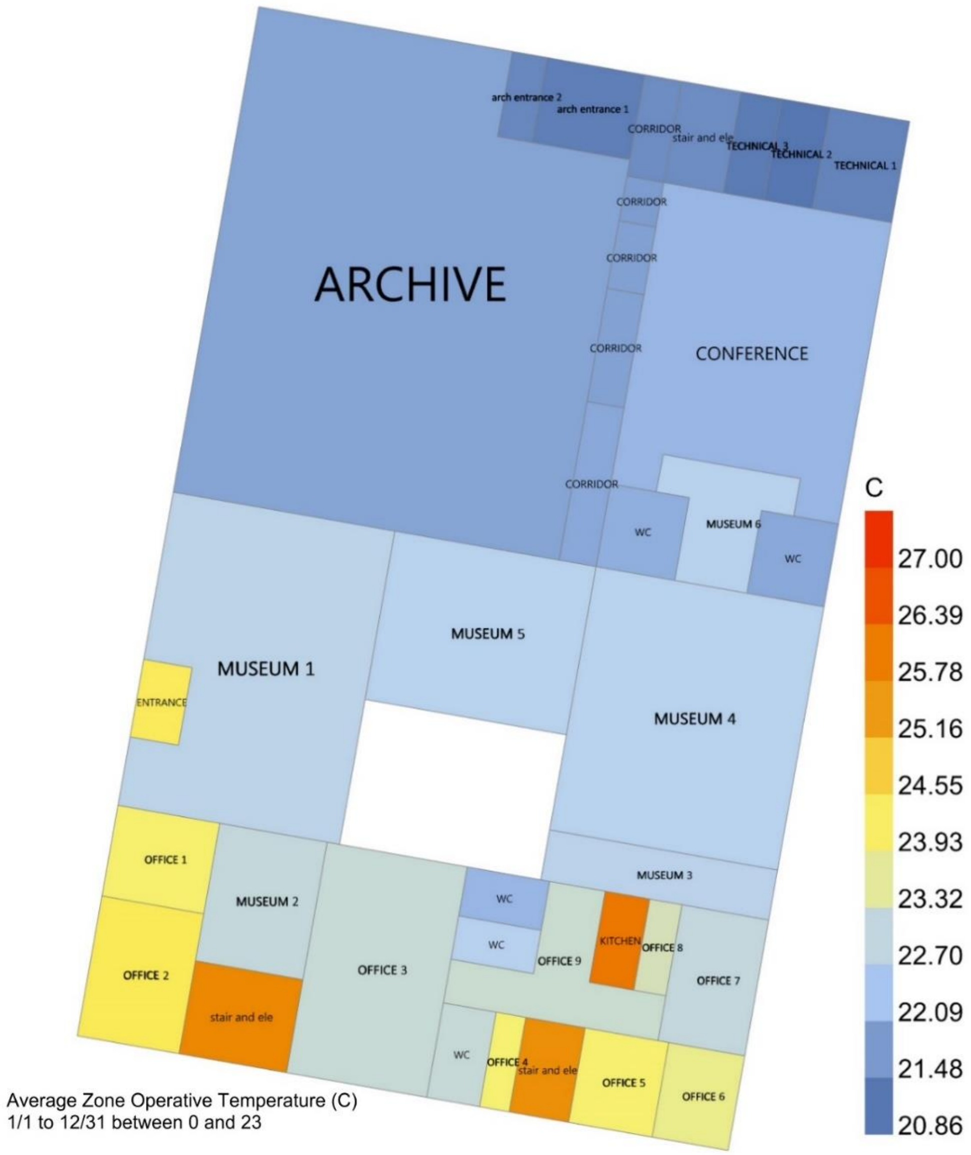
To observe the extent of the utility of the spatial organization within the building, indoor thermal comfort analysis has been deemed necessary. Indoor thermal comfort analysis, incorporating metrics like operative temperature, is essential for space organization analysis in architecture to ensure optimal occupant comfort. It helps assess how the spatial layout, arrangement, and design choices impact temperature distribution within the building. Understanding these thermal conditions is crucial for effective space organization, allowing strategic positioning of areas with different thermal needs, addressing potential disturbance zones. This analysis ensures that the organization of spaces aligns with the goal of creating a thermally comfortable and sustainable indoor environment.

Indoor thermal comfort

The critical aspect of indoor thermal comfort is explored in the final section of comprehensive sustainability assessment for Building A. Achieving and maintaining optimal thermal conditions within the building's conditioned spaces is a fundamental factor in ensuring the well-being and productivity of its occupants. This section focuses on two key parameters: operative temperature and the condition metric. These metrics provide valuable insights into the thermal status of the conditioned spaces and the comfort level experienced by individuals.

Operative temperature: The operative temperature is a crucial indicator that reflects the overall thermal environment within the conditioned rooms. It considers air and radiant temperatures, providing a more comprehensive understanding of how individuals perceive and experience the indoor climate. By assessing operative temperature, the effectiveness of the building's environmental control systems and their ability to maintain a comfortable thermal balance for occupants could be evaluated.

Condition metric: To complement the assessment of operative temperature, the condition metric would be examined. This metric provides a quantitative assessment of the thermal status of individuals within the conditioned spaces. It assigns integer values representing different thermal sensations, ranging from too dry to humid and cold to hot. These values are instrumental in gauging the perceived thermal comfort of occupants and allow us to identify areas that may require adjustments in environmental control to enhance the overall comfort. The analysis of operative temperature and the condition metric aims to provide a comprehensive overview of the indoor thermal comfort conditions within Building A. By thoroughly evaluating these parameters, opportunities for improvements and ensure that the building meets sustainability goals and provides a comfortable and productive environment could be identified for its users. The findings from this section will contribute to a holistic understanding of the building's performance and serve as a valuable resource for optimizing its indoor thermal conditions in the future.



(a)

Figure 4.14. Operative temperature a) ground floor b) first floor

(b)

Figure 4.14. (continued) Operative temperature a) ground floor b) first floor

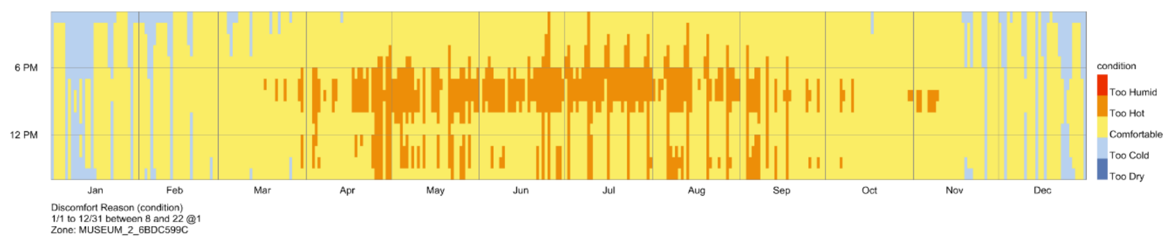


Figure 4.15. Hourly graph for four different rooms indicating thermal conditions

Figure 4.15. (continued) Hourly graph for four different rooms indicating thermal conditions

The monthly results of operative temperature and the condition of conditioned rooms within Building A reveal crucial insights into the thermal comfort conditions experienced by its occupants.

Operative temperature analysis:

1. Museum spaces (MUSEUM_2, MUSEUM_3 and MUSEUM_4) show a relatively stable operative temperature throughout the year, gradually increasing from winter to summer. The temperature increase aligns with typical seasonal variations, which is acceptable for museum spaces. The monthly operative temperatures indicate that these areas maintain thermal stability effectively.
2. Technical spaces (TECHNICAL_1 and TECHNICAL_4) exhibit the largest temperature fluctuations, particularly during the transition between seasons. The extreme variations in operative temperature could be attributed to inadequate insulation or ineffective climate control systems, which struggle to maintain stable indoor conditions.

3. Office spaces (OFFICE_3, OFFICE_7, OFFICE_8 and OFFICE_9) display relatively stable and comfortable operative temperatures throughout the year, reflecting an effective HVAC system. However, in OFFICE_2, some variations indicate that localized temperature control may require improvement.
4. Entrance and museums (ENTRANCE, MUSEUM_1, MUSEUM_5, MUSEUM_6) experience more significant operative temperature fluctuations throughout the year. This may be attributed to the building's design, with a focus on open and semi-open spaces that allow outdoor conditions to influence the indoor climate. These spaces might benefit from improved climate control solutions to enhance comfort.

Condition analysis:

The condition metric, representing the thermal sensations of occupants, demonstrates similar trends across different spaces.

1. Too cold or slightly cold: Many areas exhibit monthly condition values ranging from -0,5 to -0,2, indicating that occupants might perceive these spaces as slightly cold. This suggests that the heating systems in these areas might need adjustments or fine-tuning.
2. Neutral or acceptable comfort: In some zones, the condition metric remains close to zero, suggesting that occupants experience neutral or acceptable thermal comfort for OFFICE_3, OFFICE_7, OFFICE_8 and OFFICE_9.
3. Too humid or too hot: The entrance area and office spaces located close to the exterior walls show higher condition values, which may indicate higher humidity levels. This could be due to the semi-open nature of the entrance, which allows outdoor humidity to influence the indoor environment.

In summary, the variation in operative temperature and the condition metric across different zones may be attributed to a combination of factors, including HVAC system effectiveness, insulation, and building design. Addressing these factors will be crucial in ensuring consistent and comfortable thermal conditions throughout Building A, enhancing the well-being and productivity of its occupants.

4.1.6. Solar control and natural ventilation

Solar control and natural ventilation are the basic elements to be considered under this title. Thanks to these, the indoor air quality and comfort of the building can be ensured, as well as contributing to the ecological design of the building. Natural ventilation provides multiple services in buildings, which include providing air for breathing, moving air on human skin enhancing both convective and evaporative cooling, replacing warm air with cooler air, and thus lowering indoor air temperatures, removing heat accumulation from a building mass or structure, building enclosure drying and structural integrity (Aynsley, 2014). Shading tools and ventilation methods should be designed according to the conditions of the context.

Shading devices, chosen for their practicality and low-maintenance characteristics, are increasingly employed to mitigate the effects of solar radiation. The objective of these devices is to enhance the shading ratio, particularly on windows, to maintain conditioned spaces, decrease energy consumption, and minimize glare levels in proximity to windows. Well-designed shading solutions prevent excessive heat during summer while facilitating maximum daylight penetration in winter (Valladares-Rendón, Schmid and Lo, 2017). Shading tools are basically divided into two as horizontal and vertical. Grid-type shading tools, in which both are used together, are also used. Shading tools, which are adjusted according to the desired level of sunlight to affect the thermal comfort of the building, should be handled in accordance with the climate type of the region.

Ventilation methods are classified as natural ventilation, comfort ventilation, cross ventilation, night ventilation, and buoyancy-driven ventilation (stack effect). With the openings in the building envelope and the controlled design of these openings, a ventilation method suitable for the context of these categories can be provided.

Conditions provided by shading tools and ventilation have a significant impact on the ecological design process. The optimum methods for the climate types in Turkey are shown in Table 4.12.

Table 4.12. Optimum natural ventilation and shading tools for climate types in Turkey (Koca, 2006)

Climate Zone	Natural Ventilation	Shading Tools
Cold	Comfort ventilation	Not needed
Temperate-Humid	Comfort and cross ventilation	Horizontal and vertical shading tools
Temperate-Dry	Comfort and cross ventilation	Horizontal and vertical shading tools
Hot-Humid	Comfort and cross ventilation	Grid-type shading tool
Hot-Dry	Buoyancy-driven ventilation (stack effect)	Grid-type shading tool

Case study (Building A)

In hot and humid climate regions, where solar control is of paramount importance, the necessity of utilizing shading devices becomes evident. These devices are crucial for mitigating direct sunlight exposure. In these areas, it is recommended that shading tools take on a grid-type form. In this structure, the aluminum shell integrated as a shading tool provides substantial protection against sunlight. Therefore, the use of shading tools is positively impactful in this regard. However, due to the presence of the shell, the visual connection between the building and its external environment becomes problematic, leading to an inward-facing structure. Consequently, it is advisable that shading tools are designed in a manner that does not adversely affect the building's connection with the external world.

Table 4.13. Solar control and natural ventilation of Building A

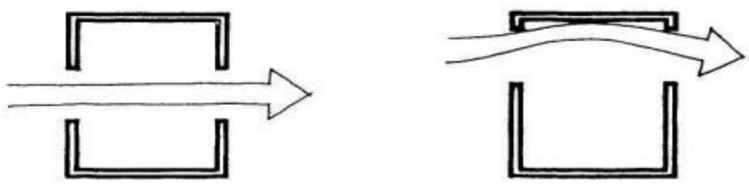
Climate Zone	Natural Ventilation	Shading Tools
Hot-Humid	Comfort ventilation	Shell-type shading tool

The type of ventilation facilitated by the openings within the structure does not strongly support cross ventilation (Table 4.13.). Consequently, if there is no aluminum shell on the exterior façade of the building or if this shell becomes non-functional as a result of scenarios like material degradation, physical damage, poor maintenance, design flaws or technological failures etc., scenarios similar to a greenhouse effect may occur within the structure. Therefore, in the event of the shell around the building becoming ineffective, the building should have been designed more in line with passive energy strategies.

At this point, examination of building openings and CFD (Computational Fluid Dynamics) analysis could be qualified as highly related to solar control and natural ventilation. Examining the building openings in existing structures is essential for a comprehensive analysis of solar control and natural ventilation. CFD (Computational Fluid Dynamics) analysis is considered necessary for solar control and natural ventilation analysis due to its ability to simulate and visualize airflow patterns, temperature distribution, and solar exposure within and around buildings. These analyzes helps to understand how air moves and heat is distributed in different spaces, providing valuable insights into the effectiveness of natural ventilation strategies and solar control measures.

<u>Building openings</u>

Windows: One of the building elements that will affect the energy and resource use of the building by affecting the heating and cooling loads of the building through ventilation and lighting is the windows. Factors such as the location, material, size of the windows and the amount of ventilation suitable for the climate type and the amount of daylight can vary and can be made more beneficial. The heat transfer through building openings would have a significant role in determining the temperature on the inner space of the building, affecting overall energy conservation and the efficiency of the interior space. To exemplify, the indoor air velocity in the areas depicted in Figure 4.16.a. will be notably high. Nevertheless, this approach results in numerous sections of the space being unaffected by the airflow. On the other hand, diagonally positioning window openings or gaps on the side walls will promote effective airflow within the interior as seen in Figure 4.16.b. (Watson and Labs, 1994).



(a)

Figure 4.16. Window Locations a) Windows on Opposite Facades b) Windows on Cross Facades (Watson and Labs, 1994)

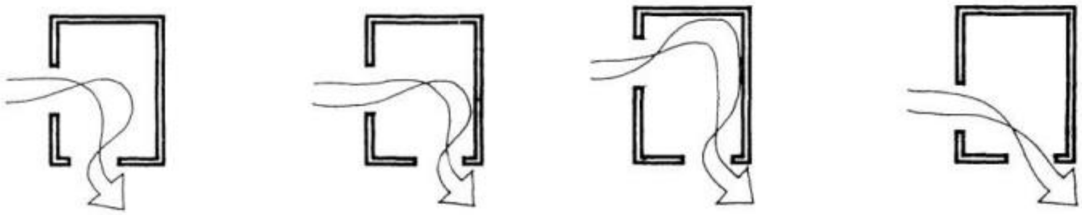


Figure 4.16. (continued) Window Locations a) Windows on Opposite Facades b) Windows on Cross Facades (Watson and Labs, 1994)

It may be preferable to position the windows in various ways according to the ratio of heating and cooling needs in the area. While positioning windows on opposite walls in cold climates can be chosen as heat loss is not desired, it is more appropriate to open window openings on cross facades in hot-dry climate type. On the other hand, information on joinery types, materials, glass layers, etc., for the bioclimatic use of windows is required. These are given in Table 4.14. for the five climate types seen in Turkey.

Table 4.14. Window types according to the climate types

Climate Zone	Windows
Cold	Double-glazed, wooden framed, small-sized window that is well insulated, multi-glazed if necessary
Temperate-Humid	Metal or wooden framed single or double glazed window large enough to provide the necessary heat control
Temperate-Dry	Single or double glazed, insulated metal or wooden framed window large enough to provide the necessary heat control
Hot-Humid	Single glazed, insulated metal or wood framed window wide enough to allow air movements between indoor and outdoor, shaded for protection from direct solar radiation
Hot-Dry	Single or double glazed wood framed window,larger on the courtyard side and smaller on the exterior

Doors: Doors are other building openings that affect the air circulation and heat transfer in the interior, as is the case with windows. After windows, doors are the next significant building components that contribute to natural ventilation within the interior. Doors allow air to be drawn from the building envelope into the interior spaces, especially in areas without direct access to the exterior (Balanlı, 2007). By opening gaps such as doors and windows in the shell of the building, natural ventilation and thus heat loss or gain can be manipulated as desired. The proportion of door and window openings on the building's shell and their specific locations on the shell play a crucial role in determining the heat loss and gain of the building, consequently affecting the comfort levels within the interior. The arrangement of window and door spaces and the design of the facade are significant factors in ensuring adequate sunlight exposure and facilitating natural ventilation within the building. Table 4.15. shows offered door types for Turkey’s climate zones.

Table 4.15. Door types according to the climate types

Climate Zone	Doors
Cold	Doors on the surface closed to the wind, with spoiler, windbreaker, gasket
Temperate-Humid	Windbreaker, gasketed doors for minimum hot circuit located to support cross ventilation
Temperate-Dry	Doors on the windproof surface located to support cross ventilation, with windbreak and gasket.
Hot-Humid	Doors on the wind-open surface located to support cross ventilation
Hot-Dry	Doors on the windproof surface, with windbreak and gasket.

Case study (Building A)

Openings such as doors and windows in the building play a significant role in facilitating the interaction between the indoor environment and the airflow in the surrounding area. These elements allow the building to align with the prioritized conditions according to the climate it is situated in.

The placement, size, and types of windows within the building envelope can support various ventilation methods within the structure, including comfort ventilation, cross ventilation, and buoyancy-driven ventilation. Depending on the design of windows, their dimensions, and types, different ventilation strategies can be accommodated to enhance indoor air quality. Particularly in a hot and humid climate type, ventilation methods such as comfort and cross ventilation are considered beneficial. These ventilation types are employed within the building to decrease excessive heat gain and distribute humidity, promoting better indoor air quality and comfort.

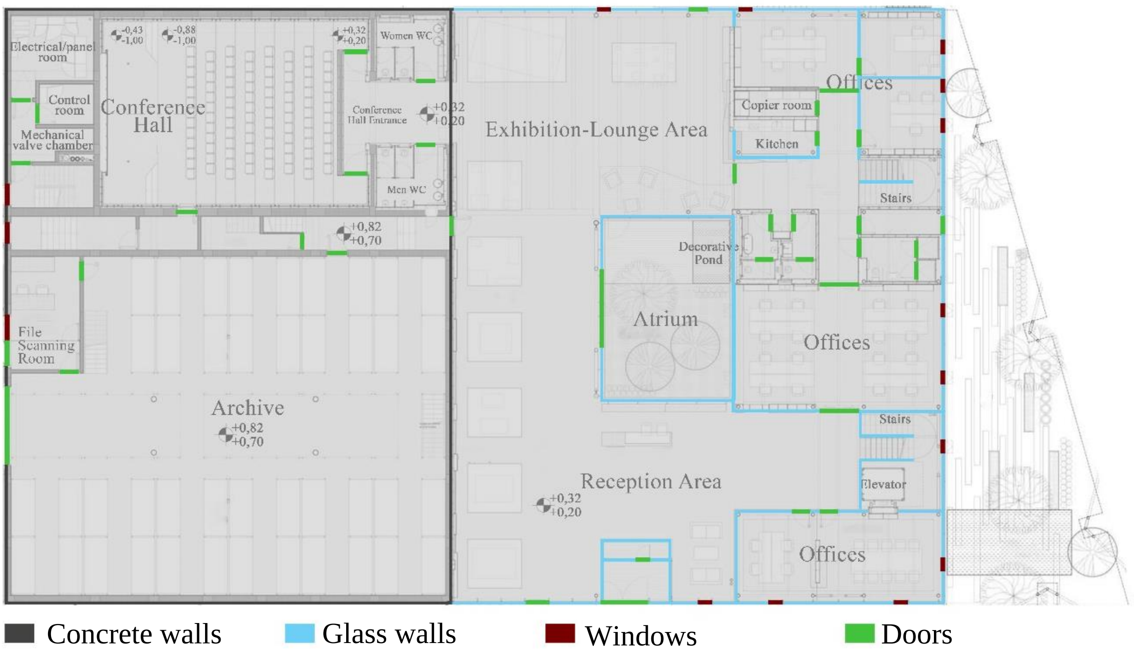


Figure 4.17. Window and door locations on floor plan of Building A

Window and door locations of the building is marked on the floor plan on Figure 4.17. Approximately 51% of the building's exterior walls consist of glass, while the remaining 49% are constructed with reinforced concrete. An integrated aluminum shell envelops the entire structure's outer surfaces. While the glass-covered exterior facades are shielded from direct sunlight by this shell, the continuous presence of the shell does not significantly contribute to the reinforced concrete walls. In the office area, only a small portion of the glass walls functions as windows and can be opened (Table 4.16.). Consequently, the glass walls that do not serve as windows contribute to additional heat within the structure, whereas the positive impact of the designated windows on the floor plan remains relatively minor.

Table 4.16. Specialties of windows and doors of Building A

Climate Zone	Windows	Doors
Hot-Humid	Double glazed, insulated metal framed windows which are not wide enough to allow air movements between indoor and outdoor, shaded for protection from direct solar radiation	Doors are not on the wind-open surface located to support cross ventilation

Although having a limited number of windows, particularly in proportion to their size, can contribute to comfort and ventilation, it still falls short of fulfilling the requirement for cross ventilation. As a result, the office area with glass walls experiences a reduced level of cross ventilation along its exterior walls, which increases the demand for cooling and diminishes indoor comfort. While the aluminum shell integrated into the building's exterior prevents direct exposure to sunlight, it is important to note that there will still be periods in the hot and humid climate region when cross ventilation will be necessary. Furthermore, the main entrance doors have not been positioned in the prevalent wind direction, which is not perceived as favorable for enhancing indoor air circulation. The doors lack the mutual support needed to strengthen ventilation between them.

Computational Fluid Dynamics (CFD) analysis for natural ventilation

In creating sustainable and comfortable indoor environments, the role of natural ventilation cannot be overstated. Natural ventilation strategies harnessed effectively, can significantly contribute to energy efficiency and occupant well-being within buildings. To this end, a critical phase of evaluation at Building A is embarked upon, which involves the utilization of Computational Fluid Dynamics (CFD) analysis.

The focus of this section is to comprehensively assess the airflow and velocity patterns within the internal yard of Building A during the summer season. The summer season is particularly significant in the context of natural ventilation, as it presents both opportunities and challenges for maintaining indoor comfort and reducing the reliance on mechanical cooling systems. The analysis assumes an average wind velocity of 6 meters per second, mirroring typical conditions, and considers the prevalent wind direction during summer.

Outdoor CFD analysis in the internal yard: The internal yard, a central component of the building design, plays a pivotal role in promoting natural ventilation. The aim to understand how air circulates within this space by conducting CFD analysis. The effectiveness of the yard's design and its capacity to harness prevailing wind patterns for optimal ventilation would be scrutinized.

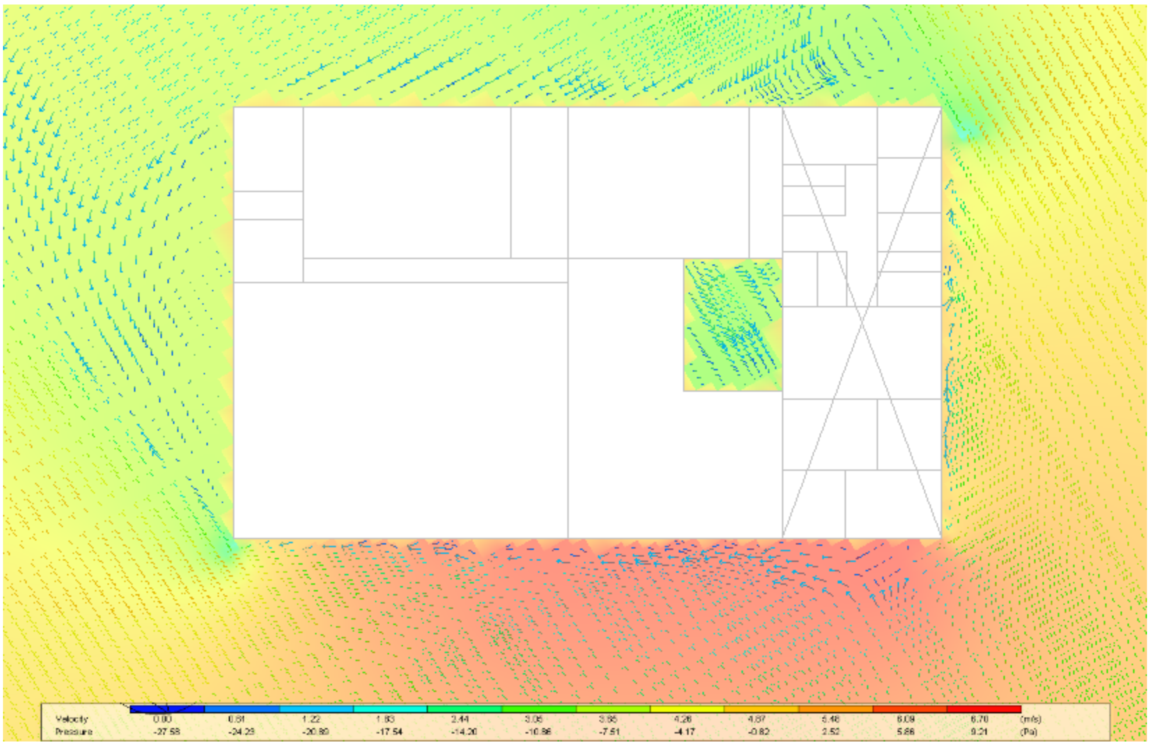


Figure 4.18. The horizontal plane on level 1 m

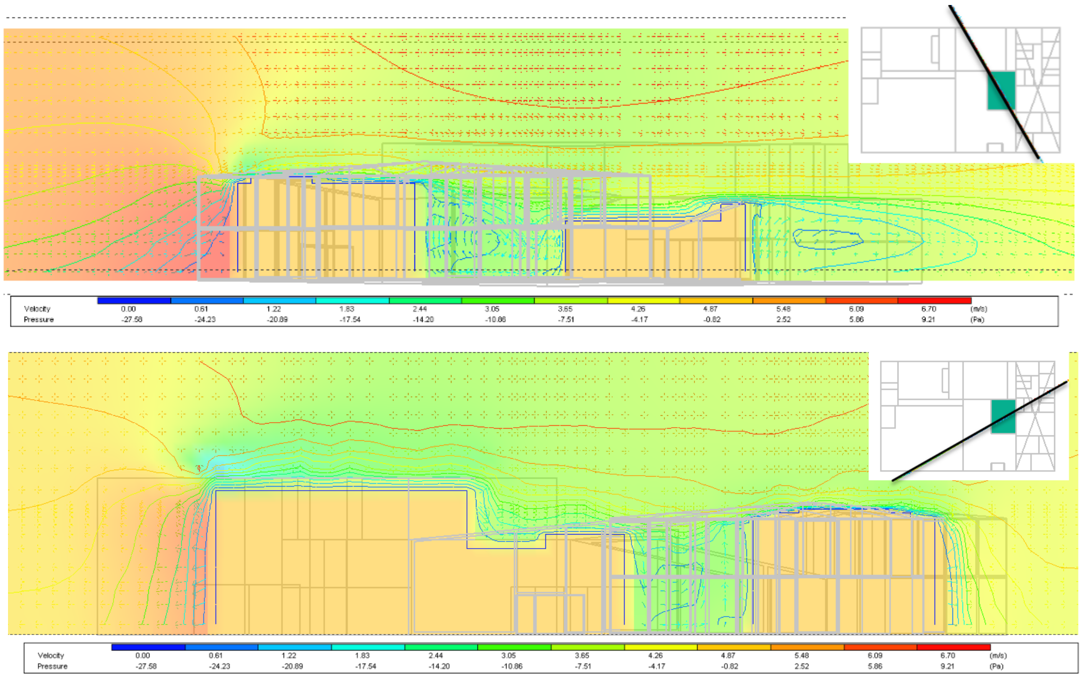


Figure 4.19. The vertical planes from the interior yard

The CFD results show how outdoor wind velocity affects the airflow within Building A's internal yard. At wind speeds of 5-6 m/s, the internal yard has airflow velocities of 0,5-2 m/s.

At the center of the yard, the highest interior airflow velocities are observed. This phenomenon is primarily attributed to the yard's design, which incorporates greenery in the form of plants and a green wall. These green elements play a pivotal role in enhancing natural ventilation. They act as natural windbreakers and disrupt the wind's laminar flow, leading to turbulence that, in turn, accelerates airflow. Consequently, this central area becomes a hotspot for improved natural ventilation. The plants and green wall not only provide aesthetic appeal but also functional benefits by promoting air circulation.

Conversely, closer to the walls surrounding the internal yard, decrease in airflow velocities is identified. This reduction can be attributed to several factors, including wind sheltering and boundary layer effects. The surrounding walls act as wind barriers, slowing down the wind as it approaches, resulting in decreased airflow near the yard's periphery. This effect can hinder the yard's ability to facilitate adequate natural ventilation. The boundary layer near the walls may experience a more stable, less turbulent flow, limiting the effectiveness of the green elements in this region.

While the central part of the internal yard is instrumental in enhancing natural ventilation due to its heightened airflow velocities, the areas near the walls do not perform as effectively. However, it is essential to recognize that this is not necessarily a design flaw but rather a characteristic inherent in the interaction between wind and the built environment.

To further optimize the natural ventilation within the internal yard, it may be beneficial to consider the various strategies. One of these strategies could be adjusting the placement of plants and green elements to account for wind patterns, ensuring a more even distribution of airflow throughout the yard. Another strategy to follow could be exploring architectural changes or wind-responsive mechanisms near the yard walls to mitigate the wind-sheltering effect and improve airflow rates. It is an aspect that should be taken into consideration since air velocity is important due to climatic conditions. The other strategy that would be utilized is implementing systems that can strategically manage ventilation elements, such as adjustable louvers or operable windows, to enhance the yard's natural ventilation performance under different wind conditions.

In summary, the CFD results demonstrate the positive impact of incorporating greenery within the internal yard on natural ventilation. While there are variations in airflow velocities within the yard, these variations are characteristic of complex wind interactions and present opportunities for fine-tuning the design to further optimize natural ventilation throughout the space.

Indoor CFD analysis for museum spaces: In pursuit of an even deeper understanding of the environmental performance of Building A, a crucial aspect of its sustainability is delved into - the indoor microclimate. This analysis focuses specifically on the museum spaces that encompass the interior yard, examining conditions during the height of summer. It is widely acknowledged that natural ventilation plays a pivotal role in enhancing indoor air quality and ensuring occupant comfort, especially in warmer seasons. To this end, an Indoor Computational Fluid Dynamics (CFD) analysis is conducted on August 25th at 12 PM, precisely when the region experienced the peak of its hottest week.

The analysis is premised on data from the EnergyPlus simulation, which provides invaluable insights into heat flow and surface temperatures. These critical parameters significantly influence the indoor environment, determining the effectiveness of natural ventilation. The study also accounts for a practical scenario where approximately 25% of the windows can be opened, mirroring real-world conditions.

This investigation aims to show how natural ventilation can alleviate indoor thermal discomfort during the hottest periods of the year. By exploring the air distribution and temperature patterns, valuable information could be gleaned that will further bolster Building A's commitment to passive design and elevate its performance in providing a sustainable, comfortable, and environmentally responsible space for its occupants.

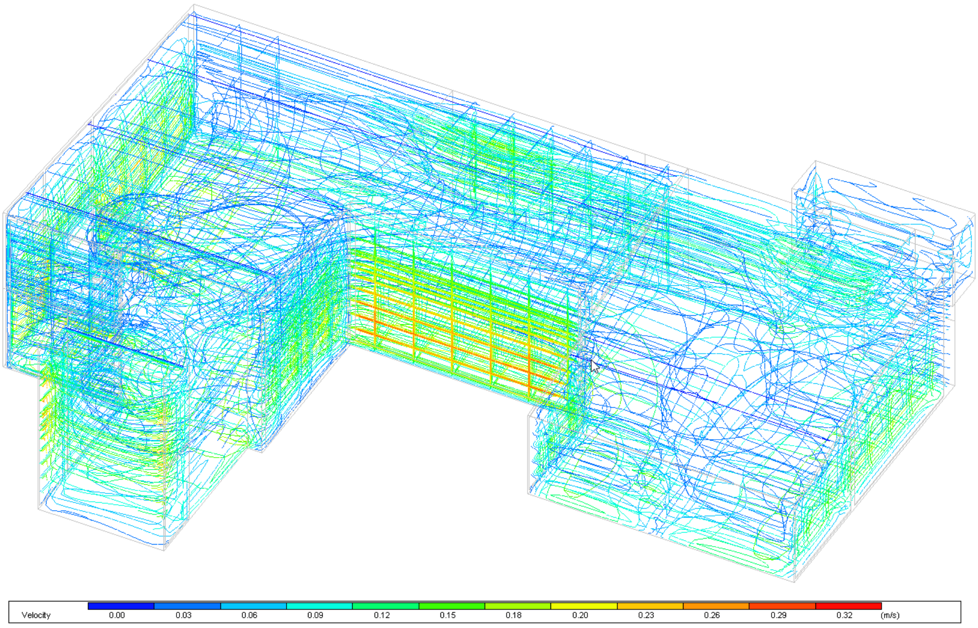


Figure 4.20. 3D contour of velocity

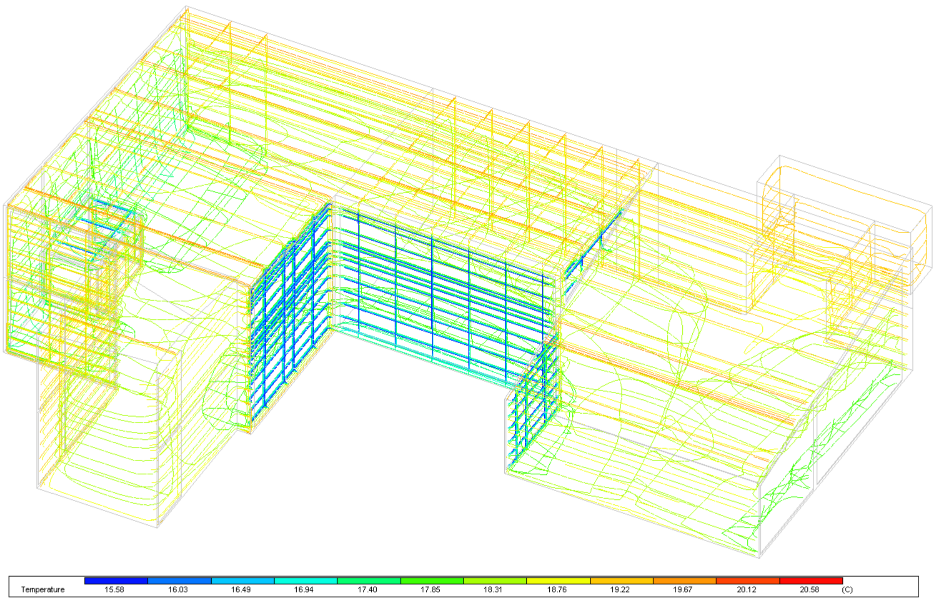


Figure 4.21. 3D contour for the temperature

4.1.7. Building envelope

The building shell is one of the main factors determining the heat and airflow permeability of the building. It is the building element that establishes the relationship of the building with the outside world and ensures its interaction. The openings in the building shell maintain this relationship with variables such as the surface area and the openings in the shell, thus shaping the relationship of the building with the physical environment. Properties such as absorbency, permeability and reflectivity, the inclination of the shell, total heat transmission coefficient, time lag, and amplitude reduction factor are effective against solar radiation related to heat and moisture transfer of the shell (Zorer, 1992). Properties such as heat permeability, reflectivity, and absorptiveness are tried to be kept at the optimum level with various variables such as the form, material, texture, and color of the building shell. Employing passive cooling techniques, such as natural airflow and shading structures that shield the building from direct sunlight, additionally contribute to achieving indoor thermal comfort levels while minimizing energy consumption (Figure 4.22.). Heat transfer between indoor and outdoor space is one of the main factors to be considered both in terms of energy use and indoor comfort.

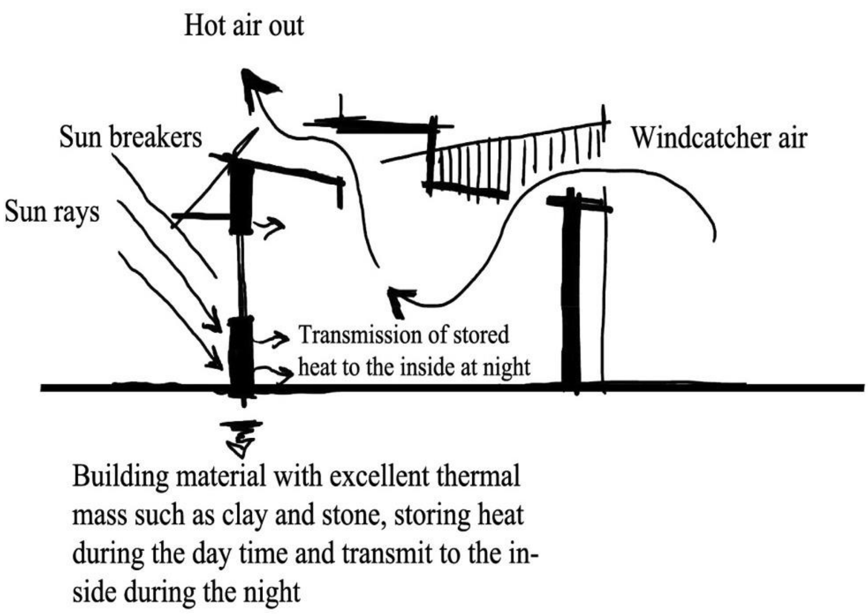


Figure 4.22. Thermal mass mechanism of building materials in walls (Sharaf, 2020)

The opaque envelope experiences three modes of heat transfer: conduction, convection, and radiation. Solar radiation is absorbed by the outer wall surface and then conducted to the building's interior. Simultaneously, convective heat transfer happens between the external wall surface and the surrounding air, as well as between the inner wall surface and the indoor air (Yu, Yang, Tian and Liao, 2009). The optical and thermophysical properties of the building shell should be examined for these conduction, convection, and radiation levels and appropriate choices should be made. Time lag and decrement factor are pivotal attributes in assessing the heat storage capacity of a material. Varied time lags and decrement factors can be achieved based on the material's thermophysical properties and wall thickness. Energy accumulated during daylight hours can subsequently be utilized during the cooler nighttime period, capitalizing on the material's stored heat (Asan and Sancaktar, 1998). Time lag refers to the duration it takes for a sinusoidal temperature wave to propagate from the exterior surface of a wall to its interior. Conversely, the decrement factor denotes the extent by which the amplitude of the indoor temperature wave diminishes in relation to the wave at the external surface (Özel, 2014). Time lag ϕ (also known as phase lag, time shift, or time delay) and decrement factor f (also referred to as decreasing ratio, dimensionless amplitude, or temperature attenuation) are formulated as follow (Kontoleon and Eumorfopoulou, 2008):

$$\phi = t_{\mathrm{Ti,min}} - t_{\mathrm{Te,min}}, \qquad \phi = t_{\mathrm{Ti,max}} - t_{\mathrm{Te,max}}, \tag{4.1.}$$

$$f = \frac{T_{\mathrm{i,max}} - T_{\mathrm{i,min}}}{T_{\mathrm{e,max}} - T_{\mathrm{e,min}}}$$

As seen in formulas above, time lag and decrement factor are focused on indoor and outdoor heat balance. These specialties are remarkable on the aspect of indoor comfort and heating-cooling loads in a building which affects the energy usage of the building. As a result, it is important to address these factors according to the characteristics of the climate zone and design the building envelope accordingly. Optimum conditions suitable for climatic regions in Turkey are shown in the Table 4.17.

Table 4.17. Optimal time lag duration and directions for different climatic zones (Olgyay, 1963)

Climate Zone	Time lag duration (clock) and direction	Color
Cold	On the west wall, 6 hours	Medium colors on sun-exposed surfaces, dark colors on non-exposed surfaces
Temperate-Humid	On the west wall, 6 hours	Medium tones on wall surfaces, light colors on roof surfaces
Temperate-Dry	On the west wall, 6 hours	Medium tones on wall surfaces, light colors on roof surfaces
Hot-Humid	Not wanted	Light colors on all surfaces
Hot-Dry	0 hours on the east wall, 10 hours in other directions	The surfaces to be benefited from the radiation effect are dark, the others are light-colored.

It is seen that wall orientation has a great effect on time lag while it has a small effect on decrement factor. The longest time lag is obtained for the east-facing wall while the shortest time lag is obtained for the west-facing wall (Özel, 2013). Therefore, cold, temperate-humid, and temperate-dry climate zones utilize time lag on the west wall on the contrary of hot-dry climate zone which utilizes time lag on the east wall. The time lag feature of different materials would be taken into account in accordance with the time lag requirement in different wall directions such as east and west. In hot humid climates, the key to building design lies in ensuring indoor comfort through proper building orientation to capture prevailing winds. This involves using light materials with low heat storage capacity in wall layering to allow for quick heating and cooling. Since the thermal mass is desired to heat up and cool down quickly in the hot humid climate region, light materials with low heat storage capacity and time delay are used in the wall layering detail, unlike in hot dry climate regions, and wall cross-sections are smaller. Walls are generally white or light colored to reduce the heat load on the wall caused by solar radiation (Koca, 2006). Materials that have been provided with examples of time lag according to the orientation of the wall and the heating or cooling requirements based on the prevailing climate, along with other materials, can be considered in the design process from this perspective. Various materials with fixed thicknesses are shown in Table 4.18. on the aspect of their time lag. These materials should be utilized in building envelope according to climate zones in Turkey.

Table 4.18. Time lag of walls of different building materials (Sharaf, 2020)

Material (thickness 30 cm)	Time lag (hours)
Adobe (clay brick)	10
Red bricks (standard)	10
Bricks (face)	6
Concrete (heavyweight)	8
Wood	20
Stone	12

In cold climate zone, it is favorable to have a substantial heat-retaining mass within the interior to counteract drastic temperature fluctuations. Using a west-facing wall material with a 6-hour time lag helps stabilize internal heat distribution while the use of a west-facing wall material with a 6-hour time lag helps balance the distribution of internal heat in temperate-humid and temperate-dry climate zones (Olgyay, 1992). In Turkey’s hot, dry climate, materials with greater thermal mass are chosen for the building envelope to exploit time lag benefits. This is ideal for hot-dry climates with intense summers and significant daily temperature shifts. The thermal mass slows heat transfer, maintaining stable indoor temperatures despite lower outdoor temperatures. However, the thermal mass rapidly loses heat at night, starting the next day cooler (Yılmaz, 2007). In designing buildings for hot and humid climates, the key is aligning the structure with prevailing winds for indoor comfort. Achieving this ensures both user comfort and a thermal mass that heats and cools rapidly, preventing discomfort from surface radiation or nocturnal conditions. In such climates, lightweight materials with low heat storage are preferred in wall stratification with no need time lag, and wall cross-sections tend to be simpler, unlike hot-dry regions.

In case of design or application of composite walls, different types of insulation applications result in change on values of time lag and decrement factor of the building envelope. As observed in Figure 4.23.a. and 4.23.b., MIM (the insulation in the middle of wall), MI (the insulation on the outer surface of wall), IM (the insulation on the inner surface of wall), MIMI (half insulation in the middle and the other half on the outer surface of wall), IMIM (half insulation in the middle and the other half on the inner surface of wall), IMI (half insulation on the inner surface and the other half on the outer surface of wall) are various Insulation applications on the building envelope and it can be indicated that there would be change on the aspect of time lag and decrement factor according to these types (Zhang et al., 2017). In the use of composite walls, the selection should be made by taking into account the time lag times required in climatic regions.

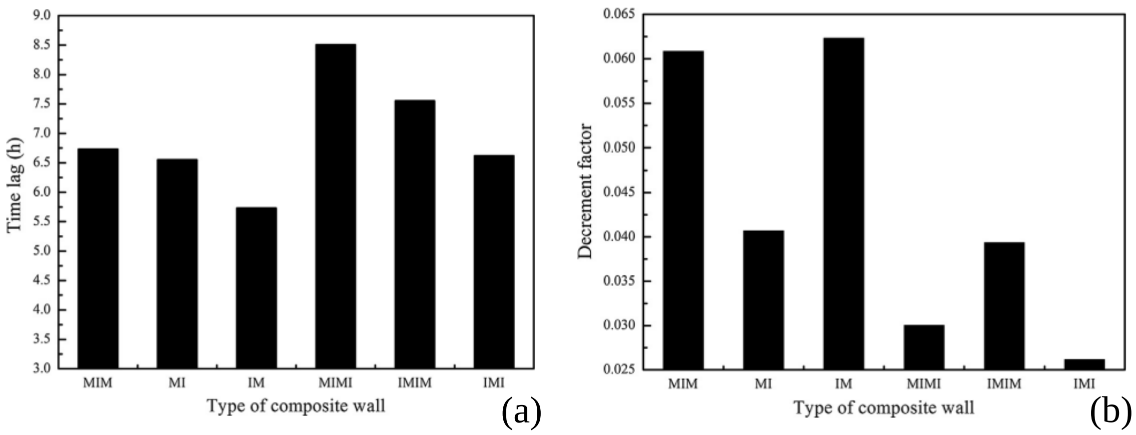


Figure 4.23. Time lag and decrement factor according to insulation type a) Time lag vs. composite wall. b) Decrement factor vs. composite wall

Case study (Building A)

In hot and humid climate zones, time lag is not desirable. In these regions, where the amplified impact of temperature with humidity is a concern, time lag in the transition of air between indoor and outdoor spaces is avoided to optimize this effect. Additionally, materials with high heat storage capacity due to their color would lead to excessively warm indoor environments in such climate zones. As a result, light colors are employed on all sides of buildings to counteract this. This approach prevents the use of dark colors on facades in this climate zone, which, in combination with already high temperatures, could increase the cooling load of the structure and reduce indoor comfort.

Table 4.19. Time lag property of Building A

Climate Zone	Time lag duration (clock) and direction	Color
Hot-Humid	More than desired	Light colors on all surfaces

Aluminum perforated shell is added to the building on all sides in case the use of only the glass façade in Building A shell could pose a problem in heat and radiation control. The main function of the shell is to hinder the heating of the outer glass surfaces. Consequently, solar radiation is channeled into the indoor area with enhanced regulation, resulting in diminished heat accumulation within both the outer surface and the inner space. Consequently, this has curtailed the demand for cooling within the structure. To exert more comprehensive oversight over the inflow of natural light and to amplify the building's usability, innovative features like sensor-equipped solar shading panels and pathways along the facades of the floors have been seamlessly integrated. The aluminum perforated shell, which is both partially permeable and dynamic, creates gardens as well as private and communal areas where it interacts with the facade. This is achieved through its motion, where it recedes from the structure in some areas and ascends and descends in others. While the archive segment was conceptualized with a self-contained function, its construction took the form of a reinforced concrete structure for stability. Conversely, office spaces were crafted to openly display the internal steel framework, backed by transparent glass facades. In contrast, the museum serves as a junction, melding two distinct programs at the convergence of the fully enclosed and entirely open aspects of the design.

While the low time delay of the glass material used in the facade is seen as beneficial for supporting indoor air circulation, the addition of the aluminum profile as part of the shell increases the time delay, which could potentially lead to decreased air quality in the office area. The aluminum shell, which is part of the dynamic structure, facing technical issues, might result in a significant increase in cooling load, particularly in the office area. Furthermore, the choice of using reinforced concrete material with a thickness of 25-30 cm in the archive and conference hall zones is not deemed suitable in terms of time delay for this climate region.

Heat island analysis is evaluated as essential for building envelope analysis, in the context of buildings, due to its influence on the thermal performance and energy efficiency of the structure. When assessing an existing building, understanding the local heat island effect is crucial for analyzing the building envelope. The heat island analysis provides insights into the surrounding microclimates and temperature variations, which directly impact the thermal stress experienced by the building envelope. For an existing structure, this information is valuable for identifying areas of potential heat-related degradation, determining insulation effectiveness, and evaluating the overall energy efficiency of the envelope.

Heat island analysis

In the quest for sustainable and environmentally conscious building design, mitigating urban heat islands has gained significant attention. Urban heat islands occur when urban areas experience higher temperatures than their rural surroundings due to human activities and the extensive use of building materials that absorb and retain heat. Building A, in its commitment to sustainability, has incorporated a metal shell as part of its building design, which could substantially impact mitigating the urban heat island effect.

In this section, the effect of the metal shell on mitigating the urban heat island effect surrounding Building A would be assessed. Specifically, the Universal Thermal Climate Index (UTCI) thermal map would be focused on, emphasizing the Heat Sensation Percentage (HSP) during the hottest week of the year. This assessment will allow us to understand how the presence of the metal shell influences heat perception and comfort in the local urban environment.

The HSP metric will be instrumental in determining how the metal shell contributes to reduced heat perception and, consequently, improved thermal comfort within the vicinity of the building. By comparing the UTCI thermal map with and without the metal shell, this study aims to provide insights into the shell's effectiveness as a sustainable building feature that mitigates the urban heat island effect.

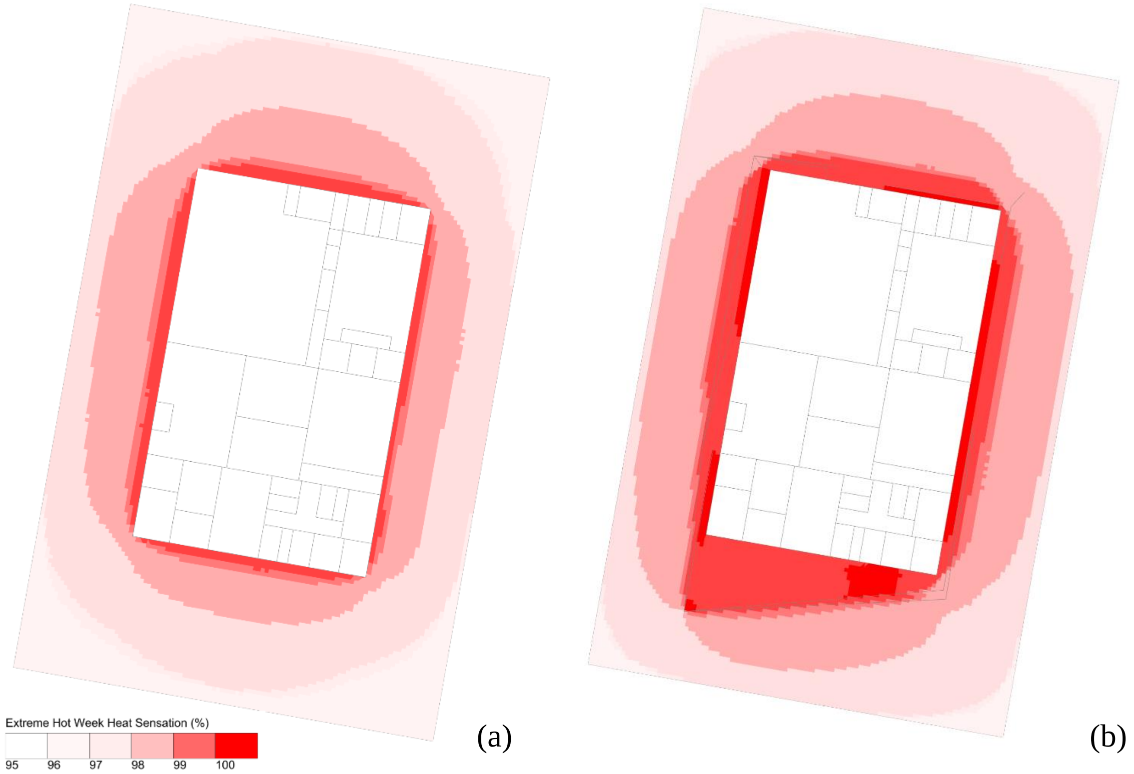


Figure 4.24. The result of HSP surrounding the boulding a) without metal shell b) with metal shell

The Heat Sensation Percentage (HSP) analysis results with and without the metal shell provide valuable insights into its contribution to mitigating the urban heat island effect. HSP reflects the percentage of time individuals would experience a certain level of discomfort due to thermal stress. A higher HSP indicates a greater level of discomfort, which can be attributed to more pronounced thermal stress. It is essential to compare the HSP values with and without the shell to assess its effectiveness in improving thermal comfort in the local urban environment.

With the shell: With the metal shell in place, the HSP values vary from 97,29% to 99,88% during the hottest week of the year. These values suggest that even with the shell, the urban environment around Building A experiences relatively high levels of heat sensation.

Without the shell: In the absence of the metal shell, the HSP values range from 96,43% to 99,35%, exhibiting a similar pattern to those observed with the shell. This indicates that the shell alone might not be a highly effective solution for mitigating the urban heat island effect, as the differences between the two scenarios are not substantial.

The results suggest that while the metal shell may offer some reduction in HSP, its impact is limited, especially during the hottest week of the year. While the aluminum perforated shell provides shading for office areas with extensive glass facades, it is observed that it does not offer significant benefits in terms of heat sensation. This implies that other factors, such as the surrounding built environment, pavement materials, or lack of green spaces, might contribute significantly to the urban heat island effect.

The deficiencies in the effectiveness of the metal shell can be attributed to its capacity to provide shading and reduce solar heat gain, which are crucial aspects in mitigating the urban heat island effect. The analysis shows that, although the shell does provide some relief, it does not create a substantial difference in heat sensation percentages compared to the scenario without the shell.

One potential reason for the inadequacy of the metal shell in thermal mitigation could be its limited coverage or design. It may not be effectively shading key areas or surfaces exposed to direct sunlight, which is crucial in reducing the heat island effect.

In summary, the analysis indicates that while the metal shell may provide some thermal comfort benefits, it is not a comprehensive solution for mitigating the urban heat island effect during the hottest periods. To address this complex environmental challenge effectively, it is imperative to consider other urban planning and design strategies, such as green roofs, reflective materials, and increased vegetation. The urban heat island effect is influenced by a multitude of factors, and the metal shell, while a valuable feature, should be part of a holistic approach to urban sustainability and heat reduction.

4.1.8. Material selection and color usage

The choice of building material is made by considering the climatic conditions of the region and local materials. It is considered necessary to choose the building material among ecological options. At this point, natural materials should be used in a conservation-utilization balance so as not to cause resource depletion and natural landscape degradation. The use of local materials during the construction phase should be preferred in terms of reducing all kinds of energy consumed as well as lower costs in material extraction and transportation expenses.

In accordance with the physical environmental conditions of the region, it should be considered and preferred among the options that have suitable absorbency, reflectivity, and conductivity levels, are easy to reach in local production, will not be harmful to nature and recyclable in use, and do not pose a danger to human health. In addition, the color of the selected material is one of the characteristics that form the basis of the relationship this material will establish with heat, light and air flow.

Considering that the material is an active factor at every stage during the life cycle of the building, its accessibility, cost, correct detailing and application should be considered in the construction process at the first stage. Afterwards, it is expected that the physical environment will not adversely affect the health of the users and be compatible with the temperature, humidity and wind conditions during the usage process. In the last stage, if the material used in the building becomes unusable for various reasons, it is essential that this material be recyclable and decomposable in nature.

Table 4.20. Material selection and color usage for different climate zones in Turkey

Climate Zone	Material Selection and Color Usage
Cold	Use of opaque and recycled materials with high heat storage capacity. Medium color should be used on sun-exposed surfaces and dark color should be used on non-exposed surfaces.
Temperate-Humid	Materials with high cooling capacity should be avoided on northwest facades. Selection of recyclable materials. Light colors should be used on wall surfaces and medium-toned roof surfaces.
Temperate-Dry	Materials with high cooling capacity should be avoided on northwest facades. Selection of recyclable materials. Light colors should be used on wall surfaces and medium-toned roof surfaces.

Table 4.20. (continued) Material selection and color usage for different climate zones in Turkey

Hot-Humid	Use of recycled materials with low heat storage capacity. Light colors should be used on all building surfaces.
Hot-Dry	Use of opaque and recycled materials with high heat storage capacity. The surfaces that will benefit from the radiation effect should be dark and light colors should be used on other surfaces.

In cold climates, energy efficiency can be increased through well-insulated, dark-colored, compact and solid walls with high thermal mass and high solar radiation absorption. As an illustration, for windward-facing aspects of structures constructed with timber framing, opting for thicker solid stone walls, as opposed to wood-framed walls filled with stone, can be advantageous in augmenting the overall resistance to heat transfer (Yüksek and Esin, 2013). Stone is employed for the ground floor walls due to soil dampness, while wood predominates on upper levels to mitigate the accumulation of summer heat in temperate-humid climate zone. Many buildings feature entirely stone walls on sections housing chimneys or on the northwest-facing facade vulnerable to wind-driven rain. In urban centers, constructions with all-stone outer walls were also erected; nevertheless, these walls are comparably slender (0,30-0,40 m) when contrasted with stone structures found in other regions (Özdeniz, 1991). Within a hot-dry climate, the high heat storage capacity inherent to the building envelope serves to mitigate the impact of external temperatures, facilitating the creation of a pleasantly cool indoor environment throughout the daytime. Consequently, materials such as limestone, stone, mud, and their various amalgamations consistently find favor in architectural preferences within this climatic context (Manioğlu and Yılmaz, 2008).

To reduce the consumption of cooling energy within a hot and humid region, it is crucial to restrain the amount of heat gain through effective management of the building envelope (Mirrahimi et al., 2016). Since it is important to reduce the cooling load in the hot-humid climate region, light-colored wall surfaces and medium-toned roof surfaces are found to be correct in terms of balancing the heating-cooling load. Structures are usually built using wood and stone, as materials are readily available in the area (Manioğlu and Oral, 2010). On the other hand, it can be said that the use of locally available and recyclable or recycled materials in climatic regions is the common point in the selection of materials in each region. The formation of the architectural structure has developed depending on the regional characteristics and the availability of the material. Climatic conditions, vegetation of the region, technical constraints, traditions, construction materials and techniques have been revealed as the most determining factors (Göğebakan, 2015). It can be observed that the main factor in the selection of materials suitable for climatic data is the requirement levels of the heating and cooling load. Based on this, the absorbency and reflectivity values of the material are the properties that refer to the heating and cooling load requirement. In Table 4.21., the absorbance and reflectivity values of the main materials used in the buildings can be seen to illustrate differences between these materials. These values are important points that should be considered in accordance with the context when designing a structure.

Table 4.21. Examples of materials with absorptivity and reflectivity values (Koca, 2006)

MATERIAL		Absorptivity	Reflectivity
Asphalt	Dark	0,90 – 0,98	0,02 – 0,10
	Medium-toned	0,80 – 0,90	0,10 – 0,20
	White	0,70 – 0,80	0,20 – 0,30
Roof Cladding	Dark	0,85 – 0,95	0,05 – 0,15
	Medium-toned	0,70 – 0,85	0,15 – 0,30
	White	0,50 – 0,65	0,30 – 0,40
Wooden Surfaces	Old	0,80 – 0,85	0,15 – 0,20
	New	0,65 – 0,75	0,25 – 0,35
Rough wooden surfaces (painted)	Dark	0,90 – 0,98	0,02 – 0,10
	Medium-toned	0,75 – 0,85	0,15 – 0,25
	White	0,55 – 0,65	0,35 – 0,45
Smooth wooden surfaces (painted)	Dark	0,85 – 0,95	0,05 – 0,15
	Medium-toned	0,75 – 0,85	0,15 – 0,25
	White	0,45 – 0,55	0,45 – 0,55
Brick	Dark	0,80 – 0,90	0,10 – 0,20
	Medium-toned	0,70 – 0,80	0,20 – 0,30
	White	0,60 – 0,70	0,30 – 0,40
Concrete Block	Dark	0,90 – 0,98	0,02 – 0,10
	Medium-toned	0,70 – 0,85	0,15 – 0,30
	White	0,50 – 0,60	0,40 – 0,50
	Not painted	0,75 – 0,80	0,20 – 0,25

Case study (Building A)

Although primary building material is steel, safety considerations factored when constructing the archive section, which was made using reinforced concrete. Essentially, the design of the building revolves around a fusion of reinforced concrete and steel, with security being a central concern. The steel, serving as the pivotal structural backbone, is meticulously fashioned. Typically associated with industrial structures, steel is not typically chosen for its aesthetic contribution. The use of steel can be considered correct in terms of low heat storage capacity and easy local accessibility (Table 4.22.). However, excessive use of glass on the facade is not beneficial in terms of keeping the heat balance between indoor and outdoor at the optimum. The use of dense transparent material on the façade in order to make the structure evident in the building has made the conservation of energy even more difficult.

Table 4.22. Material selection of Building A

Climate Zone	Material Selection and Color Usage
Hot-Humid	Use of materials like steel with low heat storage capacity, glass and concrete with more heat storage capacity. Light colors on aluminum shell profile. Dark colors on glass and concrete building surfaces.

Concrete material has been chosen for half of the east and west facades as well as the north facade of the building, while glass has been employed for half of the east and west facades and the entire south facade. The use of glass material, especially on the south facade where the main entrance is located, will lead to discomforting temperatures due to solar exposure through the openings in the outer shell of the building.

The three primary materials used in the building, namely concrete, steel, and glass, can be optimized when employed together in a balanced manner in the hot and humid climate region. However, in the case of this structure, it could be argued that the glass and concrete elements within the aluminum profiles of the exterior walls are not suitable for this climate. Considering that the aluminum profiles serve as a fundamental protective factor in a dynamic structure against environmental factors, if an issue arises within this system, the other materials of the building might not be sufficient for the climate they are situated in. In order to analyze in more detail the adequacy of the materials used in the building in this climate type, glare analysis and annual daylight analysis are carried out based on the optical properties and behavior of the materials.

Glare analysis and annual daylight analysis is highly related to material selection, especially in existing buildings, as it directly addresses the optical and thermal behavior of materials. Glare, caused by excessive brightness contrasts, can lead to discomfort and disrupt activities. The reflective and absorptive properties of materials play a crucial role in glare generation. On the other hand, annual daylight analysis provides insights into the availability and distribution of natural light which is the result of the selection linked to lighting conditions throughout the year.

Annual daylight analysis

Assessing the annual daylighting performance of a building is a fundamental aspect of sustainable design, ensuring the effective utilization of natural light while minimizing the need for artificial lighting. Two key metrics used to evaluate the annual daylighting performance are "Daylight Autonomy (DA)" and "Spatial Daylight Autonomy (sDA)." These metrics provide insights into how daylight can fulfill a space's lighting needs, reducing energy consumption and enhancing occupant comfort.

Daylight autonomy (DA): DA quantifies the percentage of occupied hours during which the illuminance levels meet or exceed a defined threshold from natural daylight alone. This metric is essential in understanding how often occupants can rely on natural light for sufficient illumination without artificial lighting. The typical range for DA is between 50% and 100%, where higher values indicate a more daylight-responsive space. An ideal range for DA might be set at 70% to 80%, signifying that natural light meets lighting needs for a significant portion of the year.

Spatial daylight autonomy (sDA): sDA is a spatially-resolved version of DA, which evaluates the daylight distribution uniformity within a space. It calculates the percentage of floor area meeting or exceeding a specified illuminance threshold for a specific percentage of the annual occupied hours. An sDA value indicates how evenly natural light is distributed throughout the space. The typical range for sDA is between 50% and 80%, with a desirable range usually falling between 55% and 75%. An sDA in this range implies that natural light uniformly contributes to the lighting requirements across the space, ensuring a comfortable and visually satisfying environment.

Notably, the rooms with DA and sDA values of 0 are indicative of spaces that lack windows or openings for natural light, rendering them dependent on artificial lighting throughout the year. These areas are not conducive to harnessing daylight for various reasons, including their purpose, location, or architectural design. It is crucial to address these spaces as they significantly impact the overall building's energy efficiency and environmental sustainability.

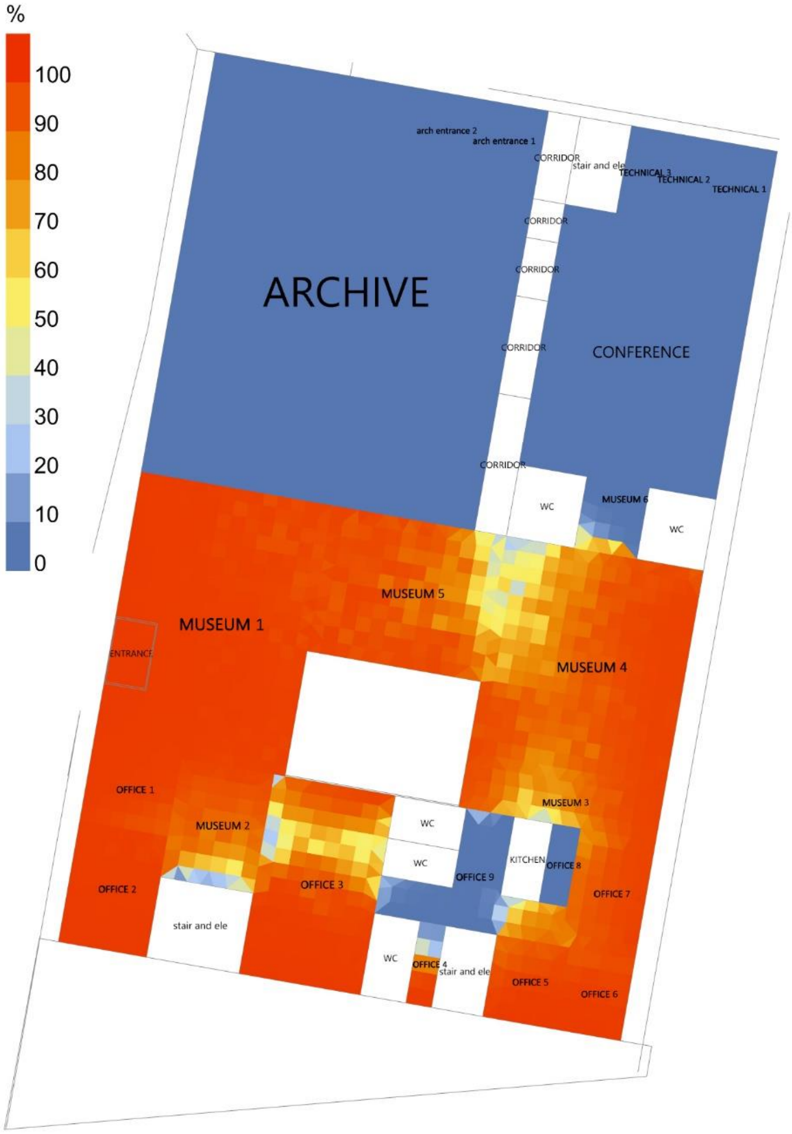


Figure 4.25. Daylight autonomy assessment a) ground floor b) first floor

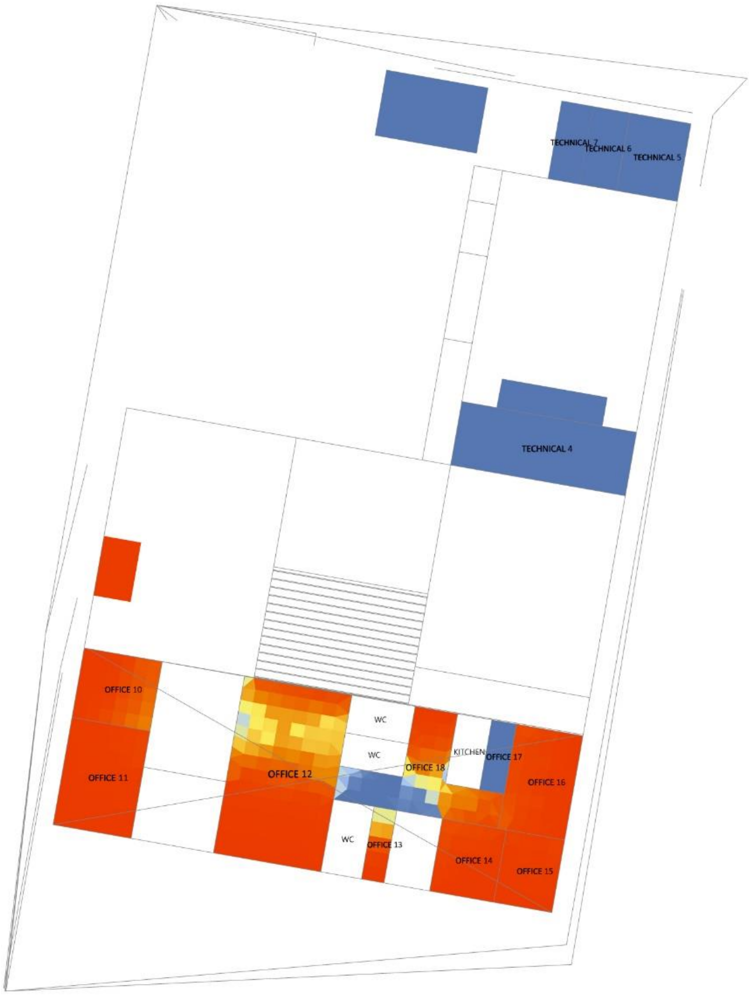


Figure 4.25. (continued) Daylight autonomy assessment a) ground floor b) first floor

Rooms without windows: Technical zones (TECHNICAL_1 to TECHNICAL_8) and Arch entrances (arch entrance_1 and arch entrance_2) have no windows to minimize external light interference, resulting in a DA and sDA value of 0. This absence of natural light can increase energy consumption and reduce occupant comfort. Conference rooms (CONFERENCE) and Archive rooms (ARCHIVE) are also typically designed without windows to meet specific functional needs, but this comes at the expense of natural light utilization.

Other rooms: In contrast, several other spaces within Building A demonstrate high DA and sDA values, indicating an effective utilization of natural light:

- Offices (OFFICE_1, OFFICE_2, OFFICE_3, OFFICE_5, OFFICE_6, OFFICE_7, OFFICE_10, OFFICE_11, OFFICE_12, OFFICE_14, OFFICE_15, OFFICE_16) are designed transparent to receive the maximum amount of natural light. Although it has been determined that high DA and sDA values can allow these areas to receive daylight to a large extent and reduce the need for artificial lighting, high values of this ratio may have a negative impact on the comfort level of the interior.

- The entrance area (ENTRANCE) welcomes occupants with abundant natural light, creating a positive first impression and enhancing the overall aesthetics. The high DA and sDA values indicate that this space is overly exposed to daylight.
- Museum spaces (MUSEUM_1, MUSEUM_2, MUSEUM_3) benefit from a well-thought-out daylighting design, contributing to the enhancement of visitor experiences. MUSEUM_4 and MUSEUM_5 comprise spaces that may require artificial lighting.

In conclusion, the DA and sDA values offer a clear understanding of where natural light is effectively integrated into the building's design and where it is notably absent. The rooms with DA and sDA values of 0 are typically those without windows, designed to meet specific functional and environmental requirements that prioritize controlled lighting and environmental conditions over daylight utilization. Addressing these limitations and exploring alternative daylighting strategies for such spaces could further improve the building's energy efficiency and environmental performance.

Glare analysis

Annual glare analysis, often called "Glare Autonomy," is a critical aspect of assessing the effectiveness of passive design compliance, such as the aluminum perforated shell in the architectural project. This analysis focuses on understanding the potential for glare within a space over a year. Glare occurs when excessive and uncontrolled daylight, often from direct sunlight, enters a space, causing visual discomfort, reduced visibility, and potential health issues for occupants. Therefore, mitigating glare is essential for creating energy-efficient spaces conducive to human well-being and productivity.

The significance of glare autonomy lies in its ability to predict and evaluate how well a building's design strategies, in this case, the aluminum perforated shell, can effectively eliminate or reduce glare. By conducting this analysis, insights into whether the shell's design is optimized to maintain visual comfort for occupants could be gained throughout the year.

As for the radiance setting you are using for the shell modifier, it is essential to provide the necessary information to conduct the analysis accurately. The radiance settings define materials' optical properties and behavior in a simulation.

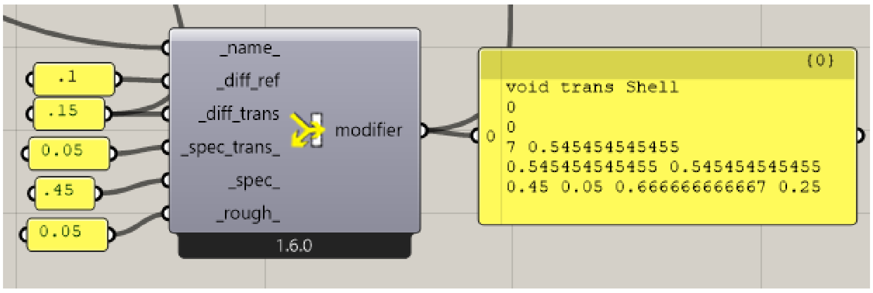
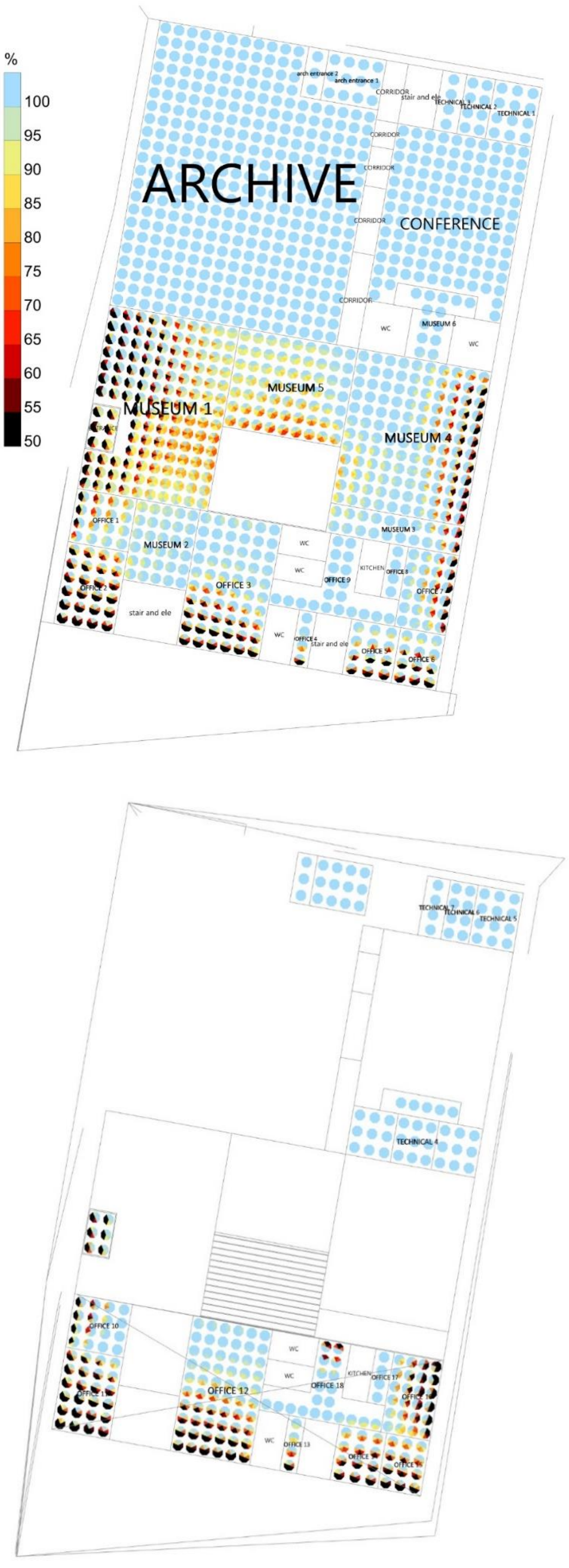


Figure 4.26. The shell material setting for daylight analysis

This radiance setting defines the material properties of the shell in the virtual environment, and it reflects the characteristics of the actual material used in the real-world construction of the building (Figure 4.26.).

- The three identical values "0,545454545455" denote the transmittance of the material. In practical terms, these values suggest that approximately 54,55% of incident light can pass through the shell, indicating a moderately transparent or translucent material.
- The value "0,45" represents the material's reflectance. This implies that around 45% of the incoming light is reflected from the shell's surface.
- The values "0,05," "0,666666666667," and "0,25" correspond to additional optical properties of the material, including the ambient reflection coefficient, diffuse reflection coefficient, and specular reflection coefficient, respectively. These properties describe how the material interacts with light in the environment.

In essence, the radiance setting provides a computational representation of the actual material characteristics of the shell used in Building A. This material behaves as a semitransparent material with specific light transmission and reflection qualities. Through glare simulations using this material setting, you can assess how effectively the real-world shell material manages glare and optimizes visual comfort for the building's occupants, ensuring a comfortable and energy-efficient indoor environment.



(a)

(b)

Figure 4.27. The glare autonomy results a) ground floor b) first floor

GA is crucial for visual comfort and overall building performance, as excessive glare can lead to discomfort and reduced productivity. According to the results:

MUSEUM_2 and MUSEUM_6:

- The GA in this area is good, staying close to 100%.
- However, there is a slight drop to 91,18 and 89,18, indicating that there might be some discomfort for occupants during specific conditions, such as a high glare-inducing sun angle.
- A deficiency exists when external conditions challenge the building's design, particularly regarding shading and light diffusion.

MUSEUM_1, MUSEUM_3 and MUSEUM_4:

- This area exhibits a more varied GA profile.
- GA ranges from 34,66 to 100%, with notable dips in performance.
- The most significant deficiency is in the 34-44 range (where the color is black), suggesting a high likelihood of glare discomfort.
- The GA is especially poor during specific conditions when the building's design does not effectively control glare.

OFFICE_1, OFFICE_3, OFFICE_10, OFFICE_12:

- The results for this office space indicate fluctuations in GA.
- Some parts are vulnerable to glare, particularly around 43,26, which might impact occupant comfort and productivity.
- There is a deficiency in maintaining consistent GA performance throughout.

OFFICE_2 and OFFICE_11:

- The GA results in this office vary widely, from 17,67 to 99,78.
- A significant deficiency is evident in the lower range, where occupants are at risk of glare-induced discomfort.
- There is a need to address how the building's design manages glare, especially in lower GA areas.

OFFICE_4 to OFFICE_9 and OFFICE_13 to OFFICE_18:

- These office spaces exhibit varying GA results.

- Some areas maintain good GA, while others have deficiencies, particularly those with lower values.
- The GA inconsistencies highlight areas where the building's design may need improvements to control glare more effectively.

The Glare Autonomy analysis reveals areas within Building A that require attention to improve occupant comfort and overall building performance. Notably, specific spaces experience deficiencies in glare management. This includes specific offices and parts of the museum areas. The issues might arise from challenges in shading, reflection, or other architectural features. To address these deficiencies, potential solutions include optimizing shading devices, considering glare-reducing coatings on windows, and refining interior design to ensure a more consistent and comfortable indoor environment.

4.2. Section Evaluation

Today, with the support of technological advancements, mechanical solutions are frequently employed in building design. Designing structures solely based on technical analyses, without harmonizing with the context in which they are situated, is considered contrary to the essence of architectural discipline. The notion of context, which has been valued for centuries in the architectural design process, should not be overshadowed despite the increasing potential for leveraging technological progress. This is because in scenarios where technical and mechanical solutions fail or are misused, the designed structure should not be left defenseless against the physical environmental conditions of its location.

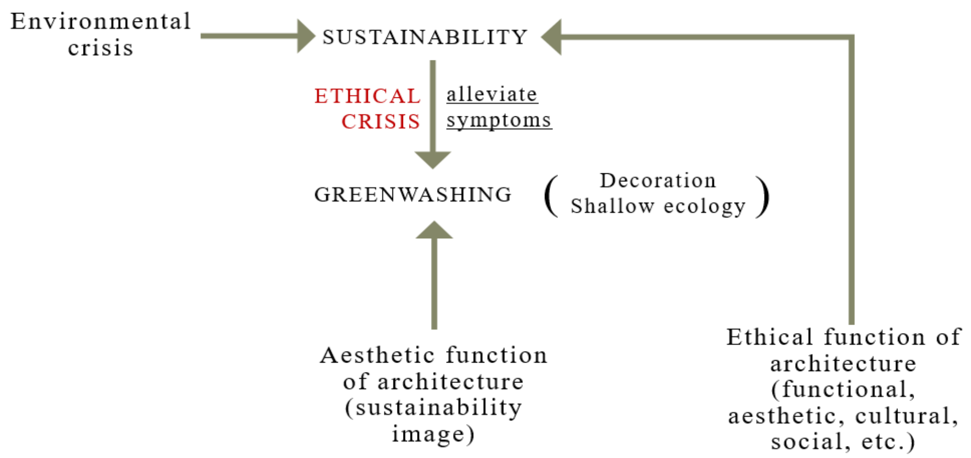


Figure 4.28. Diagram of sustainability-greenwashing relationship (by author)

As a result, the provided environmental design strategies could guide the design process to create a building that aligns with its surroundings, mitigates potential issues with technical and mechanical elements, and ultimately enhances its overall sustainability. Building location, building orientation, relationship with immediate surrounding, building form, space organization, solar control and natural ventilation, building envelope, building openings (windows, doors), material selection and color usage categories are explained as environmental design strategies.

The comprehensive assessment of Building A, considering various passive design elements, including glare analysis, annual daylight analysis, heat island analysis, CFD analysis for natural ventilation in the internal yard, and indoor thermal comfort, offers valuable insights into the strengths and weaknesses of the building's passive design. While the annual daylight analysis shows that some spaces receive sufficient natural light, there are areas with limited daylight access. These zones may require additional design strategies to enhance daylight penetration, reducing the reliance on artificial lighting. Although a part of the building maintains a comfortable indoor thermal environment, some zones exhibit fluctuations in temperature and condition metrics. These variations suggest the need for fine-tuning the passive heating and cooling systems to provide more consistent thermal comfort throughout the year. While the CFD analysis demonstrates the potential for natural ventilation, there may be limitations during specific weather conditions or seasons. Further refinements in the design could maximize the effectiveness of passive ventilation strategies.

In conclusion, Building A's analyzes of passive design have shown that it delivers some commendable results that contribute to energy efficiency, occupant well-being and sustainability. However, there are areas where the building falls short, primarily related to the optimization of daylight access in certain spaces, fine-tuning thermal comfort in some zones, and maximizing the performance of natural ventilation strategies. Addressing these challenges will be crucial to further enhance the building's passive design compliance and ensure its long-term sustainability and comfort for occupants. The focus should be on continuous improvement to achieve a higher suitability for these areas to avoid leaving Building A largely dependent on technical equipment. Environmental design strategies analyze have been compiled to test the harmony of the building with its context. (Table 4.23.).

Table 4.23. Summary of environmental design strategies analysis of the building

Analysis Type	Category	Notes
Environmental Sustainability Strategies Analysis	Building location	It does not comply with the location utilized for hot-humid climate type which is the high parts of the south-facing slopes with cool winds (hills).
	Building orientation	It is not within optimal or good orientation range. It is within valid orientation range.
	Relationship with the immediate surrounding	It has been determined that the distances of the building from its surroundings are not in the optimum range specified according to the sun and wind.
	Building form	Ratio of building form is not optimal, but it does not exceed the highest ratio limit.
	Space organization *Depth of space* *Indoor thermal comfort*	Depth maximum, width is longer than depth which is not appropriate. Indoor thermal comfort indicates that office and entrance parts of the building experience too hot or too humid thermal conditions. On the other hand, archive and conference hall parts of the building experience too cold or slightly cold thermal conditions.
	Solar control and natural ventilation *Building openings* *CFD Analysis for Natural Ventilation*	The openings of the building which does not strongly support cross ventilation and shell-type shading tool do not coincide with climate type. Double glazed, insulated steel framed windows which are not wide enough to allow air movements between indoor and outdoor. Doors are not on the wind-open surface located to support cross ventilation. CFD Analysis shows that technical support is needed in the museum areas, which constitute the majority of the building volume while the inner yard provides good natural ventilation thanks to its open space
	Building envelope *Heat island analysis*	Time lag duration is more than desired, light color of the shell is suitable. This indicates that the shell alone might not be a highly effective solution for mitigating the urban heat island effect, as the differences between the two scenarios which is with and without the shell are not substantial.

Table 4.23. (continued) Summary of environmental design strategies analysis of the building

	Building openings	Double glazed, insulated steel framed windows which are not wide enough to allow air movements between indoor and outdoor. Doors are not on the wind-open surface located to support cross ventilation
	Material selection and color usage *Annual daylight analysis* *Glare analysis*	Glass and concrete elements within the aluminum profiles of the exterior walls are not suitable for this climate. According to annual daylight analysis, the archive, conference hall and one office section need technical support in this regard while the office, museum and entrance sections of the building are successful in that they do not receive disturbing levels of daylight or have transparent facades to receive daylight. Glare analysis reveals areas within the building that require attention to improve occupant comfort and overall building performance. Specific spaces experience deficiencies in glare management. This includes specific offices and parts of the museum areas.

When analyzes at Table 4.23. are examined, it can be claimed that the building is successful with the technical improvements made. However, compared to the high importance given to the technique, it was relatively inferior in terms of passive design. This implies that the building's sustainability is bolstered by deliberate interventions. Although the noteworthy contribution of technically advanced solutions to the building's sustainability cannot be overlooked, it is evident that these solutions are universally applicable to diverse building contexts. At this point, there will be points to consider regarding ethics of sustainable architecture.

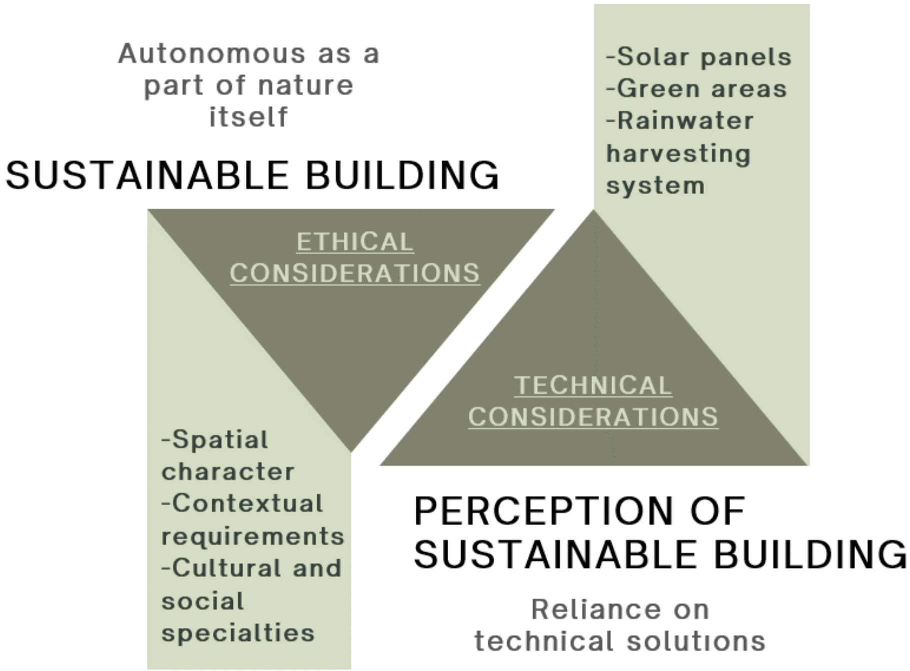


Figure 4.29. The relationality of technics and ethics in sustainable architecture (by author)

The analysis specifically focuses on hot-humid climate zone, delving into the ethical implications of sustainable architecture through environmental design strategies and climate data simulations. The assessment of environmental design strategies draws from literature-derived information and deductions, while simulation analyses offer a nuanced perspective. The concurrent evaluation and fusion of these analyses unveil the implementation of sophisticated technical features in the building, contributing to successful outcomes. However, when contemplating the ethical dimension of sustainable architecture, there is a potential for increased emphasis on context-specific characteristics.

5. CONCLUSION

As explained briefly in Chapter 2, architecture has fulfilled its ethical function by staying in communication with the society and conditions in which it exists since the beginning of humanity. Within the framework of Karsten Harries, it can be observed that the correct understanding and evaluation of the meaning of the notion of ethics is of critical importance, especially in the ornamentation-decoration transition period in the 19th century. The sustainability-greenwashing and deep ecology-shallow ecology relationships experienced today can be analyzed by establishing an analogy through the ornament-decoration relationship. It can be claimed that there is a similar loss of ethics between these analogous relationships. It is obvious that as a result of the loss of ethics in architecture, buildings will not reflect their attributes and qualities in a spontaneous communication, but will need signs or indicators for them. It is a problematic situation that the ethical side of architecture is reduced and becomes in need of aesthetic indicators. For this reason, this study is based on Harries' criticism that architecture has lost its value, especially as art, and is seen as a purely functional or purely aesthetic event. His proposal to reshape the ethical and political aspects of architecture in a new way that will shape the bond between nature and human is taken into consideration.

It has been deemed necessary to examine the concept of sustainability, which has gained strength as a result of the environmental crisis that has increased its impact recently, in an ethical context. Architectural works, which become reality as an organic product of society and the individuals within it, preserve their ethical dimension and preserve communication with this interaction. Nowadays, buildings designed to be sustainable can offer valid and successful solutions for all buildings, as technical possibilities improve and offer many opportunities. However, regardless of whether these solutions achieve successful results or not, buildings designed in relation to the society and context in which the technique is located can maintain their sustainability qualities where the technique may be blocked or have problems. In this way, the ethical dimension of sustainable architecture may have found its place. It can be said that designs made in this direction in the discipline of architecture fall within the scope of passive design. As a result, in this study, it was deemed necessary to evaluate a building that offered technically successful solutions and was entitled to receive the LEED certificate, one of the most globally recognized and accepted certificates, in terms of passive design along with ethical questioning.

In this context, passive design compliance are discussed instead of active design applications. The main objective of passive construction is to attain comfort levels without relying on external heating mechanisms. Passive buildings achieve optimal energy efficiency by carefully managing the interplay between heat loss and heat gain, considering the prevailing climatic conditions. Creating a successful passive building involves incorporating diverse elements of architectural design, including aspects like thermal insulation, thermal mass, window glazing, dimensions, configurations, and placements, external surface colors, external shading solutions, building orientation, and overall architectural form (Omrany and Marsono, 2016). Given the adaptability of active design strategies to any building, it could be argued that within the realm of architecture, environmental design strategies which is compatible with passive design should take precedence. Taking into consideration different climate regions in Turkey, environmental design strategies have been formulated, aiming to ensure that the structure is designed to be self-sufficient up to a certain extent in cases where technical and mechanical supports encounter issues.

During the case study selection process, the studies and reports of the Ministry of Environment, Urbanization and Climate Change were used. In the light of this information, it has been determined that office buildings with large construction areas are more prominent compared to other building types in terms of energy use and sustainability. For this reason, the office buildings in Turkey that were entitled to receive the Platinum certificate, which is the highest level in the LEED Building Design and Construction category, which is accepted for the global sustainability success mentioned before, were sorted and it was seen that they were 24. When these buildings were categorized according to climate zones, the analysis process was carried out on Building A, which has a larger construction area and an emphasis on sustainability in its name.

The case building, which has achieved a significant success in terms of sustainability by receiving the LEED Platinum certificate, was evaluated for the ethical dimension by considering passive design requirements according to its context. This analysis was carried out with optimum design conditions suitable for Turkey's climate zones compiled from the literature and simulations using various computer programs, and the ethical dimension of sustainable architecture was discussed today by trying to answer the question of whether the building is from its location or not.

According to the analysis results, although it is seen that the building partially complies with the requirements of the hot-humid climate region in which it is located, most of the sustainability performance is achieved with the support of technical and technological developments. The analysis conducted with environmental design strategies revealed categories where the building lacks with passive design compliance, and it is observed that even in areas deemed compatible, the compliance is not at an optimal level. Even if the success achieved with the intensive use of the technique is considered remarkable, if the requirement of conformity to the context, which architecture undertakes with its ethical role, is not achieved to a large extent, the autonomous structure of architectural works and the organic communication it establishes with the society in which it exists carries the danger of being damaged. Therefore, today, sustainably designed buildings are largely supported by technological solutions, as seen in the analysis of the sample building, and this leads to an ethical crisis in sustainable architecture.

To summarize, technical solutions offered in the name of sustainability can leave the building in a helpless situation when they are associated with an ethical crisis and reach a point where they themselves are unsustainable. For this reason, it should be avoided that the solutions offered as a solution to the environmental crisis turn into examples of greenwashing, as they only alleviate the symptoms of this crisis, not the crisis itself. This scenario differentiates the aesthetic and functional tasks that architecture has undertaken on the same plane for centuries, and leads to the ideas of decoration and shallow ecology, which are analogized by turning sustainability into a sustainable image that serves only aesthetics.

Therefore, in this thesis study, a structure that has achieved significant success in terms of sustainability has been discussed and analyzed. As a result, it has been observed that sustainable architecture is in danger of breaking away from its ethical aspects with the opportunities offered by technology. Although it is not wrong to use technology that can promise innovative and advanced solutions, supporting a building with passive design elements that can respond to the conditions of the region in which it is located will not only make the building dependent on technical equipment but also include its ethical function. As a result, it has been concluded that instead of every technical solution being applicable to every building in any place, the context in which the building is trying to sit and the requirements of this context should be carefully considered. With this proposal, it is thought that buildings can become sustainable in themselves, without the need for indicators such as solar panels and green areas, as can be seen in the perception of sustainability.

To conclude, based on the analysis conducted with passive design strategies in line with Harries' ethical understanding, it has been observed that the spatial-contextual harmony of the building takes a back seat compared to its technical equipment. The point is not to undermine the concept of truth within the context of sustainability. Instead, the objective is to scrutinize the processes through which this conception of truth is established in the realm of sustainable architecture. In other words, rather than undermining the reality of the technical equipment added to the building in the architectural sense, the intention is to highlight the kind of process the availability of these technical components is preparing. The analogy established in Chapter 2 of this thesis, namely ornament-decoration, sustainability-greenwashing, deep ecology-shallow ecology, serves as a precaution against the risk of sustainable buildings deviating from their ethical function in case spatiality diminishes.

In navigating the complexities of sustainability in architecture, a meticulous approach is imperative to avoid potential ethical crises associated with the application of technical solutions. It is crucial to discern between aesthetic and functional roles, preserving the harmonious balance achieved over centuries, and preventing sustainability from devolving into a mere superficial image. While embracing advanced technology, there exists a need for a nuanced integration that prioritizes passive design elements tailored to regional contexts, ensuring the convergence of technical and ethical dimensions. The universal application of technical solutions should be eschewed in favor of context-specific considerations, proposing that sustainability can inherently manifest in buildings without relying solely on external indicators. The analysis, grounded in Harries' ethical understanding and incorporating passive design strategies, illuminates a potential imbalance where technical equipment eclipses spatial-contextual harmony. It underscores the importance of scrutinizing processes that establish the truth of sustainability, emphasizing the maintenance of ethical dimensions in sustainable architecture. The analogy drawn from ornament-decoration, sustainability-greenwashing, and deep ecology-shallow ecology serves as a cautionary framework, highlighting the risk of sustainable buildings deviating from their ethical function if spatial considerations are marginalized.

REFERENCES

Adorno, T.W.& Horkheimer M.(2014). *Aydınlanmanın Diyalektiği.* (N. Ülner-E.Ö. Karadoğan Çev.) (Birinci Baskı) İstanbul: Kabalcı Yayıncılık.

Ahmad, T., & Thaheem, M. J. (2018). Economic sustainability assessment of residential buildings: A dedicated assessment framework and implications for BIM. *Sustainable cities and society*, 38, 476-491.

Albatayneh, A., Alterman, D., Page, A., & Moghtaderi, B. (2018). The significance of building design for the climate. *Rigas Tehniskas Universitates Zinatniskie Raksti*, 22(1), 165-178.

Asan, H., & Sancaktar, Y. S. (1998). Effects of wall's thermophysical properties on time lag and decrement factor. *Energy and buildings*, 28(2), 159-166.

ASHRAE (2006). *ASHRAE green guide: the design, construction, and operation of sustainable buildings.* Burlington: Elsevier Publications.

Ateek, G. (2020). *Energy-efficient building design guide: Design strategies for office buildings in a temperate-dry climate.* 10.13140/RG.2.2.20271.97440.

Aynsley, R. (2014). Natural ventilation in passive design. *Environment Design Guide*, 1-16.

Balanlı, A. (2007), *Yapı Elemanları III: Doğramalar*, Yayınlanmamış Ders Notu, Yıldız Teknik Üniversitesi, Mimarlık Fakültesi – Mimarlık Bölümü, İstanbul.

Brundtland, G.H., (1987). *Our Common Future: The World Commission on Environment and Development.* Oxford: Oxford University Press.

Chen, X., & Zhong, D. (2011). The principles of passive cooling alley and its inspiration. *New Architecture*, 3, 88-91.

Çaylı, E.(2023). *İklimin Estetiği.* İstanbul: Everest Yayınları

Demircan, R. K., & Gültekin, A. B. (2017). Binalarda pasif ve aktif güneş sistemlerinin incelenmesi. *TÜBAV Bilim Dergisi*, 10(1), 36-51.

Demos, T.J.(2023). Sürdürülebilirlik Politikası: Çağdaş Sanat ve Ekoloji. E.Sezgin (Der.), *Sanat ve Ekoloji* içinde. İstanbul:İletişim Yayınları,19-65.

Deviren, S., (2006). Bir eko-ev Örneği, *XXI Dergisi*, (47), İstanbul.

Du, X. (2019). Space Design for Thermal Comfort and Energy Efficiency in Summer: Passive cooling strategies for hot humid climates, inspired by Chinese vernacular architecture. *A+ BE| Architecture and the Built Environment*, (10), 1-322.

Dursun, D., & Yavas, M. (2015). Climate-sensitive urban design in cold climate zone: the City of Erzurum, Turkey. *International review for spatial planning and sustainable development*, 3(1), 17-38.

Edwards, B.(2007). *Sürdürülebilirlik Kültürü ve Mimari Tasarımın Önündeki Güçler*, Ekolojik Mimarlık ve Planlama Ulusal Sempozyumu, Antalya, 22-34.

Genosko, G.(2023) Guattari'nin Üç Ekoloji'sinde Sanat ve Öznellik. E.Sezgin (Der.), *Sanat ve Ekoloji* içinde. İstanbul: İletişim Yayınları, 77-99.

Givoni, B. (1998). *Climate considerations in building and urban design*. New York: John Wiley & Sons.

Göğebakan, Y. (2015). Karakteristik bir değer olan geleneksel Türk evi'nin oluşumunu belirleyen unsurlar ve bu evlerin genel özellikleri. *İnönü Üniversitesi Kültür ve Sanat Dergisi*, 1(1), 41-55.

Gökşen, F., Güner, C., & Koçhan, A. (2017). Sürdürülebilir kalkınma için ekolojik yapı tasarım kriterleri. *Akademia Disiplinlerarası Bilimsel Araştırmalar Dergisi*, 3(1), 92-107.

Göksu, Ç. (1999). *Güneş Kent*. Ankara: Göksu yayınları, 3, 88-134.

Golany, G. S. (1996). Urban design morphology and thermal performance. *Atmospheric Environment*, 30(3), 455-465.

Harries, K. (2000). *The Ethical Function of Architecture*. Massachusetts: MIT Press.

Heidegger, M.(1998). *Tekniğe İlişkin Soruşturma*. D. Özlem (Çev.), İstanbul: Paradigma Yayınları.

Internet: Tarihten referans alan kamu binaları tasarım rehberi. *Çevre, Şehircilik ve İklim Değişikliği Bakanlığı.* URL-1: https://webdosya.csb.gov.tr/db/yapiisleri/menu/tarihten-referans-alan-kamu-binalari-tasarim-rehberi-bolum-1_20190521051042.pdf, Last accessed: 29.07.2023.

Internet: Ghisleni, C. (2022). 50 shades of green: The contradictions of greenwashing in architecture. *ArchDaily*. URL-2: https://www.archdaily.com/978874/50-shades-of-green-the-contradictions-of-greenwashing-in-architecture, Last accessed: 29.07.2023.

Internet: Perkins + Will's Antilla "Green" Tower in Mumbai. *Inhabitat.* URL-3: https://inhabitat.com/sites-residence-antilia-green-tower-in-mumbai/, Last accessed: 27.09.2023.

Internet: Bosco Verticale / Boeri Studio. *Archdaily.* URL-4: https://www.archdaily.com/777498/bosco-verticale-stefano-boeri-architetti, Last accessed: 27.09.2023.

Internet: Tree-Covered Skyscrapers Aren't Actually That Green. URL-5: https://www.youtube.com/watch?v=wFNDfSa7Ak8, Last accessed: 27.09.2023.

Internet: One Central Park / Ateliers Jean Nouvel. *Archdaily*. URL-6: https://www.archdaily.com/551329/one-central-park-jean-nouvel-patrick-blanc, Last accessed: 27.09.2023.

Internet: MVRDV Designs Hollowed-out Mountain for London's Hyde Park. *Archdaily*. URL-7: https://www.archdaily.com/957106/mvrdv-designs-hollowed-out-mountain-for-londons-hyde-park, Last accessed: 27.09.2023.

Internet: Sürdürülebilir ve çevre dostu ambalaj modelleri, Plastik & Ambalaj Teknolojisi. URL-8: http://www.plastik-ambalaj.com/en/plastic-packaging-products/3274-suerdueruelebilir-ve-cevre-dostu-ambalaj-modelleri

Internet: Kamu Binalarının Enerji Verimli Yenilemesine Yönelik Rehber, *Çevre, Şehircilik ve İklim Değişikliği Bakanlığı.* URL-9: https://webdosya.csb.gov.tr/db/meslekihizmetler/icerikler/kamu-b-nalarinin-enerj--ver-ml--yen-lemes-ne-yonel-k-rehber-20201014100010.pdf, Last accessed: 11.07.2023.

Internet: LEED rating system, *U.S. Green Building Council.* URL-10: https://www.usgbc.org/leed, Last accessed: 07.01.2024.

Internet: Yeşil bina ve bütünleşik tasarım, *TURKECO*. URL-11: https://turkeco.com/yesil-bina-ve-butunlesik-tasarim/, Last accessed: 11.07.2023.

Internet: Betti G., Tartarini F., Nguyen C., Schiavon S. (2022). CBE Clima Tool: a free and open-source web application for climate analysis tailored to sustainable building design. URL-12: https://clima.cbe.berkeley.edu, Last accessed: 01.11.2023.

Johnson, P.A.(2013). *Heidegger Üzerine*. A. Esenyel (Çev.), Ankara: Sentez Yayıncılık.

Koca, Ö. (2006). *Sıcak kuru ve sıcak nemli iklim bölgelerinde enerji etkin yerleşme ve bina tasarım ilkelerinin belirlenmesine yönelik yaklaşım,* Doktora tezi, İstanbul Teknik Üniversitesi Fen Bilimleri Enstitüsü.

Koçlar Oral, G. (2010). Güneş Enerjisi ve Yapı, *Diyarch Bülten (Diyarbakır Mimarlar Odası Bülteni)*, 1 (11), Diyarbakır.

Kontoleon, K. J., & Eumorfopoulou, E. A. (2008). The influence of wall orientation and exterior surface solar absorptivity on time lag and decrement factor in the Greek region. *Renewable energy*, 33(7), 1652-1664.

Kun, F. (2005). *Turizm Amaçlı Yapıların İklimle Dengeli Tasarımı Kapsamında Soğutma Yükü açısından Değerlendirilmesi (Kuşadası Örneği)*, Yüksek Lisans Tezi, YTÜ Fen Bilimleri Enstitüsü, İstanbul.

Kwok, A. G., & Rajkovich, N. B. (2010). Addressing climate change in comfort standards. *Building and environment*, 45(1), 18-22.

Lechner, N. (2014). *Heating, cooling, lighting: Sustainable design methods for architects*. New Jersey: John wiley & sons.

Macdonald, A. J. (2018). *Structure and architecture*. London: Routledge.

Manioğlu, G., & Oral, G. K. (2010). *Ekolojik yaklaşımda iklimle dengeli cephe tasarımı.* 5. Ulusal Çatı Cephe Sempozyumu, 15-16.

Manioğlu, G., & Yılmaz, Z. (2008). Energy efficient design strategies in the hot dry area of Turkey. *Building and Environment*, 43(7), 1301-1309.

Manioğlu, G., & Yılmaz, Z. (2011). Bina kabuğu ve ısıtma sistemi işletme biçiminin ekonomik analizi. *İTÜDERGİSİ/a*, 1(1), 21-29.

Maywald, C., & Riesser, F. (2016). Sustainability–the art of modern architecture. *Procedia Engineering*, 155, 238-248.

McLean, L., & Roggema, R. (2019). Planning for a prosumer future: The case of Central Park, Sydney. *Urban Planning*, 4(1), 172-186.

MFA (Republic of Turkey Ministry of Foreign Affairs), (2018). *Turkey's energy profile and strategy*, available at: http://www.mfa.gov.tr/turkeys-energy-strategy.en.mfa.

Ministry of Energy and Natural Resources, (2018). *Ulusal Enerji Verimliliği Eylem Planı*, Ankara, available at: http://www.mfa.gov.tr/turkeys-energy-strategy.en.mfa.

Mirrahimi, S., Mohamed, M. F., Haw, L. C., Ibrahim, N. L. N., Yusoff, W. F. M., & Aflaki, A. (2016). The effect of building envelope on the thermal comfort and energy saving for high-rise buildings in hot–humid climate. *Renewable and Sustainable Energy Reviews*, 53, 1508-1519.

Muhaisen, A. S., & Gadi, M. B. (2006). Effect of courtyard proportions on solar heat gain and energy requirement in the temperate climate of Rome. *Building and Environment*, 41(3), 245-253.

Naess, A. (1984). The arrogance of antihumanism. *Ecophilosophy*, 6, 8-9.

Naess, A.(2023). Sığ ve Derin: Ekoloji Hareketinde Açılımlar. E.Sezgin (Der.), *Sanat ve Ekoloji* içinde. İstanbul: İletişim Yayınları, 67-75.

Olgyay, V. (1963). *Design With Climate-Bioclimatic Approch To Architectural Regionalism*, New Jersey: Princeton University Press, 6-175.

Omrany, H., & Marsono, A. K. (2016). Optimization of building energy performance through passive design strategies. *British Journal of Applied Science & Technology*, 13(6), 1-16.

Orhan, G., & Ekici, B. B. (2022). Farklı İklim Bölgelerinde Çatı Türünün Bina Isıtma ve Soğutma Yüküne Etkisi. *Avrupa Bilim ve Teknoloji Dergisi*, (43), 110-115.

Orhon, İ., Küçükdoğu, M. Ş., Ok, V. (1988). *"Doğal İklimlendirme", Toplu Konut İşletmesi Proje Planlama Tasarım El Kitabı,* Ankara: TUBİTAK YAE, 1-22.

Ovalı, P. K. (2019). Biyoklimatik tasarım matrisi (türkiye). *Trakya Üniversitesi Mühendislik Bilimleri Dergisi*, 20(2), 51-66.

Özdeniz, M. B. (1991). Bioclimatic analysis of traditional Turkish houses. *Environment international*, 17(4), 325-336.

Özel, M. (2013). Thermal, economical and environmental analysis of insulated building walls in a cold climate. *Energy Conversion and Management*, 76, 674-684.

Özel, M. (2014). Effect of insulation location on dynamic heat-transfer characteristics of building external walls and optimization of insulation thickness. *Energy and Buildings*, 72, 288-295.

Paredes, G., & Herrera, R. F. (2020). Teaching multi-criteria decision making based on sustainability factors applied to road projects. *Sustainability*, 12(21), 8930.

Ragheb, A., El-Shimy, H., & Ragheb, G. (2016). Green architecture: A concept of sustainability. *Procedia-Social and Behavioral Sciences*, 216, 778-787.

Rapoport, A., 1969, *House Form and Culture*, New Jersey: Prentice-Hall.

Sharaf, F. (2020). The impact of thermal mass on building energy consumption: A case study in Al Mafraq city in Jordan. *Cogent Engineering*, 7(1), 1804092.

Sijakovic, M., & Peric, A. (2021). Sustainable architectural design: towards climate change mitigation. *Archnet-IJAR: International Journal of Architectural Research*, 15(2), 385-400.

Smith, N.(2023) Bir Birikim Staratejisi Olarak Doğa. E.Sezgin (Der.), *Sanat ve Ekoloji* içinde. İstanbul:İletişim Yayınları, 125-156.

Sun, W., Li, M., Han, Y., Wang, M., & Ansourian, P. (2016). *Façade Greening: High-rise apartment building in Milan using pre-stressed concrete slab*. In AIP Conference Proceedings, 1762 (1). AIP Publishing.

Susorova, I., Tabibzadeh, M., Rahman, A., Clack, H. L., & Elnimeiri, M. (2013). The effect of geometry factors on fenestration energy performance and energy savings in office buildings. *Energy and Buildings*, 57, 6-13.

Tönük, S. (2001). *Bina Tasarımında Ekoloji*, İstanbul: Yıldız Teknik Üniversitesi Basım-Yayın Merkezi.

Turkington, R. & Sangster, K., (2006). From housing to social mix: housing's contribution to social sustainability. *Town and Country Planning*, 75, 184–185.

Umaroğulları, F., & Motor, C. (2019). Toplu Konutların İklimsel Konfor Tasarım Parametrelerine Göre Değerlendirilmesi: Ilıman Nemli İklim Bölgesi: Edirne Binevler (1. Kısım) Konut Yapı Kooparetifi Örneği. *Mimarlık ve Yaşam*, 5(1), 105-122.

Utkutuğ, G. (2011). *Sürdürülebilir Bir Geleceğe Doğru Mimarlık ve Yüksek Performanslı Yeşil Bina Örnekleri.* X.Ulusal Tesisat Mühendisliği Kongresi, İzmir.

Valladares-Rendón, L. G., Schmid, G., & Lo, S. L. (2017). Review on energy savings by solar control techniques and optimal building orientation for the strategic placement of façade shading systems. *Energy and Buildings*, 140, 458-479.

Watson, D. & Labs, K. (1992). *Climatic Design: Energy-Efficient Building Principles and Practices,* New York: McGraw-Hill Book Company.

Williams, D. E. (2007). *Sustainable design: ecology, architecture, and planning*. New Jersey: John Wiley & Sons.

Woodcraft, S. (2012). Social sustainability and new communities: Moving from concept to practice in the UK. *Procedia – Social and Behavioural Sciences,* 68, 29–42.

Yeang K., 2006, *Ekotasarım - Ekolojik Tasarım Rehberi*, Çev: Eryıldız S., Eryıldız D., İstanbul: Yem Yayınları.

Yeang, K., 2012, *Eko Tasarım*, İstanbul: Yem Yayınları.

Yılmaz, A. Z. (2008). *Low Energy Design Strategies for Different Climates of Turkey: Comparison of Traditional and Modern Samples.* 25th Conference on Passive and Low Energy Architecture, Dublin.

Yılmaz, Z. (2006). Akıllı binalar ve yenilenebilir enerji. *Tesisat Mühendisligi Dergisi*,(91), 7, 15.

Yılmaz, Z. (2007). Evaluation of energy efficient design strategies for different climatic zones: Comparison of thermal performance of buildings in temperate-humid and hot-dry climate. *Energy and buildings,* 39(3), 306-316.

Yu, J., Yang, C., Tian, L., & Liao, D. (2009). A study on optimum insulation thicknesses of external walls in hot summer and cold winter zone of China. *Applied Energy*, 86(11), 2520-2529.

Yüksek, İ., & Esin, T. (2013). Analysis of traditional rural houses in Turkey in terms of energy efficiency. *International Journal of Sustainable Energy*, 32(6), 643-658.

Zeren, L. (1978). *Mimaride Güneş Kontrolü*, İstanbul: İTÜ Yayınları.

Zeren, L. (1987). *Türkiye'de Yeni Yerleşmeler ve Binalarda Enerji Tasarrufu Amacıyla Bir Mevzuat Modeli'ne İlişkin Çalışma*, Araştırma Projesi, İTÜ, Uygulama ve Araştırma Merkezi, İstanbul.

Zhang, L. Y., Jin, L. W., Wang, Z. N., Zhang, J. Y., Liu, X., & Zhang, L. H. (2017). Effects of wall configuration on building energy performance subject to different climatic zones of China. *Applied Energy*, 185, 1565-1573.

Zimmermann, M.E.(2011). *Heidegger Moderniteyle Hesaplaşma.*(Arslan H. Çev.). İstanbul: Paradigma Yayınları.

Žižek, S. (2007). *Gıdıklanan Özne: Politik Ontolojinin Yok Merkezi*. Ankara: Epos Yayınları.

Žižek, S. (2022). *Yamuk Bakmak: Popüler Kültürden Jacques Lacan'a Giriş*. İstanbul: Metis Yayınları.

Zorer, G. (1992). *Yapılarda Isısal Tasarım İlkeleri*, İstanbul: YTÜ Mimarlık Fakültesi Baskı İşliği.

Zuo, J., Jin, X. H., & Flynn, L. (2012). Social sustainability in construction–an explorative study. *International Journal of Construction Management*, 12(2), 51-63.

APPENDICES

APPENDIX-1. Outdoor temperature analysis (URL-12)

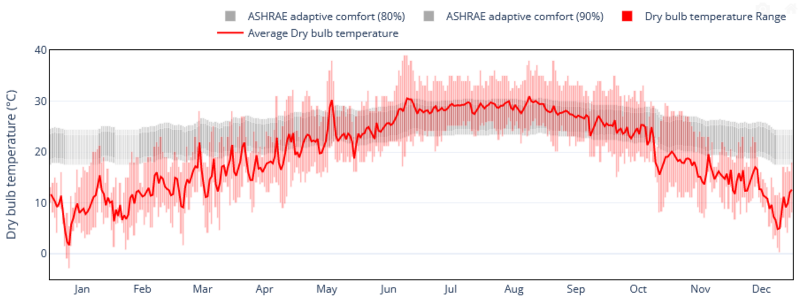


Figure 1.1. Graph of monthly dry air temperature changes

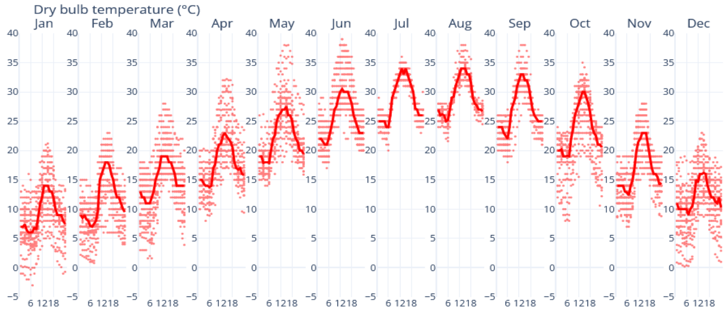


Figure 1.2. Graph of daily changes in dry air temperature

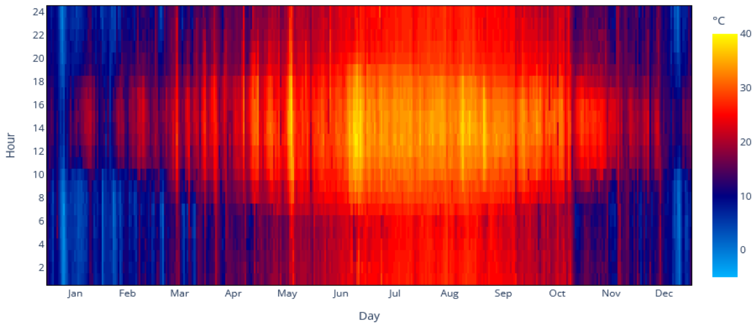


Figure 1.3. Hourly air temperature condition throughout the year

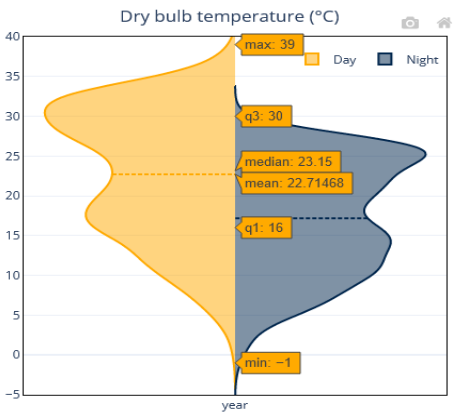


Figure 1.4. The annual temperature profile of air temperature at night

APPENDIX-2. Monthly heating and cooling degree days with a comfort range (URL-12)

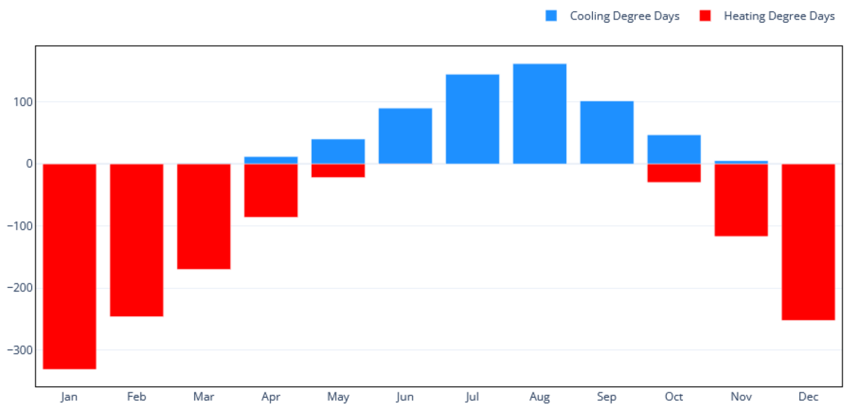


Figure 2.1. Monthly heating and cooling degree days with a comfort range (URL-12)

APPENDIX-3. Relative humidity analysis (URL-12)

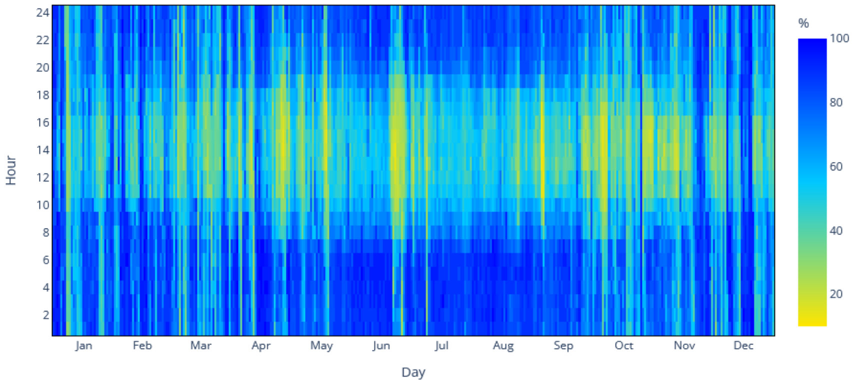


Figure 3.1. Hourly graph of monthly relative humidity

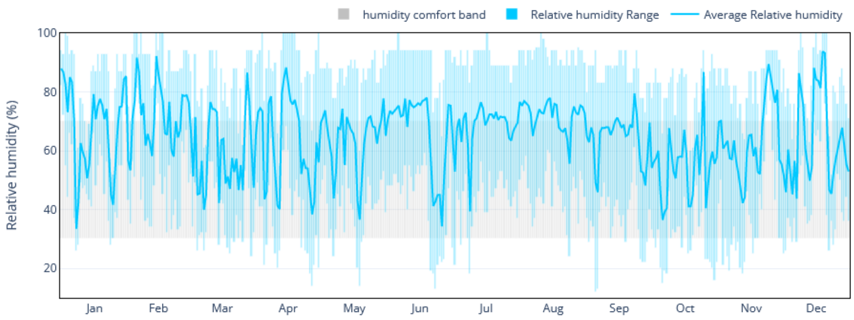


Figure 3.2. Monthly graph of relative humidity

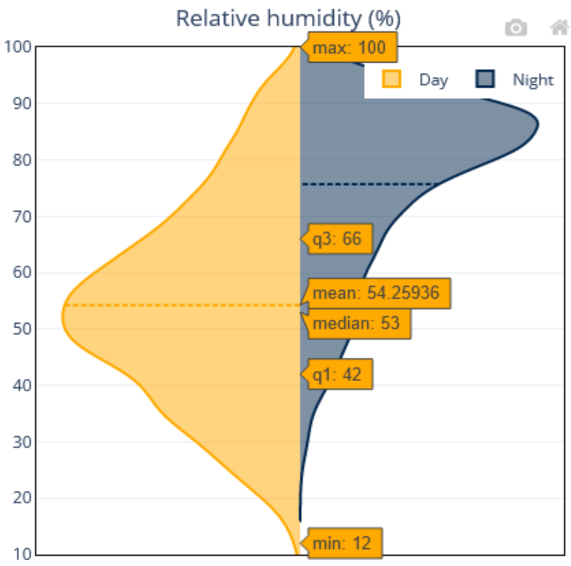


Figure 3.3. Annual relative humidity profile on night and day

APPENDIX-4. Wind analysis (URL-12)

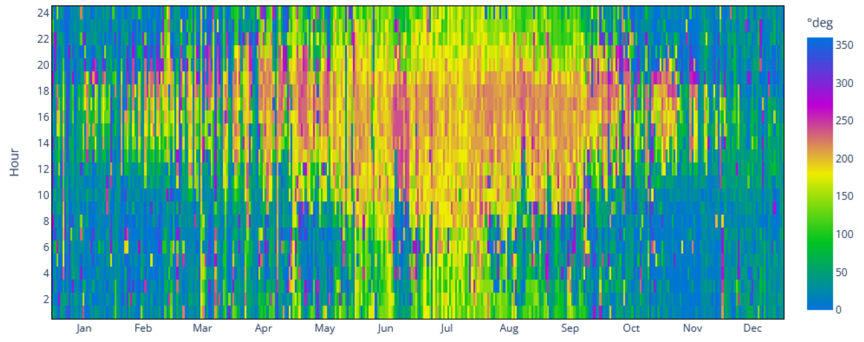


Figure 4.1. Hourly wind direction diagram throughout the year

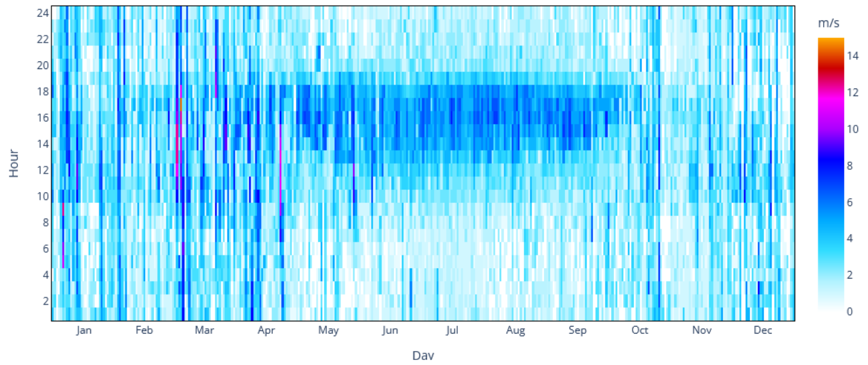


Figure 4.2. Hourly graph of wind speed throughout the year

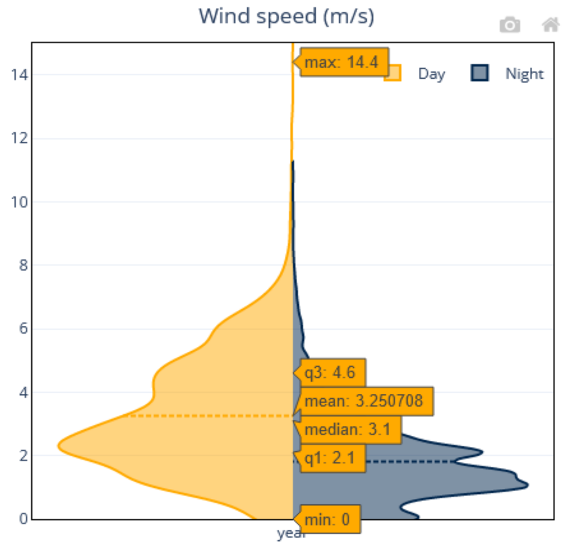
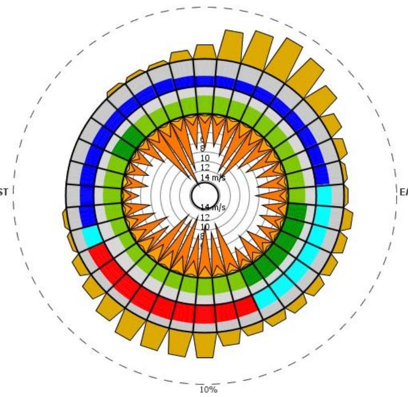
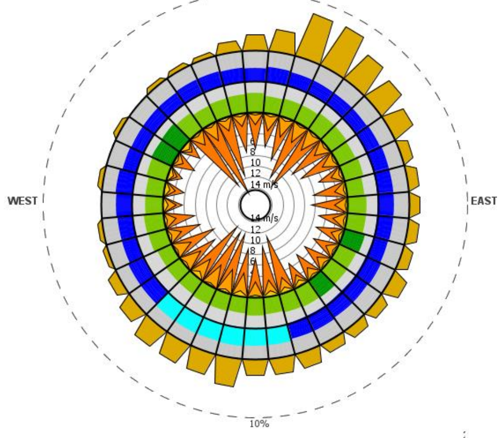
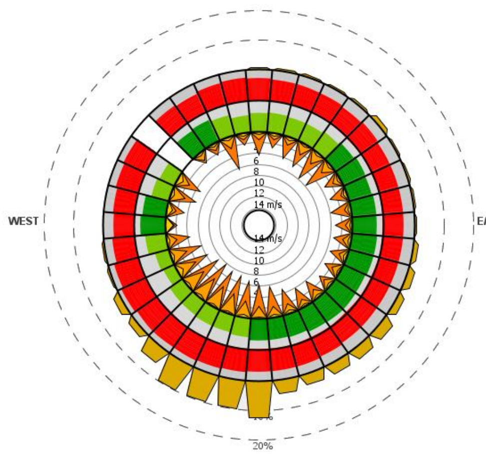


Figure 4.3. Wind speed profile at night and day

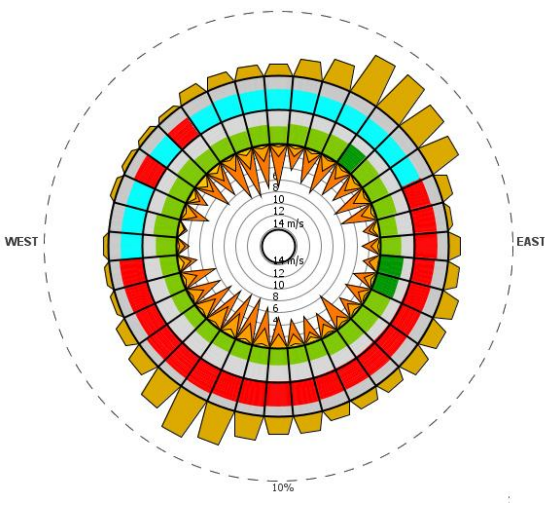
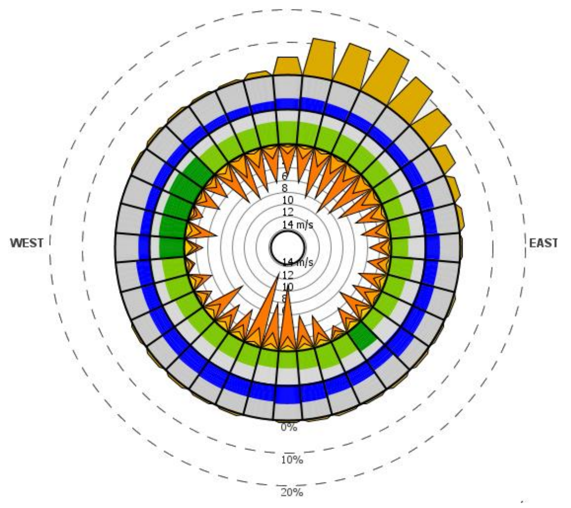
APPENDIX-5. Wind rose patterns (by author using Climate Consultant)

Table 5.1. Wind rose patterns (for seasons and annual) (by author using Climate Consultant)

<table>
<tr><td colspan="2">Annual wind rose</td></tr>
<tr><td colspan="2">
</td></tr>
<tr><td colspan="2">-Prevailing wind blows from the northeast and almost from the southwest.
-The temperature is in the red range, which shows 24 to 38 degrees Celsius, for the southeast east, and dark blue, 0 to 22, for the northeast.
-The humidity is in light green colors from 30 to 70%, which is of medium range.
There is prevailing winds from the northeast and southwest. The temperature is warm to hot, with the southeast being hotter than the northeast. Humidity levels are moderate, ranging from 30% to 70%.</td></tr>
<tr><td>Spring season wind rose</td><td>Summer season wind rose</td></tr>
<tr><td>
</td><td>
</td></tr>
<tr><td>-Prevailing wind mostly blows from the northeast.
-Temperature range is between 0 to 22 degrees in dark blue color.
-The humidity, which ranges between 30% and 70%, is indicated by light green colors and is considered moderate.
In spring, there is cool temperatures ranging from 0 to 22 degrees Celsius and moderate humidity levels between 30% to 70%. The prevailing wind comes from the northeast.</td><td>-Prevailing wind comes from the south and shifts more towards the west.
-Temperature ranges from 24 to 38 degrees.
-Moderate humidity range (30 to 70%) for those from the southwest and above 70% for the southeast ones.
During summer, the prevailing winds shift from south to west. Temperatures range from 24 to 38 degrees Celsius, and humidity varies from moderate (30-70%) in the southwest to high (>70%) in the southeast.</td></tr>
</table>

APPENDIX-5. (continued) Wind rose patterns (by author using Climate Consultant)

Table 5.1. (continued) Wind rose patterns (for seasons and annual) (by author using Climate Consultant)

Fall season wind rose	Winter season wind rose
	
-The predominant wind direction blows from the southwest and the northeast. -Temperature is high (24 to 38 degrees) for the wind blows from the southwest and is light blue, 22-24, for one from the northeast. -Humidity is in the light green color range (30 to 70 percent), which means medium humidity. Winds blow from the southwest and northeast during fall, bringing high and cooler temperatures. Humidity levels remain moderate, ranging from 30 to 70 percent.	-The predominant wind direction completely blows from the northeast. -The temperature is cold, ranging from 0 to 22. -Humidity is in the light green color range (30 to 70 percent), which means medium humidity for the prevalent wind. During winter, northeast winds prevail, and temperatures range from 0 to 22 degrees Celsius. Humidity is moderate, between 30% and 70%, denoted by the light green range. During the hot months, in the middle of the day, the wind direction often blows from south to southwest. This wind is an undesirable one to enter the interior space. During the hot season, a beneficial wind blows from the northeast to the north at night.

Gazili olmak ayrıcalıktır